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Economic Convergence in EU
The case of New Member States

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Αφιερωμένο στον γιο μου, Τάκη
και στον ξάδελφο που δεν πρόλαβα

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1. INTRODUCTION

European Union was firstly formed as a European community by France, W. Germany, Italy, Belgium and the Netherlands, followed by Luxemburg then Denmark, Ireland and United Kingdom. The next to join were Greece, then Portugal and Spain and lastly Austria, Finland and Sweden. This formation, today named as European union, has encompassed 10 more countries on May 1 2004, expanding from 15 to 25 members. The countries joining the union were Cyprus, Malta, the Check Republic, the Slovak Republic, Slovenia, Hungary, Latvia, Lithuania, Estonia and Poland. But there was also interest from Bulgaria and Romania, probably joining in 2007 and Turkey, which is a special case. Turkey has the status of a candidate country, but does not meet conditions criteria for entering accession negotiations.

The European Council meeting at Copenhagen in June 1993 set accession criteria. These criteria, required for a candidate to switch to an accession country for EU membership to satisfy political, economic and the so-called aquis communautaire criteria.

- Existence of stable institutions guaranteeing democracy, the rule of law, human rights and the protection of minorities.
- Existence of a functioning market economy as well as the ability to cope with competitive pressures and market forces within the EU.
- Ability to take on the obligations of membership, including adherence to the aims of political, economic and monetary union. Also granting full independence to country 's central bank, prohibiting monetary authorities financing of government deficit, no special access of government to financial institutions and fully liberalizing capital flows within EU as well as vis-à-vis third countries.

The 10 candidate countries have been granted EU membership at the European Council in Athens in April 2003. From the rest three interested countries, only Turkey fails to meet political criteria, hard. Although now EU members, those 10 countries do not have the option to reject neither the European Constitution nor the joining of the European Monetary Union (EMU) like UK did. The last one should not be of concern since all of them have expressed their will to join the EMU.

EU enlargement should not be seen just from economic point of view but rather from political. The new size of the population has increased by 75 millions, from 380 to 455 (20%) and area covered by 23%. The economic effect is a 5%, at 2004 prices, increase of GDP or 9% at PPP units. Their GDP corresponds to 24% of EU-15 (48% at PPP), so the per capita GDP of EU-25 is now less compared to EU-15 by 12% (9% at PPP) to the amount of € 21.232 (€ 22.185 at PPP), totaling to € 9.715 billion (€ 10.151 at PPP). The differences between 2004 prices and PPP units exist due to the strong Ballassa-Samuelson effect. To get a feeling of the numbers mentioned above, USA 's are 283 million population, per capita GDP of € 33.017 (€ 34.0005 at PPP), totaling to € 9.616 billion (€ 9.904 at PPP). Although now 1,03% richer in GDP the EU-25 compared to USA, per capita GDP is 70,58% less for a bigger population size of 60,78% consisting of 9 more spoken languages over 11 already existing, among EU-25 countries.

Lisbon 's 2000 summit strategic target of EU seems a more distant prospect. "EU in next decade will become the most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion".

As in old EU at the advent of the EMU, fulfillment of the economic criteria appears to be more demanding. The capability of the accession countries to deal with competitive pressures and market forces within EU seems weak. "The accession countries need to continue liberalizing prices, guaranteeing property rights, improving corporate governance and enabling the transfer of decision-making responsibilities from government bodies to market participants (ECB Enlargement paper No 8). This emphasizes the lack of appropriate institutions. Legally, in order to be part of EMU, accession countries have to comply with the Maastricht criteria, which concern nominal magnitudes only:

- Government Budget in two perspectives. Government deficit to GDP ratio below 3% and government debt to GDP not greater than 60%.
- Nominal long term interest rates, during the year before examination do not exceed 200 bps the average of the three best performing EU countries in terms of price stability.

- Price Stability[*] is sustained and an average rate of inflation, measured by the Harmonized Index of Consumer Prices (HICP), during the year before examination, does not exceed 1,5 percentage points the average of the three best performing EU countries in terms of price stability.
- A two years participation in the Exchange Rate Mechanism (ERM II) of the European Monetary System, allowing currency fluctuation within specific margins without severe tensions.

The role of ERM II has been controversial. "ERM II offers a meaningful framework for combining nominal and real convergence and should therefore not be seen as a mere "ante-chambre" before the adoption of the euro. ERM II should be seen as a useful regime on its own right, as a number of policy challenges can be tackled within that framework in the run-up to the adoption of the euro. Therefore, the length of participation should be assessed in terms of what is most helpful to accompany the convergence process rather in terms of the required minimum period of two years" (ECB 21/11/2002).

Neoclassical macroeconomic models suggest that the exchange rate system is irrelevant in influencing the real economy (Stockman 1981, p1485). International monetary system seems to confirm that (Salvatore 2000), suggesting that a credible exchange rate regime depends upon the trust evoked by governments. A governance structure that enforces the rule of law and sanctity of contracts and a political system that delivers credible non-inflationary policies, are prerequisites for the existence of a sustainable exchange rate regime.

Maybe ERM II for accession countries should be seen as world –market test for them to pass, on policy credibility, built during EU membership up to the moment of EMU membership[**].

There are many writers arguing that from an economist 's point of view, for accession countries the Maastricht criteria and especially the two years of purgatory ERM II phase is not to be recommended[+]. The changes to the new EU-25 as for Maastricht criteria for the whole EU seem to be marginal. Large foreign ownership

[*] Price Stability shall be defined as a year on year increase in the HICP for the euro area of below 2% (ECB 1999 p46)
[**] See Hochreiker and Tavlas for a discussion on that same issue for Austria and Greece.
[+] See Breuss, Fink & Haiss for this. Also Rossi is in favor, too.

and high bank concentration in the hands of foreign banks are important stabilizing factors, considering the fact that these foreign banks are properly supervised in their home countries, most of them being an EU-15 member! There is more administrative cost than the involved risk that could harm EMU as a whole. For countries with significant destabilizing factors, like bad debt in Poland, EU and ECB could allow some time for such a country to overcome this problem while still taking full advantage of the enlargement. Mundells 's position is supportive for this approach. How could there exist a common market without a common currency but instead keep 14 fluctuating exchange rates! (the €, 3 non-EMU countries of EU-15 and 10 accession countries currencies'). Bitter & Graffe and Genberg are also in favor of this approach, stating that simultaneously EU and EMU membership would not necessary involve grater adjustment pains than a drawn out one.

Several empirical studies have used time series and cross section data to measure and evaluate economic convergence among countries and regions. Sapir (1992) used trade data from various sources, for the 1960's, 1970's and 1980's, to evaluate the effects of European integration on trade, welfare and income distribution for twelve EC countries and subsets of it. He finds these effects to be beneficial, but, at the same time, not all regions reaped the same benefits. In some cases, regional disparities were exacerbated.

Ben-David (1993) studied the link between trade liberalization and income convergence within the EC. Using country data up to 1985 from various sources, his results support the convergence hypothesis that poor regions tend to grow faster than rich ones. According to Ben-David most of the convergence occurred in the post world war era, during a period of increased trade liberalization.

Neven and Gouyette (1995) assessed convergence in output per capita across 107 EC regions, for the period 1975-90. Their results support the convergence hypothesis for regions in the north of Europe but not in south Europe.

Deuhurst and Mutis-Gaitan (1995) utilized a model of varying convergence rates in GDP per capita among 63 NUTS Level 1 regions of the EU between 1981 and 1991:1 Their results indicated that the varying convergence rates for different sub-groups in the sample adjust toward a common equilibrium growth rate.

Armstrong (1995) constructed three 85-region data sets drawn from twelve EU member states that span the periods of 1950-70, 1970-90 and 1975-92. His empirical findings strongly supported European convergence with the additional insight that the convergence rates were lower in the 1970s and 1980s than in earlier periods.

Cheshire and Carbonaro (1995) examined GDP per capita growth rates for a set of 118 urban regions of the EU for the time period 1980-1990. These authors argued that the estimated convergence rates depend on the conditioning variables in cross section regressions. They reported mixed results depending on the specification of the models. Convergence was confirmed when the conditioning variables were those consistent with the standard neoclassical model, but their results are not robust. The introduction of other variables in cross section regressions such as proxies for scale economies in cities, congestion and other costs in large cities and spatial proximity to other city regions led to evidence of divergence.

Fagerberg and Verspagen (1996) analyzed regional growth in the EC in the postwar period for a sample of 70 regions covering six EC member states. Their empirical results suggested a reversal in the convergence process within the EC that characterized most of the postwar period. The signs of divergence are attributed to different levels of R&D, effort, investment, and support from the EC, and the structure of regional GDPs and differences in unemployment.

Giannas, Liargovas and Manolas (1999) examined convergence among EU countries for the period of 1970-1990 by considering not only economic indicators but also social quality of life variables such as crime rates, pollution, public services, health care and infrastructure. Their main tool of analysis was the Coefficient of Variation (CV) constructed for eight economic and quality of life indicators for each of three sub-groups of EU countries. In order to study the relative position of each country in comparison to other EU countries, these authors ranked the countries by a composite quality of life index constructed as the weighted average of the eight CVs through time particularly for the years 1970, 1975, 1980, 1985, and 1990. According to this broadly defined measure of convergence (the weighted average CV), most countries converged during the period of 1970-75, diverged in the period 1980-85 and started converging again after 1985.

Yin, Zestos and Michelis (2000) examined whether EU countries have been successful in integrating their economies during the period 1960-1995. In particular, they studied whether there was a tendency for convergence of the real per capita GDP among the EU countries. Two measures of economic convergence were utilized; the cross-sectional standard deviation of the real per capita GDPs, and the (3) measure of convergence of the real per capita GDPs based on the neoclassical growth model. The empirical results suggest evidence of ongoing convergence among the EU economies during the entire sample period with the exception of the sub-period 1980-1985.

When the 10-year sub-periods were employed, it was shown that convergence in the EU was strong and uninterrupted. This study also examined convergence/divergence within and between EU subgroups of countries. Convergence was supported between EU subgroups of countries and within each EU subgroup but in different and explainable degrees. Comparing convergence among five continents, EU15 and APEC they found that the EU is the only group of countries that succeeded in pursuing economic integration during the last three and a half decades. The study also revealed that existing economic, socio-political and policy differences among EU member countries reduce the rate of convergence in the EU. It is difficult to pinpoint the exact reasons that contributed to convergence of the European Union. They suggested that adopted EU policies played a crucial role in integrating the EU economies. The creation of the Customs Union and the formation of a Common Market along with the international trade agreements spearheaded by the GATT led to global trade liberalization. Trade liberalization among the EU countries, structural policies aiming to integrate the economies as well as the proximity of these countries, have all contributed to economic convergence of the EU countries.

The empirical literature relating to different aspects of the nominal convergence criteria in the EU has been quite large.

Karfakis and Moschos (1990) used the bivariate framework of Engle and Granger (1987) to investigate interest rate linkages between Germany and each of the countries, Belgium, France, Ireland, Italy and the Netherlands. Using monthly data from 1979:4 to 1988:11, they found no evidence of cointegration in the pairs of interest rates.

