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Current account convergence to the long-run steady state for Bosnia and Herzegovina and the Western Balkans

Abstract

From the Western Balkan perspective, EU membership can be seen as a means toward greater political and economic stability. The Maastricht criteria with their focus on nominal and macroeconomic convergence are important conditions that countries will have to accomplish. The inability of Western Balkan countries to converge on EU inflation rates might be a problem, but warning signals are especially evident from persistent current account deficits in the Western Balkans. In this paper an assessment of current account sustainability is conducted by refining the concept of sustainable current account deficits through a stationary condition and mean reversion proposition. A stationary current account to GDP ratio is considered consistent with a finite external debt to GDP ratio. The current account rate of convergence to its steady state is estimated for Bosnia and Herzegovina and each of the Western Balkan countries. We find that four of the five Western Balkan countries have a stationary current account to GDP ratio and therefore meet the minimum requirement for current account sustainability based on our less strict solvency condition.

The author is a PhD student at Staffordshire University, UK

Author e-mail address: shlivnjak@cbbh.ba or S.Hlivnjak@staffs.ac.uk

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1. Introduction

EU membership can be seen from the perspective of the Western Balkans as a means towards greater political and economic stability. In turn, macroeconomic policy is a key matter of common concern for the EU member states, especially with respect to: price stability; sustainable balance of payments and sound fiscal policy (ECB, 2007). It can be argued that, based on the data availability, the Western Balkan countries will have to reach higher levels of nominal and real convergence before they can become EU member countries. The Maastricht criteria with their focus on nominal and macroeconomic convergence are important conditions that these countries will have to accomplish, but persistent current account deficits in Western Balkans raise questions about their external sustainability and competitiveness and the consistency of their current policies with these convergence objectives.

This paper is organised as follows: section 2 starts with an examination of the Maastricht criteria; here we stress the importance of nominal and macroeconomic convergence on the EU's levels for Bosnia and Herzegovina on its road towards membership. In section 3 we extend our analysis through estimating current account convergence to a long-run steady state for: Bosnia and Herzegovina; for each of the other Western Balkan countries; and for the Western Balkan countries as a group. In estimating this we do not impose the restriction that the current account deficit should be set at maximum of 5% of GDP, generally considered in the empirical literature to be the criteria for it to be sustainable. Instead, we let it be country specific and based on that indicative of the Western Balkan average. The conclusions of this paper are presented in section 4

2. The Maastricht criteria as guidelines and constraints on macroeconomic policy in BH

Nominal and macroeconomic convergence of Western Balkan economies with the European member states should lead these countries toward economic and monetary integration with the European Union (EU). It can be argued that Bosnia and

Herzegovina's integration toward the EU began in June 1998, when the European Council approved the Declaration of Special Relations with Bosnia and Herzegovina and then, in May 1999, a Stabilisation and Association Process was initiated by the European Council (BH's Directorate for European Integration, 2007).

2.1 Nominal and macroeconomic convergence in BH

The path toward EU membership is composed of different stages and progress to the next stage depends on the degree of convergence previously achieved. Anderton, Barrell and Veld (1991) define convergence as the narrowing of international differences in the development of certain economic variables. They argue that a distinction between nominal and real convergence must be made, since nominal convergence refers to costs and prices, while real convergence refers to working conditions and living standards. It can be argued that the convergence progress of a transition economy towards complete integration into EU is evaluated by the European Commission based on a country's ability to achieve their nominal and real convergence goals.

There are several stages toward EU accession which can be identified: Feasibility study; Stabilisation and Association Agreement; Application for Membership; and Accession itself (Sorsa, 2006). By investigating the progress of countries based on social inclusion reports (EC, 2007), it can argued that countries from the Western Balkan group have achieved different degrees of progress. They have all finished the first stage and most are currently between the second and the third stage. The exception is Croatia which has almost finished its negotiation with the EU. Croatia is currently working toward closing all of the Chapters of the Acquis Communautaire[1] before it can end the negotiations and achieve candidate status.

Each country in the Western Balkans has a permanent, independent and professional body[2] with responsibility to harmonise activities and to oversee the implementation of the

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[1] EU laws accumulated so far

[2] In Bosnia and Herzegovina that professional body is called the "Directorate for European Integration" (DEI).

decisions of its government and assist the EU integration process. At the Thessaloniki Summit in March 2004 the EC approved a Decision (EC No. 533/2004) on the establishment of a European Partnership in the framework of the Stabilisation and Association process for all the Western Balkan countries. We can interpret the main role of the European partnership[3] as identifying the key priorities that each country has to implement through reforms. Reforms are part of a contractual relation, the so called "Stabilisation and Association Agreement" (SAA)[4], which provides a country with potential candidate status (BH's Directorate for European Integration, 2007). The actual signing of the SAA therefore depends on the progress of a country. After the SAA is signed, the negotiation of the Acquis Communautaire chapters starts. After all chapters are negotiated and closed, the country receives candidate status and the final stage of accession starts.

Sorsa (2006) argues that in all the stages of EU accession macroeconomic stability seems to be a key criterion. According to her, during the early stages of the process the benchmarks are looser than those of the Maastricht criteria. This was evident from the previous experiences of Romania, Bulgaria and currently Croatia. Romania still has high rates of inflation and current account imbalance, Bulgaria also has a current account imbalance while Croatia has both a current account imbalance and large fiscal deficit (actually the largest of all Western Balkan economies[5]). All three countries need to identify which specific policies they will have to implement in order to meet their nominal and macroeconomic convergence targets to accomplish the Maastricht criteria.

2.2 The Maastricht criteria and convergence

Meeting the Maastricht criteria with their focus on nominal and macroeconomic convergence is an important condition that countries will have to accomplish, but persistent current account deficits in the Western Balkans raise questions about external sustainability, sustained competitiveness and the consistency of their policies with these convergence objectives. Misalignment of a real exchange rate with too high current

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[3] Full text available on www.dei.gov.ba

[4] The second stage of accession toward EU membership.

[5] Data available from CROSTAT at www.dzs.hr

account deficits in Western Balkan countries could cause an inability to meet these criteria. According to the fundamental view (Roubini and Wachtel, 1998), a worsening of the current account is usually a response to underlying structural weaknesses and fundamental changes in the economy.

The fundamental concern of the Maastricht criteria is price stability, given price stability the other monetary conditions are fulfilled: interest rate convergence via the uncovered interest parity condition and exchange rate stability via the relative PPP relation. The fiscal criteria are included to support the fundamental aim of price stability by removing the temptation of a government to solve its fiscal problems by an inflation tax (seigniorage). In respect to the Maastricht criteria rules, we can argue that the stability of the currency board in BH and the low levels of inflation that were evident in recent years, (CBBH Bulletin, 2008) could make an it easy for BH to transfer from its currency board arrangement into the ERM2[6], since adopting a peg regime to the euro enhances the credibility of domestic monetary policy and strengthens links with the EU (Coricelli, 2002; Buiter and Grafe, 2002; Lipinska 2008).

Afxentiou (2000: 248) argues that the Maastricht criteria are “simple rules” for price and fiscal stability, while Ravenna (2005) argues that the Maastricht criteria can serve as a sort of commitment that improves the credibility of macroeconomic policies in the accession countries. In the context of the Maastricht criteria and the Western Balkan economies, we would not necessarily agree with the word “simple”, since it takes time to accomplish the Maastricht criteria. The criteria emphasise stability, but the achievement of stability also is not “simple” in the Western Balkans. The algorithm to achieve stability is not known. It seems to be a lengthy and on-going process for these countries (i.e. it is still an on-going process for BH, Serbia, Macedonia and Albania). We would rather address the Maastricht criteria as “rules”. The Maastricht criteria have to operate within an environment of economic stability, not of internal and external disequilibrium The achievement of economic stability seems not to be simple, since all Western Balkan

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[6] The ERM2 (exchange rate mechanism) is based on the exchange rate arrangement framework between the Eurosystem and EU Member States that have not yet adopted the euro (European Central Bank, 1999).

economies have persistent current account imbalances, though these countries are in different phases of accession. The common pattern that Western Balkan countries have is a current account deficit above 5% of GDP. However, the Maastricht criteria do not explicitly mention any criteria for the current account, though a large and persistent current account imbalance could be seen as a threat to currency stability and hence, price stability.

