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USING PANEL DATA MODELS TO TEST FOR A UNIT ROOT IN INFLATION RATES

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ABSTRACT

The purpose of the paper is to test whether there is evidence of a unit root in inflation rates using a sample of 45 diverse countries. Univariate Augmented Dickey Fuller and Kwiatkowski et al. unit root tests as well as Perron and Vogelsang's test that allows for a possible structural break in the series are applied. All these procedures provide little evidence against the presence of a unit root in inflation rates. Finally, panel unit root tests with heterogeneous intercepts are carried out on the full sample and on a number of smaller panels. With the panel tests, which have better power with short time spans of data, the unit root null is strongly rejected in favor of stationary alternatives in all examined panels. This provides evidence that inflation rates generally have low persistence of shocks and thus shocks affect them only in a temporary manner.

Keywords: *Inflation rates, Unit root tests, Panel data models.*

JEL Classification: *E31, C22, C23*

1. INTRODUCTION

A branch of economic research that has gained a lot of attention over the previous decade is the search for the optimal way to characterize the properties of economic time series. Unit root testing has played an increasingly important role in this field. The behavior of more and more economic variables is analyzed using many widely accepted unit root tests.

Modeling the inflation rate as a unit root or a stationary process has important implications both for policy choices and economic analysis. Choosing the best target for monetary policy is an important topic that is closely related to the characterization of the inflation rate as a stationary or a unit root process. Targeting the inflation rate implies that inflation is stationary. Nominal income targets are sometimes criticized (Ball, 1997) for causing both output and inflation to follow non-stationary processes whether the policy takes the level of nominal income or its growth rate as its target. Rogoff (1994) finds that money supply targeting can raise the time consistent inflation rate, which results in non-stationarity of the inflation rate. Thus knowing about the stationarity vs. non-stationarity of inflation rates may influence the choice of targets followed by central banks for their monetary policy.

Whether the inflation rate is a stationary or a unit root process also has important implications for the relation between nominal and real interest rates. This is because given that the nominal interest rate contains a unit root, the real interest rate can only be stationary if inflation has a unit root and is cointegrated with the nominal interest rate. Thus, characterizing the behavior of the inflation rate helps in making conclusions about that of the real interest rate.

As a result of the important implications of the stationarity vs. non-stationarity of the inflation rate, researchers have recently showed interest in studying inflation rates using unit root tests. Culver and Papell (1997), using monthly data, find stationarity in only four of thirteen OECD countries with individual country tests. However, with a panel unit root test, they strongly reject the unit root hypothesis for the panel of all thirteen countries as well as for a number of smaller panels. Chaudhuri (2002), using individual country data for eighteen OECD countries during the flexible exchange rate period, finds evidence of nonstationarity in most cases. With a panel data model, he can strongly reject the unit root hypothesis but the evidence in favor of stationarity is less in case of countries in the European community or in case of EMS countries. Lee and Wu (2001) apply two panel root tests to reexamine the stationarity of inflation rates in thirteen OECD countries and find strong empirical evidence to support the mean reversion of inflation rates.

On the other hand, Ball and Cecchetti (1990) find that as trend inflation has risen over the past 100 years, the persistence of changes in inflation also increased. Greater persistence suggests non-stationarity of inflation rates. Parker (1989) studying the persistence of price shocks in the Pre-World War I and Post-World War II eras, finds that inflation has greater persistence in the post war period. This supports Barsky's (1987) hypothesis that inflation evolved from a white noise process in the pre-World War I years to a highly persistent, non-stationary ARIMA process in the post-1960 period. Moreover, Murthy (2002) using several unit root tests on annual inflation rate data for the United States during the 1966-99 period, shows that the series is nonstationary in levels, I(1) but stationary in first-differences, I(0), at the 5 percent level of significance.

The purpose of this paper is to expand the previously done research by testing for a unit root in the inflation rates of a wide range of different countries (45 countries). As a benchmark, we estimate the Augmented Dickey Fuller (ADF) tests, which impose the null of non-stationarity and Kwiatkowski et al. (KPSS) tests, which impose the null of stationarity. The combined results do not give much evidence against the unit root hypothesis.

Perron (1989) introduced the idea that a time series that is stationary around a trend with a single structural change will bias standard unit root tests towards non-rejection of the unit root null. Using the procedure proposed by Perron and Vogelsang (1992) to test for a unit root allowing for a possible structural change at an unknown date, the unit root null is rejected for about a third of the 45 countries. The tests that allow for structural change therefore provide little evidence against a unit root in inflation rates.