MacDonald and Taylor (1991) used monthly data from 1979:3 to 1988:12 to analyze bilateral US dollar nominal and real exchange rates for three EMS countries (France, Germany and Italy) and three non-EMS countries (Canada, Japan and Britain). Based on Johansen's multivariate cointegration method, these authors found some evidence of cointegration in the two types of exchange rates.

Similarly, Hafer and Kutan (1994) adopted the multivariate cointegration framework to test for long run co-movements of short-term interest rates and money supplies in a group of five EMS countries. Using monthly data from 1979:3 to 1990:12, they reported evidence of partial policy convergence among these countries.

Bayoumi and Taylor (1995) compared the behavior of real output growth and inflation of countries participating in the Exchange Rate Mechanism (ERM) with a group of non-ERM countries. They concluded that the ERM had contributed to macro-policy coordination among the ERM members.

Haug, MacKinnon and Michelis (2000) employed Johansen's cointegration approach to determine which EU countries would form a successful monetary union based on the Maastricht nominal convergence criteria. Using monthly and quarterly data of various time spans from 1979 to 1995 on 12 EU countries, these authors suggested that not all of the 12 countries would form a successful monetary union over time, unless several countries make significant adjustments in their fiscal and monetary policies.

Even though most theoretical and empirical studies to date have been concerned with estimating and analyzing cointegrating relations, common trends analysis can be equally useful and insightful. The identification and estimation of common trends in a set of economic variables can convey information that may be important and useful to applied economists and policy makers. Consider for instance the long-term interest rates of France, Germany and the Netherlands. If one finds two cointegrating relations among the three interest rates, then there must be a common stochastic trend maicers for the design of their monetary policies.

Hafer, Kutan and Zhou (1997) used the multivariate cointegration and common trends techniques of Gonzalo and Granger (1995) to study linkages in the term structures of interest rates in 4 EMS countries: Belgium, France, Germany and the Netherlands. Using a sample of monthly observations from 1979:3 to 1995:6 and decomposing each term structure into its transitory and common trend components, these authors found that the long term interest rate, and not the short rate, is the source of the common trend in each country. Further, the common trends are cointegrated and thus move together over time, but no single country dominates the common trends in the long-term interest rates of the four EMS countries.

Koukouritakis and Michelis (2002) use data from 1990:1 to 2002:12 and the multivariate cointegration approach of Johansen (1988, 1994, 1995) to analyze the cointegrating relations among the exchange rates, inflation rates, interest rates, deficits and debts of the 10 new prospective EU members mentioned above, and subsets of them in relation to the 3 EMU countries, France, Germany and the Netherlands. They also analyze the long run cointegration properties of real per capita GDPs among the 10 new countries and the 3 EMU countries and they have found evidence of long run co-movements in real per capita GDPs as strengthening the case for successful EMU enlargement by some or all the new countries. They also use the Gonzalo and Granger methodology to identify and estimate the number common trends that drive the cointegrating relations in each group of variables. Hypothesis testing on the estimated vectors that enter the common trends provides information as to which countries contribute significantly to the common trends. In this study, they have presented cointegration and common trends analysis among the 10 new countries of the EU enlargement alone, as well as in relation to 3 EMU countries. Cointegration is a necessary condition for co-movement of key variables in the long run and, thus for a successful future accession of the prospective new countries into the EMU. The analysis was based on the nominal convergence Maastricht criteria and an aspect of real convergence, using as a proxy the real per capita GDP's of those countries. Their empirical results support the view that the new countries are only partially ready to join the EMU at the present. Additional work is required in order to achieve not only nominal convergence, but also real convergence among them, as well as in relation to the Euro zone countries. In order to carry out the analysis they decomposed each system of variables into its transitory and common trend components so as to identify which country or group of countries drive these trends. More specifically, in the cases of nominal exchange rates, real exchange rates and deficit/GDP, their analysis indicates only partial convergence among these countries. In the cases of debt/GDP ratio and long-term interest rates, these countries have achieved almost full convergence among them. In the case of inflation, the results indicate full convergence among the 10 new countries. The group of the 5 enlargement countries with high income dominates the one common trend of that system, while the group of the 5 enlargement countries with low income dominates the other. The empirical findings are similar when they combine these countries with the 3 Euro zone countries. They found only partial convergence in most of the variables and almost full convergence in the cases of inflation and interest rates. In this case, the one common trend is dominated by the EMU countries while the other by the enlargement countries. Comparing the group of the richest new countries with the 3 EMU countries, they found almost full nominal convergence in the cases of deficit/GDP ratio and interest rates. Further they claim for almost full convergence between these two groups of countries, in terms of real output. Overall, for all the variables specified by the Maastricht criteria, except for inflation in the system of the 10 enlargement countries, the number of common stochastic trends is greater than one.

Beyaert (2003) uses a bootstrapped method proposed by Evans and Karras (1996a). His results indicate that the richer countries of the European Union have been in absolute convergence since 1970. The poorer countries who entered the Union in the 80's - Greece, Portugal and Spain - were only conditionally converging to their European partners at the time of their entrance: That is, their steady state path was parallel but not as high as those of the richer members. Since 1987, the situation has evolved so that the convergence tests applied on the data between 1987 and 2000 reveal signs of absolute convergence. This evolution points out that the Structural Funds that these countries have mostly received since 1987 may have been helpful. The case of Ireland is different, because this country experienced a very intensive growth process which may have resulted not only from an efficient use of the structural funds but also from the Foreign Direct Investment policy of the United States which have been using this country as an export base for their products towards the European countries. Ireland constitutes a case of such a fast catching-up process that it seems to have even "overshot" its goal of convergence, since it stands nowadays above the per capita output of any other EU member. As far as the Eastern European countries are concerned, his analysis focused on the case of Poland, Hungary and the Check Republic, for which the available series of per-capita output cover a longer period than for any other forthcoming member. The tests indicate that these countries were diverging until 1990. However, since then, they have moved to a more liberal economic system, which has been accompanied by a different evolution of their per capita output. The statistical tests indicate that they are now in a situation of conditional convergence with respect to each other, as well as with respect to the EU members. This is similar to the situation of Greece, Portugal and Spain at the moment they joined the EU. So it is to be hoped that these future members will be able to take full profit of their belonging to the EU.

Lavrac and Zumer (2003) examine Optimum Currency Area in the case of Slovenia and state its suitability for joining the EMU, as it is a small open, diversified economy with trade and financial links geographically concentrated towards EU. The argue for it would not expect serious asymptotic shocks endangering its economy once in the euro zone since it 's cyclically rather synchronized with EU. Also supportive is the fact that real per capita GDP is the highest of all 10 accession countries, exceeding that of the lowest of EU members, Greece and Portugal.

Matkowski & Prochniak (2004) have tested growth and cyclical convergence among the 8 CEE accession countries and the EU. Their results indicate that: There is a clear-cut convergence among the eight EU accession countries of CEE as to income levels. The GDP growth rates in the period 1993-2001 were generally negatively correlated with the initial GDP per capita level. Income differences between individual countries reveal a decreasing trend, especially during 1997-2001. As regards cyclical convergence, CEE countries should be divided into three subgroups: (a) Czech Republic and Slovak Republic; (b) Hungary and Poland; (c) the Baltic states. Slovenia may be included in one of the two first subgroups. The countries in each subgroup reveal a good conformity of cyclical fluctuations while the correlation with other subgroups is weak. All the considered CEE countries reveal a strong economic convergence towards the EU, both as regards income levels and business cycles. The accession countries tend to develop faster than the elder EU members. The income gap between CEE and EU is generally decreasing, although it still remains very large. Most CEE countries also reveal quite a good conformity of cyclical fluctuations with the euro area. The existing trade and capital links between CEE countries and the EU are already quite strong. Therefore, we should not expect a major improvement in their real economic convergence just after the accession. Moreover, the possibility of some divergence tendencies cannot be excluded.

2. APPLIED METHODS

Nominal Convergence: A process of nominal variables approaching stability levels (i.e. Interest Rates, Inflation, Exchange Rates, Government Deficit, Government Debt as % of GDP)

Real Convergence: A process where levels of economic welfare or development moving towards the same amount (i.e. per capita Income, Unemployment Rate, Productivity)

Convergence: A tendency towards equalization of per capita income levels, across economies in the long run (Abramovitz, 1986). Reflects polarization, distribution and inequality (Quah, 1997)

A starting point for growth and convergence is the neoclassical model of Solow (1956), referenced as the Bible for economic policy since the WW II. This model states that the level of output is determined by the labor force and fixed capital, leveraged by the technological achievements, which are available to all countries. As fixed capital relies on minimizing marginal productivity, all economies tend to reach a specific long-run stable growth path, the “Steady State”. This steady state is achieved during the enlargement of the labor force and technological improvements. Running higher than the steady state could be spotted from time to time using labor and capital in a more efficient way. The speed towards that steady state although is to return to normal. Increasing returns to capital while per worker capital is less than the optimum value stimulates the tendency to reach the steady state, what is known to be the efficient production frontier of the economy. This stimuli to speed up growth towards that frontier, describes one of the “Transitional Dynamics”. When the optimum per capital level is near to achievement, the whole process steams off to a rate similar to the technological advances.

The convergence hypothesis shows up. Outdated technology and minimum capital – labor ratios, far away from the optimum found among poorer countries, lead to greater return ton fixed capital compared to that of richer ones! Thus a systematic procedure of faster growth for poorer countries against richer ones is to be expected up to the efficient production frontier the “Steady State”.

The bottom line is that quantity and quality are the factors that change per capita income among countries. Quantity and quality of labor force (educational level), willingness to invest and encompass latest technological innovations.

When market forces are unleashed, convergence in per capita income and steady economic growth in the long run, are certain, according to the neoclassical theory framework. For developing and transitional economies to catch up with the developed countries, this is what to enforce.

Absolute b-convergence implies that on average, poorer countries are supposed to grow faster that richer ones, over the long run, eliminating inequalities among them.

Another measure of convergence is the dispersion of that growth across a group of countries, named as σ-convergence, as standard deviation (σ), is usually the selected desperation measurement. This last one depends not only on the differences of growth over time but also on the starting point of the process, the initial gap between income levels.

But economic growth is not just a simple function of couple parameters. It is determined by a wide range of factors, usually interrelated, so complex that absolute convergence shouldn't be the case. A new approach about b-convergence is conditional b-convergence, which is also well accepted according to the neoclassical model. Each country drives its own path to its steady state and thus differences of growth rates among countries, show their distance from their own steady state.

When group of countries are under examination with similar long run equilibrium positions, a tendency for some of them to converge within such groups might exist(the so-called convergence clubs), but it is also possible for that tendency not to exist between the groups.