The combination of exchange rate targeting and a high degree of euroization in the Western Balkan economies suggest that monetary policy cannot be used as a central bank tool to deal with the external deficit. Hence if the financial sector in these economies is not strong, international reserves are insufficient to sustain the value of domestic currency and fiscal policy is not sound, this can put sustained pressure on the external balance[7]. Therefore the threat that a current account deficit could become unsustainable exists (Kaminsky, Lizondo and Reinhart, 1997; IMF 1998; Carranza 2002). The Maastricht criteria do require that inflation rates must be similar in all EU states. Once inflation rates converge then the interest rates and exchange rate should converge too (through uncovered interest parity and relative purchasing power parity) in the absence of differential country risk factors. So the inability to converge on EU inflation rates might be a problem for Western Balkans. These countries have inflation rates above the EU states, partly reflecting Balassa-Samuelson processes. Convergence of inflation to the EU's level is faster in the tradable sector than in the nontradable sector. Productivity growth in the tradable sector in transition economies is faster than in the nontradable sector, though wage rate increases will tend to be the same (Roubini and Wachtel, 1998; Liargoves 1999; Egert et al., 2006; Kemme and Saktinil, 2006). Even if the candidate country maintains a fixed exchange rate with respect to the Euro, the Balassa-Samuelson process implies a higher inflation rate of nontradables in transition economies and overall higher inflation rates (Pelkmans, Gros and Ferrer, 2000). It follows therefore that the adoption of the Maastricht inflation target requires Western Balkan countries to target a higher output gap, than would be the case of the absence of the Balassa-Samuleson effect.

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[7] The on-going process of privatisation (i.e. oil industry and telecommunication) in BH could be seen as an indication that the country has still not finished its basic transition reforms, which could result in potentially volatile capital inflows or even large external shocks (Sorsa, 2006).

A large and persistent current account imbalance could be seen as a threat to currency stability and hence, price stability, yet medium to long-run sustainability for the transition economies is usually assessed based on available descriptive analysis (Milesi-Ferretti and Razin, 1996; Krzak, 1998; Roubini and Wachtel, 1998; Carranza, 2002). We can argue that even though transition countries are usually deficient in the availability of long time series data, descriptive analysis is not a sufficient tool and some empirical work should have been applied. Hence in order to assess the macroeconomic weaknesses potentially arising from current account deficits, in the following section we will develop more rigorous empirical work that is theory informed.

3. Current account convergence to the long-run steady state

Carranza (2002) argues that concept of current account sustainability can be made operational by assessing strict and less strict solvency conditions, where both conditions imply that external debt must be repaid fully. The less strict solvency condition implies a constant debt to GDP ratio, where the growth rate of GDP has to be greater than real interest rate. A strict solvency condition implies that the higher the growth rate is in relation to the real interest rate, the smaller the primary surpluses necessary to repay the debt. Based on the above, a country's current account deficit can be seen as sustainable as long as the ratio of foreign debt to GDP is not accelerating. Wu (2000) and Lau and Baharumshah (2005) suggest that a stationary current account to GDP ratio is consistent with a finite external debt to GDP ratio. Applying a single equation method, Wu (2000) finds a stationary current account to GDP ratio consistent with a finite external debt to GDP ratio for ten OECD countries. Lau and Baharumshah (2005) find a stationary current account to GDP ratio for three out of twelve Asian countries. Finding the ratio of current account to GDP to be either stationary or declining over time is a necessary but not a sufficient condition for current account sustainability, which is consistent with the less strict intertemporal solvency condition. If this is the case then there is no need for drastic policy changes from the government or for future default on its foreign debt. In this section we will test if the ratio of current account to GDP is stationary for the Western Balkans.

Next we estimate current account convergence to a steady state. We follow the work of Jiandog and Shang-Jin (2007) and the recent economic literature on convergence calculation (Ball and Seridan, 2003; Hyvonen 2004) based on the mean-reversion proposition. In other words we argue that countries with potentially high current account deficits will experience a significant degree of current account decrease just by returning to some underlying long-run cross country mean rate. These deficits will tend to decrease if their size were a consequence of the country's initial performance because of transitory factors and poor policy performance. This convergence may occur as a consequence of the policy to join the EU, since we assume that Western Balkan countries are aware that EU accession with high current account deficits is not possible. The current account rate of convergence to its steady state is estimated for BH and each of the Western Balkan countries[8]. We will use this estimation as an indication of how far is each country from the region's long-run steady state for current account convergence. This estimation is particularly important for BH due to EC decision no. 533/2004. The "EC confirmed it determination fully and effectively to support the European perspective of the WB countries, affirming that WB will become an integral part of the EU once they meet the established criteria". The European partnership will identify priorities for action that will be adapted to countries specific needs and their respective stages of preparation. Hence the calculated-long run current-account steady state will present an indicator that compares to the other Western Balkan countries. In estimating this we do not impose the restriction that a country's current account should be zero or the deficit limited to 5% of GDP. Instead we let it be region specific. The calculated long-run current account steady state presents a minimum requirement for current account sustainability in this period based on less strict solvency condition. We will start with a short description of the data used and then proceed with the estimation procedure.

3.1 Data

We use seasonally unadjusted quarterly data from International Financial Statistics (IFS); National Bank of Serbia; Bank of Albania; Croatian National Statistics Office (Crostat);

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[8] Based on individual country's data availability.

Statistical Agency for BH and Central Bank of BH (CBBH); for the period from 2002 to 2007. An exception is made with regard to Albanian data. Here estimates are made based on yearly data from 1996 to 2007 since the necessary quarterly data on GDP were not available. Our main variable is the ratio of the current account to GDP.

In table 3.1 we provide yearly data on the current account to GDP ratio as an overview. This particular time period is selected since it could be considered as a time-period without sudden reversals in the Western Balkan economies. Reversals are associated with sudden stops in capital inflow and if a country cannot finance its current account deficit, then the sustainability of its current account is in question (Edwards, 2004).

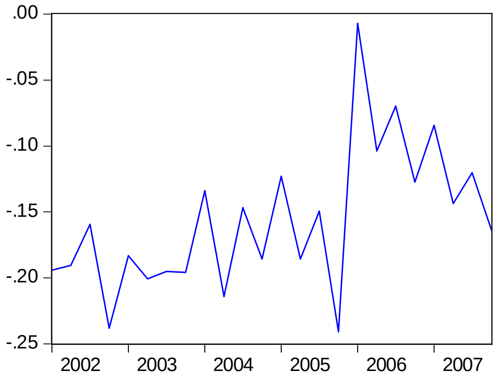
Table 3.1: Ratio of the current account to GDP for Western Balkans (WB)

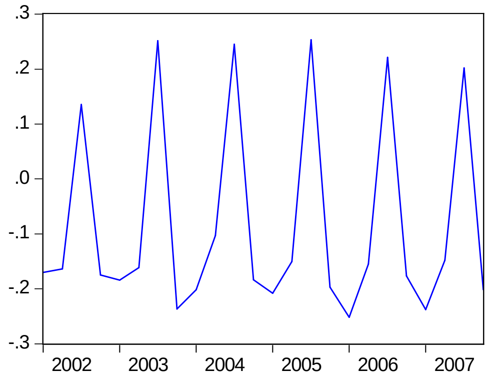
year	Bosnia	Croatia	Macedonia	Albania	Serbia
2002	-19.7%	-8.6%	-11.9%	-9.0%	-7.1%
2003	-19.4%	-7.2%	-5.0%	-6.2%	-8.4%
2004	-17.2%	-5.0%	-10.3%	-4.4%	-13.7%
2005	-18.0%	-6.3%	-3.3%	-7.1%	-11.3%
2006	-8.4%	-7.9%	-1.2%	-7.1%	-16.0%
2007	-13.1%	-8.6%	-4.3%	-9.6%	-0.6%