To overcome the problem of low power of unit root tests with short time spans of data, Levin and Lin-type panel unit root tests are estimated. Using Monte Carlo Simulations, exact finite sample critical values that account for serial correlation in the disturbances are calculated. With these tests, very strong evidence against the unit root null is obtained. Finally, the question of the stationarity of inflation rates is further investigated using selected panels grouped by inflation level, income level and indebtedness. For all panels considered, evidence is consistently found in favor of stationary alternatives.

The data for this study is obtained from the International Monetary Fund's International Financial Statistics CD-ROM. The quarterly[1] inflation rate data of 45 countries is used. The countries are chosen solely on the basis of data availability. The data starts with the first quarter of 1957 and covers a period of four decades.

2. UNIT ROOT TESTS

2.1. Augmented Dickey Fuller Tests

The ADF (1979) procedure involves regressing the first difference of a variable on a constant, the variable's lagged level and k-lagged first differences. The inclusion of lagged first differences allows accounting for serial autocorrelation in the errors. The following equation is used to test for a unit root in the inflation rate, π_t:

$$\Delta\pi_t = \mu + \alpha\pi_{t-1} + \sum_{i=1}^{k} c_i \Delta\pi_{t-i} + \varepsilon_t. \qquad ...(1)$$

The null hypothesis of a unit root is rejected in favor of the alternative of level stationarity if α is significantly different from zero. The order of k is chosen using the recursive procedure[2]. Maximum k (k_{max}) is set at 12 with the significance determined at the 10% level of the asymptotic normal distribution. It is worth noting that the asymptotic distribution of α does not depend on the order of k. Since the asymptotic distribution of the t-statistic for α is non-normal, the critical values used in ADF tests are non-standard. The critical values used here are obtained from MacKinnon (1991) adjusted for the number of observations in the data.

Using the ADF test, the unit root null can be rejected for only 9 of the 45 countries: 5 countries at the 1% level; 2 countries at the 5 % level; and 2 countries at the 10% level. These results are given in Table I.

2.2. KPSS Tests for Stationarity

Kwiatkowski et al. (1992) have proposed a procedure to test the null hypothesis of stationarity against the alternative hypothesis of a unit root for univariate time series. To provide additional evidence on the stationarity vs. non-stationarity of the inflation rate, a version of the KPSS that does not allow for a trend is applied to the inflation rate data of the 45 countries.

The distribution of the KPSS test statistic is non-standard; the test is an upper tail test and the critical values are provided in Kwiatkowski et al. (1992) via Monte Carlo simulation. The results of the KPSS test are reported in Table I. With the KPSS, the null of stationarity can be rejected for 33 out of 45 countries: 13 countries at the 1% level, 9 countries at the 5% level and 11 countries at the 10% level.

Combining the results from both the ADF and KPSS tests gives evidence for a unit root in 28 out of 45 countries (both tests agree on this result). Evidence for stationarity is found in four countries. The combined results do not yield a conclusive result in the remaining 13 countries. Thus, the results of the ADF and the KPSS tests do not give much evidence against the unit root hypothesis.

Table I
Augmented Dickey Fuller and KPSS Tests

Country	*ADF Test*			*KPSS Test*
	μ	α	t_α	*KPSS Statistic*
Australia	0.23	-0.03	-1.69	0.5**
Austria	0.32	-0.08	-2.17	0.28
Argentina	107.06	-0.31	-5.27***	0.33
Belgium	0.18	-0.04	-2.00	0.32
Bolivia	108.37	-0.3	-5.20***	0.18
Canada	0.11	-0.02	-1.34	0.43*
Colombia	0.93	-0.05	-1.55	1.11***
Cyprus	1.44	-0.29	-2.21	0.50**
Denmark	0.33	-0.05	-1.53	0.38*
Dominican Rep.	0.9	-0.07	-2.20	0.84***
Ecuador	0.56	-0.02	-1.44	1.34***
Egypt	0.61	-0.05	-1.63	1.31***
Elsalvador	0.32	-0.02	-1.29	1.37***
Finland	0.29	-0.04	-2.04	0.28
France	0.08	-0.01	-0.96	0.3
Germany	0.2	-0.06	-2.27	0.21
Greece	0.38	-0.03	-1.50	1.21***
Haiti	1.07	-0.09	-1.58	0.75***
Honduras	0.34	-0.02	-0.67	1.08***
India	1.14	-0.14	-3.17**	0.23
Ireland	0.3	-0.04	-1.57	0.35*
Israel	1.89	-0.04	-1.92	0.39*
Italy	0.25	-0.03	-2.02	0.48**
Jamaica	0.99	-0.06	-2.31	0.94***
Japan	0.22	-0.05	-1.71	0.44*
Luxembourg	0.18	-0.04	-1.96	0.31
Malta	0.34	-0.1	-2.34	0.2
Mexico	0.97	-0.03	-2.19	0.75***
Morocco	0.41	-0.07	-1.69	0.55**
New Zealand	0.19	-0.02	-1.19	0.5**
Norway	0.22	-0.04	-1.26	0.41*
Pakistan	0.9	-0.1	-2.79*	0.35*
Paraguay	0.8	-0.05	-1.49	1.08***
Peru	60.32	-0.17	-3.25**	0.38*
Philippines	1.14	-0.1	-2.58*	0.46**
Portugal	0.36	-0.03	-1.36	0.70**
South Africa	0.21	-0.02	-1.39	1.43***
Spain	0.41	-0.04	-1.72	0.27
Suriname	3.25	-0.24	-4.27***	0.59**
Sweden	0.26	-0.04	-1.30	0.48**
Switzerland	0.38	-0.1	-3.49***	0.15
UK	0.22	-0.03	-1.39	0.36*
United States	0.11	-0.02	-1.45	0.40*
Uruguay	7.12	-0.12	-3.76***	0.39*
Venezuela	0.52	-0.004	-0.16	1.3***
Critical Values				
	1%	5%	10%	
ADF Test	-3.47	-2.88	-2.58	
KPSS	0.74	0.46	0.35	