On the quest for conditional b-convergence the variables needed to provide the long run growth path have to be chosen. Economic, political and institutional variables have been tested and many have been found to be statistically significant for a country 's economic growth. Although an ad hoc selection of them uncovers drawbacks for econometric evaluation techniques, such as measurement errors, lack of data estimated with other techniques, endogeneity and model uncertainty to name a few. Positive correlation with long run economic growth has been found along the openness of the country (trade to GDP) and investment as percentage of GDP. A different approach to bypass regression analysis drawbacks is to build a γ-convergence index. This index is based on the ranking of per capita income, capturing changes of ordinal ranking of economies among countries.

Both γ-convergence and σ-convergence, offer a good test for b-convergence. Also to mention that b- convergence is necessary but not sufficient condition for σ-convergence.

We should keep in mind that technological innovations are not available to all countries at the same time and the process for a country to catch up with others is not so automated as supposed to be from market liberalization. Even if imitation and adaptation is enforced to activate a grater growth, the expected result might not been seen.

Studies within OECD countries, the states of USA and W. Europe have shown that to cover half distance from the starting point towards the efficient production frontier takes about 35 years. It is on average, a 2% p.a. towards the Steady State.

Methods Evaluating Convergence

Let y_{nt} be the log real per capita GDP of *n*-country at time *t* and α_{nt} the long run growth path of the *n*-country at time *t*. Then $y_{nt} - \alpha_{nt}$ contains only non-permanent shocks, as deviations of y_{nt} around α_{nt} won't exist on the long run. This drives to the conclusion that $y_{nt} - \alpha_{nt}$ is I(0). In the other case that it is an I(1) variable, α_{nt} cannot stand for Steady State path for that economy.

Since α_{nt} is not observable then $y_{nt} - \alpha_{nt}$ is not testable for I(0) or I(1).

A group of N countries converging to the same steady state path is an across-convergence test. In an absolute across convergence, all countries must have a common long run path, meaning that $\alpha_{nt} = \alpha_t$ for all n=1, 2, …, N. For such a case ($y_{nt} - \alpha_t$) is I(0) around a zero mean for all n=1, 2, …, N. For those N countries if long run paths are in parallel then $\alpha_{nt} = \alpha_t + c$ for all n=1, 2, …, N, a conditional across convergence. And ($y_{nt} - \alpha_t$) is I(0) around a not necessary zero mean for all n=1, 2, …, N. This is interpreted as that some countries may follow the growth path of others but they might not reach the same level of per capita GDP, due to worse initial conditions.

Let two (2) countries n, m with y_{nt} and y_{mt} respectively, that converge to the same steady state path at $\alpha_t + c$. Then $(y_{nt} - y_{mt}) = (y_{nt} - \alpha_t) - (y_{mt} - \alpha_t)$ is I(0), since both (y_{nt} -

α_t) and (y_{mt} - α_t) are I(0). If (y_{nt} - y_{mt}) is I(1), then at least one of them is I(1) and thus α_t is not a steady path for that country. That n, m countries diverge.

When dealing with N countries, choosing the benchmark country that the rest of the group should converge to, ends up to be the most developed one leading the way.

When (y_{nt} - y_{kt}) are I(0) for every n=1, 2, … , k-1, k+1, … , N and k is the benchmark country, we get a global convergence. If for a j we have (y_{jt} - y_{kt}) ~ I(1) we get a partial convergence. So the null hypothesis and the alternative are :

H_0 : (y_{nt} - y_{kt}) ~ I(0) for every n=1, 2, … , k-1, k+1, … , N
H_A : (y_{nt} - y_{kt}) ~ I(1) for one or all n=1, 2, … , k-1, k+1, … , N

Instead for choosing one benchmark country often the average is the most commonly used.

$$\overline{y_t} = \frac{1}{N}\sum_{n=1}^{N} y_{nt}$$

Then testing for (y_{nt} - $\overline{y_t}$) to be I(0). So the null hypothesis and the alternative are :

H_0 : (y_{nt} - $\overline{y_t}$) ~ I(0) for every n=1, 2, …, N

H_A : ((y_{nt} - $\overline{y_t}$) ~ I(1) for every n=1, 2, …, N (because of one or all countries)

- Augmented Dickey – Fouler test (ADF)

$$\Delta x_{i,t} = \alpha_i + b_{i,t} + b_{i,0}x_{i,t-1} + \sum_{j=1}^{p_j-1} b_{i,j}\Delta x_{i,t-j} + \varepsilon_0 \text{ , t=1, 2, … , T}$$

where ε_0 ~ N(0, 1).

When $b_{i,0}$ is significantly less than zero, H_0 of unit root non-stationarity is rejected. To determine the lag parameter p_j we use the Akaike criterion.
The regression incorporates constant and time trend. The constant term is to handle the situation where the group of countries shares a parallel steady state path. Evans has shown that many exogenous growth models predict that countries may have the

same long run output growth, which are determined by technological innovations and have parallel output paths. The trend term is included to set the results independent of the value of α_i (Evans & Sanin 1984). ADF is inconsistent if the process is stationary around time trend and this trend is excluded (West 1987). Including the trend weakens the power of the test.

♦ Levin & Lin (1992, 1993), set $\alpha_i + b_{i,t}$ to be constant for all countries during the whole period and set a common $b_{i,0}$, assuming that all series have the same first order autocorrelation. For them the null and the alternative are

$$H_0 : x_{i,t} \sim I(1) \; \forall \; n$$
$$H_A : x_{i,t} \sim I(0) \; \forall \; n$$

♦ Im, Paseran & Shin (1995, 2003) implement a first order heterogeneity among the series, estimating a different $b_{i,0}$ for each country. For them the null and the alternative are

$$H_0 : x_{i,t} \sim I(1) \; \forall \; n$$
$$H_A : x_{i,t} \sim I(0) \text{ for some } n$$

Comparing them, Levin & Lin test for global convergence and Im, Paseran & Shin for partial convergence.

♦ Im et al (1997), choose a Langrangian Multiplier approach, defined by the average of individual
Langrangian Multiplier statistic, to test the existence of unit roots in a panel, that is $b_{i,0} = 0$ for every I

$$LM = \frac{1}{N} \sum_{i=1}^{N} LM_i$$

$$H_0 : b_{1,0} = b_{2,0} = \ldots = b_{N,0} = 0$$

This test has an asymptotic standard normal distribution. The H_0 demonstrates a no convergence statement for all countries. Heterogeneity in the cross sectional data is grater in Im et al procedure as data can be demeaned and the lag parameter may be chosen to include more or less lagged information.

♦ Sano & Taylor estimate the ADF as a N-system of equations, using Feasible Generalized Least Square technique and Wald test to evaluate the null hypothesis of

$$H_0 : b_{1,0} = b_{2,0} = \ldots = b_{N,0} = 0$$

This test has better power properties than the univariate ADF and more flexible structure to accommodate cross sectional correlation, compared to Im et al method.

♦ Breuer et al (2002) test within the panel framework for unit toot properties, series by series. The result is the rejection or not of a global no convergence tested by Im et al and Sano & Taylor. This new approach clarifies which member of the N-system is stationary or not. Their method applies the FGLS to estimate the N-system equations, examining separately each of the null hypothesis of

$$H_0 : b_{1,0} = b_{2,0} = \ldots = b_{N,0} = 0$$

They also suggest specifying sample specific critical values to check statistical inference.

♦ Choin & Ahn Panel Stationary Test.

Instead of checking for H_0 to be a panel no convergence (non-stationarity), the opposite is to check for H_0 to be a panel convergence. Working on Sargan & Bhargava (1983) test

$$\text{SBDH} = \text{trace}\left[\left(\frac{1}{T^2}\sum_{t=1}^{T}\hat{S}_t\hat{S}_t'\right)\hat{\Omega}_t\right]$$

Where

$\hat{S}_t$	=	$\sum_{t=1}^{T} \hat{X}_t$	
X_t	=	$\beta_0 + \beta_1 t + \hat{X}_t$	, $X_t = [x_{i,t}]$ been the N x 1 vector i=1, 2, … , N
$\hat{\Omega}_t$	=	$\sum_{t=1}^{T} C(n)k(n/l)$	Heteroscedasticity and autocorrelation consistent covariance matrix estimator
k(n/l)			Quadratic spectral kernel
l			Bandwidth parameter, capturing serial correlation in the data

They suggest estimating

$$\sum_{k=1}^{t} X_k = b_0 \sum_{i=1}^{t} i^0 + b_1 \sum_{i=1}^{t} i^1 + S_t^*$$

in order to replace $\hat{S}_t$ with S_t^*, in the SBDH method to implement their SBDHT method.

Both SBDH and SBDHT methods test the hypothesis that all series converge simultaneously with the alternative at least one does not converge. None of the methods provide information about witch one does not converge.

- Convergence form dispersion point of view.

Let dsp_t be a measure of dispersion of y_{nt} for n=1, 2, … , N. If $\lim_{t \to \infty} dsp_t = 0$ the σ-convergence exists. The measure could be variation, standard deviation or coefficient of variation. The most common is standard deviation. The main drawback of variation, also inherited to standard deviation is that both are subject to the scale of units been measured. For that the coefficient of variation should be favored against the others. In order to include the magnitude of each economy we could elect for dsp_t to be :

$$\text{dsp}_t = \frac{\sqrt{\frac{1}{N-1}\sum_{i=1}^{N}\left(y_{it}-\overline{y_t}\right)^2(p_{it}-1)}}{\overline{y_t}}$$

where p_{it} displays the ith-economy population share among the sample at time t.

- Gini Index of Inequality

This index plots a cumulative frequency curve of % of population (on X-axis) to % of income (Y-axis), of the sample. It is described by the equation

$$G_t = \frac{1}{2\overline{y_t}}\sum_{i=1}^{N}\sum_{j=1}^{N} p_{ti}p_{jt}\left|y_{it}-y_{jt}\right|,\ G_t \in [0,1]$$

When $G_t = 0$ denotes complete equality and $G_t = 1$ complete inequality.
When $\lim_{t\to\infty} G_t = 0$ there is a process towards equality among the countries.

- Theil Index of Inequality

Originating t form the information theory entropy its equation is defined as

$$T_t(1) = \frac{1}{N}\sum_{i=1}^{N}\frac{y_{it}}{\overline{y_t}}\log\left(\frac{y_{it}}{\overline{y_t}}\right)$$

If it is divided by Log(N), the Theil Index is normalized $T_1^n(1) \in [0,1]$, sharing the same notion of the Gini Index.
It is possible to decompose this index as

$$T_t(1) = \sum_{k=1}^{K} s_k T_{Kt}(1) + \sum_{k=1}^{N} s_k \log\left(\frac{y_{kt}}{\overline{y_t}}\right)$$

The first part describes inequality within each of K population groups in the sample and the second, inequality between these groups. Income share of group k in total income is denoted by s_k

What inequality fails to describe is the existence of one global mean convergence or two, clustering around local means (convergence clubs).

3. DATA

We focus on Maastricht convergence criteria to test the existence of panel unit roots. The variables under examination are the Consumer Price Index on a year-on year percentage change (CPI), Nominal Exchange Rates, Real Exchange Rates, Long Term Interests Rates, Deficit and Debt as percentage of GDP. We also examine Real per Capita GDP. The ten accession countries are tested against the average of the three best performing EU countries, Germany, France and the Netherlands according to the Maastricht criteria. This test is for examine convergence towards the EU.

