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A Narrative Explanation of Breakpoints and  
Convergence Patterns in Yugoslavia  
and its Successor States 1952-2015





# The wiiw Balkan Observatory

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## *About*

Shortly after the end of the Kosovo war, the last of the Yugoslav dissolution wars, the Balkan Reconstruction Observatory was set up jointly by the Hellenic Observatory, the Centre for the Study of Global Governance, both institutes at the London School of Economics (LSE), and the Vienna Institute for International Economic Studies (wiiw). A brainstorming meeting on Reconstruction and Regional Co-operation in the Balkans was held in Vouliagmeni on 8-10 July 1999, covering the issues of security, democratisation, economic reconstruction and the role of civil society. It was attended by academics and policy makers from all the countries in the region, from a number of EU countries, from the European Commission, the USA and Russia. Based on ideas and discussions generated at this meeting, a policy paper on Balkan Reconstruction and European Integration was the product of a collaborative effort by the two LSE institutes and the wiiw. The paper was presented at a follow-up meeting on Reconstruction and Integration in Southeast Europe in Vienna on 12-13 November 1999, which focused on the economic aspects of the process of reconstruction in the Balkans. It is this policy paper that became the very first Working Paper of the wiiw Balkan Observatory Working Papers series. The Working Papers are published online at [www.balkan-observatory.net](http://www.balkan-observatory.net), the internet portal of the wiiw Balkan Observatory. It is a portal for research and communication in relation to economic developments in Southeast Europe maintained by the wiiw since 1999. Since 2000 it also serves as a forum for the Global Development Network Southeast Europe (GDN-SEE) project, which is based on an initiative by The World Bank with financial support from the Austrian Ministry of Finance and the Oesterreichische Nationalbank. The purpose of the GDN-SEE project is the creation of research networks throughout Southeast Europe in order to enhance the economic research capacity in Southeast Europe, to build new research capacities by mobilising young researchers, to promote knowledge transfer into the region, to facilitate networking between researchers within the region, and to assist in securing knowledge transfer from researchers to policy makers. The wiiw Balkan Observatory Working Papers series is one way to achieve these objectives.



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The Global Development Network, initiated by The World Bank, is a global network of research and policy institutes working together to address the problems of national and regional development. It promotes the generation of local knowledge in developing and transition countries and aims at building research capacities in the different regions.

The Vienna Institute for International Economic Studies is a GDN Partner Institute and acts as a hub for Southeast Europe. The GDN–wiiw partnership aims to support the enhancement of economic research capacity in Southeast Europe, to promote knowledge transfer to SEE, to facilitate networking among researchers within SEE and to assist in securing knowledge transfer from researchers to policy makers.

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**A NARRATIVE EXPLANATION OF BREAK POINTS AND  
CONVERGENCE PATTERNS IN YUGOSLAVIA AND ITS SUCCESSOR  
STATES 1952-2015**

*Working Paper*

*written for WIIWGDN Project*

'Falling Behind and Catching Up in Southeast Europe

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## Contents

INTRODUCTION .....	1
1. LITERATURE SURVEY.....	2
1.1 Studies of regional long term growth before 1990.....	2
1.2 Post 1990 Croatia as a case study.....	4
2. DATA.....	5
3. BREAK POINTS .....	7
3.1 Single break point analysis 1: Quandt-Andrews test and Bai-Perron test for one break point .....	8
3.2 Multiple break point analysis 2: Bai-Perron test for multiple breakpoints.....	9
3.3 Summarizing the results of measured break points.....	14
4. CONVERGENCE.....	14
4.1 $\sigma$ -convergence: the results .....	15
4.2 $\beta$ -convergence: the results .....	17
4.3 Pair convergence of successor states: results.....	20
4.4 Pair convergence of successor states and benchmarks: results.....	24
5. NARRATIVE EXPLANATION OF CONVERGENCE AND BREAK POINTS .....	27
5.1 A narrative explanation of break points and convergence.....	27
5.1.1 First break points: the early and mid-sixties .....	28
5.1.2 1980 the dominant year for break points .....	29
5.1.3 An 'obvious' point of discontinuity: the early mid nineties.....	31
5.1.4 The selective impact of the great recession and national specifics .....	32
5.2 Growth in sub-periods derived from the narrative approach.....	33
5.3 Quarter of a century of independence and transformation .....	35
6. CONCLUDING REMARKS.....	36
REFERENCES .....	38
Appendix 1: Data and construction of time series 1952-2015 .....	45
Appendix 2: The methodological approach to determining one or multiple break points.....	53
Appendix 3: Convergence .....	55

## INTRODUCTION

Yugoslavia started its transformation into capitalism in 1989. The change implied the start of dismantling the hitherto operative 'self-management socialist' system, and its replacement over time with some sort of 'capitalist' system. In 1990 Yugoslavia decomposed into successor states. Initially into 5 and eventually the decomposition led to 7 successor states, 6 of which were directly involved in some part of the Wars of the Yugoslav succession. The transformation was not stopped by the Wars and four processes, namely the transformation, decomposition, independence and war, became interrelated.

In 2016, after more than a quarter of a century from the start of the transformation and the decomposition even by historical standards one can make a first attempt at answering the 'big question' - how these events relate to long term, i.e. secular, growth? Strictly speaking they are not yet 'historic events' due to the '30 year rule' and archives are not yet open so important original documents are not available (even the Hague court sometimes could not get unedited documents). However, 25 years after an event one could start placing it in a historical context, especially if this does not depend on archives and is not built on a 'soft' data subject to change.

In this paper the authors place the transformation, decomposition and new state formation in terms of long term, secular, economic growth during the 61 year period from 1952 to 2013. The first year is determined by the first sufficiently reliable macroeconomic data and the last by the most recent at the time of writing. This period can be divided into 38 years of 'socialism' from 1952 to 1989 and 25 years of 'capitalism' from 1990 to 2015. The 'hard' data used for representing secular growth are changes in Gross Domestic Product per capita (GDP p/c). In spite of its well-known limitations this is a variable which economists do consider the most representative one for secular growth and which is hence most widely used in this kind of analysis. The data used is taken either directly from official statistics or is recalculated using only data generated by official statistics. In this sense the data is not subject to reevaluation

This is a very simplified approach because it depends on only one variable, GDP p/c. With full awareness of the simplifications involved it still does allow a formeaningful analysis of the 'big' question. The secular changes in GDP p/c in the period from 1952 to 2015 generate a time series that is analyzed for the successor states in terms of

- (i) points of discontinuity (break points) in secular growth and
- (ii) convergence patterns among successor states.

The paper is organized as follows. The first section has a literature review that is more illustrative than exhaustive. In the second section we briefly explain how the GDP p/c time series for the successor states used here was derived, while a more detailed explanation is provided in Appendix 1. The third section discusses results of the analysis of break points in the secular development of individual successor states, a detailed explanation of the approach and results is provided in Appendix 2. The results of the convergence analysis where the relationship of individual secular growth paths are taken together, compared as all possible pairs or compared to benchmarks are given in section 4, a detailed explanation of the approach and results is provided in Appendix 3. Section 5 attempts to link a narrative explanation with the results of break points and convergence analysis. The last section has concluding remarks.

# 1. LITERATURE SURVEY

*This section is not a complete and comprehensive survey either of the Yugoslav literature on secular growth or of the literature on secular growth published in the seven successor states. It aims at providing a survey of topics and context in which secular growth was discussed after 1952. As a result for the 'Yugoslav period' not all references are included and many that are included are done so as examples and for the post 1990 period the Croatian survey is taken as a case study of topics discussed at similar times in other successor states. Hopefully a more thorough survey would not disprove the claims made here.*

Looking at the literature on secular growth of Yugoslavia or its successor states it is clear that so far no one has yet published the kind of time series analysis attempted here. There is no *state-of-the-art* cliometric analysis of the time series of Gross Domestic Product per capita of the Yugoslav successor states for the period from 1952 to 2015. Such estimates have not until now been attempted neither for individual successor states neither in comparative terms. This will probably soon change because the Maddison Growth Project data base of GDP per capita since 1952 has become available (see Milanović (2013)) but the data set still remains incomplete and the inconsistencies noted in the data appendix of this paper remain.

The little econometric analysis of long term growth of Yugoslavia or its successor states has dealt with two aspects. First, the research has concentrated either only on the Yugoslav period or only on the post 1990 period but did not consider them together. There has so far not yet been any attempt at a comparative analysis of successor state secular growth covering the period before and after 1990 (or any other 'threshold year'). Second, the work on long term growth has been limited to decomposing the growth rate and calculating the Solow residual, i.e. total factor productivity. For the 'Yugoslav' period growth factors and especially total factor productivity were recently analyzed in terms of what were later successor states in Popović and Čizmović (2013) or in a Yugoslav context in Kukić (2015) who uses business cycle accounting and finds that total factor productivity was the main growth drivers and labor frictions the main barrier. For the post 1990 period such measurements were made either for individual successor states, see Raguž et al. (2011) for the Croatian example or in comparative terms, see Morozgova et al (2015) or for the national Yugoslav growth.

While the use of modern cliometric tools for the analysis of secular growth with the exception of TFP measurement remains a research lacuna this does not mean that there have not been attempts at looking at secular growth of the successor states in terms of narratives and simple descriptive statistics. For the period before 1990 there are even comparative research results but for the period after 1990 there are none as well as for the whole period after 1952.

## 1.1 Studies of regional long term growth before 1990

The Yugoslav literature on secular growth of what were later successor states but where then republics or autonomous provinces was discussed under the heading of regional economics on the national, i.e. Yugoslav, level. In addition to this level of regional economics there was also a voluminous literature of intra-republic regional analysis, for a Croatian example see

Bogunović(1985), for a Serbian one Marsenić (1981), but a survey of this albeit interesting and important literature is not included here.

Regional issues in the sense used here in Yugoslavia were considered important but were never in the limelight. Contemporary standard textbooks of the Yugoslav economy till 1990 included them as an obligatory chapter but regularly placed them among the last ones, see Sirotković et al (1984) for a Croatian example, or Marsenić (1986) and Jurin (1986) as a Serbian one and Černe (1987) as a Slovene one. In all these textbooks when regional secular growth was considered it was approached primarily as a Yugoslav topic, both by Yugoslav authors, see Bogunović (1985) and foreigners, see Schrenk (1986). The most comprehensive analysis of regional development in Yugoslavia was made by Pleština (1992) and Kraft (1992).

Regional secular growth when it was discussed by scholars before 1990 it appeared in two contexts. The first was to support the development of the less developed regions and was largely concerned with income redistribution linked to growth generation and spatial convergence. The second was in the context of the functioning of the integrated Yugoslav market and economy and later in the context of the build up to the decomposition and spatial inequality and policy efficiency.

Regarding the first Yugoslavia had an elaborate system of redistributions to the less developed regions (three republics, Bosnia and Hercegovina, Macedonia and Montenegro and one autonomous province, Kosovo, all of them eventually became a successor states). The institutional framework evolved over time and every change spawned discussion among economists. For a description of the final form of the Yugoslav system of aid and investment support for the less developed regions, see Mladenović (1981) and Đurđević (1987). The system evolved in the direction of greater donor control increasingly proffering direct aid and investments to that redistributed through the federal fund.

By the mid-eighties the regional research agenda was dominated by three interrelated topics. The first was the renegotiation of support to the less developed parts of the country. In this discussion Slovenia and Serbia were most vocal, the first wanted more direct control and less leaky bucket redistributions, the second claimed that as an average region it should be left out of the redistribution. The second topic was concerned with institutional economic asymmetries in which every single region except Croatia (the 'infamous Croatian silence') argued that there were systemic redistributions in favor of others. The less developed Bosnia and Herzegovina and Kosovo argued that regulated energy and raw material prices were not in their favor. The most developed Slovenia and to a less extent Croatia (which made similar arguments in the early seventies when these issues were discussed under the title of unified market in a multinational state, see Novak (1971)) who were the main exporting regions argued that the foreign trade system and administrative exchange rate led to unfavorable redistribution. The third topic discussed was conducted under the heading of 'the unity of the Yugoslav market'. The topic was taken up predominantly by economists from Serbia or those close to the federal government who argued that the unified national market was undergoing a process of breaking up into what they called 'republican economies'. Each region developed 'its' bank, oil refinery, steelworks which were under the control of its regional administration. They also argued that such a system



reduced the efficiency of economic policy. For a survey of the literature and an evaluation of the data see Bićanić (1989). The topic also received international attention, see Rusinow (1988).

The research and discussions of Yugoslav economists regarding regional differences led to two stylized facts. The first concerned the big differences in the level of development. The second was the lack of convergence. The stylized fact which emerged was that Yugoslavia was a country of unusually large regional inequality that was increasing, that spatial divergence was the rule and that Yugoslavia was not a 'convergence machine'. This divergence continued in spite of policies to the contrary. These stylized facts were accepted both in the official documents, see SIV (1988), semi-official articles, see Uredništvo (1988) which concluded that "In spite of relatively high growth rates 1971-1985 of the insufficiently developed regions...this did not lead to a substantial increase in their sectoral share..." (Uredništvo (1988:252) and numerous research articles and monographs, both by Yugoslav authors, see Bogunović (1985) or Mihailović (1990), and foreigners, see Pleština (1992) or Ottolenghi and Steinherr (1993)

## **1.2 Post 1990 Croatia as a case study**

After 1990, when the hitherto Yugoslav republics and one autonomous province became independent successor states the framework changed and what was regional economics became standard national macroeconomics. Long term growth of regions in a Yugoslav context now became the long term growth of the seven successor states. One may think that this change would have quickly generated a very voluminous literature but this is not the case. The Croatian example which the authors know best can provide an example. Croatia does not seem to be the exception

Till 1990 the slide to decomposition and the solutions offered were treated exclusively within the Yugoslav framework, see Korošić (1989), Horvat (1989) and Sirotković (1990) or papers for the regular meetings of Yugoslav economists, Rohatinski et al. (1990). With independence there were few scholarly attempts by Croatian economists (in contrast to the many journalistic or pamphlets with biased accounts) to tackle the issue of the decomposition and independence, the exceptions are Vojnić (1993) or Bićanić (1994). Furthermore only one economist reinterpreted the Yugoslav experience from a Croatian perspective, Sirotković (1993). This was less due to lack of data or expertise and more due to lack of interest. Understandably, economists were concerned with analysis of current economic problems and the short term of the individual successor states, e.g. the transformation, privatization, stabilization and monetary and fiscal issues, EU integration, etc. and secular growth and the long term was not their concern. Economic history and comparative economic development was certainly not in the limelight.

This changes somewhat after 2000 from when there was a renewed interest in Croatian long term growth. Three authors attempted to construct long term GDP per capita series. The data offered by two, Družić and Tica (2002) and Stipetić (2002, 2012) are not reliable because none of the authors explained the methodology used in their respective calculations and the data shows some important inconsistencies, for an assessment see Bićanić and Tuđa (2014). This means their results cannot be checked and thus will not be given here in spite of it being used by Croatian authors, see Družić (2009). Tica (2004) however offers a fully explained time series generated by backcasting for the post 1950 period till 1989 (the earlier period is very speculative). Tica (2004) concludes "The average growth rate of GDP per capita of Croatia during 1950-1987 was 4.15%"

(Tica 2004:125). However, he does not go beyond the simplest descriptive statistics (growth rates with *ad hoc* chosen sub periods).

In this period there is also an attempt to provide a history of the transition in Croatia, see Družić (2009). Similar efforts can be seen in other successor states, for Serbia Uvalić (2015), for Slovenia Borak (2002) or Montenegro see Popović (2010).

## 2. DATA

All the calculations and therefore all the conclusions in this Working paper are derived from an analysis of the time series of Gross Domestic Product per capita, GDP p/c, for individual successor states of Yugoslavia (except Kosovo for which there is insufficient data). We assume that GDP p/c is an acceptable measure of the level of development and economic welfare.

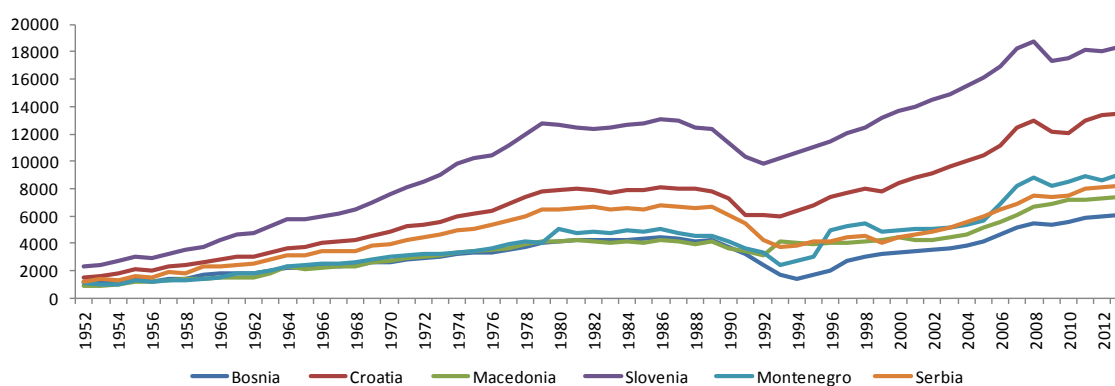
Economists know the limitations of this approach and there is a long history pointing them out and of constructing alternative measures. The limitations of using gross domestic product per capita are both conceptual and technical. Strictly speaking gross domestic product per capita is not a measure of domestic consumption and thereby welfare or level of development. On a technical level its defects include the inherent error in designing time series of comparative values and omissions, especially with E-commerce. For a comprehensive review of all these issues see Stiglitz et al (2009), Oulton (2012) and Coyle (2014). Regarding alternative measures two influential bodies and data sources use alternative measure. The World Bank now uses Gross National Product while the United Nations Development Project since the nineties constructs a Human Development Index. There are now many other similar constructions which claim to better represent welfare, happiness, development etc.