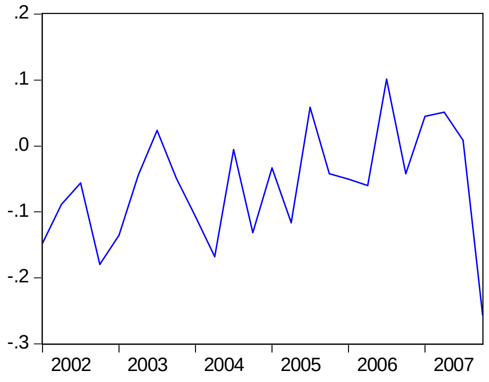
Source: author’s calculation (for data source see section 3.1)

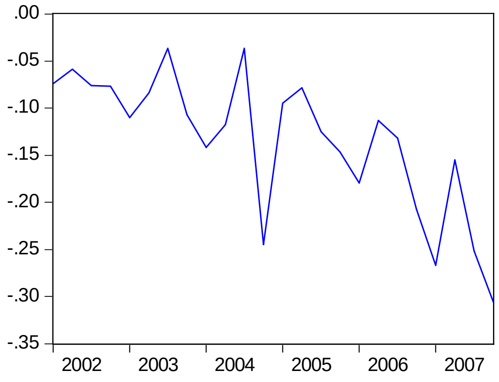
In order to assess whether the ratio of current account to GDP is stationary we apply a unit root test. We plot the data first and then check if all variables are stationary in levels (Graph 3.1).

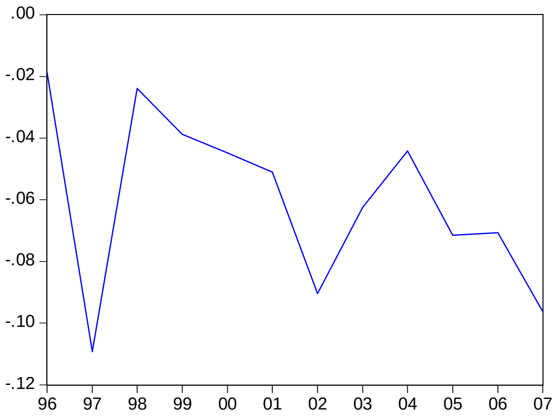
Graph 3.1: Data plot


Bosnia and Herzegovina CA/GDP


Croatia CA/GDP


Macedonia CA/GDP


Serbia CA/GDP


Albania CA/GDP

Note: CA/GDP is a current account to GDP ratio

Based on the data plot, we can see a strong seasonality influence in each third quarter of Croatian data, this is most likely due to the summer season and Croatia's strong orientation to tourism. In the BH data there is a structural break evident in the first quarter of 2006 which is when VAT was introduced in BH. A similar pattern can be noticed in Serbia's data in 2005, which is also the year when VAT was implemented. Macedonian data are expressing a positive trend in the current account to GDP ratio, with a sudden rise in imports at the end of 2007. Albanian data show a negative trend in the current account to GDP ratio. The plots in graph 3.1 suggests that trends are important components of the data and that results of unit root testing are likely to be very sensitive to beginning and end values of the data.

We applied the two most commonly used unit root tests: the Augmented Dickey-Fuller (ADF) and the Phillips-Peron (PP). The ADF test for the unit root is usually applied on long time-series data (Shiller and Perron, 1984; Wu, 2000).

Table 3.2: Order of integration for the ratio CA/GDP indicated by unit root testing

Unit root test	Bosnia	Croatia	Macedonia	Serbia	Albania
ADF (Augmented Dickey-Fuller)	I(1)**	I(1)**	I(0)**	I(1)**	I(0)**
PP (Phillips-Peron)	I(0)**	I(0)**	I(0)**	I(1)**	I(0)**

Note: Computed in Eviews 6.0
** significant at 1% level or better;
* significant at 5% level or better;

The PP unit root test (table 3.2) suggests that all time-series except Serbia's are integrated I(0) in levels or stationary. The ADF test suggests that only time series for Macedonia and Albania are integrated I(0) in levels or stationary. The ADF test suggests that time series for Bosnia; Croatia; Serbia are integrated I(1) or stationary in first differences. Jenkins and Snaith (2005) indicate that panel unit root and cointegration tests evolved in order to address the problem of the low power of standard unit roots tests. These tests intend to distinguish between unit roots and near unit roots. The result of panel unit root test is presented in Appendix, table 3.5 and 3.6. Although evidence is mixed from the ADF and the PP tests, the panel unit root test suggests that our time series are I(0) in levels or stationary. Since the ADF test is generally considered to be less powerful then the PP test (Maddala and Kim 1998, Ferda, 2004), we conclude that all series, except

Serbia’s, are integrated I(0) in levels or stationary. Hence we concluded that Serbia’s data are not suitable for convergence speed estimation.

3.2 Current account convergence speed estimation

To estimate the speed of current account convergence we again follow the work of Jiandog and Shang-Jin (2007). The only deviation from Jiandog and Shang-Jin is that we are not going to test the speed of current account convergence with regard to labour market rigidity, terms of trade and exchange rate regime, since our interest is not to replicate their new specific investigation. Instead, our focus is to estimate the speed of current account convergence to its long-run steady state. We apply two different methods. The first method is ordinary least squares and the second method is panel data regression. The first method is applied to each country’s data individually. The second method is applied to the Western Balkan countries as a group. With regards to sensitivity analysis, we want to compare our findings with those of Jiandog and Shang-Jin (2007), though they did not report estimates for the speed of current account convergence to the steady state. What they report is an explanation of how they dealt with the potential serial correlation in the error term.

The estimation procedure is based on the following steps. We present initially the first model estimation procedure and then that for the second model.

First model estimation procedure

1. ***First*** we calculate x_t which represents each country’s current account (ca) as a share of its GDP in period (t). $x_t = \frac{ca_t}{gdp_t}$ (3.1)

Where:
t is indexing the years from 2002 to 2007

2. ***Second*** we test if x_t follows a unit root process. If we reject the hypothesis of a unit root process then we can proceed with step 3. (3.2)

In section 3.1 we found enough evidence to reject the hypothesis of a unit root process.

3. ***In step three*** based on the mean reversion proposition the speed of convergence of the current account to GDP ratio to its long run mean is estimated by utilising the following regression:

$$\Delta x_t = \alpha + \beta \, x_{t-1} + e_t \tag{3.3}$$

Where:

Δ is the first differences of the current account as a share of GDP.

α is a constant term that represents autonomous growth in the current account to GDP ratio

β is the speed of convergence to its long run mean

e_t is the uncorrelated error term

The Jarque-Bera statistic was used in order to test whether the series are normally distributed. Under the null hypothesis of a normal distribution, the Jarque-Bera statistic is distributed as χ^2 with 2 degrees of freedom. The reported probability is the probability that a Jarque-Bera statistic exceeds (in absolute value) the observed value under the null hypothesis. A small probability value leads to the rejection of the null hypothesis of a normal distribution. Based on the Jarque-Bera test we find a normal distribution of residuals as reported in Appendix, model 1. This test points out that there are outliers in the residuals which are included in the estimated country equations as dummy variables. These dummy variables corresponds to our findings already established based on the data plot from section 3.1.

The null hypothesis is that the current account as a share of GDP does not converge, hence, β =0,

the alternative hypothesis is that the current account as a share of GDP converges to a long-run steady state, where β should be expected to be negative and smaller than one in absolute value.

From equation (3.3) it follows:

$$x_t - x_{t-1} = \alpha + \beta\, x_{t-1} + e_t \tag{3.4}$$

$$x_t = \alpha + x_{t-1} + \beta x_{t-1} + e_t \tag{3.5}$$

$$x_t = \alpha + (1+\beta)x_{t-1} + e_t \tag{3.6}$$

$$-\beta \leq 1 \tag{3.7}$$

The closer to one is β_j in absolute value, the faster the speed of convergence.