We also perform a test to examine if accession countries are converging towards their average, which is if they are forming a convergence club.

Data collected from International Financial Statistics and span from January 1991 to December 2002. All variables are measured on a monthly basis except for those concerning GDP, which are on a quarterly basis over the same period. Real variables are deflated using the CPI of the country and the CPI of Germany.

4. METHOTHOLODGY

In this study we test using two similar methods.. Levin & Lin and Im, Pesaran & Shin.

4.1 Levin & Lin - Common Unit Root Process

These authors allow no heterogeneity in the group. They are assuming that all series have the same first order autocorrelation, but they allow the lag order for the difference terms, p_j to vary across cross sections.

$$\Delta x_{i,t} = c + bx_{i,t-1} + \sum_{j=1}^{p_j-1} b_{i,j} \Delta x_{i,t-j} + X'_{it}\delta + \varepsilon_{it}$$

All the errors ε_{it} are assumed to be mutually independent idiosyncratic disturbance, while the term X'_{it} represents the exogenous variables in the model.

The null and the alternative hypotheses for the test may be written as:

$$H_0: \quad b = 0$$
$$H_A: \quad b < 0$$

The method derives estimates of b from proxies for $\Delta x_{i,t}$ and $x_{i,t}$ that are standardized and free of autocorrelations and deterministic components.

For a given set of lag orders the process begins by estimating two additional sets of equations, regressing both $\Delta x_{i,t}$ and $x_{i,t-1}$ on the lag terms $\Delta x_{i,t-j}$ (for j=1, 2, … ,p_i) and the exogenous variables X_{it}. The estimated coefficients from those two regressions will be denoted $(\tilde{b}, \tilde{d})$ and $(\dot{b}, \dot{d})$, respectively.

Now defining

$$\Delta \bar{x}_{it} = \Delta x_{i,t} - \sum_{j=1}^{p_i - 1} \tilde{b}_{i,j} \Delta x_{i,t-j} + X'_{it}\tilde{d}$$

and

$$\bar{x}_{it} = x_{i,t} - \sum_{j=1}^{p_i - 1} \dot{b}_{i,j} \Delta x_{i,t-j} + X'_{it}\dot{d}$$

autocorrelations and deterministic components have been eliminated, using the two sets of auxiliary coefficients.

Now proxies are obtained by standardizing both $\Delta \bar{x}_{it}$ and $\bar{x}_{it}$ by dividing them by the regression standard error

$$\Delta \tilde{x}_{it} = \frac{\Delta \bar{x}_{it}}{s_i}$$

and

$$\tilde{x}_{it} = \frac{\bar{x}_{it}}{s_i}$$

Estimation of b is now obtained from the pooled proxy equation

$$\Delta \tilde{x}_{it} = b\ \tilde{x}_{it} + \eta_{it}$$

Under the null hypothesis a modified t-statistic for the resulting $\hat{b}$ is asymptotically normally distributed

$$t_\alpha^* = \frac{t_\alpha - (\mathrm{N\tilde{T}}) \times S_{\mathrm{N}} \times \tilde{s}^{-2} \times \mathrm{se}(\tilde{\mathrm{b}}) \times m_{m\tilde{T}^*}}{s_{m\tilde{T}^*}} \rightarrow \mathrm{N}(0,1)$$

Where t_α is the standard t-statistic for $\hat{b} = 0$, $\tilde{s}^2$ is the estimated variance of the error term η, se($\hat{b}$) is the standard error of $\hat{b}$ and

$$\tilde{T} = T - \left(\sum_i \frac{p_i}{N} \right) - 1$$

The average standard deviation ratio S_N, is defined as the mean of the ratios of the long-run standard deviation to the innovation standard deviation for each individual. Its estimate is derived using kernel-based techniques. The remaining two terms, $m_{m\tilde{T}^*}$ and $s_{m\tilde{T}^*}$ are adjustment terms for the mean and standard deviation.

This method requires a specification of the number of lags used in each cross-section ADF regression, p_i, as well as kernel choices used in the computation of S_N. In addition, we must specify exogenous variables used in the test equations. We may choose to include no exogenous repressors, or to include individual constant terms, or individual constant terms and time trends.

4.2 Im, Pesaran & Shin - Individual Unit Root Process

In the suggest model, the assumption of homogeneity in convergence rates is relaxed because of potential bias in heterogeneous panels.

$$\Delta x_{i,t} = c + b_{i,t} x_{i,t-1} + \sum_{j=1}^{p_j - 1} b_{i,j} \Delta x_{i,t-j} + X'_{it} \delta + \varepsilon_{it}$$

The null and the alternative hypotheses for the test may be written as:

$$H_0: \quad b_i = 0, \ \forall \ i$$
$$H_A: \begin{cases} b_i = 0, i = 1,2, \ldots N_1 \\ b_i < 0, i = N_1 + 1, N_1 + 2, \ldots N \end{cases}$$

(i could be reorder as needed) which may be interpreted as a non-zero fraction of the individual process is stationary.

After estimating the separate ADF regressions, the average of t-statistics for b_i from the individual ADF regressions, $t_{iTi}(p_i)$

$$t_{NT} = \frac{\sum_{i=1}^{N} t_{iT_i}(p_i)}{N}$$

is then adjusted to arrive at the desired test statistics.

IPS method has significantly greater power compared to Levin & Lin especially when the number of countries is small and also has better size properties when the choice of the ADF order is misspecified.

5. RESULTS

Regression results from the dataset tested against the best three performing EU countries, using Levin & Lin process, reject group convergence in all cases except for one out of six. But partial convergence is supported by the Im, Pesaran & Shin process, for two more cases. Both strongly support real per capita GDP convergence. Results are depicted on Table 1

New Member States to Three Best Performing
Regression Results

	Method	
Variable	Levin & Lin	Im Pesaran & Shin
CPI	5,26690 [1,0000]	-6,28833 [0,0000]
Nominal Exchange Rates	-0,95282 [0,1703]	-1,41673 [0,0783]
Real Exchange Rates	-14,40920 [0,0000]	-8,90214 [0,0000]
Long Term Interest Rates	-0,83841 [0,2009]	-1,90518 [0,0284]
Debt as % of GDP	0,77170 [0,7799]	-0,13960 [0,4445]
Deficit as % of GDP	-0,76573 [0,2219]	-4,19567 [0,0000]
Real Per Capita GDP	6,61682 [1,0000]	-5,19933 [0,0000]

Table 1: Levin & Lin and Im, Pesartan & Shin Regressions

Real exchange rates, show strong convergence in both methods, while CPI %Δ y-o-y strongly supports partial convergence for two members of the group (Cyprus and Slovenia), like Deficit as % of GDP (Poland and Lithuania, Slovakia is included at 5% level). We could state that there is a partial convergence for the long term interest rates at a 5% level (for Lithuania and Estonia). All other variables, accept the null hypothesis of unit roots, suggesting no convergence.

New member states were also tested against their average whether they are forming a club convergence group. Results are depicted on Table 2

New Member States to Their Average
Regression Results

	Method	
Variable	Levin & Lin	Im Pesaran & Shin
CPI	24,81250 [1,0000]	-0,38506 [0,3501]
Nominal Exchange Rates	4,19047 [1,0000]	5,38386 [1,0000]
Real Exchange Rates	0,89712 [0,8152]	-14,37480 [0,0000]
Long Term Interest Rates	0,55296 [0,7099]	-0,69556 [0,2434]
Debt as % of GDP	-3,18611 [0,0007]	-0,87655 [0,1904]
Deficit as % of GDP	-8,65896 [0,0000]	-0,80448 [0,0000]
Real Per Capita GDP	-6,13108 [0,0000]	-7,28813 [0,0000]

Table 2: Levin & Lin and Im, Pesartan & Shin Regressions

Now, Debt and Deficit as % of GDP reject the panel unit root for the group and also real per capita GDP. In all other cases, there is no common convergence. Partial convergence is supported for real exchange rates and Deficit as % of GDP.

For the real convergence proxy we observe that the new accession countries do converge to their mean and some of them towards three best performing EU members.

All regressions include exogenous variables individual effects and individual line trends, incorporating constant and time trends. The selection of lag parameter for all regressions was based on the Akaike criterion, with Newey-West bandwidth selection using Bartlett kernel.

6. CONCLUSIONS

In this study, we have presented an analysis of panel test among the ten accession countries, joining European Union. Panel unit root tests are considered to have grater power than the usual unit root tests. The analysis was based on nominal convergence Maastricht criteria and an aspect of real convergence, using as a proxy the real (log) per capita GDP of those countries. We have chosen not to use a benchmark country of EU or the average of the Eurozone, a common way in the literature, but what the benchmark for Maastricht criteria is, the three best performing countries of EU (France, Germany and The Netherlands).

We have included exogenous variables individual effects and individual line trends, incorporating constant and time trends to allow shocks for each country.

The empirical results support the view that the accession countries are not fully prepared to join at the moment the EMU. We have found that there is a convergence in real exchange rates either as a common convergence (Levin & Lin) or an individual convergence (Im, Pesaran & Shin), when compared to the three best performing countries. Probably this is due to the effort of these countries to realign their currency for a period before entering the ERM II and the strong Balassa-Samuelson effect. We have also found that there exists partial convergence in CPI and on Deficit as a % of GDP.

When examining the ten accession countries to their average, convergence exists on Deficit as a % of GDP, either as a common convergence or an individual one. Real exchange convergence exists only as an individual convergence. Although Debt as a % of GDP rejects the common no convergence hypothesis at 1% level, we should drop that and favor common no convergence. Im, Pesaran & Shin does not reject the null and since it demonstrates a grater power over the sample, we should trust their result.

Real convergence for the new member states is strongly supported from both methods. Real per capita GDP demonstrates a less strong movement when examined against the average of those countries.

The dataset under examination is the same used by Koukouritakis & Michelis (2002). The different methods provide same results concerning CPI, Real Exchange Rates and Deficit as % of GDP. We have ended with no convergence for Debt as % of GDP and long-term interest rates against their result of convergence. Referring to

Real (log) per Capita GDP we share the same result of partial convergence to three best performing EU countries.

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Appendix

Analytical results from regressions follow.

A New members against three best performing EU countries.