In spite of these well known limitations the use of GDP p/c remains widespread. Oulton (2012) provides a convincing justification for its continued use. Krugman also succinctly provides a justification: '...no matter how much they claim that a one-dimensional measure like GDP is too crude to capture a complex reality, in practice they cannot find any country whose level of development is seriously misindicated by that measure.' Krugman (1996:720). There are also practical reasons for the widespread use of GDP p/c because it has a QWERTY characteristic. It is simply still the most commonly used macroeconomic variable. This is especially visible in the construction of long term historical data, see Maddison (2002) and later publications from the Maddison Project at the Groningen Growth Center. There have been attempts to construct historical series with alternative measures, see Crafts (2002), but they exist only for a small number of countries so historical research remains dependent on GDP p/c, the variable used here.

The time series for GDP p/c used here was specially constructed for this purpose. There are two reasons. First, while time series have been constructed for individual successor states they are sometimes unreliable and/or prevent a comparative analysis. Second, the available Maddison Project data still has some inconsistencies that prevent its use in an analysis such as this one. Regarding the first reason Croatia can provide an example. There three sets of historical data have been published but each has very serious flaws so their use is not recommended, see Bićanić and Tuđa (2014). The Groningen Growth Project as of recently offers a time series of gross domestic product per capita, see Milanović (2013) This time series at the suggestion of

Angus Maddison was constructed by Branko Milanović. The high reputation and integrity of two names involved should themselves justify its use. However, for the kind of analysis conducted in this paper they showed certain aberrations (e.g. the relationship of Macedonia and Serbia thereby the former starts more developed than the latter) and written communication with their author pointed to other ones (the calculations for Serbia). Since Serbia while not the most developed is by far the largest successor state (in 1952 its population and social product was eleven and twelve times larger than that of the smallest successor states Montenegro and three and two times larger than the most developed Slovenia, in 2015 the Serbian GDP was ten times larger than Montenegro's GDP) it is important to have reliable data for it. That justified the construction of a special time series for this paper. To maintain comparability the new time series was constructed in the same way for all the successor states. The methodology used is described in detail in Appendix 1. Kosovo is left out either due to lack of data or lack of reliable data. The first year, 1952, was chosen because this is the first year with reliable data. The last year, 2015, was the last year for which data was available at the year of writing, also it provides a 'round' 25 years of independence. The raw data of the time series for Following this we base our calculations on GDP p/c of the successor states from 1952 to 2015 is depicted in Figure 1.

Figure 1: Gross domestic product per capita of the successor states of Yugoslavia (except Kosovo) from 1952 to 2015 in 1990 international dollars



The research only used the data GDP p/c. Obviously, more reliable results could be derived by using more data. That implies constructing time series from 1952 to 2015 for other macroeconomic aggregates. This, however for the most important ones used in this kind of analysis was not possible. For other macroeconomic variables constructing a time series spanning the whole period are much bigger than they are for gross domestic product and in some cases they are probably unsolvable. For example trade statistics for the successor states cannot be compiled for the period before 1990 and exchange rate data makes no sense. This is because before independence the trade of later successor states was internal trade not statistically was not separately registered. Data on interrepublican trade was published in Grubišić (1986) but it cannot be used in lieu of trade data. For trade data there is also a problem of exchange rates, before 1990 all successor states shared the same exchange rate, furthermore there were multiple exchange rates and COMECON trade had a special regime. The same difficulty exists for financial sector data. Snapshots for interrepublican investments do exist but a useful time series cannot be constructed so series of 'domestic' investments and savings cannot be reconstructed. Employment and wages

data presents least problems. It could be reconstructed if private sector employment especially in agriculture was recalculated. This could be done but given the notorious difficulties of defining the agricultural surplus in peasant farming, and private sector agriculture in Yugoslavia was only peasant farming, the task is not straightforward. Data for some sectors is not comparable due to the private sector (trade, agriculture, crafts). The least problem in reconstructing historical series would be for employment and wages in sectors where the private sector was not present (e.g. manufacturing and mining) but this is highly correlated with GDP and so of limited use for the purpose of this research. Regarding net wages and wage inequality example of a analysis of secular changes in Croatia was made by Hofman et al. (2012).

### 3. BREAK POINTS

The economic history of Yugoslav successor states from 1952 to 2015, the time span included here, was unquestionably turbulent. There were frequent institutional changes, almost continuous destabilization shocks, reflexive stabilization policies and a continuum of political tensions not to mention a regime change and the decomposition of the country with its consequences and subsequent Wars of the Yugoslav Succession. There were also multiple internal non-economic shocks (the death of Josip Broz Tito, droughts, etc.). To this one must add external shocks (cycles, oil crises, cold war tensions, etc.). In short, this was a time of almost continuous change. Under such circumstances it was a great challenge to find break points. With most of the research done by Yugoslav or foreign political scientists, e.g. Ramet (1992) and Bilandžić (1985), historians, e.g. Lampe (2000) or Goldstein and Goldstein (2015), descriptive economists, see Pailaret (1997) and Sirotković (1990), and many journalists, the dominant approach was primarily narrative and a concentration on the impact of events, more precisely of internal political, policy or institutional shocks. In this section we take a different approach. Here we apply standard econometric tests for determining break points in time series of GDP per capita series for Yugoslav successor states. This approach has not been attempted till now.

Break points are defined as points in a time series in which there is a detectable change in equation parameters according to some criteria. The first generation of tests allowed the existence of only one break point but later econometric techniques allowed for the determination multiple break points in the time series. The first attempt was the procedure devised by Chow (1960) where break points are externally and *ad hoc* chosen and econometric procedures used to tested for their existence. The next step was the Quandt-Andrews test aimed at eliminating the *ad hoc* feature. In this test the Chow test was sequentially applied for all data points. The criteria for the break point remained unchanged. After that theoretical work concentrated on introducing the criteria for determining multiple break points. This was done by the Bai-Perron test. This test recalculates the data and determines the break points for the recalculated series. The Bai-Perron test does however require an *ad hoc* assumption regarding the maximum number of possible break points the recalculation can recognize and a choice of lags.

Both single and multiple breakpoint tests were applied to the time series of GDP per capita for Yugoslav successors states (how the series was derived from primary data is explained in the previous section and in detail in Appendix 1). The methodological basis, i.e. the equation, used in the paper for determining the two types of break points are described in Appendix 2.

### 3.1 Single break point analysis 1: Quandt-Andrews test and Bai-Perron test for one break point

Single break points were determined by two different procedures. The first was the chronologically older Quandt-Andrews test, the second was the Bai-Perron test with one break point. The difference is that the former procedure only uses the raw data while the second introduces lags and recalculates the original series.

The Quandt-Andrews test was the first test designed to recognize break points. The test allows the recognition of only one break point. It is usually used to estimate the existence and timing of one structural change in OLS estimated parameters. Using the methodology described in A2.1 and the equation A2.1 for the GDP per capita growth rates determined as in Appendix 1. Table 3.1 summarizes the results.

Table 3.1 Single break points: Quandt-Andrews test in GDP growth rates for successor states 1952-2015

	SINGLE BREAK POINT
Bosnia and Herzegovina	1996
Croatia	1964
Macedonia	1982
Montenegro	1980
Serbia	1960
Slovenia	1980

Source: authors

Looking at these break points three things stand out. First, it is clear that their range is very wide, 36 years from 1960 for Serbia to 1996 for Bosnia and Herzegovina. Second, the three larger successor states with the greatest weights have no common break points. Third, all three small successor states have a joint break point in 1980 and 1982. Given these results and the known turbulence of the period it seems much more probable that there were multiple break points.

The second procedure for determining a single break point uses the Bai-Perron procedure which recognizes only one possible break point. This procedure uses formula A2.2 and the results are given in Table 3.2.

Table 3.2 Single break points: Bai-Perron test in GDP growth rates for successor states 1952-2015

	SINGLE BREAK POINT
Bosnia and Herzegovina	1979
Croatia	1964
Macedonia	1966
Montenegro	1984
Serbia	1981
Slovenia	1966

Source: authors

The Bai-Perron break point tests for one break point are in a wide 20 year range between 1964 (Croatia) and 1984 (Montenegro). All the break points are in the Yugoslav period of the successor states development and the dominant period are the mid sixties when there were 3 break points (Croatia, Macedonia and Slovenia). Two break points were around 1980 (Bosnia and Herzegovina and Serbia). As will be clear later both these periods support the narrative explanation but omit independence, transformation and war as influencing break points.

Comparing the two procedures shows that the only for Croatia the break points is the same in both procedures, for the other 4 successor states the differences break points are dramatic. For Quandt-Andrews the dominant dates are the early eighties, for Bai-Perron the mid sixties. What is common is that neither procedure recognizes independence of transformation related dates as break points.

With this in mind the authors consider the identification of multiple break points a more meaningful approach.

### 3.2 Multiple break point analysis 2: Bai-Perron test for multiple breakpoints

The disadvantage of recognizing one break point is overcome by the Bai-Perron test for multiple break points. The test requires that the lag and the largest number of possible break points must be externally determined. In the test conducted here the chosen maximum was 5 break points. Results from the Bai-Perron structural break test show multiple breakpoints in the individual growth rates of Yugoslavia's successor countries during the period from 1952 to 2015.

The years of the estimated break points are given in Table 3.3.

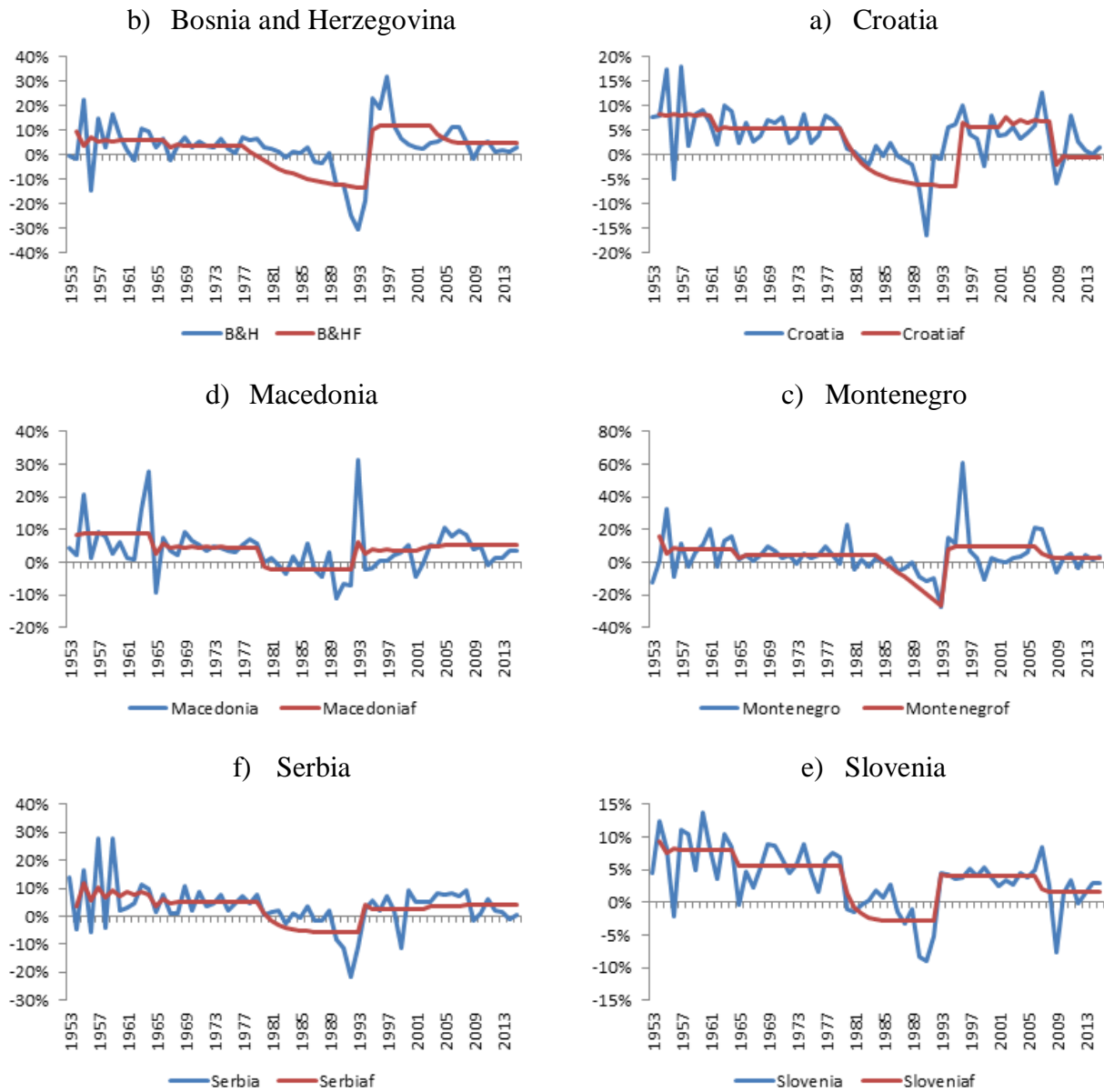
Table 3.3 Structural break dates (Bai-Perron test) for the successor states using the whole sample, period 1952-2015

.	1960-1969	1970-1979	1980-1989	1990-1999	2000-2015
Bos. & Her	1967	1978		1995	2004
Croatia	1965		1981	1992	2007
Macedonia	1965		1980	1993	2002
Montenegro	1965		1985	1994	2007
Serbia	1965		1980	1994	2003
Slovenia	1965		1980	1993	2007

Source: authors

The results from Table 3.3 are clearer if shown in graphs. This was done in Figure 3.1. Here the blue lines are the actual growth rates and the red line the estimated growth rates from formula A2.2. The equation is constructed in such a way so that it allows multiple changes in its parameters through different time periods. Thus, the red line on the picture depicts the estimated sudden changes in the underlying evolution of GDP growth rates. The estimated years for the break points are given in Table 3.3.

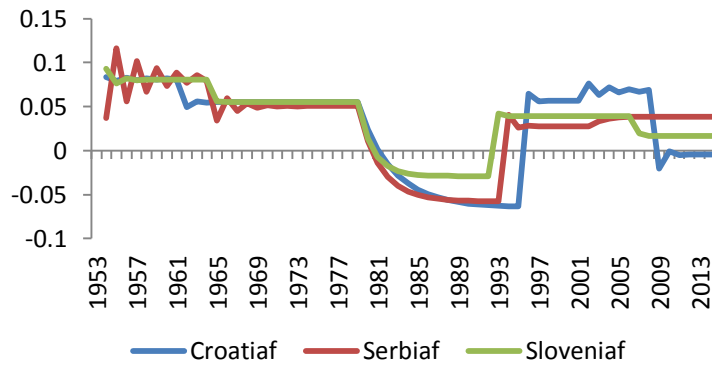
Figure 3.1: Multiple break points (Bai-Perron test) in GDP growth rates for successor states using the whole sample 1952-2015



Source: authors

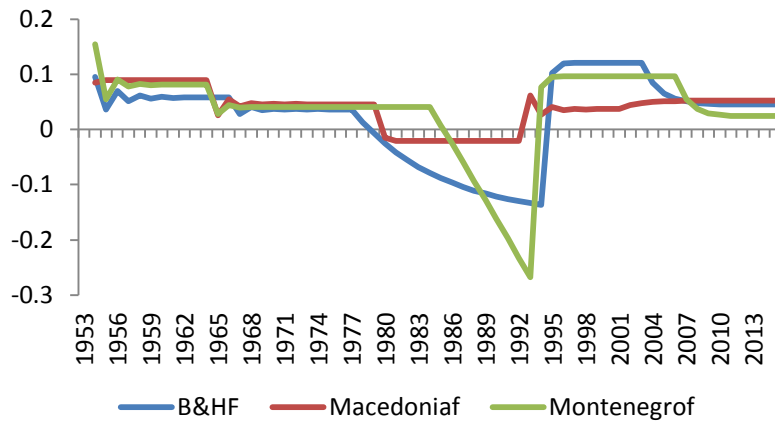
The above six figures for the individual successor states are clearer if they are grouped into the 3 more developed and 3 less developed successor states (the more developed are defined as above the Yugoslav average). The results are presented in Figure 3.2 and Figure 3.3.