Note: ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

2.3. Testing for Unit Roots in the Presence of Structural Change

Perron (1989) showed that the existence of a one-time structural change in the trend function of a time series, whether the change is in the intercept or the slope or both, biases the usual unit root tests towards non-rejection. He proposed a model that tests the null hypothesis that a given series has a unit root with drift and an exogenous structural break against the alternative of stationarity about a deterministic trend which has an exogenous structural break.

Perron's model was criticized because it treated the date of the break as being determined exogenously, i.e. known a priori. This triggered a series of models that endogenized the date of the break, namely those in Christiano (1992); Banerjee, Lumsdaine, and Stock (1992); Zivot and Andrews (1992); and Perron and Vogelsang (1992).

In this paper, the procedure proposed by Perron and Vogelsang (1992) is applied to test for a unit root in the inflation rate series used allowing for a possible structural change in the level of the series occurring at an unknown date. Their methodology is appropriate for non-trending data and, like Perron, they allow for a break under both the null and the alternative hypotheses.

Under the null hypothesis of a unit root, the model used in this study is represented as follows:

$$\pi_t = \delta D(TB)_t + \pi_{t-1} + \varepsilon_t, \qquad t = 2, \ldots\ldots\ldots\ldots, T, \qquad \ldots(2)$$

where the dummy $D(TB)_t$ =1 if $t = T_B$ +1 and zero otherwise (T_B is the time of the break). Under the alternative hypothesis of stationarity, the model is represented by:

$$\pi_t = \mu + \delta DU_t + \varepsilon_t, \qquad t = 2, \ldots\ldots\ldots\ldots, T. \qquad \ldots(3)$$

where the dummy DU_t = 1 if $t > T_B$ and zero otherwise.

The testing strategy for the model used is given by a two-step procedure. The first step removes the deterministic part of the series using the estimates of the regression:

$$\pi_t = \mu + \delta DU_t + \varepsilon_t, \qquad t = 1, \ldots\ldots\ldots\ldots, T. \qquad \ldots(4)$$

The residuals obtained are then tested as follows:

$$\Delta\varepsilon_t = \sum_{i=0}^{k} \omega_i \, D(TB)_{t-i} + \alpha\varepsilon_{t-1} + \sum_{i=1}^{k} c_i \Delta\varepsilon_{t-i} + e_t, \;\; t = k + 2 \ldots\ldots\ldots, T. \qquad \ldots(5)$$

The use of the lagged dummy $D(TB)_{t-i}$ (i = 0,……k) ensures that the t–statistic on α is invariant to the order of the truncation lag k. The recursive general to specific method is used to choose k.