Now if we drop the time subscripts from $x_{j,t}$, then equation (3.4) can be written as:

$$x - x = \alpha + \beta x_j + e_t \tag{3.8}$$

$$-\beta x = \alpha + e_t \tag{3.9}$$

$$x_j = -\frac{\alpha}{\beta} + \frac{e_t}{\beta} \tag{3.10}$$

4. Based on (3.10), ***in step four*** we calculate the long-run steady state of the current account to GDP ratio. Jiandog and Shang-Jin's (2007:35) specification does not impose the constraint that the long-run value of the current account to GDP ratio should be zero. Jiandog and Shang-Jin propose to calculate the country specific long-run value toward the steady state in the following specification:

$$\text{Long-run steady state} = -\ \frac{\alpha}{\beta} \tag{3.11}$$

or autonomous growth in current account to GDP ratio divided by the speed of convergence. The units used in estimation procedure are percentage points; hence the calculated long-run steady state indicates the percentage point where the current account to GDP ratio settles. We can obtain those values from our ***step three*** estimation.

Second model estimation procedure

This model is applied in order to find the steady state rate which can be an indicator of the current account sustainability for the Western Balkans as a region.

Here we estimate a two-way fixed effects panel data regression model. This estimation is conducted by pooling time-series and cross-section observations. The two way fixed effects model seems to be appropriate since we are focusing on a specific number of countries and our inference is restricted to the behaviour of these sets of countries (Baltagi, 2008). We estimate a panel regression model based on quarterly data; hence the Western Balkan group does not include data on Albania[9].

1. ***The first step*** is the same as in the model one. We calculate ($x_{i,t}$) which represents each country's current account as a share of its GDP**.** (3.12)

2. ***Second,*** we pool the data together ($x_{i,t}$) and organise it as cross-sectional units observed in a period (t). Where:
t stands for the number of periods and since we have quarterly observations, t = 24.
i refers to the Western Balkan countries (i = 4).

3. ***Third,*** we test if ($x_{i,t}$) follows a unit root process. If we reject the hypothesis of a unit root process then we can proceed with step 4. We do reject the Ho of a unit root process and results are provided in Appendix, table 3.5 and 3.6 (3.13)

4. ***In step four*** the speed of convergence of the current account to GDP ratio is estimated by utilising the following two way fixed effects model:

$$\Delta x_{i,t} = \alpha + \beta_i x_{i,t-1} + \mu_i + \lambda_t + e_{i,t} \tag{3.14}$$

Here we estimate the Western Balkans common mean value for the intercept (α) and the individual difference in the intercept values of each country are reflected in the country specific error term (μ_i) and time effect (λ_t)

then $w_{i,t} = \mu_i + \lambda_t + e_{i,t}$ (3.15)

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[9] Quarterly data for GDP were not available for Albania.

Where $w_{i,t}$ is the error term and it consists of three components: unobservable individual effect (μ_i) assumed to be fixed, unobservable time effects (λ_t) and remainder observation-level disturbances, the error component ($e_{i,t}$). If unobservable individual effects (μ_i) and unobservable time effect (λ_t) are assumed to be fixed parameters to be estimated and the reminder disturbance error component $e_{i,t}$ ~IID(0, δ^2), then:

$$\Delta x_{i,t} = \alpha + \beta_i x_{i,t-1} + w_{i,t} \tag{3.16}$$

Δ is the first differences of a current account as a share of GDP.

α is a constant term that represents autonomous growth in the current account to GDP ratio

β_i is the speed of convergence for each country i.

The null hypothesis is that the current account as a share of GDP does not converge; hence, β_i=0,

the alternative hypothesis is that the current account as a share of GDP converges to a long-run steady state, where β_i should be expected to be negative and smaller than one in absolute value.

5. ***In step five*** we calculate the long-run steady state for the current account to GDP ratio. Long-run steady state is calculated as:

$$\text{Long-run steady state} = -\frac{\alpha}{\beta_i} \tag{3.17}$$

We can obtain those values from our step four estimation.

3.3 Implementation and discussion of results

Now in order to make this procedure operational[10] ***first*** we check the test diagnostics. All regression results and diagnostics are reported in Model 1 of Appendix. After we confirmed, based on the coefficient t-test and LM serial correlation test, that the two conditions from equation (3.3) are fulfilled, we report an estimated speed of convergence and calculated long-run steady state value in table 3.3 for model one.

Table 3.3: Model 1, long-run steady state and speed of convergence

Estimation	Bosnia	Croatia	Macedonia	Albania
Long run steady state	-18.2%	-8.1%	-4.5%	-6.2%
Speed of convergence	-144.8%	-106.2%	-83.1%	-131.3%

Source: authors' calculations (for data source see section 3.1)

Estimates are conducted country by country based on equation (3.3). Least squares regression results are reported in Appendix, Model 1 for each country individually. Jiandog and Shang-Jin's (2007) proposition is that all variables should have a negative speed of convergence of less than one. The closer the speed of convergence is to one in absolute value, the faster the speed of convergence. Based on our findings (Table 3.3) we can conclude that all variables have the expected negative sign, but all countries except Macedonia have a speed of convergence greater than one. Jiandog and Shang-Jin say nothing about convergence speeds greater than one. BH's speed of convergence is 144.8% per period. This seems to be a result of a current account to GDP ratio path which contains trends in both directions, this particularly exaggerates large changes in the observed current account to GDP ratio. A convergence path can be seen from the graph 3.2.

Graph 3.2: Convergence path for BH current account to GDP ratio

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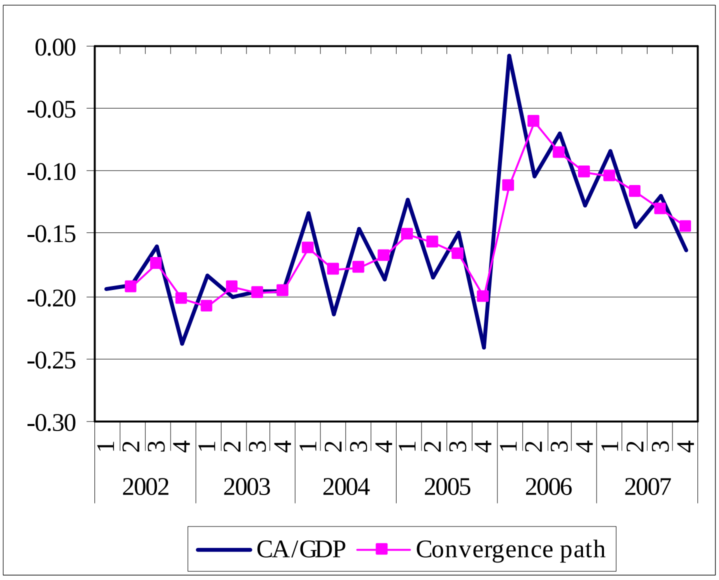
[10] Empirical results were generated by EViews 6



Source: authors' calculations (for data source see section 3.1)

This observed variability of the current account to GDP ratio could be a signal of an economy most vulnerable to the external shocks. Based on our estimations, Albania's speed of convergence is 131.3% per year, while Croatia's speed of convergence is 106.2% per period. This degree of overshooting may reflect not only variability in the observed current account to GDP ratio but also that BH, Albania and Croatia are in the process of rapid changes in their economies.

Now turning to the steady state estimation, we noticed that Croatia's current account to GDP is estimated at 8.1% in its long-run steady state rate, which is what we would expect to see based on a data provided in table 3.1. In the context of the empirical findings on sustainable current account deficits, our estimation suggests that each country in the Western Balkan group, except Macedonia, is far above the 'maximum' of 5% of current account to GDP ratio. Macedonia's current account to GDP ratio is estimated at 4.5% at its long run steady state rate.