Figure 3.2: Multiple break points (Bai-Perron test) in GDP growth rates for the more developed successor states using the whole sample 1952-2015



Source: authors

Figure 3.3: Multiple break points (Bai-Perron test) in GDP growth rates for the less developed successor states using the whole sample 1952-2015

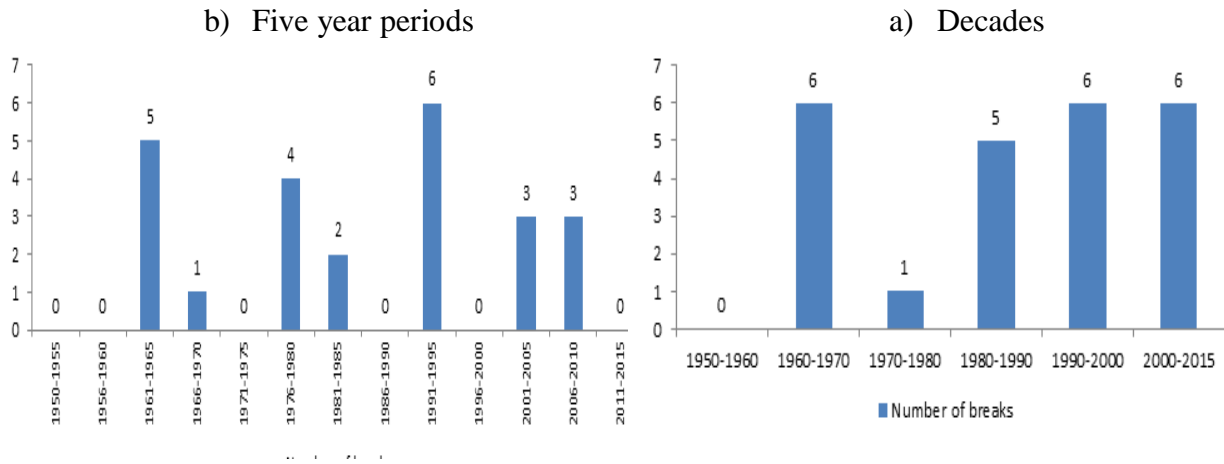


Source: authors

The results are clearer if they are depicted in figures showing number of breaks. Figure 3.4 summarizes the breakpoint according to five year periods and decades and Figure 3.5 according to individual years.

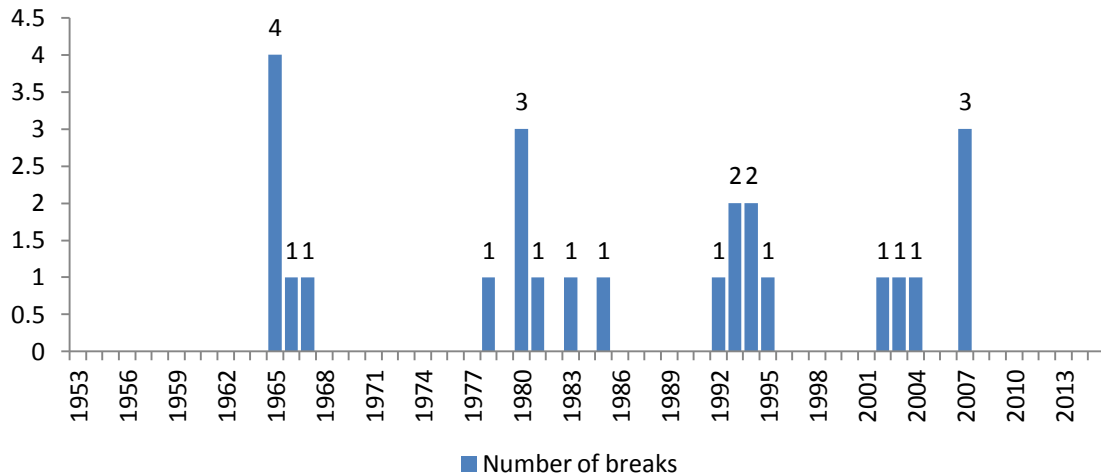


Figure 3.4: Bai-Perron break points distributed according to (a) five year periods and (b) decades



Source: authors

Figure 3.5: Bai-Perron break points distributed according to years



Source: authors' calculations

Figure 3.4 shows there was an equal number of break points (six) in the sixties, nineties and after 2000. During the seventies there were least (1) break points. During the eighties there was one break point less (5). After seventies when there was only one break point there is a rising trend of break points during the ensuing decades. Interestingly, with the political stability i.e. following the end of the Wars of the Yugoslav succession and establishment independence the number of break points does not change but they are over a longer period (7) years than earlier (in the seventies, eighties and nineties 3, 5 and 3 years respectively). Considering shorter periods the break points are groups around the mid-sixties (6) with the dominant year 1965 (5), the early eighties (6) with the dominant year 1980 (3), early mid-nineties (6) with no clear dominating year and 2007 (3).

Chronologically, the first sudden change in the growth regime occurred in the mid-sixties. In all successor states this structural break in economic growth was also a regime change accompanied by a decline in growth rates for all successor states. Until the early 1960's (the period 1953-1960 or 1953-1965) the average growth rate was around 7% and after 1965 (the period from 1965 to 1980) the average decreased to 5%. Furthermore, the deceleration in growth rates was accompanied by a decrease in the volatility of economic growth which occurred for most of the studied successor states, see Table 3.4. The fall in volatility signified a lower but more stable growth path for these countries. Our methodology recognized the break in volatility of economic growth for Bosnia and Herzegovina, Croatia, Serbia and Slovenia and descriptive statistics show that Montenegro also established more stable economic growth rates during the 1960-ies (Table 3.4). Descriptive statistics show that high volatility of growth rates similar to the 1950-ies returned again during the tumultuous 1990-ies when the first years of transformation coincided with independence and the Wars of the Yugoslav succession. In view of this, the early 1960's break point may be viewed as a transition period to more stable growth rates and the nineties as a temporary return to volatility. During the whole 39 year 'socialist' period there were altogether 12 break points and during 25 year 'capitalist' were the same number of break points.

Table 3.4: Decadal standard deviations in GDP growth rates for Yugoslav successor states

	B.& H	Croatia	Maced.	Monten.	Serbia	Slovenia	Yugosl.
1950's	0.13	0.08	0.06	0.14	0.14	0.05	0.08
1960's	0.04	0.03	0.10	0.04	0.04	0.04	0.04
1970.s	0.02	0.03	0.01	0.02	0.02	0.02	0.02
1980.'s	0.05	0.03	0.05	0.03	0.03	0.03	0.03
1990's	0.30	0.10	0.05	0.13	0.10	0.08	0.08
2000's	0.04	0.04	0.03	0.05	0.03	0.04	0.04
2010's	0.01	0.02	0.02	0.03	0.02	0.02	0.02

Note: Yugoslavia is the sum of real GDP of the studied countries

Source: authors' calculation

After the early sixties the analysis of multiple break points in the growth path of the successor states indicates the next cycle of break points in the growth regime that was common for all but one of Yugoslavia's successor states was around 1980. The exception is Bosnia and Herzegovina that experienced a break point two years earlier, in 1978. This structural break was accompanied by a huge decrease in average growth rates for these countries, from an average of 5% *per annum* in the 1970's to 0% during the 1980's. Even though economic growth collapsed after the break point of the early eighties, GDP per capita growth rates did not show the instability which was characteristic for 1960's and 1990's.

The next break point of the successor states in the early nineties can be viewed in a wider context. First, in a wider international context and second in a narrower 'Yugoslav' context. International evidence on growth episodes (Berg, Ostry and Zettelmeyer, 2008) identified the first half of the 1970s as a structural break for high income countries (the end of 'Golden growth'); the period between 1978 and 1983, for Latin America; the 1970s and the first half of the 1980s, for Africa. So, the date of Yugoslavia's and its successor states down-break in economic growth roughly corresponds to the one experienced in Latin America and Africa. In a Yugoslav context this was a period of policy shocks discussed in Section 5.

### 3.3 Summarizing the results of measured break points

The Yugoslav successor countries exhibited unstable economic growth rates during the whole period from 1952 to 2015 but the variation among them decreased. Economic growth was subject to sharp changes which altered the growth pattern that followed after these structural breaks.

Chronologically, the first abrupt change in economic growth follows the break points that can be recognized in the second half of the 1960-ies. The second wave of breakpoints that emerged from our analysis is roughly placed in the early 1980-ies. Around this date economic growth stopped in Yugoslavia and thus in its successor states and was followed by disintegration of federation as the existing economic system did not manage to generate economic growth afterwards. Interestingly, our methodology recognizes the first part of the tumultuous 1990-ies as a continuation of the growth regime in the 1980's. Only in the mid 1990-ies economic growth picked up again and is recognized as a start of the new economic growth regime. There was another wave of breakpoints after 2000 but in only two successor states was it linked to the Great Recession.

For the two more developed successor states (Slovenia and Croatia) two break points can certainly and another one perhaps be linked to international cycles. After independence in 1990 the waves of breakpoints are wider. Two events in the world economy that are not reflected in breakpoints is the Oil crises and the Great moderation.

## 4. CONVERGENCE

In the context of the secular economic development of Yugoslavia's successor states an analysis of economic convergence is as important as the previous discussion of break points. Convergence can be discussed in two contexts.

The first concerns the mutual relationship of the successor states, first as republics of the Yugoslav federation and after 1990 for 5 and eventually for 7 independent states. Two aspects stand out. First, how did the relationships in levels of development levels of all the successor states taken together change, was it reduced implying convergence or did the differences increase implying divergence. Especially how did the multiple shocks of the transformation, independence, war and EU integrations influence the relationships. This approach to convergence is the 'classical approach' implied by the 'canonical' neoclassical one sector growth model (the 'Solow' model). The model provides the theoretical background for expecting economies to converge over time so that their differences in levels of development decrease. Such convergence is possible only if less developed successor states have higher growth rates than more developed ones and if the dispersion of growth rates and income per capita decrease over time. The first convergence measure is called absolute  $\beta$ -convergence and the second  $\sigma$ -convergence. In the first approach convergence concerns all the successor states.

The second approach to convergence considers the possible convergence or divergence of pair's of growth paths. Again two aspects' are considered. The first looks at a pairs of successor states and measures whether they converge or diverge from another one. This is important since such

comparison of pairs allows the identification of possible convergence clubs among successor states, not only if they existed but whether these clubs are stable during the period or did their composition change. The second aspect compares the growth path of successor states with the growth path of an *ad hoc* chosen benchmark country. Two such benchmarks are ‘natural candidates’ and were chosen, the first is Austria and the second Greece. Both benchmarks are economies that during the period grew successfully. The first benchmark, Austria is a member of the European core economies, three successor states and parts of one were in the Austro-Hungarian Empire and hence referred to it when looking at their own development and finally it has a psychological appeal as a benchmark. Greece was less developed but after 1974 when it became a member of the EU it enjoyed the advantages of EU membership and redistributions and became part of the EU convergence club, see Gill and Inderdit (2014).

The chosen approach to convergence described above required using more than one approach. The equations used are standard in the literature so here already derived and tested. The more detailed explanation of the equations used here are given in Appendix 3. Only the results of these tests are described in the section while the numerical results are in the Appendix 3.

#### 4.1 $\sigma$ -convergence: the results

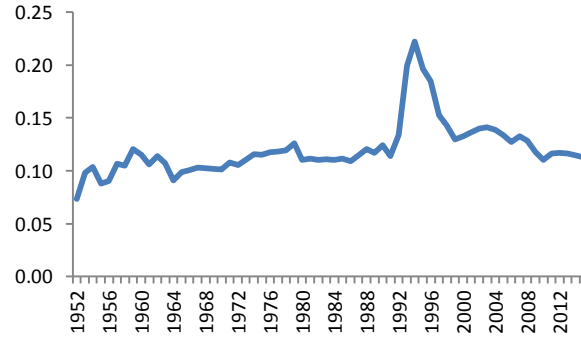
The first convergence measurement is  $\sigma$ -convergence. It is the least sophisticated measurement but used here because there is a long tradition of measuring  $\sigma$ -convergence ( $\sigma$  is used because the measure is the standards deviation of average *per capita* income in the successor states) among Yugoslav republics and autonomous provinces till 1990.  $\sigma$ -convergence of social product per capita for republics and autonomous provinces appeared in official documents, see SIV (1988) or Uredništvo (1986) as well as all previous six five year plans, semi-official publications, see Uredništvo (1988) and research articles and monographs, see Bogunović (1985). Foreign analysts also initially used  $\sigma$ -convergence, see Ottolenghi and Steinherr (1993). Using the results of  $\sigma$ -convergence led to the identification of a stylized fact about Yugoslav economy, namely that spatial differences increased and that Yugoslavia was not a ‘convergence machine’ in spite of a complex system of support for the less developed regions and reiterated policy proclamations in all official documents.

Here  $\sigma$ -convergence is measured differently because it is measured for successor states (meaning Serbia and Vojvodina are taken together) and Kosovo is left out (due to data issues). The results for  $\sigma$ -convergence are depicted in Figure 4.1. We can see that in ‘Yugoslav’, i.e. pre-1990 period, income differences were continuously rising just as the stylized fact would have it. There were two brief exceptions in 1962-1964 and 1978-1980. During 1980s income differences were relatively stable, moving around the level from the beginning of 1970s. In the last years of 1980s we can see gradual increase of income differences which temporarily and slightly decreased in 1991. With independence after 1990 from 1991 to 1994  $\sigma$ -convergence increased dramatically reaching its historical highs in 1994, no doubt due to the Wars of the Yugoslav succession. After this maximum value  $\sigma$ -convergence started falling thus reflecting convergence. Eventually, by the end of the period it reached levels similar to ones in the early eighties.

Coinciding with the global crisis at the beginning of 2000s, income differences started to rise again, while after 2003 we could see strong compression of income differences, as a result of convergence of less developed successor states toward its developed peers. After 2009 we can

see gradual reduction of income differences as Croatia, Slovenia and Serbia recorded prolonged fall and/or stagnation of per capita income, while other countries kept strong economic performance.

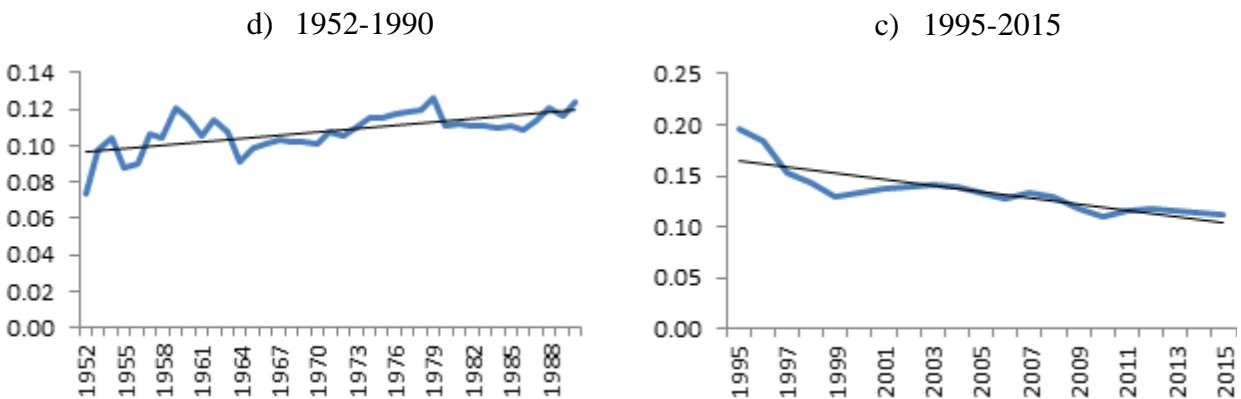
Figure 4.1:  $\sigma$ -convergence 1952-2015



Source: authors

These two periods of  $\sigma$ -convergence are clearer if the data of Figure 4.1 is divided into the two periods. This was done in Figure 4.2 (the data from 1990 to 1995 was omitted because of the spike but this does not change the results).

Figure 4.2:  $\sigma$ -convergence for sub-periods: (a) ‘Yugoslav’ 1952-1990, (b) ‘independent’ 1995-2015



Source: authors

The changes in  $\sigma$ -convergence over the whole period indicate an interesting result. Taking the whole ‘socialist’ or Yugoslav period from 1952 to 1990 there was a steady increase in the standard deviation implying  $\sigma$ -divergence. This result is in line with the mentioned stylized fact. For the second period the result is unexpected. For the ‘capitalist’ or independent period there is  $\sigma$ -convergence.

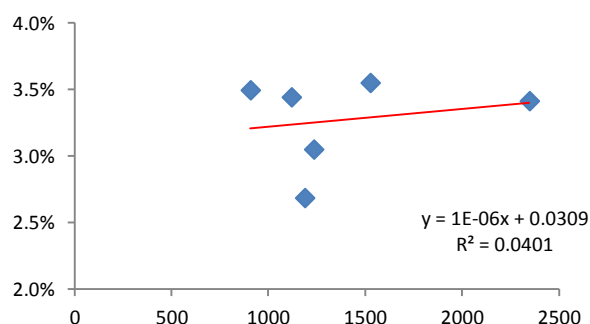
## 4.2 $\beta$ -convergence: the results

A more robust analysis of convergence is by looking at absolute, unconditional,  $\beta$ -convergence. This convergence is estimated from equation A3.1 explained in Appendix 3. The equation was tested for the data set for the Yugoslav successor states (how these values were derived is explained in Appendix 1). Like before the present territory of the successor states is taken as the data points (Serbia is treated in its present borders i.e. as the sum of what used to be called ‘Serbia proper’ and Vojvodina) but Kosovo is omitted due to the lack of data.

For each successor state the average growth rate is calculated from 1952 to 2015. These growth rates are then plotted against the initial, 1952, level of *per capita* income. Only if the slope of the regression line is negative is there is absolute  $\beta$ -convergence since such a slope implies less developed economies have higher growth rates and are decreasing the lag behind developed successor states. In all other cases there is no convergence and the economies are not converging to a common growth path.

