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Trends in relative GDP per capita

Paper submitted by ECE Secretariat*

This analysis of trends is based on a projector of relative GDP per capita that is used to extrapolate the results of the 1996 ECP round forwards to 1998 and backwards to 1990. The results of course depend on the quality of the projector series. The projectors have the advantage of being based on a relatively consistent methodology over the years as compared to the ECP, which has undergone substantial methodological changes from one round to the next. On the other hand much of the estimation of projectors is done at an aggregate level, and may be distorted by an inability to pick up shifts underneath these totals. How these characteristics balance against each other can only be answered empirically, and before presenting the trend analysis we will briefly review the consistency of the projector series with the benchmarks from the various ECP rounds.

Two main methods, the rolling benchmark method and global extrapolation were used to extrapolate the 1996 ECP benchmark year results. The rolling benchmark method updates ECP comparison results for each level of aggregation up to GDP. The global extrapolation method is used for estimating at the level of GDP only. The rolling benchmark approach is used by Eurostat to obtain new PPPs for fifteen EU and four associated countries (Switzerland, Iceland, Norway and Poland). The Eurostat approach consists of carrying out new annual price surveys on one third of the consumer basket. Basic heading parities for the other two thirds are extrapolated on the basis of detailed national price indices. For consumer products the cycle of replacement and extrapolation lasts three years and results in a complete matrix of new benchmark parities. New price data for other expenditure categories are normally collected annually.

* Abstract from the ECE publication International Comparison of GDP in Europe, 1996. Results of the European Comparison Programme.

A natural approach for estimating PPPs and real values for those countries which do not take regular price surveys for PPP purposes is the method of global extrapolation. According to this method benchmark year GDPs are extrapolated by the movement in the ratio of the implicit GDP price deflators. For example, country K's GDP-PPP for year (t+1) can be obtained by multiplying its GDP-PPP for the benchmark year (t) by the ratio of the country K's implicit deflator [$I_K(t+1)$] to the implicit deflator in the numéraire country [$I_A(t+1)$]. Updated PPPs are then used to convert nominal national GDP data for year (t+1) into a common currency to obtain volume measures for that year.

Unfortunately many Group II and Group III countries re-denominated their currencies several times during the 1990's, and this contributed to very unreliable implicit GDP deflators during this period. For Groups II and III therefore the 1996 ECP results were extrapolated and retrapolated by means of the ratio (country/Austria) of GDP per capita volume indices valued at domestic prices.

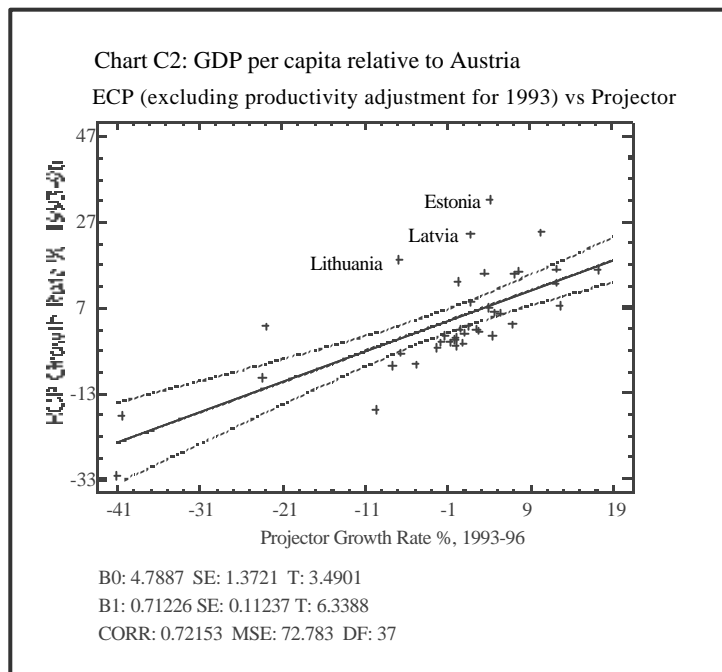
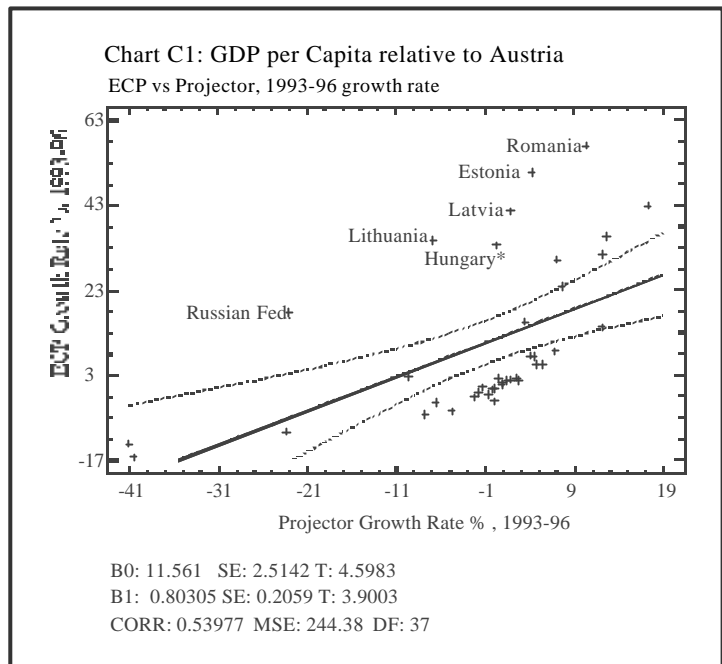
Time series for years 1990-1998 based on the above methods of extrapolation are presented in Table C1. The figures in this table are based on the 1996 ECP methodology, but take into account latest available (as of May 1999) revisions of national accounts and population data. With the exception of Turkmenistan, which recorded a significant revision in GDP for 1996, the projector series vary slightly from the ECP results in the 1996 benchmark year.