A.1 Common Unit Root Process

CPI %Δ y-o-y

Null Hypothesis: Unit root (common unit root process)
Date: 07/11/05 Time: 21:43
Sample: 1991M01 2002M12
Exogenous variables: Individual effects, individual linear trends
Automatic selection of maximum lags
Automatic selection of lags based on AIC: 0 to 12
Newey-West bandwidth selection using Bartlett kernel
Total number of observations: 1155
Cross-sections included: 10

Method	Statistic	Prob.**
Levin, Lin & Chu t*	5.26690	1.0000

** Probabilities are computed assuming asymptotic normality

Intermediate results on B_CPI

Cross section	2nd Stage Coefficient	Variance of Reg	HAC of Dep.	Lag	Max Lag	Band-width	Obs
CYPRUS	-0.58520	5.E-05	7.E-05	12	13	1.0	131
CZECH	-0.08373	3.E-05	8.E-05	12	12	5.0	95
ESTONIA	-0.04713	9.E-05	0.0084	12	12	6.0	107
HUNGARY	-0.03409	5.E-05	0.0002	12	13	6.0	131
LATVIA	-0.06106	0.0001	0.0097	10	12	8.0	109
LITHUANIA	-0.05031	0.0001	0.0047	10	12	5.0	105
MALTA	-0.13742	3.E-05	4.E-05	12	13	4.0	131
POLAND	-0.10978	0.0001	0.0004	12	13	6.0	131
SLOVAK	-0.06542	9.E-05	0.0001	12	12	1.0	95
SLOVENIA	-0.21288	0.0001	0.0009	0	12	7.0	120

	Coefficient	t-Stat	SE Reg	mu*	sig*		Obs
Pooled	-0.09230	-12.424	1.046	-0.563	0.686		1155

Nominal Exchange Rates

Null Hypothesis: Unit root (common unit root process)
Date: 07/11/05 Time: 21:44
Sample: 1991M01 2002M12
Exogenous variables: Individual effects, individual linear trends
Automatic selection of maximum lags
Automatic selection of lags based on AIC: 0 to 4
Newey-West bandwidth selection using Bartlett kernel
Total number of observations: 1320
Cross-sections included: 10

Method	Statistic	Prob.**
Levin, Lin & Chu t*	-0.95282	0.1703

** Probabilities are computed assuming asymptotic normality

Intermediate results on B_NM_EX

Cross section	2nd Stage Coefficient	Variance of Reg	HAC of Dep.	Lag	Max Lag	Band-width	Obs
CYPRUS	-0.05489	0.0447	0.0461	0	13	0.0	143
CZECH	-0.06757	0.5747	0.3216	4	12	13.0	115
ESTONIA	-0.07566	0.0586	0.0554	0	12	4.0	126
HUNGARY	0.00668	9.5882	12.323	1	13	1.0	142
LATVIA	-0.05667	0.0495	0.0510	0	12	0.0	130
LITHUANIA	-0.11441	0.0884	0.1223	1	12	4.0	130
MALTA	-0.05621	0.0448	0.0462	0	13	0.0	143
POLAND	-0.08435	0.0526	0.0529	1	13	6.0	142
SLOVAK	-0.06720	0.3959	0.6141	1	12	4.0	118
SLOVENIA	-0.19446	4.7226	6.8716	1	12	8.0	131
	Coefficient	t-Stat	SE Reg	mu*	sig*		Obs
Pooled	-0.05537	-6.764	1.019	-0.559	0.675		1320

Real Exchange Rates

Null Hypothesis: Unit root (common unit root process)
Date: 07/11/05 Time: 21:45
Sample: 1991M01 2002M12
Exogenous variables: Individual effects, individual linear trends
Automatic selection of maximum lags
Automatic selection of lags based on AIC: 0 to 10
Newey-West bandwidth selection using Bartlett kernel
Total number of observations: 1311
Cross-sections included: 10

Method	Statistic	Prob.**
Levin, Lin & Chu t*	-14.4092	0.0000

** Probabilities are computed assuming asymptotic normality

Intermediate results on B_RL_EX

Cross section	2nd Stage Coefficient	Variance of Reg	HAC of Dep.	Lag	Max Lag	Band-width	Obs
CYPRUS	-0.05337	0.0448	0.0461	0	13	0.0	143
CZECH	-0.12818	0.4745	0.2421	0	12	14.0	119
ESTONIA	-0.16638	0.5828	4.8515	0	12	7.0	126
HUNGARY	-0.16047	11.112	16.484	1	13	2.0	142
LATVIA	-0.07503	0.0537	0.0665	0	12	4.0	130
LITHUANIA	-0.11654	0.0787	0.9722	10	12	4.0	117
MALTA	-0.05456	0.0448	0.0462	0	13	0.0	143
POLAND	-0.06557	0.0563	0.0549	0	13	5.0	143
SLOVAK	-0.10408	0.3584	0.5164	2	12	3.0	117
SLOVENIA	-0.16543	11.084	2.3511	1	12	43.0	131

	Coefficient	t-Stat	SE Reg	mu*	sig*		Obs
Pooled	-0.12073	-16.898	1.016	-0.559	0.676		1311

Long term interest rates

Null Hypothesis: Unit root (common unit root process)
Date: 07/11/05 Time: 21:44
Sample: 1991M01 2002M12
Exogenous variables: Individual effects, individual linear trends
Automatic selection of maximum lags
Automatic selection of lags based on AIC: 0 to 11
Newey-West bandwidth selection using Bartlett kernel
Total number of observations: 904
Cross-sections included: 10

Method	Statistic	Prob.**
Levin, Lin & Chu t*	-0.83841	0.2009

** Probabilities are computed assuming asymptotic normality

Intermediate results on B_INT

Cross section	2nd Stage Coefficient	Variance of Reg	HAC of Dep.	Lag	Max Lag	Band-width	Obs
CYPRUS	-0.08963	6.E-06	9.E-06	3	10	4.0	65
CZECH	-0.03852	6.E-05	7.E-05	0	12	4.0	113
ESTONIA	-0.40315	0.0002	6.E-05	7	12	16.0	100
HUNGARY	-0.18195	9.E-05	2.E-05	5	10	13.0	54
LATVIA	-0.10223	0.0006	0.0003	11	12	12.0	108
LITHUANIA	-0.64536	0.0003	0.0003	0	11	1.0	83
MALTA	-0.04197	3.E-06	8.E-06	3	12	6.0	116
POLAND	-0.11575	6.E-05	8.E-05	5	12	4.0	101
SLOVAK	-0.09317	0.0007	0.0003	9	11	20.0	88
SLOVENIA	-0.18424	2.E-05	1.E-05	0	11	7.0	76

	Coefficient	t-Stat	SE Reg	mu*	sig*		Obs
Pooled	-0.07992	-6.262	1.030	-0.571	0.710		904

Debt as % of GDP

Null Hypothesis: Unit root (common unit root process)
Date: 07/11/05 Time: 23:15
Sample: 1991Q1 2002Q4
Exogenous variables: Individual effects, individual linear trends
Automatic selection of maximum lags
Automatic selection of lags based on AIC: 0 to 7
Newey-West bandwidth selection using Bartlett kernel
Total number of observations: 106
Cross-sections included: 6 (4 dropped)

Method	Statistic	Prob.**
Levin, Lin & Chu t*	0.77170	0.7799

** Probabilities are computed assuming asymptotic normality

Intermediate results on B_DEBT

Cross section	2nd Stage Coefficient	Variance of Reg	HAC of Dep.	Lag	Max Lag	Band-width	Obs
CYPRUS	-1.21076	0.0007	0.0022	4	4	0.0	20
CZECH	-0.03935	6.E-05	9.E-06	7	7	14.0	25
ESTONIA		Dropped from Test					
HUNGARY	-1.24104	4.E-05	0.0002	4	4	4.0	15
LATVIA		Dropped from Test					
LITHUANIA	-0.42729	0.0002	4.E-05	2	4	18.0	17
MALTA	-0.98286	0.0002	7.E-05	0	0	5.0	6
POLAND	-0.72947	0.0004	0.0001	0	4	6.0	23
SLOVAKIA		Dropped from Test					
SLOVENIA		Dropped from Test					

	Coefficient	t-Stat	SE Reg	mu*	sig*		Obs
Pooled	-0.47169	-4.804	1.141	-0.703	1.003		106

Deficit as % of GDP

Null Hypothesis: Unit root (common unit root process)
Date: 07/11/05 Time: 23:16
Sample: 1991Q1 2002Q4
Exogenous variables: Individual effects, individual linear trends
Automatic selection of maximum lags
Automatic selection of lags based on AIC: 0 to 7
Newey-West bandwidth selection using Bartlett kernel
Total number of observations: 194
Cross-sections included: 8 (2 dropped)

Method	Statistic	Prob.**
Levin, Lin & Chu t*	-0.76573	0.2219

** Probabilities are computed assuming asymptotic normality

Intermediate results on B_DEFICIT

Cross section	2nd Stage Coefficient	Variance of Reg	HAC of Dep.	Lag	Max Lag	Band-width	Obs
CYPRUS	-0.88723	0.0008	0.0005	7	9	10.0	34
CZECH	-2.21795	0.0008	0.0007	6	9	10.0	32
ESTONIA		Dropped from Test					
HUNGARY	-0.85268	0.0009	0.0002	0	4	11.0	22
LATVIA	-0.44378	0.0011	0.0005	4	5	3.0	22
LITHUANIA	-1.51797	0.0006	0.0010	0	2	2.0	14
MALTA		Dropped from Test					
POLAND	-1.35620	0.0009	0.0009	0	5	2.0	26
SLOVAKIA	-2.03950	0.0006	0.0003	6	9	11.0	32
SLOVENIA	-1.13906	0.0017	0.0009	2	2	9.0	12

	Coefficient	t-Stat	SE Reg	mu*	sig*		Obs
Pooled	-1.25663	-11.688	1.042	-0.703	1.003		194

Real per capita GDP

Null Hypothesis: Unit root (common unit root process)
Date: 07/11/05 Time 23:17:54
Sample: 1991Q1 2002Q4
Exogenous variables: Individual effects, individual linear trends
Automatic selection of maximum lags
Automatic selection of lags based on AIC: 0 to 6
Newey-West bandwidth selection using Bartlett kernel
Total number of observations: 174
Cross-sections included: 10

Method	Statistic	Prob.**
Levin, Lin & Chu t*	6.61682	1.0000

** Probabilities are computed assuming asympotic normality

Intermediate results on D(B_GDP)

Cross section	2nd Stage Coefficient	Variance of Reg	HAC of Dep.	Lag	Max Lag	Band-width	Obs
CYPRUS	-3.36428	22132.	12107.	2	6	9.0	27
CZECH	-2.32891	9191.0	3266.6	2	4	8.0	19
ESTONIA	-1.70811	314.89	2690.0	4	4	0.0	17
HUNGARY	-2.50188	191.94	533.48	2	2	2.0	11
LATVIA	-3.11822	255.52	1374.7	6	6	5.0	23
LITHUANIA	-1.13274	445.96	568.68	4	4	11.0	17
MALTA	-1.42173	27552.	29528.	0	1	2.0	9
POLAND	-4.09541	307.65	373.45	2	2	9.0	11
SLOVAKIA	-1.18277	600.86	686.76	3	4	9.0	18
SLOVENIA	-1.66563	1285.5	930.29	3	5	10.0	22

	Coefficient	t-Stat	SE Reg	mu*	sig*		Obs
Pooled	-2.28554	-14.159	1.116	-0.703	1.003		174

A.2 Individual Unit Root Process

CPI %Δ y-o-y

Null Hypothesis: Unit root (individual unit root process)
Date: 07/11/05 Time: 21:49
Sample: 1991M01 2002M12
Exogenous variables: Individual effects, individual linear trends
Automatic selection of maximum lags
Automatic selection of lags based on AIC: 0 to 12
Total number of observations: 1155
Cross-sections included: 10