Absolute  $\beta$ -convergence for the period is calculated in two ways. The first is for the whole period from 1952 to 2015 and these results are given in Fig 4.3. The line is almost horizontal indicating virtual absence of any convergence among the successor states over the whole period. The absence of absolute  $\beta$ -convergence in the regressions indicates there is no common growth path for the successor states. During the period the successor states with higher levels of per capita income grew faster than their less developed peers (had Kosovo been included the divergence would have been even more pronounced).

Fig 4.3 Regression lines for absolute  $\beta$ -convergence 1952-2015



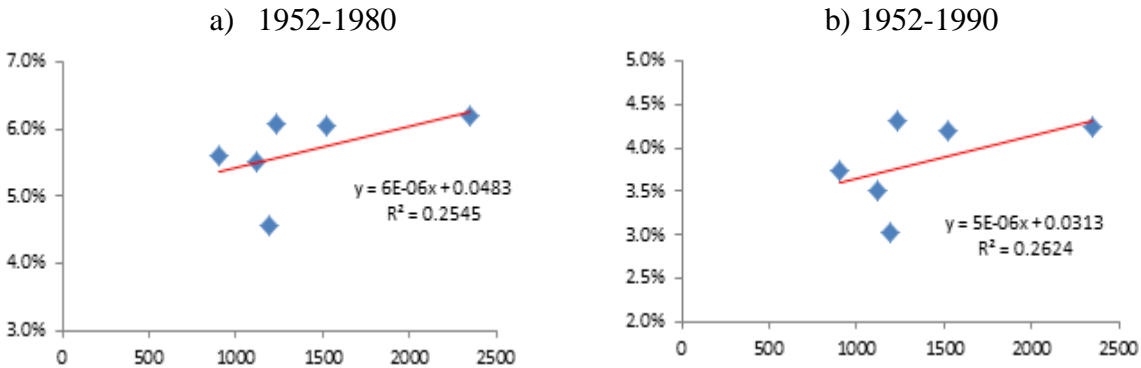
Source: authors

The second approach is by identifying the two periods whose existence was indicated by  $\sigma$ -convergence. The first is the ‘socialist’ and Yugoslav period from 1952 to 1990, these results are in Figure 4.4(a), and the second is the ‘capitalist’ and independent period from 1990 till 2015, these results are in Figure 4.5(a). The absolute  $\beta$ -convergence of each of these periods is different.

Convergence during the ‘socialist’ and Yugoslav period from 1952 to 1990 is depicted in Figure 4.4(a). The regression line has a positive slope implying there was no absolute  $\beta$ -convergence. At that time federal republics (except for Serbia composed as previously described) with higher

incomes had higher growth rates. The discussion of break points in section 3 indicated 1980 is the most common break point during the whole period. However, this break point did not influence absolute  $\beta$ -convergence during the ‘socialist’ period. This is visible in Figure 4.4(b) where the regression line also has a positive slope indicating divergence. The period from 1952 to the first break point in 1980 has another interesting feature. Growth rates were significantly higher than after it so the regression line is higher.

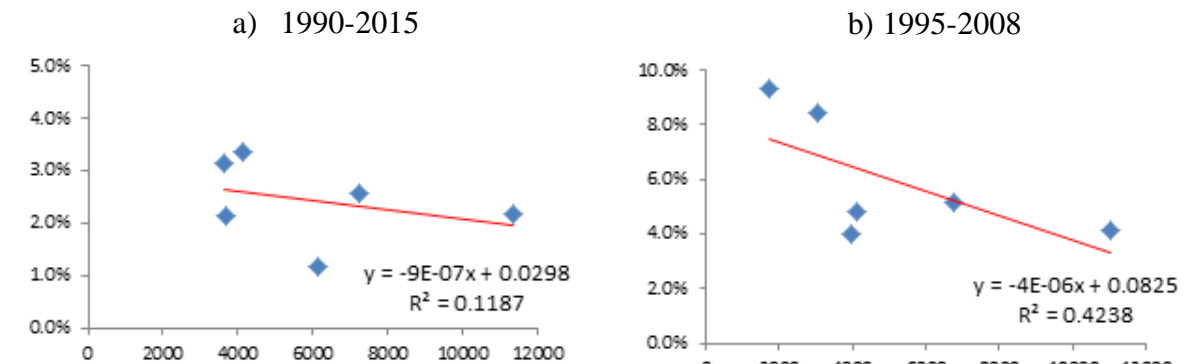
Fig 4.4 Regression lines for absolute  $\beta$ -convergence 1952-1980 (a) and 1952-1990 (b)



Source: authors

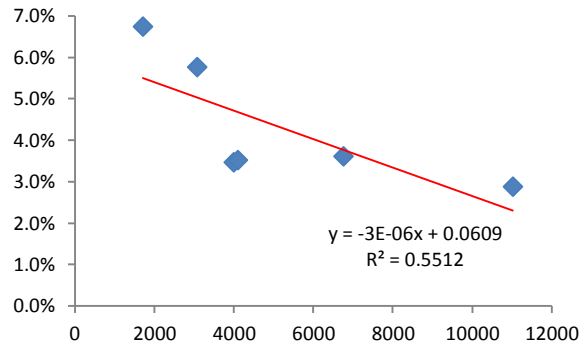
Calculating  $\beta$ -convergence for the whole second ‘capitalist’ and independent period are depicted in Figure 4.5(a). In Figure 4.5(a) the regression line is falling which indicates there was absolute  $\beta$ -convergence during the whole ‘capitalist’ period from 1990 to 2015. This is also true if the period is trimmed in two ways. First the ‘war’ years 1990-1995 and the post-Recession years after 2008 are excluded and the period reduced to 1995-2008, the result are in Figure 4.5 (b). Then only the ‘war years’ were excluded and the period reduced to 1995-2015, the results as seen from Figure 4.5(c). In all three cases there is  $\beta$ -convergence, the differences among the economies were decreasing

Figure 4.5: Regression lines for absolute  $\beta$ -convergence during selected post 1990 periods: (a) 1990-2015, (b) 1995-2008 (c) 1995-2015



Source: authors

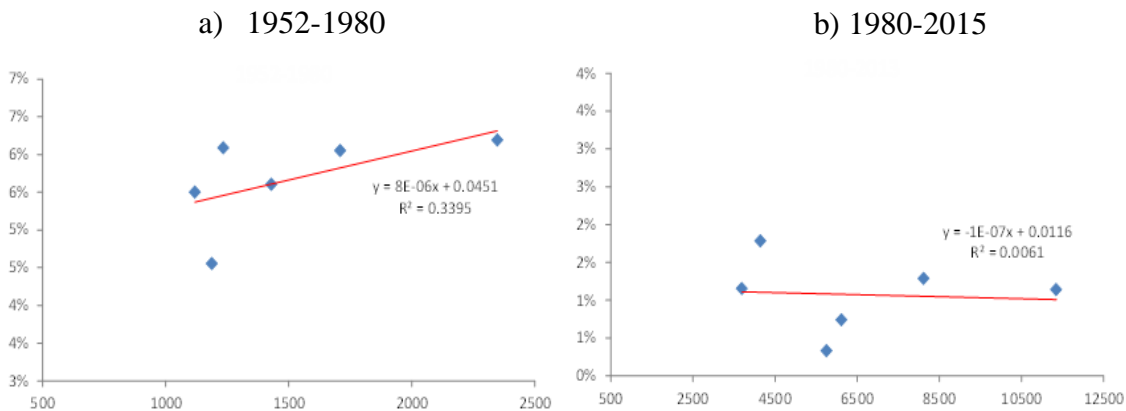
(c) 1995-2015



Source: authors

The final  $\beta$ -convergence result uses 1980 as a break point. The results for the first period from 1952 to 1980 are given Figure 4.6(a) and they show strong divergence. For the second period from 1980 to 2015 this means combining ‘late socialist years’ after 1980 and ‘post-socialist years’ till 2015. Results presented in Figure 4.6(b) show that from 1980-2015 there was no absolute convergence or divergence as the slope of regression line is flat.

Figure 4.6: Regression lines for absolute  $\beta$ -convergence (a) 1952-1980 and (b) 1980-2015



Source: authors

It is usual to analyze  $\beta$ -convergence on as large a data sample as possible since this gives greater reliability to the estimated regression and robustness to the result. It is not unusual to include more than 100 economies. Here only 6 data points are used, one for each successor state. The reasons for this restricted approach are twofold. First, prior to 1990 the successor states were constituent parts of Yugoslavia and it would seem wrong to ‘mix’ them up with independent states since they had no economic sovereignty (it would be like mixing Bavaria, Scotland, Denmark and Portugal into a  $\beta$ -convergence regression). Second, one of the central results concerns of the paper is the effect of independence and the changing patterns of convergence under its influence. Using a larger data set would prevent deriving these results.

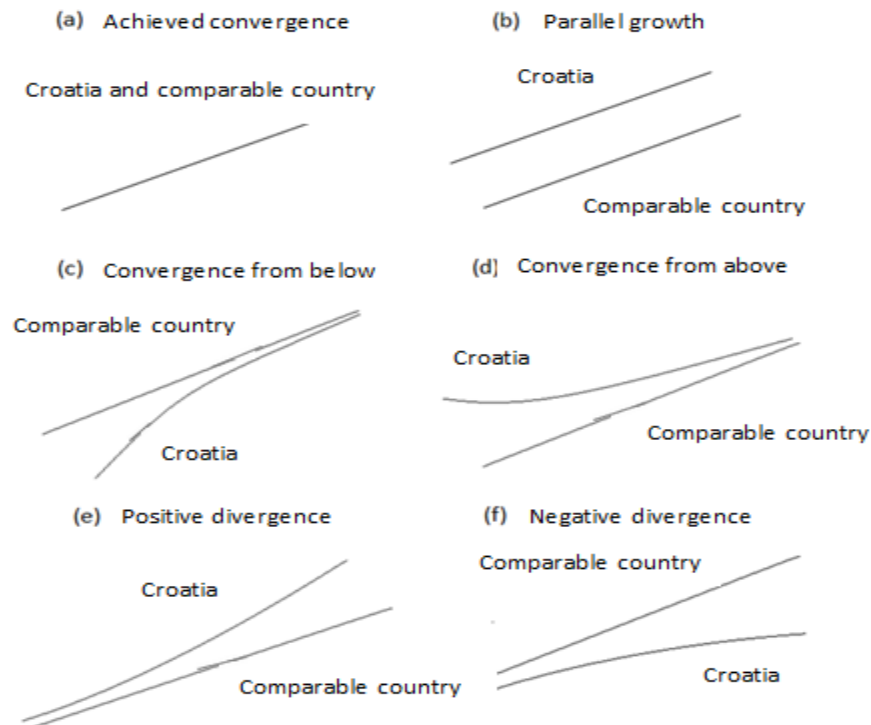


### 4.3 Pair convergence of successor states: results

In this section we will present the results of the second approach to convergence. This approach compares growth trajectories of pairs of economies. This is done in two ways. To do this we estimated the equation A 3.3 for the Bai-Perron test in two ways. The first was for all pairs of successor states, i.e. for income differences between all pairs of successor states. The second way was by comparing growth to the *ad hoc* chosen benchmarks.

This approach enables us to distinguish between six possible cases depicted in Figure 4.8 where Croatia is used as merely as an example. The first case, Fig 4.8(a) is when growth paths coincide and convergence has been completed. In Fig 4.8(b) growth trajectories are parallel with and there is neither convergence or divergence which means that country of interest and its pair have similar growth rates on different levels of per capita income. The next two cases are convergence. It is possible to have convergence ‘from below’ as in fig 4.8(c) when the economy in question is through higher growth rates converging to its benchmark, this is also ‘good or positive’ convergence since there is ‘catch-up’. The next case, Fig 4.8(d), is convergence ‘from above’, when the country of interest is converging due to slowing down and decreasing growth rates. Because this convergence is generated by deceleration this is ‘negative’ convergence. The last two are cases of divergence. In Fig. 4.8(e) which can be called ‘positive’ divergence the country of interest begins on a similar level of income as its pair but begins to grow faster and ‘leaves its pair behind’. Finally there is ‘negative’ divergence as in fig 4.8(f) where the country of interest falls behind of its pair.

Figure 4.8 Classification of convergence cases



Source: authors

The results of comparing the calculating break points in pairs of successor states are given in Table 4.1. All the breakpoints are statistically significant and thus represent real changes in convergence patterns.

Table 4.1: Break point among pairs of successor states

Breaks in <b>B&amp;H</b> convergence with:						Breaks in <b>Croatian</b> convergence with:					
Successor states						Successor states					
	CRO	MK	MN	RS	SI	B&H	MK	MN	RS	SI	
1960s					1968	1960s				1967	
1970s	1978			1977		1970s	1978	1977	1971	1978	
1980s		1983			1980	1980s		1980		1980	
1990s	1993	1993	1996	1998	1990	1990s	1993	1991	1996	1992	
2000s	2007	2002	2007		2007	2000s	2007	2007	2006	2002	
										1990, 1999	

Breaks in <b>Macedonian</b> convergence with:						Breaks in <b>Montenegrin</b> convergence with:					
Successor states						Successor states					
	B&H	CRO	MN	RS	SI	B&H	CRO	MK	RS	SI	
1960s					1967	1960s				1967	
1970s		1977		1979	1977	1970s		1971		1974	
1980s	1983		1987		1986	1980s		1980	1987	1987	
1990s	1993	1991	1996	1992	1995	1990s	1996	1996	1996	1996	
2000s	2002	2007	2006	2002	2006	2000s	2007	2006	2006	2006	

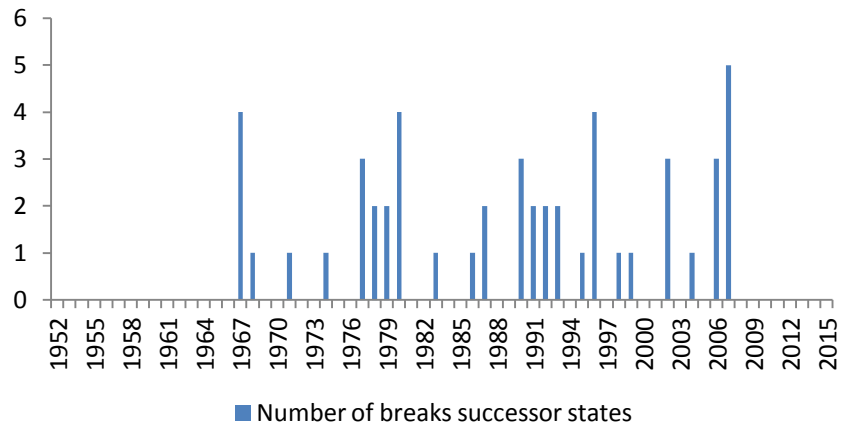
  

Breaks in <b>Serbian</b> convergence with:						Breaks in <b>Slovenian</b> convergence with:					
Successor states						Successor states					
	B&H	CRO	MK	MN	SI	B&H	CRO	MK	MN	RS	
1960s					1967	1960s	1968	1967	1967	1967	
1970s	1977	1978	1979	1974		1970s		1977	1979		
1980s				1987	1980	1980s	1980	1980	1986	1980	
1990s		1992	1992	1996	1990	1990s	1990	1990	1995	1991	
2000s	1998	2002	2002	2006	2004	2000s	2007	1999	2006	2007	

Source: authors

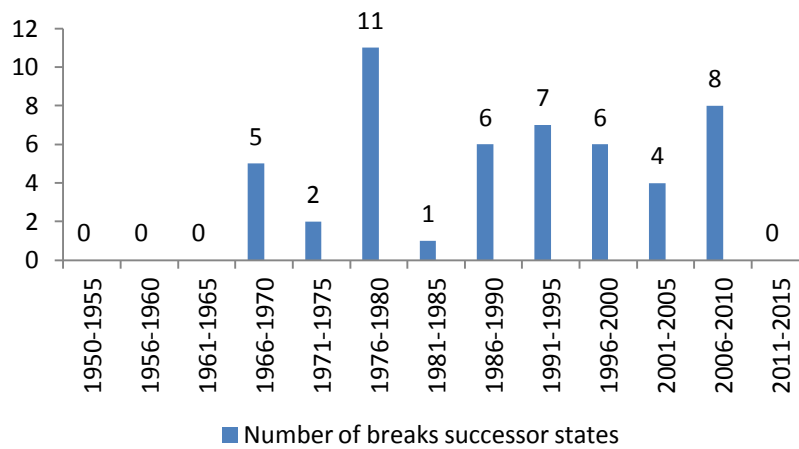
Common characteristics among these break points are better visible if they are first distributed by years as in Figure 4.9 and then in five year periods as in Figure 4.10

Figure 4.9: The yearly distribution of break points among successor states



Source: authors

Figure 4.10: The distribution of break points among successor states in five year periods



Source: authors

The yearly maximum number of break points is given in Table 4.2.