Next we discuss the results from the second model estimation. The two way fixed panel model results are reported in Appendix, Model 2, under the Hausman test. Based on our estimation, the long-run steady state rate for BH is much higher than the estimated steady state rate for the Western Balkans. This is concluded based on quarterly data used in estimated panel regression. This estimate is presented in (Table 3.4).

Table 3.4: Model 2, long-run steady state and speed of convergence for WB

Estimation	Quartarly data
long run steady state	-14.9%
speed of convergence	-106.2%

Source: authors' calculations (for data source see section 3.1)

Based on the results in Table 3.4 we can argue that BH is the only country which is far behind the estimated steady state rate for the Western Balkans. This rate can be an indicator of current account sustainability in this period. However, from our earlier discussion finding that the current account to GDP ratio to be stationary is not a sufficient condition to assess its sustainability, but it presents a minimum requirement for sustainability assessment based on less strict solvency conditions. This estimation also provides a warning signal of a potentially unsustainable current account deficit in this country, particularly if reversal occurs.

From Table 3.4 it is evident that our results with quarterly data suggest a 14.9% steady state rate as an indicator of current account sustainability in the WB region. The speed of convergence seems to be high for the Western Balkan countries. According to the quarterly data model a speed of convergence for Western Balkans is 106.2% per period. The mean-reversion proposition suggests that countries with potentially high current account deficits will experience a significant degree of current account decrease just by returning to some underlying cross country mean rate. Since our research interest is particularly focused on BH and the indications of a possible unsustainable current account deficit, our estimation of BH current account to GDP steady state rate is 18.2%.

4. Conclusions

Overall, based on the convergence speed estimations and steady state rate calculations we can conclude that these findings for the Western Balkans raise questions about external sustainability (particularly for BH) and the consistency of their recent policies with their nominal and real convergence objectives.

A stationary condition seems to be a necessary, but not sufficient, condition for current account sustainability. This condition presents a minimum requirement for current account sustainability assessment based on less strict intertemporal solvency conditions. BH current account to GDP ratio is found to be stationary but at a rather high level. We would assume that the Western Balkan countries are aware that EU accession with high current account deficits is not possible. The empirical literature finds a stationary current account to GDP ratio consistent with a finite external debt to GDP ratio. We found that four of the five WB countries have a stationary current account to GDP ratio and therefore met the minimum requirement for sustainability based on less strict intertemporal solvency conditions.

Even though transition countries usually do not have available long time-series data, we have shown that empirical work can be developed even with limited time-series availability. As a robustness check it would be very desirable to re-estimate the model as new data becomes available.

Our findings also suggests that improved statistics will help to better understand domestic and foreign pressures in the market, it will enable more data transformation, as well as, alignment of methodology with more developed countries.

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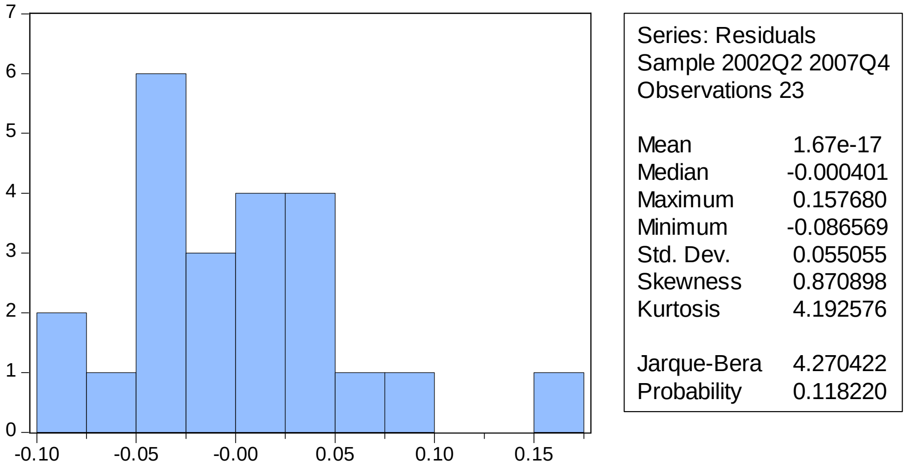
Appendix

Model 1: Individual Countries

Bosnia and Herzegovina

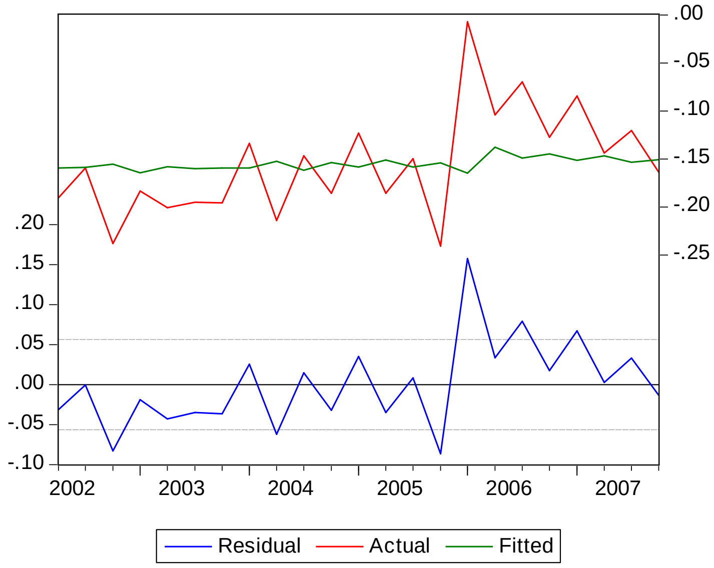
Bosnia and Herzegovina’s residuals



```
Series: Residuals
Sample 2002Q2 2007Q4
Observations 23

Mean          1.67e-17
Median       -0.000401
Maximum       0.157680
Minimum      -0.086569
Std. Dev.     0.055055
Skewness      0.870898
Kurtosis      4.192576

Jarque-Bera   4.270422
Probability   0.118220
```



Dependent Variable: D(BOSNCAGDP)
Method: Least Squares
Date: 12/02/08 Time: 02:00
Sample (adjusted): 2002Q2 2007Q4
Included observations: 23 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.210266	0.038346	-5.483425	0.0000
BOSNCAGDP(-1)	-1.173303	0.205245	-5.716601	0.0000
DUMSHIFT2006	0.077795	0.023575	3.299894	0.0040
DUMQ42005	-0.056415	0.034456	-1.637290	0.1189
DUMQ12006	0.083656	0.046143	1.812960	0.0865

R-squared	0.840708	Mean dependent var	0.001316
Adjusted R-squared	0.805310	S.D. dependent var	0.074036
S.E. of regression	0.032668	Akaike info criterion	-3.815208
Sum squared resid	0.019209	Schwarz criterion	-3.568361
Log likelihood	48.87489	Hannan-Quinn criter.	-3.753127
F-statistic	23.75005	Durbin-Watson stat	1.923353
Prob(F-statistic)	0.000001		

Dependent Variable: D(BOSNCAGDP)
Method: Least Squares
Date: 12/02/08 Time: 02:03
Sample (adjusted): 2002Q2 2007Q4

Included observations: 23 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.263565	0.031178	-8.453455	0.0000
BOSNCAGDP(-1)	-1.448863	0.165873	-8.734771	0.0000
DUMSHIFT2006	0.110641	0.019081	5.798519	0.0000

R-squared	0.793756	Mean dependent var	0.001316
Adjusted R-squared	0.773132	S.D. dependent var	0.074036
S.E. of regression	0.035264	Akaike info criterion	-3.730799
Sum squared resid	0.024871	Schwarz criterion	-3.582691
Log likelihood	45.90419	Hannan-Quinn criter.	-3.693550
F-statistic	38.48630	Durbin-Watson stat	1.364659
Prob(F-statistic)	0.000000		

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1.078927	Prob. F(4,16)	0.3996
Obs*R-squared	4.885937	Prob. Chi-Square(4)	0.2992