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	-6.28833	0.0000

** Probabilities are computed assuming asympotic normality

Intermediate ADF test results

Cross section	t-Stat	Prob.	E(t)	E(Var)	Lag	Max Lag	Obs
CYPRUS	-4.3340	0.0038	-2.088	0.670	12	13	131
CZECH	-1.8330	0.6809	-2.081	0.680	12	12	95
ESTONIA	-2.8326	0.1891	-2.088	0.670	12	12	107
HUNGARY	-1.7406	0.7275	-2.088	0.670	12	13	131
LATVIA	-2.6018	0.2805	-2.088	0.670	10	12	109
LITHUANIA	-2.8686	0.1770	-2.088	0.670	10	12	105
MALTA	-2.4631	0.3459	-2.088	0.670	12	13	131
POLAND	-2.8364	0.1871	-2.088	0.670	12	13	131
SLOVAK	-1.5398	0.8088	-2.081	0.680	12	12	95
SLOVENIA	-14.117	0.0000	-2.177	0.597	0	12	120
Average	-3.7167		-2.096	0.665			

Nominal Exchange Rates

Null Hypothesis: Unit root (individual unit root process)
Date: 07/11/05 Time: 21:50
Sample: 1991M01 2002M12
Exogenous variables: Individual effects, individual linear trends
Automatic selection of maximum lags
Automatic selection of lags based on AIC: 0 to 4
Total number of observations: 1320
Cross-sections included: 10

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	-1.41673	0.0783

** Probabilities are computed assuming asympotic normality

Intermediate ADF test results

Cross section	t-Stat	Prob.	E(t)	E(Var)	Lag	Max Lag	Obs
CYPRUS	-2.0708	0.5572	-2.177	0.597	0	13	143
CZECH	-1.5415	0.8095	-2.135	0.629	4	12	115
ESTONIA	-2.5277	0.3145	-2.177	0.597	0	12	126
HUNGARY	0.4767	0.9992	-2.179	0.605	1	13	142
LATVIA	-1.9570	0.6188	-2.177	0.597	0	12	130
LITHUANIA	-3.8041	0.0193	-2.179	0.605	1	12	130
MALTA	-2.0876	0.5479	-2.177	0.597	0	13	143
POLAND	-2.5416	0.3079	-2.179	0.605	1	13	142
SLOVAK	-2.1744	0.4990	-2.179	0.605	1	12	118
SLOVENIA	-6.9925	0.0000	-2.179	0.605	1	12	131
Average	-2.5220		-2.174	0.604			

Real Exchange Rates

Null Hypothesis: Unit root (individual unit root process)
Date: 07/11/05 Time: 21:51
Sample: 1991M01 2002M12
Exogenous variables: Individual effects, individual linear trends
Automatic selection of maximum lags
Automatic selection of lags based on AIC: 0 to 10
Total number of observations: 1311
Cross-sections included: 10

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	-8.90214	0.0000

** Probabilities are computed assuming asympotic normality

Intermediate ADF test results

Cross section	t-Stat	Prob.	E(t)	E(Var)	Lag	Max Lag	Obs
CYPRUS	-2.0646	0.5606	-2.177	0.597	0	13	143
CZECH	-2.9973	0.1374	-2.177	0.597	0	12	119
ESTONIA	-15.071	0.0000	-2.177	0.597	0	12	126
HUNGARY	-4.1276	0.0073	-2.179	0.605	1	13	142
LATVIA	-3.8908	0.0151	-2.177	0.597	0	12	130
LITHUANIA	-5.3054	0.0001	-2.088	0.670	10	12	117
MALTA	-2.0741	0.5554	-2.177	0.597	0	13	143
POLAND	-2.4599	0.3475	-2.177	0.597	0	13	143
SLOVAK	-2.8111	0.1964	-2.158	0.613	2	12	117
SLOVENIA	-2.8061	0.1978	-2.179	0.605	1	12	131
Average	-4.3608		-2.167	0.607			

Long term interest rates

Null Hypothesis: Unit root (individual unit root process)
Date: 07/11/05 Time: 21:50
Sample: 1991M01 2002M12
Exogenous variables: Individual effects, individual linear trends
Automatic selection of maximum lags
Automatic selection of lags based on AIC: 0 to 11
Total number of observations: 904
Cross-sections included: 10

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	-1.90518	0.0284

** Probabilities are computed assuming asympotic normality

Intermediate ADF test results

Cross section	t-Stat	Prob.	E(t)	E(Var)	Lag	Max Lag	Obs
CYPRUS	-2.1118	0.5295	-2.144	0.662	3	10	65
CZECH	-1.4751	0.8325	-2.177	0.597	0	12	113
ESTONIA	-3.8526	0.0177	-2.112	0.661	7	12	100
HUNGARY	-1.6488	0.7600	-2.093	0.720	5	10	54
LATVIA	-1.3081	0.8807	-2.088	0.670	11	12	108
LITHUANIA	-6.5208	0.0000	-2.175	0.604	0	11	83
MALTA	-2.1012	0.5394	-2.158	0.625	3	12	116
POLAND	-2.8323	0.1894	-2.135	0.638	5	12	101
SLOVAK	-1.7420	0.7241	-2.071	0.693	9	11	88
SLOVENIA	-2.5840	0.2887	-2.175	0.607	0	11	76
Average	-2.6177		-2.133	0.648			

Debt as % of GDP

Null Hypothesis: Unit root (individual unit root process)
Date: 07/11/05 Time: 23:18
Sample: 1991Q1 2002Q4
Exogenous variables: Individual effects, individual linear trends
Automatic selection of maximum lags
Automatic selection of lags based on AIC: 0 to 7
Total number of observations: 106
Cross-sections included: 6 (4 dropped)

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	-0.13960	0.4445

** Probabilities are computed assuming asympotic normality

Intermediate ADF test results

Cross section	t-Stat	Prob.	E(t)	E(Var)	Lag	Max Lag	Obs
CYPRUS	-1.9241	0.6049	-1.911	1.052	4	4	20
CZECH	-0.2545	0.9875	-1.851	1.145	7	7	25
ESTONIA		Dropped from Test					
HUNGARY	-4.2735	0.0214	-1.823	1.332	4	4	15
LATVIA		Dropped from Test					
LITHUANIA	-0.9449	0.9256	-2.018	0.974	2	4	17
MALTA	-2.0128	0.4850	-2.404	11.314	0	0	6
POLAND	-3.3323	0.0860	-2.167	0.733	0	4	23
SLOVAKIA		Dropped from Test					
SLOVENIA		Dropped from Test					
Average	-2.1237		-2.029	2.758			

Deficit as % of GDP

Null Hypothesis: Unit root (individual unit root process)
Date: 07/11/05 Time: 23:18
Sample: 1991Q1 2002Q4
Exogenous variables: Individual effects, individual linear trends
Automatic selection of maximum lags
Automatic selection of lags based on AIC: 0 to 7
Total number of observations: 194
Cross-sections included: 8 (2 dropped)

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	-4.19567	0.0000

** Probabilities are computed assuming asympotic normality

Intermediate ADF test results

Cross section	t-Stat	Prob.	E(t)	E(Var)	Lag	Max Lag	Obs
CYPRUS	-1.7232	0.7188	-1.942	0.954	7	9	34
CZECH	-2.6384	0.2671	-1.937	0.922	6	9	32
ESTONIA		Dropped from Test					
HUNGARY	-3.7908	0.0369	-2.168	0.743	0	4	22
LATVIA	-0.8913	0.9392	-1.934	0.996	4	5	22
LITHUANIA	-6.6285	0.0006	-2.167	0.922	0	2	14
MALTA		Dropped from Test					
POLAND	-6.3431	0.0001	-2.168	0.708	0	5	26
SLOVAKIA	-4.5944	0.0046	-1.937	0.922	6	9	32
SLOVENIA	-1.1252	0.8786	-1.948	1.391	2	2	12
Average	-3.4669		-2.025	0.945			

Real per capita GDP

Null Hypothesis: Unit root (individual unit root process)
Date: 07/11/05 Time: 23:19
Sample: 1991Q1 2002Q4
Exogenous variables: Individual effects, individual linear trends
Automatic selection of maximum lags
Automatic selection of lags based on AIC: 0 to 6
Total number of observations: 174
Cross-sections included: 10

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	-5.19933	0.0000

** Probabilities are computed assuming asympotic normality

Intermediate ADF test results

Cross section	t-Stat	Prob.	E(t)	E(Var)	Lag	Max Lag	Obs
CYPRUS	-8.0471	0.0000	-2.082	0.780	2	6	27
CZECH	-4.7258	0.0069	-2.037	0.913	2	4	19
ESTONIA	-2.5480	0.3043	-1.858	1.220	4	4	17
HUNGARY	-3.7914	0.0609	-1.931	1.509	2	2	11
LATVIA	-4.5322	0.0078	-1.832	1.130	6	6	23
LITHUANIA	-1.4232	0.8151	-1.858	1.220	4	4	17
MALTA	-3.8934	0.0644	-2.225	3.677	0	1	9
POLAND	-6.3626	0.0022	-1.931	1.509	2	2	11
SLOVAKIA	-1.5796	0.7603	-2.010	1.075	3	4	18
SLOVENIA	-2.3391	0.3979	-2.045	0.934	3	5	22
Average	-3.9242		-1.981	1.397			

B. New members against their average

B.1 Common Unit Root Process

CPI %Δ y-o-y

Null Hypothesis: Unit root (common unit root process)
Date: 07/11/05 Time: 21:37
Sample: 1991M01 2002M12
Exogenous variables: Individual effects, individual linear trends
Automatic selection of maximum lags
Automatic selection of lags based on AIC: 0 to 12
Newey-West bandwidth selection using Bartlett kernel
Total number of observations: 1197
Cross-sections included: 10

Method	Statistic	Prob.**
Levin, Lin & Chu t*	24.8125	1.0000

** Probabilities are computed assuming asympotic normality

Intermediate results on T_CPI

Cross section	2nd Stage Coefficient	Variance of Reg	HAC of Dep.	Lag	Max Lag	Band-width	Obs
CYPRUS	-0.15153	0.0017	0.0016	4	13	5.0	139
CZECH	-0.04103	0.0001	0.0001	0	12	10.0	107
ESTONIA	-0.03557	0.0001	0.0065	12	12	7.0	107
HUNGARY	-0.09603	0.0017	0.0014	4	13	4.0	139
LATVIA	-0.08627	7.E-05	0.0069	11	12	8.0	108
LITHUANIA	-0.06502	0.0001	0.0035	10	12	9.0	105
MALTA	-0.15354	0.0016	0.0014	4	13	4.0	139
POLAND	-0.12494	0.0019	0.0017	4	13	5.0	139
SLOVAK	-0.04948	0.0001	0.0001	1	12	8.0	106
SLOVENIA	-0.01187	6.E-05	0.0033	12	12	7.0	108

	Coefficient	t-Stat	SE Reg	mu*	sig*		Obs
Pooled	-0.06921	-6.982	1.006	-0.562	0.683		1197