Consistency of GDP per capita projectors with the ECP results

To test the consistency of the projector series with the ECP benchmarks, it was examined how well projector growth rates were able to predict growth rates as given by the various ECP rounds. Chart C1 shows the results of a regression of the projector growth rates against the ECP growth rates over the three years from 1993 to 1996. The overall correlation (r^2) is .54 as shown opposite CORR in the bottom left part of the chart. ECP growth rates for six countries were well above the 95% confidence band shown on the Chart. These countries were all involved in a significant change in ECP methodology between the 1993 and 1996 rounds.

The most important difference between the 1996 and previous ECP rounds was the use of productivity adjustments (PA) for non-market services. Productivity adjustments were carried out for Group II countries in all ECP rounds prior to 1996. Productivity adjustments were never made within Group I under the implicit assumption that productivity was identical in these countries. The validity of this assumption has often been questioned. However, no satisfactory theoretical and methodological solution acceptable to all countries concerned has been found. For the time being, ECE wide comparisons continue without productivity adjustments.

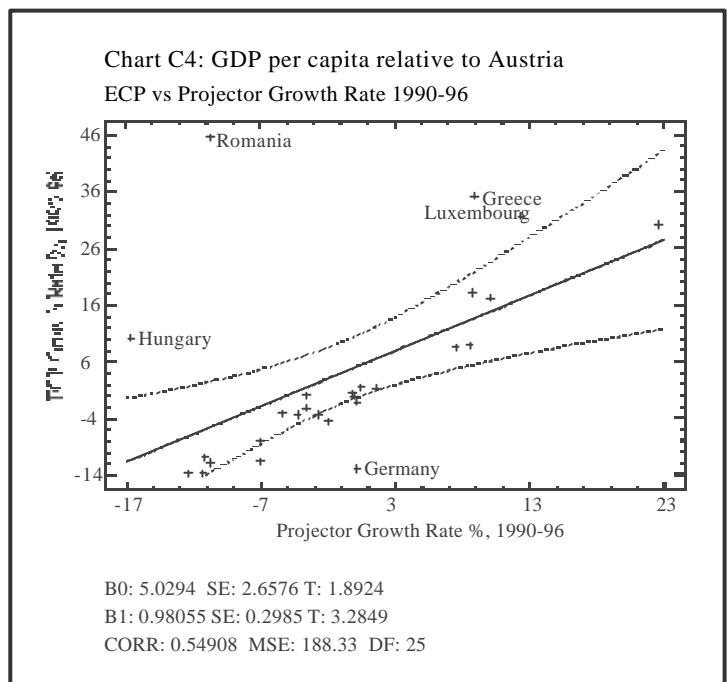
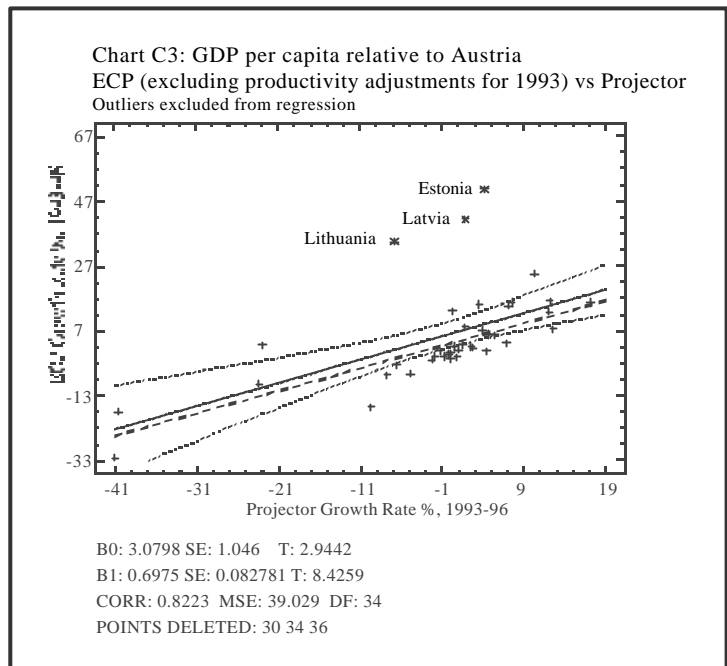
The regression in Chart C1 is therefore not a completely fair test of the projector, since the results are skewed by an inconsistency over time in the ECP series. In order to control for this the productivity adjustments were removed from the 1993 ECP results and the regression analysis was repeated. The results in Chart C2 show a higher correlation of .72, but with three countries still lying significantly outside the confidence bounds. At the time of writing this paper, the original productivity adjustments made for these countries for the 1993 round were not available, so they were estimated by an average adjustment made for the other countries. This