Ramsey RESET Test:

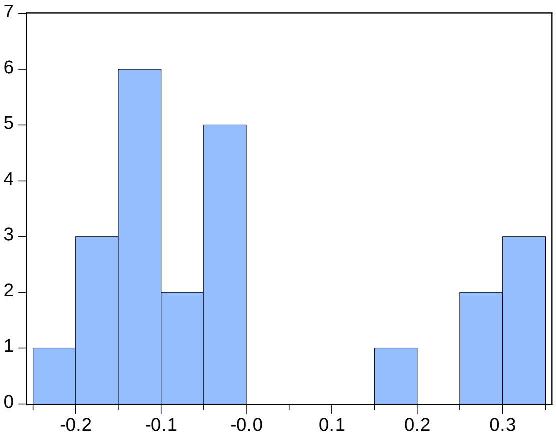
F-statistic	2.953100	Prob. F(1,19)	0.1020
Log likelihood ratio	3.322795	Prob. Chi-Square(1)	0.0683

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.480018	Prob. F(2,20)	0.6257
Obs*R-squared	1.053473	Prob. Chi-Square(2)	0.5905
Scaled explained SS	0.379984	Prob. Chi-Square(2)	0.8270

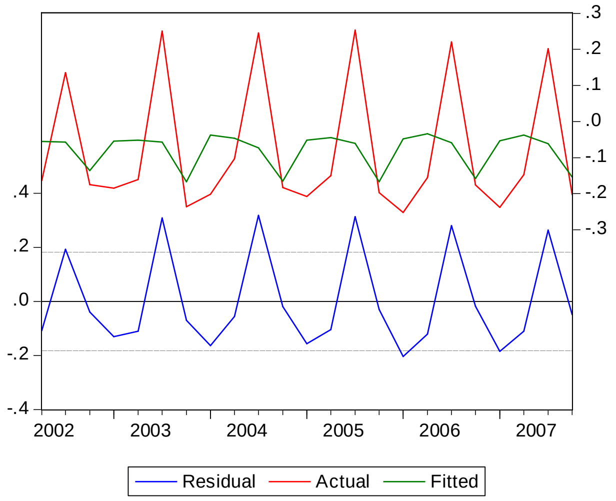
Croatia

Croatia’s residuals



Series: Residuals
Sample 2002Q2 2007Q4
Observations 23

Mean	1.18e-17
Median	-0.056255
Maximum	0.318073
Minimum	-0.204320
Std. Dev.	0.178270
Skewness	0.876306
Kurtosis	2.194893
Jarque-Bera	3.564855
Probability	0.168229



Dependent Variable: D(CROCAGDP_SA)
Method: Least Squares
Date: 11/20/08 Time: 01:42
Sample (adjusted): 2002Q2 2007Q4
Included observations: 23 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.086365	0.013509	-6.393134	0.0000
CROCAGDP_SA(-1)	-1.062797	0.153907	-6.905456	0.0000
DUMCROQ32002	-0.096382	0.021952	-4.390641	0.0003

R-squared	0.760812	Mean dependent var	-0.002380
Adjusted R-squared	0.736894	S.D. dependent var	0.041783
S.E. of regression	0.021432	Akaike info criterion	-4.726753
Sum squared resid	0.009187	Schwarz criterion	-4.578645
Log likelihood	57.35766	Hannan-Quinn criter.	-4.689504

F-statistic	31.80817	Durbin-Watson stat	1.669156
Prob(F-statistic)	0.000001		

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.182507	Prob. F(4,16)	0.9441
Obs*R-squared	1.003622	Prob. Chi-Square(4)	0.9092

Ramsey RESET Test:

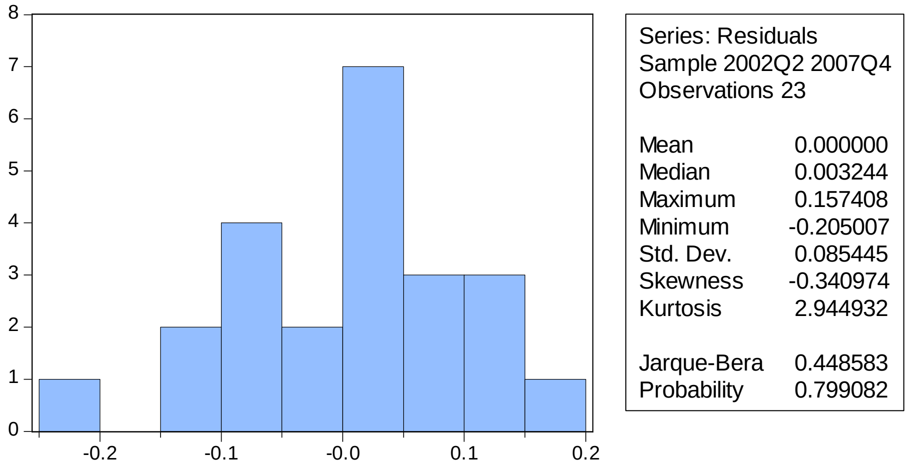
F-statistic	0.689258	Prob. F(1,19)	0.4167
Log likelihood ratio	0.819588	Prob. Chi-Square(1)	0.3653

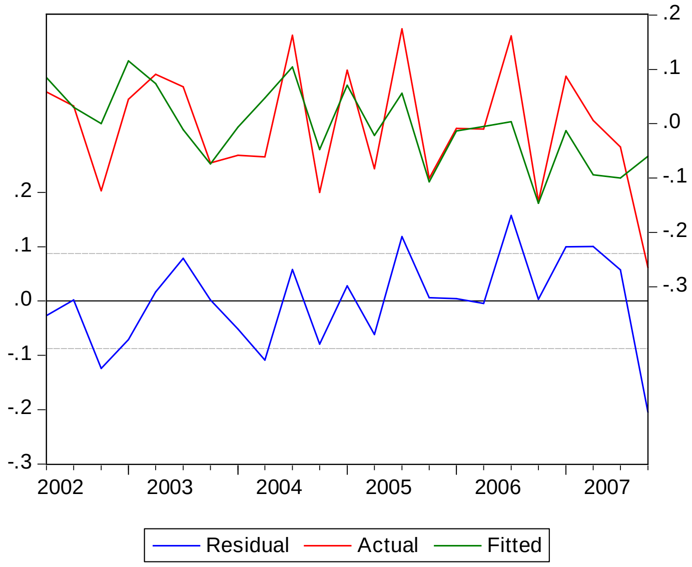
Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.434641	Prob. F(2,20)	0.6535
Obs*R-squared	0.958034	Prob. Chi-Square(2)	0.6194
Scaled explained SS	0.800126	Prob. Chi-Square(2)	0.6703

Macedonia

Macedonia’s residuals





```
Dependent Variable: D(MACECAGDP)
Method: Least Squares
Date: 11/20/08   Time: 01:44
Sample (adjusted): 2002Q2 2007Q4
Included observations: 23 after adjustments
==========================================================================
                         Coefficient     Std. Error     t-Statistic   Prob.
==========================================================================
   MACECAGDP(-1)          -0.831115      0.214846       -3.868421     0.0010
        C                 -0.037556      0.019883       -1.888842     0.0735
     DUMQ42007            -0.220612      0.078796       -2.799799     0.0111
==========================================================================
R-squared                  0.576598    Mean dependent var          -0.004758
Adjusted R-squared         0.534257    S.D. dependent var           0.111301
S.E. of regression         0.075958    Akaike info criterion       -2.196168
Sum squared resid          0.115392    Schwarz criterion           -2.048060
Log likelihood             28.25593    Hannan-Quinn criter.        -2.158919
F-statistic                13.61819    Durbin-Watson stat           2.122596
Prob(F-statistic)          0.000185
==========================================================================

Breusch-Godfrey Serial Correlation LM Test:
==========================================================================
F-statistic                1.261402    Prob. F(4,16)                  0.3256
Obs*R-squared              5.514167    Prob. Chi-Square(4)            0.2385
==========================================================================


Ramsey RESET Test:
==========================================================================
F-statistic                0.000589    Prob. F(1,19)                  0.9809
```