Nominal Exchange Rates

Null Hypothesis: Unit root (common unit root process)
Date: 07/11/05 Time: 21:38
Sample: 1991M01 2002M12
Exogenous variables: Individual effects, individual linear trends
Automatic selection of maximum lags
Automatic selection of lags based on AIC: 0 to 7
Newey-West bandwidth selection using Bartlett kernel
Total number of observations: 1291
Cross-sections included: 10

Method	Statistic	Prob.**
Levin, Lin & Chu t*	4.19047	1.0000

** Probabilities are computed assuming asympotic normality

Intermediate results on T_NM_EX

Cross section	2nd Stage Coefficient	Variance of Reg	HAC of Dep.	Lag	Max Lag	Band-width	Obs
CYPRUS	-0.00514	1.0342	0.2173	7	13	16.0	136
CZECH	-0.11379	0.3398	0.3428	4	12	6.0	115
ESTONIA	0.01083	0.1456	0.0625	5	12	19.0	121
HUNGARY	0.00546	8.4399	11.151	1	13	2.0	142
LATVIA	0.02309	0.1608	0.1178	5	12	11.0	125
LITHUANIA	0.00447	0.2164	0.2342	0	12	5.0	131
MALTA	-0.00485	1.0345	0.2186	7	13	16.0	136
POLAND	-0.00995	1.0092	0.2146	7	13	15.0	136
SLOVAK	-0.02525	0.3119	0.3672	1	12	4.0	118
SLOVENIA	-0.18714	4.6247	8.2642	1	12	1.0	131

	Coefficient	t-Stat	SE Reg	mu*	sig*		Obs
Pooled	-0.00874	-1.259	1.020	-0.560	0.677		1291

Real Exchange Rates

Null Hypothesis: Unit root (common unit root process)
Date: 07/11/05 Time: 21:39
Sample: 1991M01 2002M12
Exogenous variables: Individual effects, individual linear trends
Automatic selection of maximum lags
Automatic selection of lags based on AIC: 0 to 13
Newey-West bandwidth selection using Bartlett kernel
Total number of observations: 1252
Cross-sections included: 10

Method	Statistic	Prob.**
Levin, Lin & Chu t*	0.89712	0.8152

** Probabilities are computed assuming asympotic normality

Intermediate results on T_RL_EX

Cross section	2nd Stage Coefficient	Variance of Reg	HAC of Dep.	Lag	Max Lag	Band-width	Obs
CYPRUS	-0.15715	0.1188	5.4028	13	13	5.0	130
CZECH	-0.31077	0.2612	0.2070	7	12	11.0	112
ESTONIA	-0.18717	0.8120	3.0694	0	12	5.0	126
HUNGARY	-0.07449	9.5035	14.255	9	13	4.0	134
LATVIA	-0.35350	0.1326	0.4931	6	12	3.0	124
LITHUANIA	-0.21372	0.1065	0.7446	10	12	2.0	117
MALTA	-0.15639	0.1171	5.4042	13	13	5.0	130
POLAND	-0.16140	0.0996	5.3013	13	13	5.0	130
SLOVAK	-0.18115	0.2792	0.2221	1	12	11.0	118
SLOVENIA	-0.30355	11.566	2.0410	1	12	46.0	131

	Coefficient	t-Stat	SE Reg	mu*	sig*		Obs
Pooled	-0.18729	-19.515	1.014	-0.561	0.680		1252

Long term interest rates

Null Hypothesis: Unit root (common unit root process)
Date: 07/11/05 Time: 21:37
Sample: 1991M01 2002M12
Exogenous variables: Individual effects, individual linear trends
Automatic selection of maximum lags
Automatic selection of lags based on AIC: 0 to 12
Newey-West bandwidth selection using Bartlett kernel
Total number of observations: 895
Cross-sections included: 10

Method	Statistic	Prob.**
Levin, Lin & Chu t*	0.55296	0.7099

** Probabilities are computed assuming asympotic normality

Intermediate results on T_INT

Cross section	2nd Stage Coefficient	Variance of Reg	HAC of Dep.	Lag	Max Lag	Band-width	Obs
CYPRUS	-0.15205	3.E-05	1.E-05	0	10	26.0	68
CZECH	-0.08596	7.E-05	9.E-05	12	12	27.0	101
ESTONIA	-0.34583	0.0002	6.E-06	2	12	103.0	105
HUNGARY	-0.33700	7.E-05	9.E-06	0	10	13.0	59
LATVIA	-0.05456	0.0005	0.0002	11	12	16.0	108
LITHUANIA	-0.35472	0.0002	0.0002	3	11	2.0	80
MALTA	-0.09573	4.E-05	0.0001	12	12	3.0	107
POLAND	-0.14149	9.E-05	8.E-05	5	12	2.0	101
SLOVAK	-0.06558	0.0006	0.0002	7	11	18.0	90
SLOVENIA	-0.17268	4.E-05	1.E-05	0	11	19.0	76

	Coefficient	t-Stat	SE Reg	mu*	sig*		Obs
Pooled	-0.12949	-6.791	1.010	-0.572	0.712		895

Debt as % of GDP

Null Hypothesis: Unit root (common unit root process)
Date: 07/11/05 Time: 21:37
Sample: 1991M01 2002M12
Exogenous variables: Individual effects, individual linear trends
Automatic selection of maximum lags
Automatic selection of lags based on AIC: 0 to 12
Newey-West bandwidth selection using Bartlett kernel
Total number of observations: 895
Cross-sections included: 10

Method	Statistic	Prob.**
Levin, Lin & Chu t*	0.55296	0.7099

** Probabilities are computed assuming asympotic normality

Intermediate results on T_INT

Cross section	2nd Stage Coefficient	Variance of Reg	HAC of Dep.	Lag	Max Lag	Band-width	Obs
CYPRUS	-0.15205	3.E-05	1.E-05	0	10	26.0	68
CZECH	-0.08596	7.E-05	9.E-05	12	12	27.0	101
ESTONIA	-0.34583	0.0002	6.E-06	2	12	103.0	105
HUNGARY	-0.33700	7.E-05	9.E-06	0	10	13.0	59
LATVIA	-0.05456	0.0005	0.0002	11	12	16.0	108
LITHUANIA	-0.35472	0.0002	0.0002	3	11	2.0	80
MALTA	-0.09573	4.E-05	0.0001	12	12	3.0	107
POLAND	-0.14149	9.E-05	8.E-05	5	12	2.0	101
SLOVAK	-0.06558	0.0006	0.0002	7	11	18.0	90
SLOVENIA	-0.17268	4.E-05	1.E-05	0	11	19.0	76

	Coefficient	t-Stat	SE Reg	mu*	sig*		Obs
Pooled	-0.12949	-6.791	1.010	-0.572	0.712		895

Deficit as % of GDP

Null Hypothesis: Unit root (common unit root process)
Date: 07/11/05 Time: 21:46
Sample: 1991Q1 2002Q4
Exogenous variables: Individual effects, individual linear trends
Automatic selection of maximum lags
Automatic selection of lags based on AIC: 0 to 5
Newey-West bandwidth selection using Bartlett kernel
Total number of observations: 204
Cross-sections included: 8 (2 dropped)

Method	Statistic	Prob.**
Levin, Lin & Chu t*	-8.65896	0.0000

** Probabilities are computed assuming asympotic normality

Intermediate results on T_DEFICIT

Cross section	2nd Stage Coefficient	Variance of Reg	HAC of Dep.	Lag	Max Lag	Band-width	Obs
CYPRUS	-0.40156	0.0003	0.0001	3	8	10.0	32
CZECH	-1.47109	0.0004	0.0002	0	9	14.0	38
ESTONIA		Dropped from Test					
HUNGARY	-1.05382	0.0007	0.0003	0	4	6.0	22
LATVIA	-0.74786	0.0003	0.0003	5	5	1.0	21
LITHUANIA	-1.09460	0.0005	0.0001	0	2	9.0	14
MALTA		Dropped from Test					
POLAND	-1.06038	0.0012	0.0001	0	5	16.0	26
SLOVAKIA	-0.90287	0.0006	9.E-05	0	9	22.0	38
SLOVENIA	-2.44217	0.0011	0.0006	1	2	9.0	13

	Coefficient	t-Stat	SE Reg	mu*	sig*		Obs
Pooled	-1.13121	-14.684	1.068	-0.703	1.003		204

Real per capita GDP

Null Hypothesis: Unit root (common unit root process)
Date: 07/11/05 Time: 21:46
Sample: 1991Q1 2002Q4
Exogenous variables: Individual effects, individual linear trends
Automatic selection of maximum lags
Automatic selection of lags based on AIC: 0 to 6
Newey-West bandwidth selection using Bartlett kernel
Total number of observations: 181
Cross-sections included: 10

Method	Statistic	Prob.**
Levin, Lin & Chu t*	-6.13108	0.0000

** Probabilities are computed assuming asympotic normality

Intermediate results on D(T_GDP)

Cross section	2nd Stage Coefficient	Variance of Reg	HAC of Dep.	Lag	Max Lag	Band-width	Obs
CYPRUS	-4.98573	15373.	10217.	6	6	9.0	23
CZECH	-1.36762	9741.7	11371.	0	4	2.0	21
ESTONIA	-1.46445	1117.1	517.69	1	4	10.0	20
HUNGARY	-2.83835	1020.6	2709.4	2	2	1.0	11
LATVIA	-2.32509	8017.7	12730.	4	6	1.0	25
LITHUANIA	-2.40280	1171.0	884.97	4	4	15.0	17
MALTA	-1.41618	17376.	6020.0	0	1	3.0	9
POLAND	-2.30586	708.28	207.12	2	2	12.0	11
SLOVAKIA	-2.47404	1701.3	617.96	2	4	14.0	19
SLOVENIA	-1.34072	18604.	3047.0	0	5	13.0	25

	Coefficient	t-Stat	SE Reg	mu*	sig*		Obs
Pooled	-1.63401	-15.621	1.088	-0.703	1.003		181

B.2 Individual Unit Root Process

CPI %Δ y-o-y

Null Hypothesis: Unit root (individual unit root process)
Date: 07/11/05 Time: 21:40
Sample: 1991M01 2002M12
Exogenous variables: Individual effects, individual linear trends
Automatic selection of maximum lags
Automatic selection of lags based on AIC: 0 to 12
Total number of observations: 1197
Cross-sections included: 10

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	-0.38506	0.3501

** Probabilities are computed assuming asympotic normality

Intermediate ADF test results

Cross section	t-Stat	Prob.	E(t)	E(Var)	Lag	Max Lag	Obs
CYPRUS	-3.2672	0.0761	-2.135	0.629	4	13	139
CZECH	-1.4960	0.8252	-2.177	0.597	0	12	107
ESTONIA	-1.1104	0.9219	-2.088	0.670	12	12	107
HUNGARY	-2.5511	0.3035	-2.135	0.629	4	13	139
LATVIA	-2.3116	0.4238	-2.088	0.670	11	12	108
LITHUANIA	-3.1603	0.0982	-2.088	0.670	10	12	105
MALTA	-3.1664	0.0956	-2.135	0.629	4	13	139
POLAND	-3.1006	0.1103	-2.135	0.629	4	13	139
SLOVAK	-1.7928	0.7015	-2.179	0.605	1	12	106
SLOVENIA	-0.2656	0.9907	-2.088	0.670	12	12	108
Average	-2.2222		-2.125	0.640			