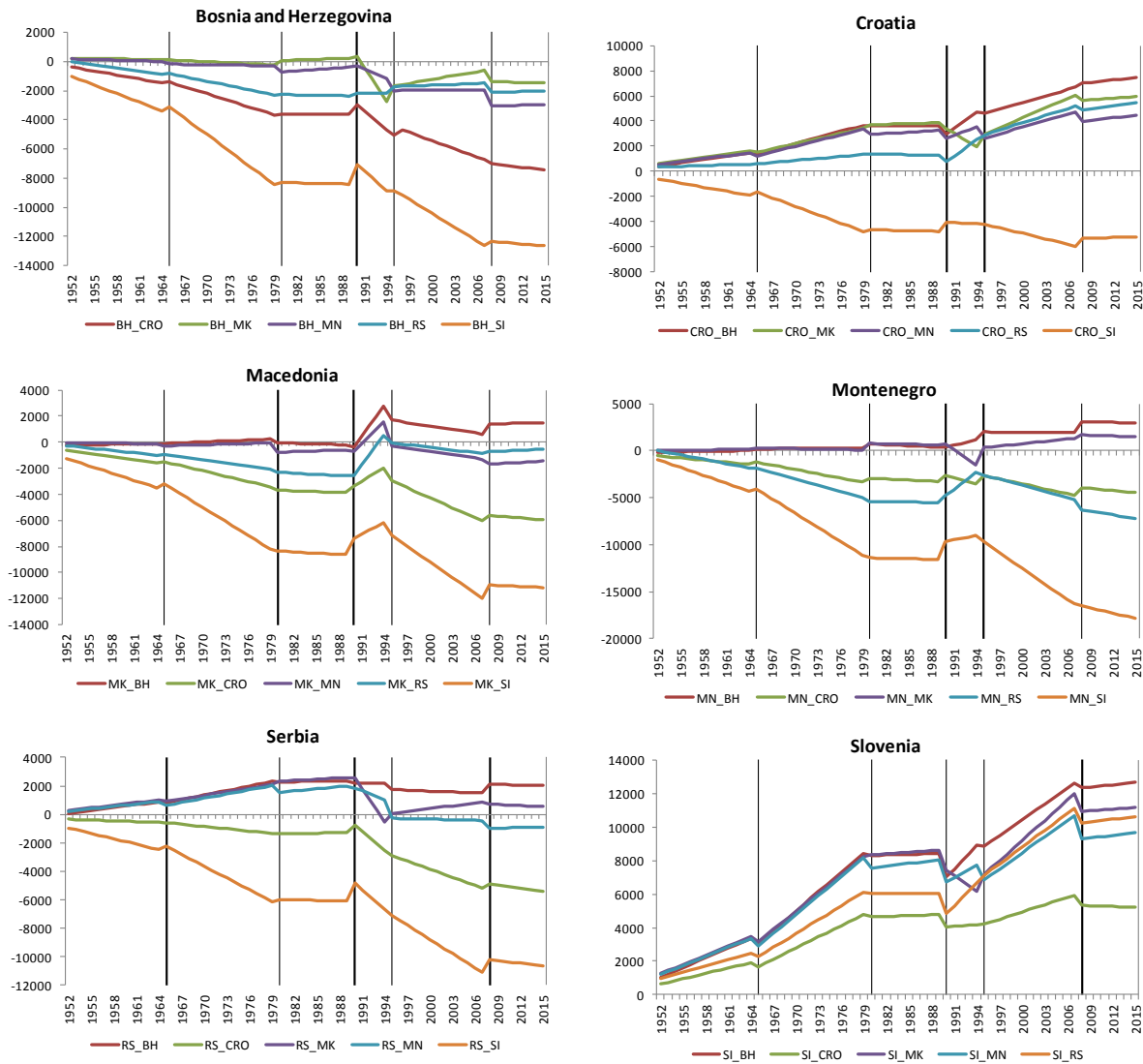
Table 4.2: Years with largest number of break points among successor states

2007	5
1967	4
1980	4
1996	4

Source: authors

Finally the break points from Table 4.1 can be depicted for each successor state in Figure 4.11. A rising trend implies divergence and a falling one convergence.

Figure 4.11: Breaks in convergence among successor states



Source: authors

When considering the years with the most breakpoints the following features can be seen. With regards to 1965 the shocks mostly hit Bosnia and Herzegovina that country lost its relative position in front of Macedonia and Montenegro while Slovenia and Croatia mostly benefited from that shock as they accelerated its positive divergence path. The shock of 1980 is specific because it had similar effect on most of successor states thus causing different growth paths to ‘converge’ so that after it parallel growth paths prevail. The exception is Bosnia and Herzegovina as it surpassed Macedonia as attained its previous position. In 1990 most successor economies were involved in the Wars of the Yugoslav Succession. This time the exception is Macedonia which benefited as it shortly closed the gap with more developed successor states and permanently overtook Bosnia and Herzegovina. With the exception of Serbia all the successor states experienced a positive shock in 1995. After that breakpoint Serbia missed that ‘opportunity’ as it permanently lost its relative position to Montenegro. But while the rest

experienced a positive shock it varied in intensity. Slovenia's and Croatia's divergence accelerated and the 'positive gap' with Macedonia and Bosnia and Herzegovina expanded when compared to pre-1990 levels. The Great Recession shock in 2009 also hit all successor states similarly, but it had the biggest effect on Slovenian convergence pattern as its rapid positive divergence significantly slowed leading almost to parallel growth paths with less developed successor states

#### 4.4 Pair convergence of successor states and benchmarks: results

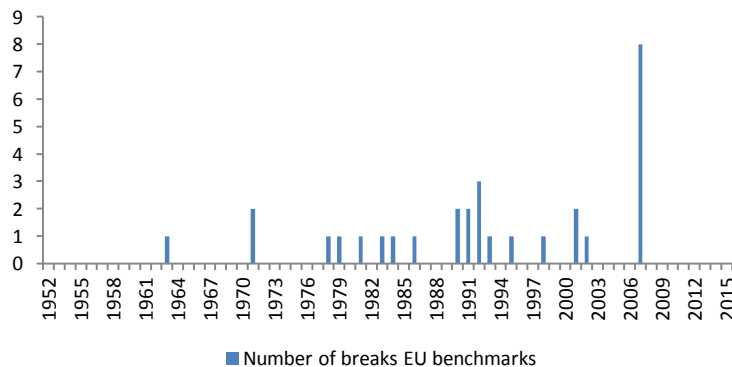
The same exercises as above can be repeated with convergence breaks of successor states and the *ad hoc* chosen benchmarks: Greece and Austria. The break points of convergence pairs for Greece and Austria are given in Table 4.3. The yearly distribution of break points is in Figure 4.12 and the distribution in five year periods on Figure 4.13.

Table 4.3: Break points in convergence pairs of successor state and benchmark

		B&H	Croatia	Macedonia	Montenegro	Serbia	Slovenia
Greece	1960s				1963		
	1970s		1979	1971	1972	1970	1974
	1980s			1988		1983	1986
	1990s	1992			1992	1992	1995
	2000s	2007	2001, 2007	2007	2007	2007	2007
Austria	1960s						
	1970s				1971		1978
	1980s		1981	1984			
	1990s	1991	1991	1993	1998	1990	1990
	2000s		2007	2002		2001	2007

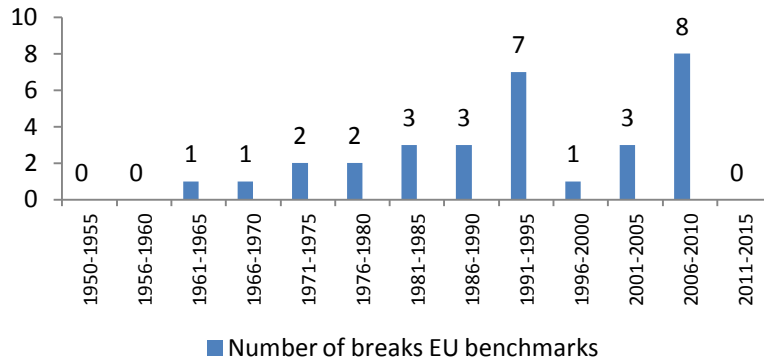
Source: authors

Figure 4.12: The yearly distribution of break points among a successor state and benchmark



Source: authors

Figure 4.13: The five year distribution of break points among a successor state and benchmark



Source: authors

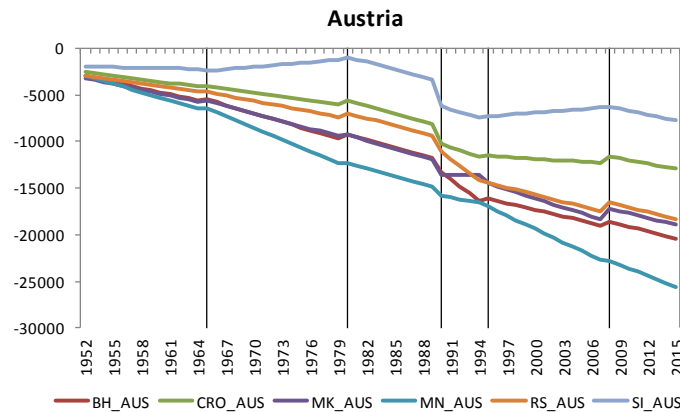
Table 4.4: Maximum number of breaks with EU benchmarks by year

2007	8
1992	3

Source: authors

The results are best seen if they are presented as figures, Figure 4.13 for Austria and Figure 4.14 for Greece. Both were drawn in the same way Figure 4.11 but this time for a successor states and the benchmark.

Figure 4.14: Breaks in convergence among successor states and Austria benchmark

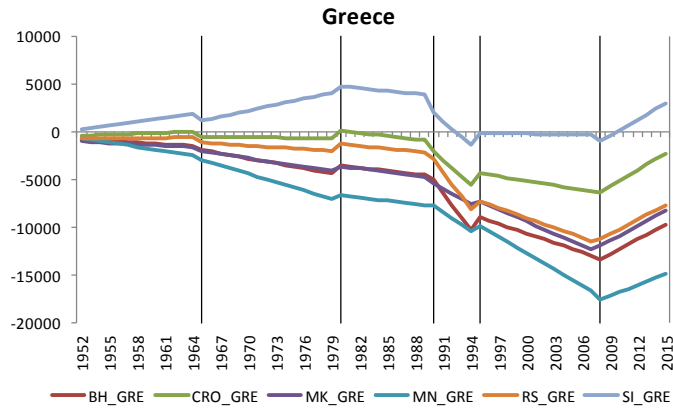


Source: authors

Looking at Figure 4.14 and the patterns of break point and convergence with Austria it can be seen that the break in 1965 was significant for Slovenia as it started rapidly converging towards Austria and almost closed the gap towards 1980. The 1980 break accelerated Austria's divergence from all successor states, with Slovenia as the 'biggest loser'. The war, transformation and independence shocks of 1990 also resulted with accelerated divergence. After 1995 Slovenia started to gradually converge towards Austria and Croatia shared the parallel path.

The Great Recession in 2009 again resulted with accelerated divergence with Slovenia as ‘the biggest loser’ again. All the other successor states continually diverged and neither did independence of the 25 years of transformation generate any lasting convergence.

Figure 4.15: Breaks in convergence among successor states and Greece benchmark

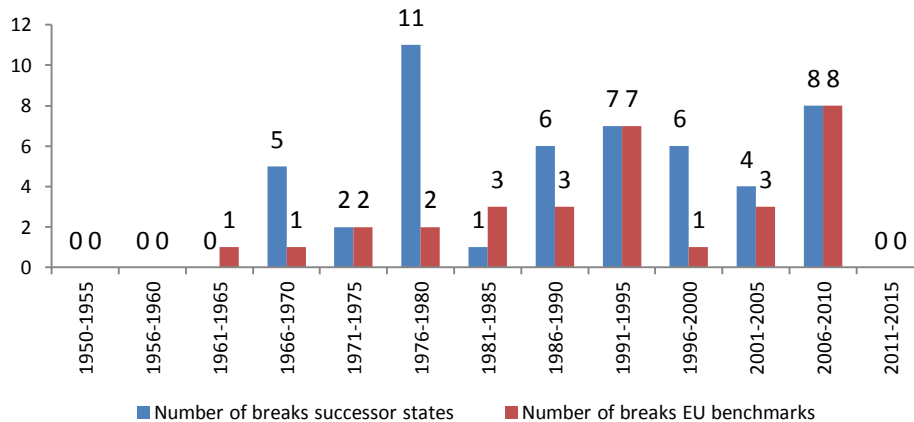


Source: authors

Till 1980 Slovenia converged and Croatia had a parallel growth path to Greece with all the other successor states falling behind. Greek membership in the EU did not affect pair convergence. In 1980 Slovenian positive divergence slowed down and negative divergence of other countries continued or accelerated. The shocks of 1990 brought acceleration of negative divergence in all lagging countries, while Slovenia lost its leading position. After 1995 Slovenian and Croatian divergence slowed down while in other countries it accelerated. After 2009 all countries started to converge towards Greece and Slovenia surpassed it after nearly 20 years

In Figure 4.16 the breakpoints among the successor states and between the successor states and the benchmarks are depicted together in five year periods.

Figure 4.16: Incidence of successor state and benchmark break point compared



Source: authors

#### 4.5 Summary of convergence results among successor states and benchmark

The results for  $\sigma$ -convergence and  $\beta$ -convergence clearly show that during the 'socialist'/Yugoslav period from 1952 to 1990 the later successor states diverged and thus the stylized fact is confirmed. However, during the 25 year 'capitalist'/independent period from 1990 to 2015 there was convergence. This convergence is largely driven by Slovenia's slowing down and Montenegro's acceleration and can be seen as sharing growth failure.

Regarding the Austrian benchmark, with exception of a brief Slovene convergence, for most of the period all the successor states diverged and the lag behind Austria increased. This is true for both the period prior to 1990 and afterwards. The regime change did not bring convergence with the EU core. Concerning the other benchmarks, Greece, the successor states diverged till the Great Recession. The only exception is Slovene convergence till 1990, i.e. during the 'socialist'/Yugoslav period.

### 5. NARRATIVE EXPLANATION OF CONVERGENCE AND BREAK POINTS

The obvious next step is to try to explain the above calculated break points and changes in convergence patterns. The formulas themselves are 'blind' and indicate the facts to be explained. It would be in the vein of the approach developed so far to continue with econometric tests. This, however, is not possible. The analysis cannot continue using econometric techniques because the required data is simply not yet available for the time period under consideration here, as is explained in Appendix 1. That is why most authors with a preference for quantitative analysis have concentrated only on the post 1990 period. Here the purpose is to take 'the long view' and deal with the period starting from 1952. This section will therefore have to try a different approach. It will try to see the relationship of the calculated results and with a narrative economic history.

#### 5.1 A narrative explanation of break points and convergence

The econometric results indicate that four periods stand out. The first are the mid sixties, the second are the early eighties, the third the early to mid nineties and the fifth is 2008 and the start of the Great Recession. This section will try to link these with institutional and policy changes and other economic developments.

Table 5.1 Structural break dates (Bai-Perron test) for the successor states using the whole sample, period 1952-2015

.	1960-1969	1970-1979	1980-1989	1990-1999	2000-2015
Bos. & Her	1967	1978		1995	2004
Croatia	1965		1981	1992	2007
Macedonia	1965		1980	1993	2002
Montenegro	1965		1985	1994	2007
Serbia	1965		1980	1994	2003
Slovenia	1965		1980	1993	2007

Source: authors



### 5.1.1 First break points: the early and mid-sixties

After the high but erratic growth rates of the late fifties events in the early sixties took a different course. In 1961 the economy slowed down and macroeconomic imbalances became visible. In 1960 and early 1961 policy makers were still unaware of these instabilities (at least in public), see S.R.-D.Č. (1961). The first party meeting referring to the changed circumstances took place in 1961, see Goldstein (2008). Instability of the early sixties is visible on three levels. The first are changes in key macroeconomic variables, the second are policy changes and the third are political and institutional changes.

Macroeconomic instability became visible in 1961 and can be seen in the changes of the main variables and in their later volatility. The visible signs were rising inflation, open unemployment, increasing foreign trade deficit and a large slowing down (deceleration) of growth with negative growth in agriculture. Real incomes fell by -1% for the first time after 1952 Agriculture still depended on the weather and in 1961 (when it contracted by 6%) there was a drought. Contemporary analyst-s used this as a scapegoat for the deceleration, blaming agriculture and weather for the economic difficulties, see S.R.-P.K. (1962).). Even though this was a modest deceleration by later standards for contemporary circumstances it was large and had the effect of a shock. Especially important were the shortages in raw materials and semi processed goods which policy makers solved on an *ad hoc* basis and hence the witty comment that the main form of planning and economic policy in Yugoslavia was the telephone, see Horvat (1970). The economic slowdown continued into early 1962 and growth picked up in the second half of 1962.

The economic slowdown of the sixties led to policy reactions of all levels. There was a stabilization policy in 1962 (the first of many to come) and plans changed. Planning priorities shifted and administered prices including the exchange rate changed. Finally there were institutional changes.

Economic policy changes in two senses. The first was a change in planning practices and the second was an economic stabilization program. Planning practices also reflected the uncertainty and imbalances. By 1962 it was obvious that the 1960-1965 five year plan could not be implemented (in 1961 national income was 8% below planned targets and in 1962 11% below, see Vasić (1964:377) and the plan was officially abandoned. It was replaced by yearly plans to be followed by a seven year plan, see Sirotković (1990:89). The yearly plans were made for 1961, see B.J. (1,961) and 1962, see M.R. (1962) and 1963, see M.R. (1963) and the seven year plan was for 1963-1970 but it was never made public. The yearly plans mark a major shift of investment priorities, away from machine construction and towards consumer durables. The stabilization program of 1962 was the first in a long and almost regular sequence of stabilization policies going on till 1994/95, first in Yugoslavia and then in successor states. The program, for an account see Vasić (1964, 375 *passim*), included restrictive monetary policy (reducing demand, especially investments, the rise in nominal wages and attempted to increase firm self financing of working capital), exchange rate reform aimed to balance the trade balance (the dinar devalued from 632 to 750 dinars for a dollar). This led to inflation, agricultural prices rose by 13% and cost of living by 8%, there were shortages. The policies also partly simplified foreign trade was by introducing customs and subsidies (replacing coefficients) but trade controls

remained. The reform also changed accounting and firm balance sheet regulation (aimed at limiting wages); see also S.R. (1963).