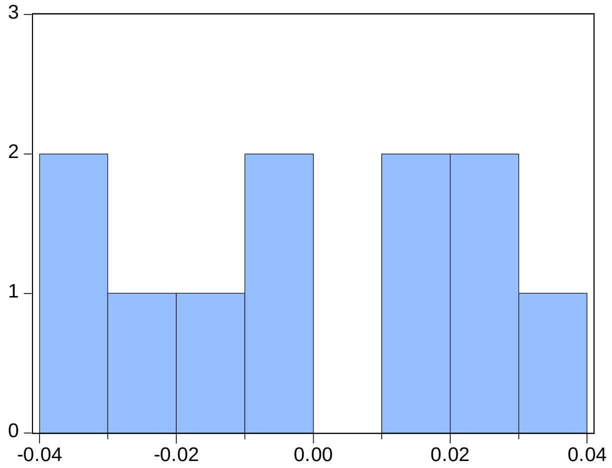
Log likelihood ratio	0.000713	Prob. Chi-Square(1)	0.9787

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.482360	Prob. F(2,20)	0.6243
Obs*R-squared	1.058375	Prob. Chi-Square(2)	0.5891
Scaled explained SS	0.586659	Prob. Chi-Square(2)	0.7458

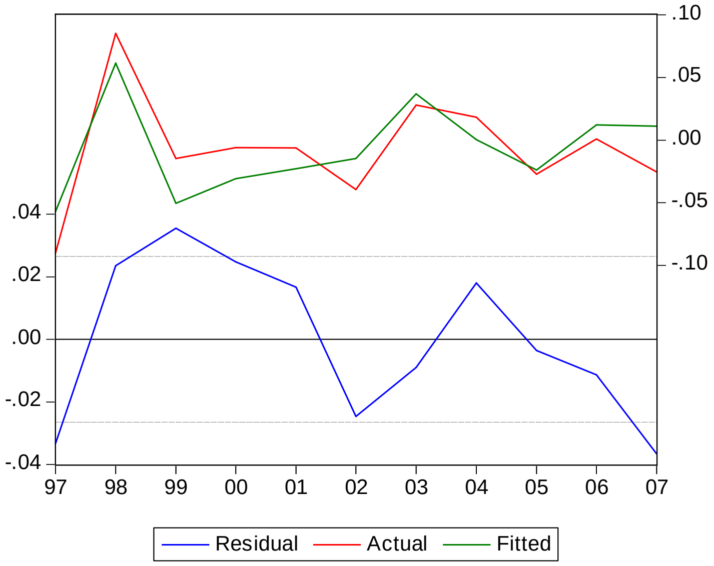
Albania

Albania’s residuals



Series: Residuals
Sample 1997 2007
Observations 11

Mean	3.15e-18
Median	-0.003601
Maximum	0.035449
Minimum	-0.036581
Std. Dev.	0.025112
Skewness	-0.130273
Kurtosis	1.620470
Jarque-Bera	0.903370
Probability	0.636555



Dependent Variable: D(ALBCAGDP)

```
Method: Least Squares
Date: 11/20/08   Time: 01:46
Sample (adjusted): 1997 2007
Included observations: 11 after adjustments
==========================================================================
                        Coefficient     Std. Error    t-Statistic    Prob.
==========================================================================
          C              -0.081745       0.019136     -4.271858     0.0021
    ALBCAGDP(-1)         -1.313528       0.305770     -4.295801     0.0020
==========================================================================
R-squared                 0.672178   Mean dependent var          -0.007033
Adjusted R-squared        0.635753   S.D. dependent var           0.043859
S.E. of regression        0.026470   Akaike info criterion       -4.262609
Sum squared resid         0.006306   Schwarz criterion           -4.190264
Log likelihood            25.44435   Hannan-Quinn criter.        -4.308212
F-statistic               18.45390   Durbin-Watson stat           1.173300
Prob(F-statistic)         0.002003
==========================================================================


Breusch-Godfrey Serial Correlation LM Test:
==========================================================================
F-statistic               1.073794   Prob. F(4,5)                   0.4574
Obs*R-squared             5.082951   Prob. Chi-Square(4)            0.2789
==========================================================================


Ramsey RESET Test:
==========================================================================
F-statistic               0.434803   Prob. F(1,8)                   0.5282
Log likelihood ratio      0.582173   Prob. Chi-Square(1)            0.4455
==========================================================================

Heteroskedasticity Test: Breusch-Pagan-Godfrey
==========================================================================
F-statistic               1.414518   Prob. F(1,9)                   0.2647
Obs*R-squared             1.494039   Prob. Chi-Square(1)            0.2216
Scaled explained SS       0.310279   Prob. Chi-Square(1)            0.5775
==========================================================================
```

Model 2: Western Balkans

Quarterly data (without Albania)

Table 3.5: Panel unit root test, quarterly data with intercept included

```
Panel unit root test: Summary
Series:  CAGDPWBQ
Date: 11/20/08   Time: 01:47
Sample: 2002Q1 2007Q4
```

Exogenous variables: Individual effects
User specified lags at: 1
Newey-West bandwidth selection using Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-2.28245	0.0112	4	88
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-3.48455	0.0002	4	88
ADF - Fisher Chi-square	31.4553	0.0001	4	88
PP - Fisher Chi-square	62.4185	0.0000	4	92

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Table 3.6: Panel unit root test, quarterly data without intercept included

Panel unit root test: Summary
Series: CAGDPWBQ
Date: 11/20/08 Time: 01:48
Sample: 2002Q1 2007Q4
Exogenous variables: None
User specified lags at: 1
Newey-West bandwidth selection using Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-1.36440	0.0862	4	88
Null: Unit root (assumes individual unit root process)				
ADF - Fisher Chi-square	25.0880	0.0015	4	88
PP - Fisher Chi-square	32.8070	0.0001	4	92

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Hausman test

Hausman test is based on difference between the fixed and the random effects estimators. Applied researchers have interpreted a rejection as an adoption of the fixed effect model and nonrejection as an adoption of the random effects model (Baltagi, 2008:22). Using

EViews 6.0 we applied three different tests to assess option under the random effects panel data procedure (Swamy and Arora; Wallace and Hussain; Amemiya/Wansbeek And Kapteyn). A central assumption in random effects estimation is the assumption that the random effects are uncorrelated with the explanatory variables. The test statistic provides sufficient evidence to adopt the fixed effect model.

Swamy and Arora

Correlated Random Effects - Hausman Test
Equation: Untitled
Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	13.371633	1	0.0003

Wallace and Hussain

Correlated Random Effects - Hausman Test
Equation: Untitled
Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	5.919810	1	0.0150

Amemiya/Wansbeek And Kapteyn

Correlated Random Effects - Hausman Test
Equation: Untitled
Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	2.918703	1	0.0876

One and two way fixed effect regression estimates are performed using both EViews 6.0 and Stata 8.0 softwares. The software’s estimates have reported the same coefficients on the speed of adjustment. The Stata 8.0 is preferred softwer for the two way fixed effects analysis since the Stata 8.0 reports the individual effect of each dummy variable included. Based on Stata 8.0 report the collective group dummies are identified as significant for the two way fixed effect model estimation. A strong seasonality influence in each third quarter was found. Assessing the individual countries data we noticed that Croatia’s data have a strong seasonality influence in each third quarter which is most likely due to the summer season and Croatia’s strong orientation to tourism.