estimate may not have been large enough, and that is likely why these countries still show up as outliers in Chart C2. This is still an unfair test of the projector, so these countries were simply excluded from the regression and the results are shown in Chart C3. The overall correlation in Chart C3 is .82, and it indicates that the projector does a reasonably good job of predicting ECP growth rates over a three year interval.

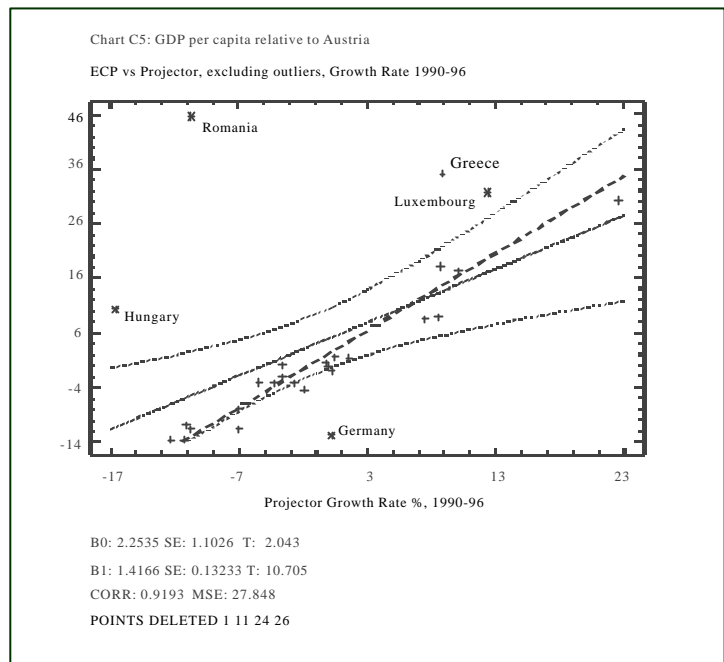
While the projector may perform reasonably well over a three year interval, there is no guarantee that it will do so over six a year interval. To test this the projector growth rates over the period 1990-1996 were regressed against ECP growth rates for the same period. The results shown in Chart C4 indicate an overall correlation of .55, with five countries lying significantly outside the confidence bounds. Hungary and Romania were subject to productivity adjustments for non-market services in 1990, but we were unable to remove these adjustments for the regression test. The results for Germany were distorted at that time by the recent re-unification of East and West Germany. Because the results for Romania and Hungary contained a methodological inconsistency in the ECP series, and because Germany had a known reason for not representing the relationship at that time, these countries were removed from the regression. That left Luxembourg and Greece as the only large outliers. Luxembourg is a small and special economy and cannot be expected to follow the same pattern as other countries so it was removed.