The third level of reaction to the slowdown was institutional and reflected the institutional requirements of policy shifts. In 1963 a new constitution was passed that later inspired the reform of 1965. With hindsight an important shift in investment policy can be seen in 1961 and later. Considering "...in the structure of investors in 1962 the shift that started in 1961 became even more pronounced..." S.R. (1963:115). This was the shift from federal investments distribution to that of republics and local government. The system of investment funds was abandoned in the 1965 reform and the federal fund closed in 1972.

The buildup of the early sixties led to the Social and Economic Reform of 1965. The narrative history of socialist development of Yugoslavia without exception identifies 1965 as a watershed year. Yugoslavia before 1965 and Yugoslavia after 1965 were not the same. This is true of Yugoslav and foreign historians, see for example Goldstein (2008) and Lampe (2000), Yugoslav and foreign political scientists, see for example Bilandžić (1985) and Ramet (2005) as well as Yugoslav and foreign economists, see for example Sirotković (1993) and Lydall (1989). Not only that but contemporaries also saw 1965 as a watershed year, see for example Bićanić R: (1973), Dragosavac (1968) or Horvat (1976) and Rusinow (1977). Here we listed examples taken from a voluminous literature but surveying this literature we did not find a single author, Yugoslav or foreign, contemporary or more recent and regardless of her or his profession, who would be an exception.

The system after 1965 is definitely a different system from the one of the fifties or early sixties. The Social and Economic Reform of 1965, see Yugoslav survey (1966), was institutionally different. State investments funds started to be phased out and they were finally closed in 1972. Investment decisions were left to firms and administrative decisions to be financed by a developed two tier banking systems whose importance over time rose. The scope for self management decisions expanded to include the investment decisions, relative wages within broad guidelines and firm independence regarding production and marketing. This all implied expanding role of markets arbitrage. However introduction of markets was limited, foreign trade remained regulated (through subsidies, permits and foreign currency regulation with a administered multiple exchange rate) and there was no overt market for capital and labour, both led to a vibrant and structurally incorporated unofficial economy, and the democratic deficit even, though reduced, unquestionably remained. Hoping that the pro-market changes this would lead to further expansion of markets and democracy led influential economists; see for example Korošić (1988), to see this as a beginning of a new era. The reform momentum did not last, by 1968 political backtracking rolled back most of the changes and the search for a new paradigm started (and was found in the associated labour institutional framework of 1974).

### **5.1.2 1980 the dominant year for break points**

Both the econometric evidence and the narrative recognize 1980 as a clear and universal break point. Regardless of which time series is taken (i.e. the 'socialist' 1950-1990 or historic 1950-2014 and especially the series 1952-2008) or which formula is used and the narrative approach to economic and institutional change all identify 1980 as a break point. This year is a break point

both for the Yugoslav economy and its constituent republics and later successor states. In the whole period it is the only undisputable break point (the only exception is Croatia which had a break point two years earlier, in 1978).

A series of events can be identified clustering around 1980 which all together through some kind of cumulative causation can explain and justify recognizing 1980 as a break point. These events can be divided into external and internal influences, in both cases they appear both as shocks and as process developing over time. Not all these changes are economic.

Economists would, understandably, tend to give greater importance to economic causes of the 1980 break point. In 1980 there was, however, one non-economic shock which had an importance that cannot be denied. This was the death of the Josip Broz Tito, President for life and dominant figure in postwar development. Even though by the late seventies his influence waned and he showed his age (he died 88 years old) he could still be referred to as an authority, see Ramet (2005) and after his death there was a power vacuum. The institutional framework was prepared for the transition to a 'post-Tito' era and there was a collective presidency with well defined relationships of constituent parts in decision making, see Sirotković (1992). In spite of this the death of Josip Broz did change matters for the party officials which had floated to the top had little charisma (e.g. Stane Dolanc or Josip Vrhovec) and little popular support. This could no longer be hidden. When faced with the complex and formidable tasks of running a complicated country in crises they were not up to the task. In this sense 1980 is the first year of the new way of policy making.

The remaining events in the 1980 break point narrative are more in the tradition of economic analysis. In the economic narrative of 1980 there were three events regarding the external environment which are clearly interlinked.

The first was the perceived external soft budget constraint. Yugoslavia had a continuous external trade deficit. From the early fifties (western aid) and especially from the mid sixties (the post Reform commercial loans and start of 'gastarbeiter' remittances) it relied on foreign loans to cover it. In this sense it faced policy makers perceived they faced an external and internal soft budget constraint, any spending could be covered by loans. As a result aggregate spending was continuously higher than production with the difference financed by loans leading to an increasing debt. This policy collapsed by 1980 when two events coincided. The first was the size of the debt and the second a world recession. Regarding the first "Yugoslavia's indebtedness.[in].1979-1980 assumed proportions which exceeded possibilities for regular repayments." (Marković:1985:51). The external liquidity crises coincided with a world recession in 1980 and a consequent rising of interest rates on loans and drying up of the supply of new long term loans to cover the deficit. Thus the conditions in the external environment under which Yugoslavia could borrow changed. This was not a peculiar development for Yugoslavia as international circumstances changed for other highly indebted countries, e.g. Mexico faced a crises in 1981-1982. The results were twofold. First, new debt led to a predominance of short term debts with high interest that put further strains on the trade balance deficit. Second, creditors required an IMF standby agreement and this implied external conditionality, see Stojanović (1991). In 1981 Yugoslavia signed its 7th standby arrangement with the IMF but its first three year one (all the previous 6 were one year arrangements). The sole aim of this one was

reestablishing external liquidity and its conditionality were linked to the policies of the 1981 stabilization program. In 1982 it became clear Yugoslavia was not fulfilling its targets in the stand-by agreement and the IMF insisted on further restrictions, see Marković:1985:455. There are authors who see the IMF behavior with the harsh conditionality it imposed (which they see as short sighted) as the main trigger for later unfavorable events, see Woodward (1995) and many years later this opinion was confirmed by the then leading IMF negotiator.

External difficulties were closely reflected in internal ones. The internal reaction to the debt crises and cumulating external and internal macroeconomic instability was twofold. The first was a result of IMF conditionality which and imposed a stabilization policy in 1981. Its sole goal was achieving external liquidity. The 1981 stabilization package required a devaluation (the dinar devalued 30%) and, more importantly import restrictions (which led shortage of everyday consumer goods, petrol rationing, limiting use of cars) and travel restriction (and travel deposit which was an enormous psychological shock going to the very heart of Yugoslavia's special position), etc. This policy package changed the everyday lives of all citizens. It was a shock which remains a collective memory till today, 35 years later. The stabilization package and policy had IMF support and was part of stand-by conditionality. The second reaction was an attempt to face the causes of the soft budget constraint that had led to the indebtedness. This implied institutional and structural changes. Once the ruling party (with an external nudge) decided reforms were imminent it established a commission to propose deep reforms. The commission completed its work in 1983 and proposed a Long term stabilization program whose goal was to institutionally reform the economy to achieve sustainable growth. The long term stabilization program known as the 'Report of the Kreigher Commission' presented its recommendation in 1983 in 4 volumes, for a short survey see Budimir (1983). The proposals recommendation stayed within the existing institutional framework (associated labour and federal arrangements) but sought to increase the scope of markets and especially provide the underpinnings of financial sector development (by changing interest rate determination, exchange rate policy, inter firm financing, etc.).

While the shock therapy did achieve external liquidity and was a success (the harshest measures were scaled down and shortages disappeared) the reforms for sustainable development were never seriously implemented. Once the danger of external default subsided and conditionality weakened the proposed reforms were either watered down or postponed. Finally, a new and similar commission, this time the 'Pašić Commission', was set up in the mid eighties. Yugoslavia backtracked on serious pro market reform.

It is important to note that economic policy makers after 1980 were losing contact with reality. For example planning became a fiasco. The planning targets became increasingly distant from reality. While this may be explained for the 1981-85 plan which was part of the IMF conditionality but virtually abandoned by 1983, see Sirotković (1984), and replaced by yearly plans there is no reason for the failure of the 1986-1990 plan which did not learn from the mistakes. The discrepancy of targets and reality became even bigger.

### **5.1.3 An 'obvious' point of discontinuity: the early mid nineties**

After 1989 the economies of the successor states were suddenly and quite unprepared for multiple shocks. First was the start of the transformation, the second the decomposition of

Yugoslavia, the third were the Wars of the Yugoslav Succession and finally there was the virtual disappearance of former Comecon markets.

The transformation started in Yugoslavia in 1989 when the final economic reform this country has equated all forms of ownership (prior to that 'social ownership' had a special privileged position) and institutionalized a process of gradual privatization. These reforms broke the ideological barriers but the transformation itself got under way once the country decomposed, i.e. after 1990. It is worth noting how quickly the successor states chose different policy options to deal with the three fundamental transformation generated process: privatization large and small, financial sector consolidation and economic stabilization, see Bićanić (1996). In spite of 72 years of sharing and institutional and economic space (with the exception of 4 years during the Second World War) within a couple of years they were recognizably different economies.

The decomposition of Yugoslavia started with the independence referendums in Croatia and Slovenia in 1990 and ended with the recognition of independent Kosovo Declaration of Independence in 2008. The dominant year of decomposition was 1991 when 5 successor states were internationally recognized. Serbia and Montenegro split in 2006 so finally the decomposition spawned 7 successor states, even though at least 2 remain dysfunctional states and international protectorates. The way the decomposition developed in did severe many previously built economic ties. Even though the level of economic integration and its changes were a hot topic of discussion prior to the decomposition mutual trade was never separately accounted, the nearest are inter-republic deliveries for two years, see Grubišić (1990). This data shows that a sudden stop in these economic links should have a major disruptive effect on the successor states.

The Wars of the Yugoslav Succession started with the '10 day war in Slovenia' in 1991 and ended with the NATO bombings of Serbia in 1999. Two important interim dates were the Dayton Peace Accords in 1995 and in 1998 the Peaceful reintegration of Western Srijem and Eastern Slavonia. The brunt of the military conflict was, however, in Croatia and Bosnia and Herzegovina from 1991 to 1994 and Slovenia and Macedonia were least affected but it seems obvious that this was a major shock for all successor states.

The final shock was external and resulted from the transformation and its consequences in Eastern and Central Europe. These were important export market for the successor states and the cutting of established economic flows was an asymmetric shock because of different exposure of successor states to this trade but still a shock.

#### **5.1.4 The selective impact of the great recession and national specifics**

The first decade of the 21st century marked beak point for all successor states but no clear relationship and common thread. This is in spite of the eyeballing the data that would seem to imply commonalities, see Figure 5.1. The 'Great Recession' was a break point only for the two most developed successor states, Slovenia and Croatia. These economies are also most integrated into the international economy, at the time one already was an EU member (Slovenia) and one already quite far in membership negotiations (Croatia). For the others the break point in this decade is probably better explained by national specifics. For example for Montenegro the 2007

break point is growth acceleration. and the newly independent Montenegro. But the effect was different. For the first two it was a contraction, for Montenegro a spurt of growth. For the remaining 3 successor states the decline started earlier

Figure 5.1: Real growth rates 2000-2009 in Southeast European economies



Source: authors

## 5.2 Growth in sub-periods derived from the narrative approach

With the strong link between the calculated break points and the narrative it impossible to distinguish the following periods. The names of the periods are determined only in relationship to the average growth rates.

1. 1952-1979 period 'successful socialism'
2. 1980-1989 period 'socialist stagnation'
3. 1990-1994 period 'capitalist turmoil'
4. 1995-2008 period 'successful capitalism'
5. 2009-2015 period 'capitalist stagnation'

For these periods average yearly growth rates are given in Table 5.2 and depicted in Figure 5.1. In the figure the blue line gives the yearly rates and the red line the average yearly growth rate for the sub-period.

Table 5.2: Average growth rates for narrative sub-periods

	B. and H.	Croatia	Macedon.	Monteneg	Serbia	Slovenia
1952-1979	4.8	6.4	6.0	5.5	6.5	6.5
1980-1989	0.5	0.0	-0.1	1.4	0.4	-0.3
1990-1994	-9.6	-8.7	0.8	-8.6	-10.0	-2.8
1995-2008	9.1	5.1	3.7	6.3	5.0	4.1
2009-2015	2.2	-0.2	2.5	1.1	1.2	0.6

Source: authors

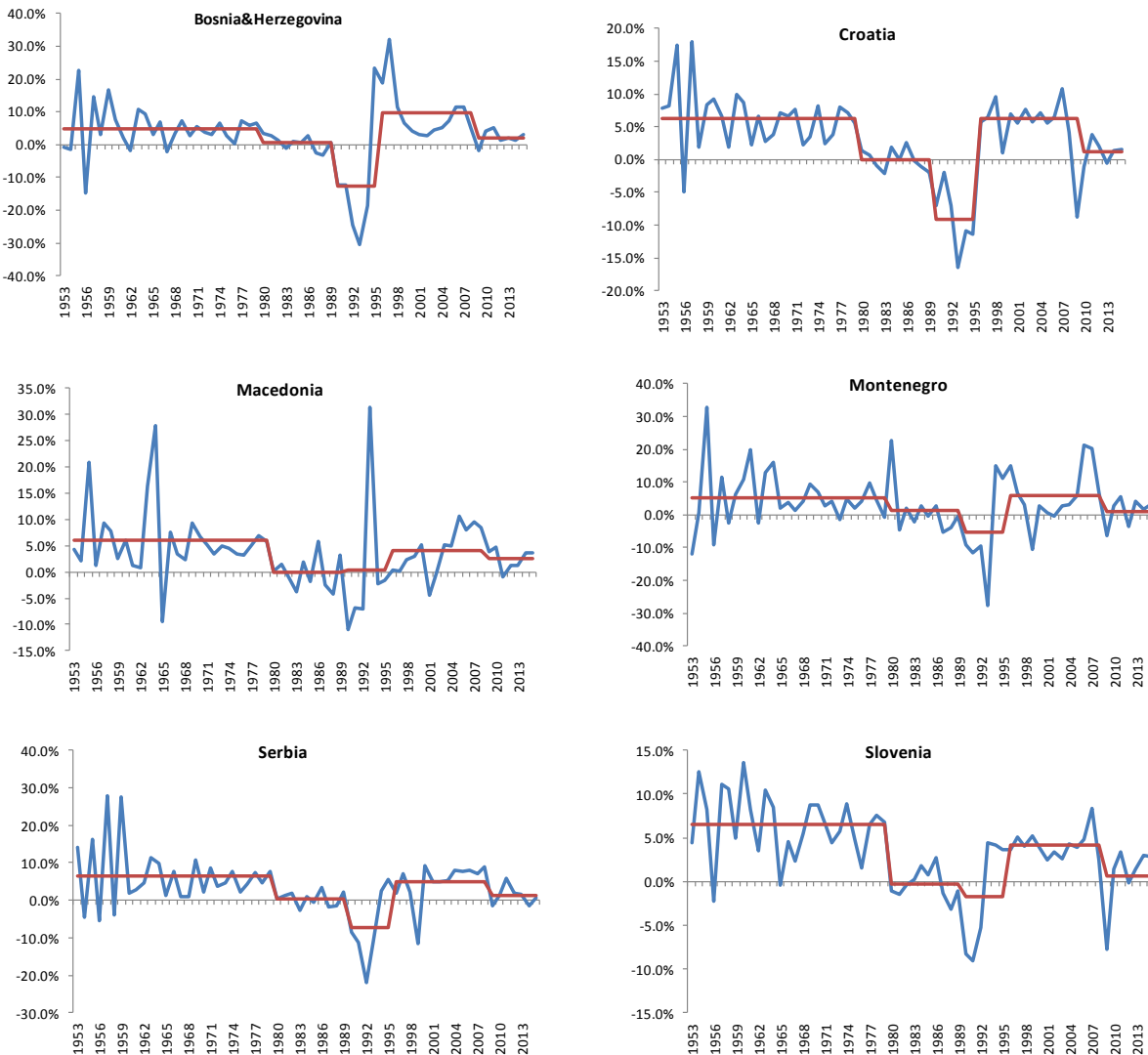
The growth rates of these subperiodsshouldbe put in context of the secular growth rate of the whole period which are calculated from the lienar trend and givne in Table 5.3.

Table 5.3: Average growth rates 1952-2015

	B. and H.	Croatia	Macedon.	Monteneg	Serbia	Slovenia
1952-2015	1.94	2.88	2.77	2.95	2.15	2.84

Source: authors

Figure 5.1: Yearly growth rates and average growth rates for narrative sub periods for successor states



Source: authors

The data shows that with the two exceptions the growth rate of 'successful socialism' is larger than that of 'successful capitalism'. Slovenia is especially interestingly the economy frequently referred to as 'the most successful transformation economy' actually experienced the largest difference in growth rates during the two periods. The two exceptions are Bosnia and Herzegovina that had the largest contraction during the Wars of the Yugoslav Succession so its reconstruction rebound may not surprise and Montenegro. Another exception is Macedonia which did not experience a 'capitalist stagnation'.