EViews 6.0 estimation output for one way fixed effect regression:

```
Dependent Variable: D(CAGDPWBQ)
Method: Panel Least Squares
Date: 11/20/08   Time: 01:09
Sample (adjusted): 2002Q2 2007Q4
Periods included: 23
Cross-sections included: 4
Total panel (balanced) observations: 92
==============================================================================
                        Coefficient    Std. Error    t-Statistic      Prob.
==============================================================================
     CAGDPWBQ(-1)        -1.129790      0.109640     -10.30454       0.0000
          C              -0.120035      0.016215     -7.402900       0.0000
==============================================================================
                          Effects Specification
==============================================================================
Cross-section fixed (dummy variables)
==============================================================================
R-squared                 0.549961    Mean dependent var          -0.003726
Adjusted R-squared        0.529270    S.D. dependent var           0.162741
S.E. of regression        0.111656    Akaike info criterion       -1.493965
Sum squared resid         1.084643    Schwarz criterion           -1.356911
Log likelihood            73.72238    Hannan-Quinn criter.        -1.438649
F-statistic               26.57919    Durbin-Watson stat           2.084666
Prob(F-statistic)         0.000000
==============================================================================
```

EViews 6.0 estimation output for two way fixed effect regression:

```
Dependent Variable: D(CAGDPWBQ)
Method: Panel Least Squares
Date: 11/20/08   Time: 01:10
Sample (adjusted): 2002Q2 2007Q4
Periods included: 23
Cross-sections included: 4
Total panel (balanced) observations: 92
==============================================================================
                        Coefficient    Std. Error    t-Statistic      Prob.
==============================================================================
     CAGDPWBQ(-1)        -0.973037      0.124647     -7.806357       0.0000
          C              -0.103897      0.016620     -6.251356       0.0000
==============================================================================
```

Effects Specification

Cross-section fixed (dummy variables)
Period fixed (dummy variables)

R-squared	0.723188	Mean dependent var	-0.003726
Adjusted R-squared	0.612464	S.D. dependent var	0.162741
S.E. of regression	0.101310	Akaike info criterion	-1.501700
Sum squared resid	0.667147	Schwarz criterion	-0.761610
Log likelihood	96.07820	Hannan-Quinn criter.	-1.202993
F-statistic	6.531412	Durbin-Watson stat	2.039905
Prob(F-statistic)	0.000000		

Stata 8.0 estimation output for one way fixed-effects regression:

```
Fixed-effects (within) regression               Number of obs      =        92
Group variable (i): country                     Number of groups   =         4

R-sq:  within  = 0.5496                         Obs per group: min =        23
       between = 0.0262                                        avg =      23.0
       overall = 0.4800                                        max =        23

                                                F(1,87)            =    106.16
corr(u_i, Xb)  = -0.3588                        Prob > F           =    0.0000

------------------------------------------------------------------------------
        diff |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         lag |  -1.129702   .1096457   -10.30   0.000    -1.347635   -.9117696
       _cons |  -.1200385   .0162142    -7.40   0.000     -.152266    -.087811
-------------+----------------------------------------------------------------
     sigma_u |  .05291466
     sigma_e |    .111637
         rho |  .18345027   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(3, 87) =     4.50             Prob > F = 0.0055
```

Stata 8.0 estimation output for two way fixed-effects regression:

```
Fixed-effects (within) regression               Number of obs      =        92
Group variable (i): country                     Number of groups   =         4

R-sq:  within  = 0.7229                         Obs per group: min =        23
       between = 0.0262                                        avg =      23.0
       overall = 0.6683                                        max =        23

                                                F(23,65)           =      7.37
corr(u_i, Xb)  = -0.2770                        Prob > F           =    0.0000

------------------------------------------------------------------------------
        diff |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         lag |  -.9730254   .1246498    -7.81   0.000    -1.221968   -.7240825
        dum1 |  (dropped)
        dum2 |   .0448998   .0728747     0.62   0.540    -.1006411    .1904406
        dum3 |   .1308333   .0724391     1.81   0.076    -.0138376    .2755042
        dum4 |  (dropped)
        dum5 |   .0177162   .0734011     0.24   0.810     -.128876    .1643085
        dum6 |   .0478319   .0730341     0.65   0.515    -.0980273     .193691
        dum7 |   .1805091   .0723889     2.49   0.015     .0359386    .3250797
        dum8 |    .018908   .0719001     0.26   0.793    -.1246864    .1625024
        dum9 |     .02417    .072892     0.33   0.741    -.1214053    .1697453
       dum10 |    .019893    .072869     0.27   0.786    -.1256364    .1654225
       dum11 |   .1845077    .072968     2.53   0.014     .0387804    .3302349
       dum12 |  -.0204297   .0719362    -0.28   0.777    -.1640961    .1232368
       dum13 |   .0567288   .0739541     0.77   0.446    -.0909678    .2044253
       dum14 |   .0367933   .0722518     0.51   0.612    -.1075035    .1810902
       dum15 |   .1790289   .0725791     2.47   0.016     .0340784    .3239794
       dum16 |   .0097052   .0718816     0.14   0.893    -.1338523    .1532627
       dum17 |   .0486695   .0731142     0.67   0.508    -.0973496    .1946886
       dum18 |   .0617389   .0723755     0.85   0.397    -.0828049    .2062827
```

```
       dum19 |   .1993612   .0721467     2.76   0.007     .0552744    .3434481
       dum20 |   .0276387   .0721467     0.38   0.703    -.1164481    .1717256
       dum21 |   .0344205   .0726874     0.47   0.637    -.1107462    .1795872
       dum22 |   .0711098   .0726403     0.98   0.331    -.0739628    .2161824
       dum23 |   .1291185   .0720216     1.79   0.078    -.0147185    .2729555
       dum24 |   -.064723   .0716323    -0.90   0.370    -.2077826    .0783365
       _cons |   -.166448   .0508843    -3.27   0.002    -.2680711   -.0648249
-------------+----------------------------------------------------------------
     sigma_u |   .0455328
     sigma_e |  .10130319
         rho |  .16806967   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(3, 65) =     3.77               Prob > F = 0.0146
```

Stata 8.0 estimation output for two way fixed-effects regression with seasonal dummies

```
Fixed-effects (within) regression               Number of obs      =        92
Group variable (i): country                     Number of groups   =         4

R-sq:  within  = 0.6975                         Obs per group: min =        23
       between = 0.0262                                        avg =      23.0
       overall = 0.6335                                        max =        23

                                                F(7,81)            =     26.68
corr(u_i, Xb)  = -0.3053                        Prob > F           =    0.0000

------------------------------------------------------------------------------
        diff |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         lag |  -1.061818   .0940235   -11.29   0.000    -1.248895   -.8747405
        dum3 |   .1026085   .0488605     2.10   0.039     .0053914    .1998255
        dum7 |   .1525285   .0488464     3.12   0.002     .0553394    .2497175
       dum11 |    .154063   .0490508     3.14   0.002     .0564674    .2516586
       dum15 |   .1501603   .0489041     3.07   0.003     .0528565    .2474641
       dum19 |   .1726903   .0487943     3.54   0.001      .075605    .2697756
       dum23 |   .1032466   .0487818     2.12   0.037     .0061862    .2003071
       _cons |  -.1493666    .014609   -10.22   0.000    -.1784339   -.1202993
-------------+----------------------------------------------------------------
     sigma_u |  .04971494
     sigma_e |  .09481303
         rho |   .2156493   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(3, 81) =     5.50               Prob > F = 0.0017
```

Based on output regression collectively group dummies are significant for the estimation.

```
. reg lag res

      Source |       SS       df       MS              Number of obs =      92
-------------+------------------------------           F(  1,    90) =    2.25
       Model |  .029073227     1  .029073227           Prob > F      =  0.1370
    Residual |   1.1622606    90  .012914007           R-squared     =  0.0244
-------------+------------------------------           Adj R-squared =  0.0136
       Total |  1.19133383    91  .013091581           Root MSE      =  .11364

------------------------------------------------------------------------------
         lag |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         res |    .179863   .1198742     1.50   0.137     -.058288    .4180141
       _cons |  -.1029565   .0118478    -8.69   0.000    -.1264942   -.0794189
------------------------------------------------------------------------------
```

The regression output shows that the independent variable and the idiosyncratic error term are not correlated, hence the assumption of strict exogeneity is not violated.