Nominal Exchange Rates

Null Hypothesis: Unit root (individual unit root process)
Date: 07/11/05 Time: 21:42
Sample: 1991M01 2002M12
Exogenous variables: Individual effects, individual linear trends
Automatic selection of maximum lags
Automatic selection of lags based on AIC: 0 to 7
Total number of observations: 1291
Cross-sections included: 10

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	5.38386	1.0000

** Probabilities are computed assuming asympotic normality

Intermediate ADF test results

Cross section	t-Stat	Prob.	E(t)	E(Var)	Lag	Max Lag	Obs
CYPRUS	-0.1321	0.9939	-2.112	0.661	7	13	136
CZECH	-2.4070	0.3741	-2.135	0.629	4	12	115
ESTONIA	0.6760	0.9996	-2.135	0.638	5	12	121
HUNGARY	0.3755	0.9988	-2.179	0.605	1	13	142
LATVIA	1.3562	1.0000	-2.135	0.638	5	12	125
LITHUANIA	0.2380	0.9981	-2.177	0.597	0	12	131
MALTA	-0.1242	0.9940	-2.112	0.661	7	13	136
POLAND	-0.2183	0.9921	-2.112	0.661	7	13	136
SLOVAK	-1.1904	0.9075	-2.179	0.605	1	12	118
SLOVENIA	-6.5154	0.0000	-2.179	0.605	1	12	131
Average	-0.7942		-2.145	0.630			

Real Exchange Rates

Null Hypothesis: Unit root (individual unit root process)
Date: 07/11/05 Time: 21:42
Sample: 1991M01 2002M12
Exogenous variables: Individual effects, individual linear trends
Automatic selection of maximum lags
Automatic selection of lags based on AIC: 0 to 13
Total number of observations: 1252
Cross-sections included: 10

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	-14.3748	0.0000

** Probabilities are computed assuming asympotic normality

Intermediate ADF test results

Cross section	t-Stat	Prob.	E(t)	E(Var)	Lag	Max Lag	Obs
CYPRUS	-5.7419	0.0000	-2.088	0.670	13	13	130
CZECH	-3.9617	0.0127	-2.112	0.661	7	12	112
ESTONIA	-10.737	0.0000	-2.177	0.597	0	12	126
HUNGARY	-1.5883	0.7927	-2.088	0.670	9	13	134
LATVIA	-8.6871	0.0000	-2.113	0.650	6	12	124
LITHUANIA	-6.9950	0.0000	-2.088	0.670	10	12	117
MALTA	-5.7755	0.0000	-2.088	0.670	13	13	130
POLAND	-5.9062	0.0000	-2.088	0.670	13	13	130
SLOVAK	-3.5248	0.0413	-2.179	0.605	1	12	118
SLOVENIA	-4.8405	0.0007	-2.179	0.605	1	12	131
Average	-5.7758		-2.120	0.647			

Long term interest rates

Null Hypothesis: Unit root (individual unit root process)
Date: 07/11/05 Time: 21:41
Sample: 1991M01 2002M12
Exogenous variables: Individual effects, individual linear trends
Automatic selection of maximum lags
Automatic selection of lags based on AIC: 0 to 12
Total number of observations: 895
Cross-sections included: 10

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	-0.69556	0.2434

** Probabilities are computed assuming asympotic normality

Intermediate ADF test results

Cross section	t-Stat	Prob.	E(t)	E(Var)	Lag	Max Lag	Obs
CYPRUS	-2.2805	0.4385	-2.174	0.612	0	10	68
CZECH	-2.1972	0.4857	-2.088	0.670	12	12	101
ESTONIA	-3.4086	0.0557	-2.158	0.613	2	12	105
HUNGARY	-3.4152	0.0591	-2.174	0.622	0	10	59
LATVIA	-0.7390	0.9671	-2.088	0.670	11	12	108
LITHUANIA	-3.0099	0.1361	-2.150	0.642	3	11	80
MALTA	-1.4931	0.8261	-2.088	0.670	12	12	107
POLAND	-2.7901	0.2044	-2.135	0.638	5	12	101
SLOVAK	-1.1891	0.9064	-2.101	0.678	7	11	90
SLOVENIA	-2.5708	0.2946	-2.175	0.607	0	11	76
Average	-2.3094		-2.133	0.642			

Debt as % of GDP

Null Hypothesis: Unit root (individual unit root process)
Date: 07/11/05 Time: 21:47
Sample: 1991Q1 2002Q4
Exogenous variables: Individual effects, individual linear trends
Automatic selection of maximum lags
Automatic selection of lags based on AIC: 0 to 4
Total number of observations: 108
Cross-sections included: 6 (4 dropped)

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	-0.87655	0.1904

** Probabilities are computed assuming asympotic normality

Intermediate ADF test results

Cross section	t-Stat	Prob.	E(t)	E(Var)	Lag	Max Lag	Obs
CYPRUS	-5.4261	0.0010	-2.167	0.723	0	4	24
CZECH	-3.0829	0.1355	-2.039	0.959	3	4	21
ESTONIA		Dropped from Test					
HUNGARY	-2.4239	0.3570	-2.168	0.784	0	4	19
LATVIA		Dropped from Test					
LITHUANIA	-1.1227	0.8893	-1.823	1.332	4	4	15
MALTA	-1.8030	0.5949	-2.404	11.314	0	0	6
POLAND	-2.3982	0.3706	-2.167	0.733	0	4	23
SLOVAKIA		Dropped from Test					
SLOVENIA		Dropped from Test					
Average	-2.7095		-2.128	2.641			

Deficit as % of GDP

Null Hypothesis: Unit root (individual unit root process)
Date: 07/11/05 Time: 21:48
Sample: 1991Q1 2002Q4
Exogenous variables: Individual effects, individual linear trends
Automatic selection of maximum lags
Automatic selection of lags based on AIC: 0 to 5
Total number of observations: 204
Cross-sections included: 8 (2 dropped)

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	-8.04408	0.0000

** Probabilities are computed assuming asympotic normality

Intermediate ADF test results

Cross section	t-Stat	Prob.	E(t)	E(Var)	Lag	Max Lag	Obs
CYPRUS	-1.2173	0.8897	-2.096	0.793	3	8	32
CZECH	-10.484	0.0000	-2.173	0.662	0	9	38
ESTONIA		Dropped from Test					
HUNGARY	-4.3685	0.0116	-2.168	0.743	0	4	22
LATVIA	-2.0802	0.5265	-1.901	1.130	5	5	21
LITHUANIA	-3.2932	0.1078	-2.167	0.922	0	2	14
MALTA		Dropped from Test					
POLAND	-5.3021	0.0012	-2.168	0.708	0	5	26
SLOVAKIA	-5.9228	0.0001	-2.173	0.662	0	9	38
SLOVENIA	-5.3039	0.0055	-2.171	1.166	1	2	13
Average	-4.7465		-2.127	0.848			

Real per capita GDP

Null Hypothesis: Unit root (individual unit root process)
Date: 07/11/05 Time: 21:48
Sample: 1991Q1 2002Q4
Exogenous variables: Individual effects, individual linear trends
Automatic selection of maximum lags
Automatic selection of lags based on AIC: 0 to 6
Total number of observations: 181
Cross-sections included: 10

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	-7.28813	0.0000

** Probabilities are computed assuming asympotic normality

Intermediate ADF test results

Cross section	t-Stat	Prob.	E(t)	E(Var)	Lag	Max Lag	Obs
CYPRUS	-4.0957	0.0195	-1.832	1.130	6	6	23
CZECH	-6.4767	0.0002	-2.168	0.753	0	4	21
ESTONIA	-5.9672	0.0005	-2.172	0.845	1	4	20
HUNGARY	-4.3539	0.0283	-1.931	1.509	2	2	11
LATVIA	-4.7253	0.0046	-1.968	0.913	4	6	25
LITHUANIA	-2.3716	0.3789	-1.858	1.220	4	4	17
MALTA	-3.8246	0.0700	-2.225	3.677	0	1	9
POLAND	-3.3986	0.1032	-1.931	1.509	2	2	11
SLOVAKIA	-4.8404	0.0055	-2.037	0.913	2	4	19
SLOVENIA	-6.6969	0.0001	-2.167	0.713	0	5	25
Average	-4.6751		-2.029	1.318			

Table 1
Maastricht convergence criteria: New EU Member States and candidate countries (precondition to enter EMU)

	Inflation	Government budgetary position		Exchange rate regime	Exchange rates	Long-term interest rates
	CPI (HICP)[a] %-change 2003	Deficit (%) of GDP 2003	Debt (gross, %) of GDP 2003	2003[b]	%-change vis à vis €: 2003/2001	Lending rate in % 2003
Reference value EU-25	1.4	−3.0	60.0	–	No devaluation	7.0
Cyprus	4.3	−6.3	72.7	FB (€)	DP	4.6
Czech Republic	0.0	−12.9	37.6	MF (€)	AP	4.1
Estonia	1.6	+2.6	5.7	CB (€)	–	6.4
Hungary	4.6	−5.9	59.0	FB (€)	AP	6.5
Latvia	2.5	−1.8	15.6	FP (SDR)	DP	5.1
Lithuania	−0.9	−1.7	21.9	CB (USD/€)	AP	5.1
Malta	1.3	−9.7	72.0	PB	DP	5.8
Poland	0.7	−4.1	45.4	FF	DP	5.9
Slovakia	8.5	−3.6	42.8	MF	AP	4.9
Slovenia	5.9	−1.8	27.1	MF	DP	5.5
New EU members	2.3	−5.0	42.4	–	–	5.0
Bulgaria	2.0	−0.0	50.8	CB (€)	–	9.4
Romania	15.3	−2.7	21.6	MF	DP	28.9
Turkey	45.0	−8.0	89.1	FF	DP	92.0
Candidate countries (CC-13)	2.8	−5.6	55.4	–	–	6.5
Euro area	2.1	−2.7	70.4	–	–	4.1
EU-15	2.0	−2.6	64.0	–	–	4.2
EU-25	2.2	−2.7	63.0	–	–	4.5

Sources: European Commission (2003e); EBRD (2003); Eurostat (2004); AMECO data base of the European Commission.

[a] HICP, harmonized index of consumer prices.

[b] CB, Currency Board (Latvia repegged from USD to the Euro in February 2002); FB, floating with bands (±15%); FF, free float; FP, fixed peg; MF, managed float (Slovenia, exchange rates within crawling bands); PB, pegged to a basket (Malta: 70% Euro, USD, Pound Sterling); The Estonian Kroon, the Lithuanian Litas and the Slovenian tolar have joined the ERM II on June 28, 2004.

[c] DP (depreciation) or AP (appreciation) against the Euro.