### 5.3 Quarter of a century of independence and transformation

There are many ways the quarter of a century experience of the independence and transformation can be tackled and evaluated. Here a very simple approach is used. The 25 year experience will be looked at in terms of what Kuznets (1966) called Modern Economic Growth and Gershenkron (1977) Spurt That Failed.

Kuznets defines Modern Economic Growth as persistently high levels of growth over a long period accompanied with restructuring and structural changes in an acceptable environment. All parts of the definition are important. Gershenkron refers to periods of high growth rates that did not last.

The secular growth rates 1952-2015 of the successor states are given in Table 5.3. They are presented together with the post-conflict growth rates for the twenty-year period 1995-2015.

Table 5.3: Average growth rates 1952-2015 and 1995-2015

Successor states							EU benchmarks	
	B. and H.	Croatia	Maced.	Mont.	Serbia	Slov	Austria	Greece
1952-2015	1.94	2.88	2.77	2.95	2.15	2.84	2.79	3.15
1995-2015	6.78	3.31	3.29	4.59	3.74	2.96	2.0	1.9

Source: authors

The post conflict ‘capitalist’ growth rates in Table 5.3 are biased in two ways. In both cases they inflate growth rates. They include the post-war reconstruction (this is especially visible for Bosnia and Herzegovina) and start measuring growth from a trough (after the contraction of the early nineties, this is especially visible for Serbia). Furthermore, the period includes two distinct sub-periods that were above referred to as ‘successful’ and ‘stagnant’ capitalism see Table 5.2. For Slovenia and Croatia they are slightly above the secular rate but the more unstable the economy the larger the difference.

In spite of the higher growth rates they imply neither Modern economic growth nor a significant acceleration with convergence. In terms of growth the 1995-2015 period has not been a success. The size of the lag and the time spans involved in catching up with the European core (Austria) are visible from the Croatian case presented in Table 5.4. Modern economic growth would require at least 5% yearly growth rates over a long period.

Tablica 2.4:Croatia: years required to catch up with ad hoc chosen benchmarks

	<b>Slovenija (growth rate 3%)</b>	<b>Austrija (growth rate 1,5%)</b>	<b>EU average (growth rate 2%)</b>
Initial value	18 093	38 541	27 394
2%	Never, increasing lag	170 years	Never Paralel paths
3%	Never	57 years	53 years



	Paralel paths		
5%	25 years	25 years	18 years

Source:authors calculations

Regarding Gerschenkron’s spurt all the successor states except Montenegro had an acceleration that did not last. This is visible from 5.2. the required growth rates did exist from 1995 to 2008 but did not last. Furthermore the spurt led to major economic imbalances (debt, structure, instability) which do not make them probable in the near future.

## 6. CONCLUDING REMARKS

The paper is based on an analysis of the per capita gross domestic product time series from 1952 to 2015 for the Yugoslav successor states (except Kosovo that is omitted due to lack of data). Using standard econometric procedures for determining multiple breakpoints in time series, the Bai-Perron test, and measuring convergence, of groups of countries or pairs, the results broadly supported the results of narrative analysis and added evidence for the recognition of sub-periods. The main breakpoints were in the mid sixties, coinciding with a major institutional reform, in 1980, coinciding with an external hard budget constraint, the early nineties, coinciding with transformation stabilization, and the first decade of the twentieth century.

The analysis of breakpoints in addition to this support added three new insights. First, the dominant breakpoint was 1980, not the oil crises that was the watershed for Golden age growth in Europe, and not 1990 with its multiple shocks of transformation, independence and war. Second, if break points can be seen as a sign of instability then the ‘socialist’/Yugoslav period 1952-1990 and the ‘capitalist’/independent period 1990-2015 are equally unstable since they have the same number of breakpoints. Stability did not increase over time. Third, as can be expected, with independence after 1990 the span of breakpoints increased as the independent states choose different policy options. Finally, the Great Recession of 2008 is a breakpoint only for the two most developed successor states and EU members (one was finalizing its membership negotiations).

The measurement of convergence did indicate some unexpected results. Both  $\beta$ -convergence and  $\sigma$ -convergence supported the established fact that in Yugoslavia there was no convergence but also clearly showed that with independence both kinds of convergence developed. However, in spite of this change over the period as a whole there was no convergence. Comparing the relationship of pairs of growth trajectories for the 6 successor indicate instability with few changes in structure. With the exception of the stagnant eighties when there was parallel growth for all the more developed diverge from the less developed and the development gradient did not change. Also the pair convergence seems to indicate the convergence was driven by Slovenia’s deceleration and Montenegro’s catch-up. The results of comparing the growth paths of individual successor states with ad hoc chosen benchmarks, Austria and Greece, indicate important results. With the exception of Slovenia during a period till the eighties all successor states diverged from the European core and increased their lag. Regarding Greece the results are more mixed, Slovenia converged for a time and Croatia had parallel growth till the eighties, after that till the Great Recession all diverged except Slovenia and after 2008 there was convergence.

The time series includes quarter of a century of independent growth. The regime change did not produce convergence to the European core and divergence continued (the best performer Slovenia kept its distance). Till the Great Recession this was also true for Greece. If the time series is divided into 4 sub-periods, 'socialist' high growth from 1952 to 1980 and stagnation from 1980 to 1989 and 'capitalist' high growth from 1995 to 2008 and stagnation from 2009 to 2015 (the period 1990 to 1995 is left out) interesting results appear. For three successor states, Croatia, Serbia and Macedonia, the two high growth and stagnation periods are very similar. For two, Bosnia and Herzegovina and Montenegro, the latter high growth period is significantly higher (for Bosnia and Herzegovina this is probable reconstruction). The unexpected result is Slovenia for which 'capitalist' growth is lower than 'socialist' growth. In terms of growth the regime change did not generate Modern economic growth in any successor state and in terms of growth the most developed is the only clear loser. With one exception, Montenegro, the two stagnation periods have a striking similarity in spite of regime changes. In both cases they were a result of an external shock, the first in 1980 and the second in 2008, and seem to indicate that in both cases there was an internal inability to react appropriate to these shocks.

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## **Appendix 1: Data and construction of time series 1952-2015**

Any kind of statistical measurement crucially depends on the data used. Good econometrics does not rely only on the correct setting of the equations and knowing their limitations but of also knowing the value and limitation of the data used in the calculation. Thus, an awareness of the data limitations is useful, all too often modern researchers with 'mouse pushing expertise' download data forgetting how it was compiled. Maybe they should remember Benjamin Disraeli who said that *'There are three kinds of lies: lies, damned lies and statistics'*, quoted from Huff (1954). This appendix concentrates on the way the used data was calculated and what limitations the procedure entails.

In the paper a time series for Yugoslavia and its successor states is derived for the period from 1952 to 2013. As a result data from three 'periods' are used. The first is data from 'socialist' period from 1952 to 1989. The second is the data from the early nineties when the statistical service and macroeconomic instability led to estimated values. The third is the period from the late nineties when reliable UNSNA data was collected.

The data used in the paper spans the period from 1952 to 2013. It uses only official data, Yugoslav data for the country and later successor states from 1952 to 1990 and data for the successor states from 1990 to 2013. The first year 1952 was chosen for two reasons. First, that is the first year for which data collected at the national and successor starts was collected by a coherent system of national accounts based on the system of material balances. Second, the institutional setting was less volatile and so the collected data is more reliable. But even for the chosen period there are many issues that raise serious reliability questions. In spite of this the authors think these problems are no greater than in other studies of long periods using data before 1960 (from when the first PENNSTATEPPP estimates are available) which are commonly used in the study of long term trends (e.g. date going back into the interwar period, the 19th century or even earlier).

### **A1.1 Justifying the exclusion of data before 1952**

The data before 1952 was not used to construct time series for GDP or GDP p/c of the successor states. The period before 1952 can be divided into three sub periods.

The first one covers Yugoslav data for the interwar period (1918-1941). During this period there were no national accounts and the collected data does not permit a simple estimate of GDP or other aggregates. Some attempts at estimating GDP or GDP p/c for Yugoslavia have been made for the period or selected years, e.g. Lampe and Jackson (1981), Palairt (1997) or Vinski (1978). There was also an estimate of National income for much of the interwar period, see Stajčić (1959). Almost certainly the same author is responsible for the connecting pre 1941 national income estimates to national income data from the fifties, see St.St. (1957). Čoblejić (1959) offers a more comprehensive link between pre world War data and post war data. These estimates were the bases for long term Yugoslav national income data, see Čobeljić (1959) for early examples and the national income data from 1923 to 1991 in Bićanić and Škreb (1994) for later ones. Deriving GDP or GDP p/c for what were later successor states from Yugoslav data is

impossible due to different territorial divisions which, to make matters even more complicated changed 3 times in the interwar period. Even the existing reconstructions are highly unreliable, for the an explanation of this regarding the Croatian attempts see Bićanić and Tuđa (2014).

The second period concerns the Second World War. During this period not only was the country dismembered (parts were annexed by neighbors, everyone except Romania, and 2 Quisling states were set up) but there was also an active antifascist and liberation war so administrations did not control their territories and data was not collected.

The third period is immediate post war period, 1945-1952. During this time Yugoslavia in spite of a command economy and central planning did not have a system of national accounts. Furthermore this was a turbulent period with post war reconstruction, nationalization, organizing a command economy and directive First five year plan in 1946 for the 1947-1952 period and then the economic consequences of the economic blockade following the 'break with Stalin' in 1948. For a reconstruction of this period and as link to pre-war data one could start with Filipović (1946) for war damages and reconstruction, Filipović (1949) for the first five year plan and more comprehensive analysis of the data can be found in Čobeljić (1959) and Hanžeković (1968). All this is data on the Yugoslav level and mostly in quantitative values.

### **A1.2 Primary data for 1952-1989: the Yugoslav system of national accounts and the UNSNA**

By 1952 Yugoslavia started building a new economic system and set up a system for collecting economic statistics, how the system evolved see Dr. M.M. (1979). Yugoslavia used a system of national accounts that differ from the United Nations System of National Accounts. The system of national accounts reflected the Marxian notion of 'productive' and 'unproductive' labor. The first created value and the latter did not. Value was created only by making physical products and by the services required for their distribution (so called 'productive services'); hence the main aggregate is Gross Material Product (GMP). This, of course is a very 19th century view. As a result those services not directly required in the production and distribution of physical products were 'unproductive' and could be left out the macroeconomic aggregates. Unproductive services were health, education, science, defense, administration etc. This system of national accounts was the System of Material Balances (other socialist economies had systems derived from the same principles but different due to the different nature of their economies).

UNSNA did not make this distinction. Most of the data for unproductive services was collected but not included in the aggregates. As a result there were plenty of attempts to recalculate GMP into GDP, i.e. Yugoslav macroeconomic aggregates into those compatible with UNSNA. Ivo Vinski, together with Boško Kitaljević (1969) and Gojko Grđić (1976) arguably the greatest Yugoslav specialists in national accounts, Vinski (1974), summarizes the difference "In addition to material production it include so called nonmaterial services of health, education, science, social security, use of housing, etc." (Vinski, 1974:113). For examples of Yugoslav attempts to calculate GDP see Vinski (1967) or Vinski (1974) and for examples of foreign attempts see Dubey (1975) who performed the recalculation as part of a World Bank report. For Yugoslav GDP per capita see Maddison (2002). GDP is larger, by how much depends on the researcher. Dubey concludes "Historical GDP is about 14% higher than GMP." (Dubey 1975:311) and in his

Statistical Appendix 1 Table 2.1 offers a Yugoslav GDP series 1950-1971. Miljković (1991) offers an equally reliable estimate this time done as part of the UN International Comparison Project. His recalculation estimates that in 1985 GDP was 11.6% higher than GMP, he also offers republican estimates.

Apart from the conceptual difference other problems with Yugoslav data concern regulated prices (e.g. for most consumer goods and energy), international trade data (e.g. with COMECON economies and administrative multiple exchange rates), the unofficial economy (in trade and private sector) and the infamous 'extra budgetary balances'. To this one must add reporting shortcomings (when data is used for planning goals there are misreporting incentive), officially doctoring of data (to achieve political goals) and problems of coverage (which varied in the country). Probably the reliability also varied in the country. It must be noted that the reliability of the data changed during the period and increased over time, especially after 1965 (the Social and Economic Reform) and 1980 (an IMF stand-by arrangement). In spite of these shortcomings Yugoslav statistical services generated a wealth of comparable data which, when one is aware of the limitations, can provide a reliable basis for use on their own and can provide a base for their recalculation into UNSNA macroeconomic variables. However, apart from the early recalculations in Dubey (1975) or Vinski (1976), no calculation of GDP from yearly national statistics exists for the whole period. Contemporary researches seem to prefer back casting, see Milanović (2013) for all the successor states or Tica (2004) who uses it for Croatia. In deriving the statistical series used in this paper we use back casting as described in section A1.6.

### **A1.3 Primary data for 1990-1995: implementing UNSNA accounting into the statistical services of successor states**

The next period of questionable data is for the period after 1990 and till UNSNA quarterly GDP data was collected and a modern statistical services organized in the individual successor states. The reasons data is unreliable for this period was organizational (local statistical offices did not have the expertise), economic circumstances (high inflation which was rampant till 1993), the Wars of the Yugoslav Succession (for example Croatia till 1995 did not control 10% of its population and 25% of its territory, Bosnia and Herzegovina was a failed state). The date after which reliable UNSNA collected data is published varies, the first was Slovenia whose data becomes reliable from the late nineties while Kosovo even now has data of questionable reliability.

There are many reliable or less reliable estimates for this period, especially for its early part. These estimates were made by national statistical offices (e.g. Croatia has yearly GDP data from 1990 but reliable ones after 1998), some were compiled by international organizations (the EBRD has GDP data from 1996) and others by non-locally based institutes (e.g. WIW, PlanEcon, etc.). But this period, like the preceding one was covered by the Milanović (2013) data used here

### **A1.4 Full implementation of UNSNA data**

Today's international standard is quarterly GDP data in original and seasonally adjusted values and yearly GDP data in original, seasonally adjusted and PPP values and deflators. For the

Yugoslav successors states the dates from when this data is available varies. A survey of when the data is available is given in Table A1.

Table A1: Availability of official gdp data for successor states

	Quarterly GDP data	Yearly GDP data	World bank estimates, yearly	EBRD estimates, yearly
Bos. and Herz	2008	2001	1994	1996
Croatia	2000	1995	1995	
Kosovo	2001	2001	2000	
Montenegro	2011	2000	2000	
Macedonia	2003	2000	1990	
Serbia	2002	1997	1995	
Slovenia	1995	1995	1995	

Source: authors

### **A1.5 Milanović data set: Groningen income study data: simple backcasting**

The construction of time series for GDP of Yugoslavia and its successor states must solve the above discussed data problem for the first two periods, i.e. for the data collected according to Yugoslav social accounting practices based on material balances from 1952 till 1990 and for successors states until full UNSNA compliance was achieved.

The correct way should be inductive, an approach undoubtedly proffered by historians and economic historians. It should use original data, i.e. a primary source, collected by the national statistical offices for any individual year and entity and from them calculate yearly GDP. This is the procedure used by Vinski (1976), Dubey (1975) and others who worked during the seventies.

While this is the correct procedure it is also a painstaking calculation requiring among other things a lot of time so authors have been trying to use a simpler and quicker approach. The most common short cut is to rely on back casting. This method uses a base year for which it assumes the data is reliable and then uses past yearly growth rates for a chosen macroeconomic variable to calculate the values for previous individual years. Cliometricians and economic historians are aware of the many pitfalls back casting involves and especially its dependence on chosen benchmark and growth rates, increased inaccuracy as the period gets longer as small errors in the growth rate compound. In spite of this it remains the favorite short cut approach.

Back casting was used to derive the data on per capita GDP for the successor states available from the Groningen Growth Centre. This data source covers yearly GDP per capital in 1993 ICP dollars for each successor state from 1952 till 2010. The calculation was made by Branko Milanović, a highly reliable and experienced researcher. In communication with one of the authors while preparing Bićanić and Tuđa (2014a) Mr Milanović sent a detailed description of his procedure and calculation expressed concern about some of the data and hoped for improvements, the authors are thankful for making this available.

For the first period 1952-1990 the procedure was to use 1990 values as a benchmark and then back cast. Having derived 1990 GDP per capita in ppp for 1990 for all successor states

Milanović then uses them as a benchmark and back casts using social product per capita growth rates in 1972 dinars (from the Yugoslav statistical service). Finding 1990 values was not straightforward. Milanović distinguishes two groups of successor states. The first group is composed of Slovenia, Croatia and Macedonia. For them the procedure was simple since World Bank GDP per capita in ppp for 1990 is available. Milanović calls this the  $\alpha$  approach. For the second group made up of Bosnia and Herzegovina, Serbia and Monte Negro such data does not exist (the latter two were not yet successors states but parts of the Federal Republic of Yugoslavia). Milanović calculates their values by using Slovenia as an anchor. He uses Slovenian GDP per capita in ppp for 1990 and Slovenia's social product per capita in 1972 dinars. The relative values for the social product per capita is then used to scale down Slovenian GDP to derive that of the successor state GDP (e.g. if social product per capita is a third of Slovenia then its GDP per capita is a third as well). This is here called the  $\beta$  approach

For the second period after 1990 again the same procedure cannot be used for all successors states. Again, for the first group composed of Slovenia, Croatia and Macedonia the procedure was straightforward and the time series in 1993 ICP dollars could be calculated because world bank data exists. This is referred to as the  $\gamma$  approach. For the second group there was a break of from 1990 to 1993. After that from 1994 till the existence of World Bank exists back casting is used. The yearly estimates are calculated by the first available World Bank estimate (for Bosnia and Herzegovina 1994, Monte Negro 1997, Serbia 2000) and back cast it using national yearly growth data. This is referred to as the  $\delta$  approach. After that World Bank data is used as in the gamma approach.