Since there was no obvious reason for the anomalous behaviour for Greece, it was left in the regression. The results with these countries removed are shown in Chart C5, which indicates a correlation of .92. Overall the results for the 1990-96 period indicate that the projector does a very good job of estimating ECP growth rates, and in the few cases when it does not, it is because of inconsistencies over time in the ECP estimates.



Trends in GDP per Capita Projectors

With the knowledge that the projectors do a reasonably good job of representing movement in the ECP results, let us turn to the trends evident in the projector series over the 1990-1998 period. It would be unwieldy to try to analyze and describe the behavior over time of relative GDP per capita for each of the 52 countries in the ECE region. What is needed is a method of condensing the information on trends in these 52 series into a manageable number of variables. We have employed principal components analysis¹ to do this. This analysis suggested there are four or five basic patterns in the data, and indicated which countries conform most closely to which patterns. We examined each series visually and made a few modifications to the group assignments suggested by the principal components analysis.



The basic patterns evident over the 1990-98 period are:

- Pattern 1: Persistently declining
- Pattern 2: Declining then firming
- Pattern 3: Truncated recovery
- Pattern 4: Generally rising
- Pattern 5: Rising then declining (this is the last and weakest pattern)

The patterns represent the typical behavior of countries that belong to one group or another. In order to convey a better idea of what these patterns mean, the projector series for all the countries that belong to a given group were averaged. The averaging was done after scaling all series to 1994=100. This was done because the interest was in the average shape over time of the group, and it was necessary to avoid having countries with a high relative GDP per capita to dominate the average shape. The basic patterns are shown as the solid dark lines in Charts C6 to C10. A few of the most conforming countries for each group are also shown in order to give a visual idea of how well individual series track the basic pattern.

¹ Principal components analysis reduces the number of variables in a data set by finding linear combinations of those variables that explain most of the variability in the overall data set. Such combinations are called principal components.