Finally the whole series is given in 1990 Geary-Khamis dollars for 1990 which makes them comparable to other data from the Groningen growth center. For this calculation for the first period for the successors states the values calculated by Maddison for Yugoslavia.

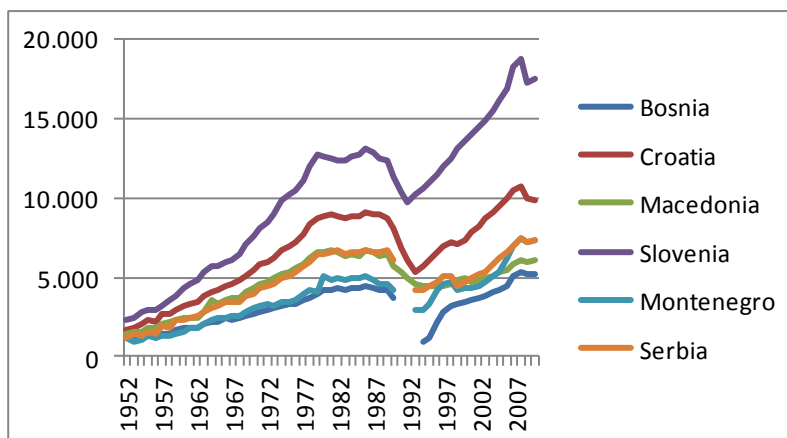
Table A2: Summary of Milanović calculations

	First period 1952-1990	Second period Data break	Third period Till WB data	Fourth period WB data
Bos. and Herz	1952-1990 ' $\beta$ approach'	Data break 1991-1993		1994-2010 ' $\gamma$ approach'
Croatian	1952-1990 ' $\alpha$ approach'			1990-2010 ' $\gamma$ approach'
Kosovo		No data		data after
Monte Negro	1952-1990 ' $\beta$ approach'	Data break 1991-1993	1994-1997 ' $\delta$ approach'	1997-2010 ' $\gamma$ approach'
Macedonia	1952-1990 ' $\alpha$ approach'			1990-2010 ' $\gamma$ approach'
Serbia	1952-1990 ' $\beta$ approach'	Data break 1991-1993	1994-2000 ' $\delta$ approach'	2000-2010 ' $\gamma$ approach'
Slovenia	1952-1990 ' $\alpha$ approach'			1990-200X ' $\gamma$ approach'

Source: personal communication with Mr. Milanovic by one of the authors

Milanović compares his estimates with three other sources, Maddison values for 2008, World Bank values for 2008 and Eurostat values for 2007 to determine the reliability of his data.

Figure A1: Groningen (Milanović) growth project estimates for GDP per capita for successor states in 1990 international dollars



Source: authors

### A1.6 Constructing the time series data for this paper

When preparing the time series from 1952 to 2013 it would have been simplest to extend the Groningen/Milanović data. However the authors noticed a major inconsistency easily visible from eyeballing the data presented in Picture A1. In Groningen data compiled by Branko Milanović in the fifties imply Macedonian GDP per capita is the third highest among the Yugoslav republics and later successor states. This makes it higher than Serbian and Montenegrin. This is obviously wrong and all primary indirect development data supports this (literacy, social product per capita, economic structure, etc. data). If the data for Macedonia and Serbia are questionable then the reliability for other successor states is lacks reliability.

As a result the authors decided to compose a new data set which avoids the inconsistencies. The calculation was made in the following way. One procedure was used for the data before 1990 and another to fill in the gap from 1990 to 1995 and after 1995 official GDP data was available. The procedure was to apply the  $\beta$  approach to all successor states for the first period from 1952 to 1990. This means that for Slovenia, Croatia and Macedonia the  $\alpha$  approach was replaced by the  $\beta$  approach.

The pre 1990 GDP per capita calculated by assuming the World Bank number for Slovenia was correct and used as the corner stone of the recalculation. This differs from the Groningen/Milanović approach since the World Bank data for other successor states are not used. The assumption about Slovenna data seems justified because as the most developed successors state Slovenia had the best developed statistical service thus providing the most sound base for the World Bank estimate. Also, it did not experience a long war and much material damage (the Slovenian episode of Wars of the Yugoslav succession lasted 10 days, from June 26th to July 5th 1991 with less than half a dozen casualties altogether and no damages). The

GDP per capita for the other successor states was derived from Slovenian data and relative social product per capita of the other successors states. For this the data from Yugoslav Statistical Yearbook for 1990 was used, this is the last statistical yearbook compiled by the Yugoslav (federal) statisticians and thus it can be assumed the data is comparable. The GDP per capita for a successor states was downscaled in the same proportion as was the social product per capita smaller than the Slovenian one. The thus derived GDP per capita for every successors states was then back casted using the social product growth rates for individual years. Yugoslav data allow for back casting for today's territory of Serbia (i.e. without Kosovo and Monte Negro which both were part of the rump Yugoslavia but eventually became successor states). In this way the time series for Yugoslavia and its successor states was calculated for the 'socialist' period from 1952 to 1990.

The procedure is based on three assumptions, first that Slovenian data for 1990 is correct, second that the relative values of GDP per capita and social product per capita are the same and third, that yearly rates of growth of GDP and social product are the same. Only the second assumption was checked with two other data sources, the WIIW data and Milenković (1991) and the differences were not such as to justify mixing two data sets. There is another justification for the procedure. One could assume that the deviations of social product and GDP per capita depend on the level of development and should be larger for Slovenia than Kosovo since the former has a larger share of services omitted by social product. However, the most reliable GDP per capita data is the one compiled by Milenković (1991) as part of a UN sponsored project and he concludes that because of direct aid to the less developed regions the difference of the two variables does not depend on the level of development.

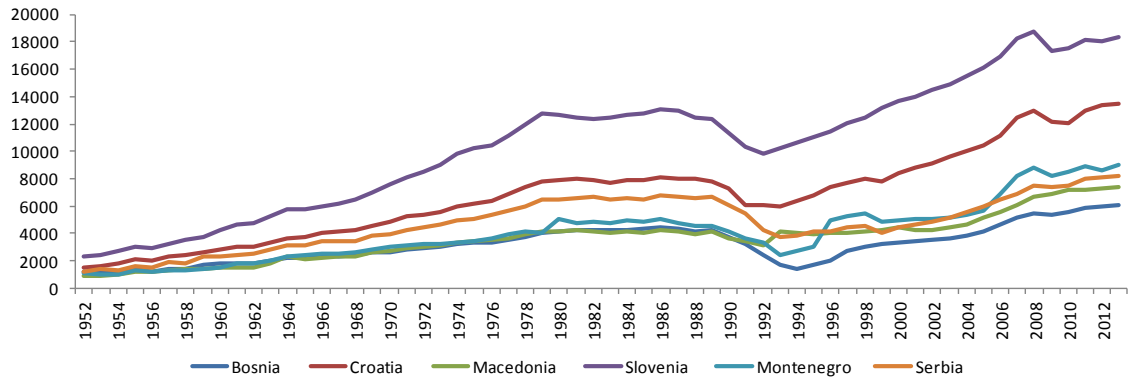
In comparison to the Groningen data it follows the same back casting procedure but uses different benchmark value. The procedure avoids the most important deficiency of the Groningen approach regarding the relationship of Macedonian and Serbian data. This can be seen in Figure A2. Furthermore, the relative values in 1990 are based on primary data.

For the period from 1990 till 1995 for which GDP primary data from national statistical offices using UNSNA data does not exist a different procedure was used. The 1995 World Bank data for every successor states was assumed as correct.

For the analysis of the paper a time series from 1950 to 2015 had to be reconstructed for Yugoslavia and the 7 successor states. Separate national estimates do exist for some of these countries but the authors choose to use data compiled by Branko Milanović and published under the authority of a reputable source such as Angus Maddison and Groningen Growth Centre.

Figure A2: Time series for GDP per capita 1952-2015 in 1990 international dollars





Source: authors

## Appendix 2: The methodological approach to determining one or multiple break points

Economists often want to know whether there are points of discontinuity, i.e. structural breaks, in the time series data they use. Frequently these points are chosen *ad hoc*, either through a narrative approach, by identifying some characteristic of the series not covered in the data itself (e.g. some institutional changes or exogenous shock) or by 'eye balling' the data. Neither is precise and is subject to the whims of the researcher. To avoid this arbitrariness in determining the date of structural change econometricians have designed tests that determine structural breaks generated by the data itself. Two tests are now used.

The first one is the Quandt-Andrews test which can identify only one break point. This test is briefly described in section A2.1. This test estimates the existence and timing of one structural change. Later econometricians developed the Bai-Perron test which is a technique that permits the estimation of multiple break points in the time series. The main features of the Bai-Perron test used in this paper is described in section A2.2.

### A2.1 The Quandt-Andrews test for one break point

The Quandt-Andrews test performs a Chow test for structural stability (Chow, 1960) between every observation in the sample with the exception of a 'trimming' percentage of the sample. Usually 7.5% in the first part and 7.5% in the last part of the sample, i.e. 15%, is trimmed. The trimmed part is used to fit the equation but is not considered as a possible break date.

The Chow test testing procedure splits the sample in two parts and fits the underlying regression in each subsample. Then classic F-statistic is computed, testing the equality of both parameters:

$$(A2.1.) F = \frac{SSR_n - (SSR_{n_1} + SSR_{n_2})}{\frac{k}{SSR_{n_1} + SSR_{n_2}}} \frac{1}{n_1 + n_2 + 2k}$$

In the equation  $SSR$  is the sum of squared residuals,  $n$  the whole sample,  $n_1$  and  $n_2$  are the size of the two sub-samples and  $k$  is the number of parameters estimated in the equation.

Performing a Chow test requires choosing *a priori* breakpoint date. As a result, different researchers pick different dates and can have completely different conclusions. The solution for this ambiguity is to treat the break date as unknown. Quandt-Andrews breakpoint test resolves this arbitrariness of the Chow test by performing a Chow test sequentially between every observation in the sample. The critical values for the test form a non-standard distribution and are higher than  $F$  and  $\chi^2$  critical values (Hansen, 2001). The p-values for the test are reported in Hansen (1997). The drawback is that it detects only one breakpoint because it uses the maximum F-statistic of all the performed F-tests, as suggested by Quandt (1960).

## A2.2 The Bai-Perron test for multiple break points

Bai-Perron (1998) provides a framework for estimating multiple structural changes with an ordinary least squares model (OLS) in time series data. The authors propose a sup Wald type test with a null hypothesis of no change against an alternative which consists of an arbitrary chosen number of break dates. Also, they provide an additional test that allows the null hypothesis of 1 changes versus the alternative hypothesis of  $l+1$  changes. Bai-Perron (1998 and 2002) use these two tests to form a specific to general modeling strategy which allows consistent estimation of the appropriate number of changes in the series.

In this paper we chose to test for structural change in multiple series by using a common AR formulation for all the series (similar to e.g. Stock and Watson (2004)). Additionally we control for serial correlation and heteroscedasticity and test for multiple breakpoints in the parameters  $\alpha$  and  $\Phi$ . The equation we use is and on which they apply the Bai-Perron (1998) procedure is:

$$(A2.2) \quad y_{it} = \alpha_{it} + \Phi(L)y_{it}$$

where  $y_{it}$  is the series of interest,  $i$  represents the specific country,  $t$  time,  $\alpha$  represents the (possibly changing) mean of a series,  $L$  is the lag operator and  $\Phi$  the appropriate autoregressive coefficient. This procedure differs from Stock & Watson (2003) as they test for one structural change in the parameters and in the variance. The proposed equation and Bai & Perron specific to general modeling constitute a common framework in dating multiple points of discontinuity through multiple series and countries. The above presented methodology enables us to formally test for structural change in various series, such as GDP.

However, the Bai-Perron tests for structural breaks use asymptotical critical values which guide the choice of the date and number of structural breaks. These asymptotical critical values are calculated for white Gaussian noise processes with a large number of observations. Although we are dealing with a time span of over 60 years, the observations are yearly, so they do not constitute a particularly large sample. Antoshin, Berg and Souto (2008) show that Bai-Perron tests lack power when used in small samples. We approach the issue in two ways. First, following Jones and Olken (2008) we may accept the shortcomings of the Bai-Perron tests and state that the breakpoint identified by the Bai-Perron methodology are a subset of the bigger set of “true” breakpoints. Secondly, in the results section we show that reasonable sample manipulation may yield additional breakpoints.

## Appendix 3: Convergence

The two approaches to convergence used in the paper are defined in greater detail below. The first has been called the ‘classical approach’ and the second the ‘time series’ approach. Both are standards in the literature so here already derived and tested equations are used.

### A3.1 Classical approach 1: absolute $\beta$ -convergence (unconditional $\beta$ -convergence)

The classical approach to the analysis of convergence is derived from the predictions of the Neoclassical one sector growth model (the Solow model). This model predicts that over time all economies converge to the same equilibrium long term growth path, hence its name ‘absolute convergence’. This is possible only if less developed economies have higher growth rates than developing ones. This is the proposition tested by the absolute  $\beta$ -convergence (unconditional  $\beta$ -convergence). The proposition has been tested frequently and the now standard formulation is presented in Sala-i-Martin (1996). This approach is used here.

The absolute  $\beta$ -convergence (unconditional  $\beta$ -convergence) proposition is tested by equation A2.1.

$$A3.1 \quad y_{i,t+T} = \alpha - \beta \log(y_{i,t}) + \varepsilon_{i,t}$$

In the equation  $y_{i,t+T} = \log(y_{i,t+T}/y_{i,t})$  denotes country  $i$ 's annualized real growth rate of GDP between time  $t$  and  $t+T$ , and  $\log(y_{i,t})$  denotes the logarithm of country  $i$ 's real GDP per capita in period  $t$ , while  $\varepsilon_{i,t}$  is an error term.

By testing the equation we can obtain the value of the coefficient  $\beta$  on which we can base our conclusion about income convergence among the selected countries. If  $\beta < 0$  the slope is falling and economies with higher incomes have smaller growth rates so there is absolute  $\beta$ -convergence, i.e. that countries with lower initial level of income in period  $t$  experience higher average growth rate between period  $t$  and  $t+T$  than countries with higher initial level of income. If  $\beta \geq 0$  then there is no absolute convergence.

### A3.2 Classical approach 2: $\sigma$ -convergence

Another measure of convergence called  $\sigma$ -convergence. If over time the difference among the developed and less developed decreases then growth rates must become more similar and when convergence is complete all economies grow at the same growth rate. This implies a reduction in the dispersion of growth rates. A good measure of dispersion is the standard deviation usually denoted by  $\sigma$  and hence this measure of convergence is called  $\sigma$ -convergence

Following this line of reasoning  $\sigma$ -convergence can be defined as follows: group of countries are converging in the sense of  $\sigma$ -convergence if the dispersion of their real per capita GDP levels tends to decrease over time. Formally, we can write this condition as:

$\sigma_{t+T} < \sigma_t$ , where  $\sigma_t$  is the time  $t$  standard deviation of  $\log(y_{i,t})$  across countries.

### A3.3 Pair convergence: time series approach

The previous two concepts of convergence, namely absolute  $\beta$ -convergence and  $\sigma$ -convergence, measure convergence for any number of economies. Another approach to convergence looks at the convergence of only two economies. The test for convergence between pair of the countries used in this paper was derived by Bernard and Durlauf (1996). Contrary to the classical approach, e.g. (Sala-i-Martin, 1996), Bernard and Durlauf (as well as Estrin and Uruga, 1997) focus on the characteristics of time series. They define convergence through the equation A 2.2

$$\lim_{k \rightarrow \infty} E = (y_{i,t+k} - \bar{y}_{t+k}) = \mu$$

This definition of convergence asks whether the long-run forecasts of output differences tend to some steady state level as the forecasting horizon tends to infinity. If  $y_{i,t+k} - y_{j,t+k}$  is a finite mean stationary process then by this definition of convergence the conditions for convergence are be satisfied. This definition has natural testable analogy from the unit root/cointegration literature. In order for countries  $i$  and  $j$  to converge their outputs must be cointegrated with cointegrating vector  $[1, -1]$ .

The formal econometrical analysis of the above definition is based on the equation A 2.3 of the augmented unit root test (ADF)

$$d_t - d_{t-1} = \beta_0 + \beta_1 d_{t-1} + \sum_{\tau=1}^g \beta_{1+\tau} (d_{t-\tau} - d_{t-\tau-1}) + \theta T + \varepsilon_t$$

Where the variable  $d_t$  is the logarithmic difference in per capita output between economies  $i$  and  $j$  in the period  $t$  ( $y_{i,t} - y_{j,t}$ ),  $T$  is a deterministic trend and  $g$  is the maximum number of time lags which is sufficient for  $\varepsilon_t$  to represent *IID* process with  $N(\mu, \sigma^2)$ , distribution.

In the equation  $d_t$  is stationary process if  $\beta_1 = 0$ , meaning that the income difference between two economies is constant and stable, i.e. that the economies are following the same growth trajectory, on different levels of income. If the process is not stationary we analyze graphical representation of time series to determine whether countries are converging to or diverging from its pair countries.