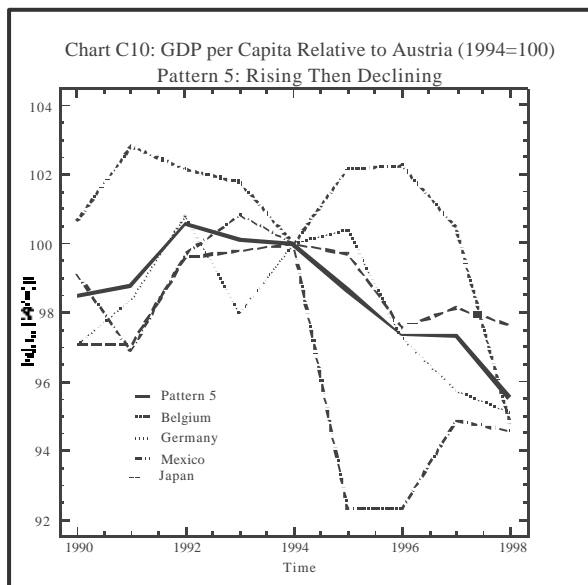
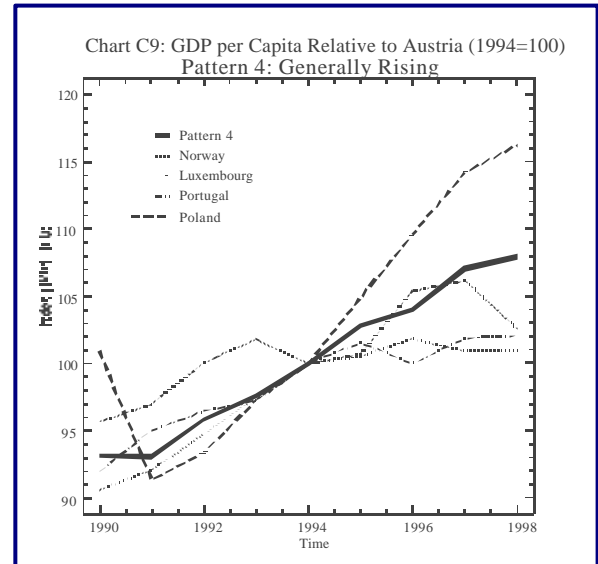
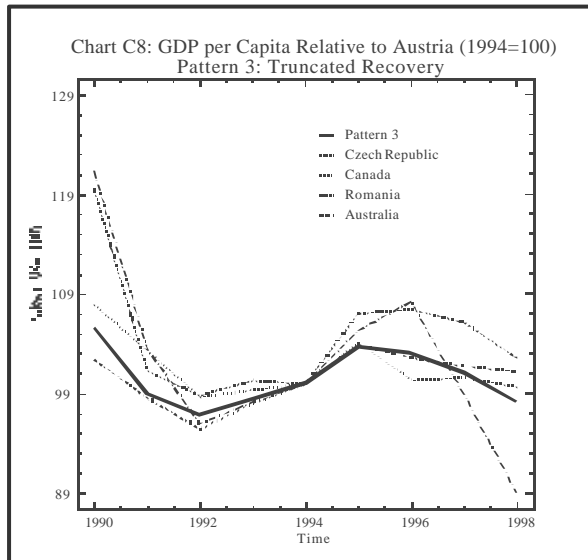
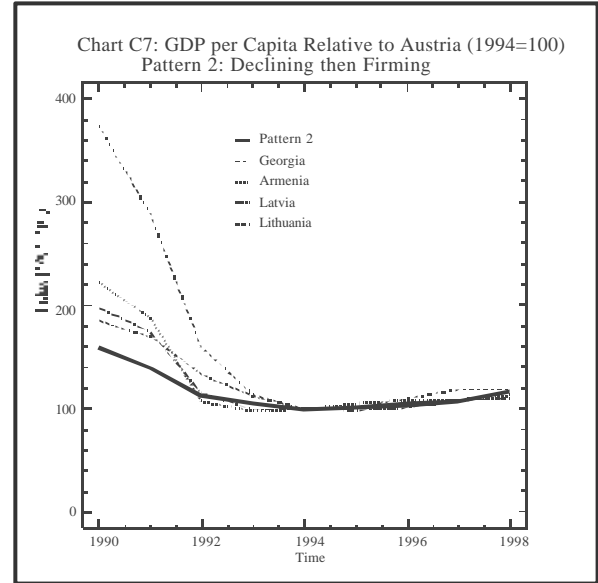
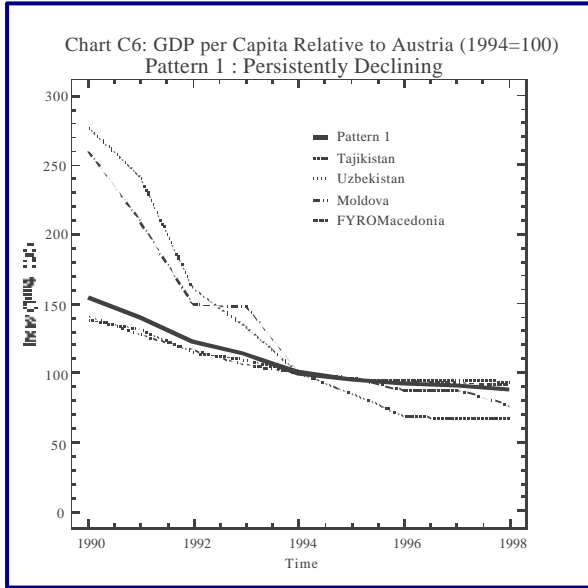


Table C2 indicates the correlation (r^2) between the projector series for each country and the pattern variable for the group to which that country has been assigned. It shows which countries belong to which groups, and the extent to which a given country's projector series tracks the pattern series for that group.

In a few cases countries with a low correlation with their associated pattern variable have been included in a group. These countries did not correlate well with any of the five groups and were assigned the best available fit. For example Slovenia, Turkey and Albania all have a low correlation with the *declining then firming* pattern variable. Yet Chart C11 shows they still follow this basic pattern, and the main reason for the low correlation is that the decline in the initial period is not as accentuated as for the pattern variable.

A similar comment is true for Denmark and Israel in the *truncated recovery* group, as shown in Chart C12.

Table C2 shows that only a handful of countries including Norway, Luxembourg, Portugal, Poland, Greece and Ireland have been persistently gaining on, or outstripping Austria in terms of GDP per capita over most of the last decade. Another group of countries including The Czech Republic, Canada, Romania, Australia, The Netherlands, New Zealand, Denmark and Israel lost ground to Austria early in the decade, began to make it up in the middle of the decade, but in the last two or three years have begun to lose ground again. A number of the countries in transition have persistently fallen behind Austria throughout most of the decade. These include pattern 1 countries such as Tajikistan, Uzbekistan, Moldova, The Former Yugoslav Republic of Macedonia, the Russian Federation and others. A number of other transition countries such as Georgia, Armenia, Latvia, Lithuania, Azerbaijan and others experienced similar decline of their relative GDP per capita early in the decade, but halted and even reversed this decline towards the middle and end of the decade.