Following the method proposed by Perron and Vogelsang, the selection of the break date T_B chooses T_B to minimize t_α, the statistic for testing that α = 0 in equation (5). Using the sequential methodology proposed by Perron and Vogelsang (1992), the minimal value of the t-statistic for testing that α = 0, t_α, is considered over all possible breakpoints T_B in the sample. The unit root is rejected in favor of the alternative of trend stationarity if t_α is greater than the critical values tabulated by Perron and Vogelsang (1992). The results are presented in Table II. The unit root null is rejected in favor of stationarity for only 17 out of 45 countries; 13 countries

Table II
Unit Root Test in The Presence of Structural Change

Country	T_B	α	t_α
Australia	1974:04	-0.062	-2.60
Austria	1984:03	-0.13	-2.98
Argentina	1989:04	-0.562	-21.68***
Belgium	1974:02	-0.067	-3.68
Bolivia	1985:02	-0.574	-39.01***
Canada	1981:02	-0.044	-2.66
Colombia	1974:03	-0.242	-3.85
Cyprus	1975:03	-0.722	-7.05***
Denmark	1981:04	-0.097	-2.63
Dominican Republic	1990:04	-0.144	-5.38***
Ecuador	1983:03	-0.133	-4.19
Egypt	1977:02	-0.218	-2.84
El salvador	1971:02	-0.156	-4.33*
Finland	1981:01	-0.056	-2.45
France	1981:03	-0.049	-2.97
Germany	1981:03	-0.101	-4.01
Greece	1971:02	-0.179	-4.66**
Haiti	1994:02	-0.196	-3.69
Honduras	1989:02	-0.171	-4.15
India	1974:02	-0.178	-4.50*
Ireland	1980:01	-0.067	-3.18
Israel	1984:03	-0.117	-6.97***
Italy	1980:04	-0.036	-2.46
Jamaica	1991:04	-0.124	-4.7**
Japan	1974:03	-0.139	-5.57***
Luxembourg	1961:02	-0.072	-3.27
Malta	1981:02	-0.176	-3.81
Mexico	1987:04	-0.074	-5.19***
Morocco	1974:02	-0.153	-3.23
New Zealand	1986:03	-0.046	-2.54
Norway	1989:01	-0.071	-2.28
Pakistan	1975:01	-0.221	-5.48***
Paraguay	1975:04	-0.181	-3.44
Peru	1990:02	-0.359	-23.39***
Philippines	1984:02	-0.122	-4.16
Portugal	1984:04	-0.044	-1.88
South Africa	1970:03	-0.124	-3.56
Spain	1977:03	-0.071	-2.83
Suriname	1992:02	-0.767	-11.37***
Sweden	1981:02	-0.078	-2.50
Switzerland	1974:02	-0.163	-5.83***
United Kingdom	1975:02	-0.062	-2.98
United States	1979:04	-0.049	-3.12
Uruguay	1967:04	-0.183	-5.34***
Venezuela	1989:01	-0.207	-5.67***
Critical Values			
1%	5%	10%	
-5.15	-4.55	-4.23	

Note: ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

at the 1% level; 2 countries at the 5% level; and 2 countries at 10% level. The inability to reject the unit root null for the remaining 28 countries implies that the unit root tests that allow for the presence of structural change provide little evidence against a unit root in inflation rates.

2.4. Panel Unit Root Tests

A major criticism of ADF type tests is that they have low power with short time spans of data. This is one possible reason for the inability, in most cases, to reject the unit root in these tests. Levin, Lin and Chu (2002) showed that even a relatively small panel could yield dramatic improvements in the power of the unit root tests against stationary alternatives. Thus, to improve the power of the test, researchers have used panel unit root tests to exploit cross-section variation in the data.

The panel unit root test used here is a Levin and Lin-type test that involves estimating the following equation by feasible GLS using Seemingly Unrelated Regressions:

$$\Delta\pi_{jt} = \mu_j + \alpha\pi_{jt-1} + \sum_{i=1}^{k} c_i \Delta\pi_{jt-i} + \varepsilon_{jt} \qquad \text{...(6)}$$

where j = 1,….. 45 denotes the countries. The model used does not include a trend but includes heterogeneous intercepts, which is equivalent to including country-specific fixed effects. Levin et al. (2002) show that using heterogeneous intercepts considerably reduces the gain in power compared to using homogeneous intercepts, because in this case each additional country in the sample adds an extra parameter to be estimated. However, the variation in the value of the coefficient μ reported in Table I does not justify using homogeneous intercepts. It should be noted that α is restricted to be the same for all countries because of the definition of the Levin et al. (2002) panel test[3]. The null hypothesis of a unit root is rejected in favor of the alternative of level stationarity if α is significantly different from zero. The values of *k* are taken from the results of the univariate ADF tests.

Exact finite sample critical values for the test statistics that account for serial correlation in the disturbances are computed using Monte Carlo methods. This is done by fitting autoregressive (AR) models to the first differences of each series and using the Schwartz criterion to choose the optimal AR models which are then treated as the true data generating processes for the errors of each of the series. For each of the panels examined, the optimal AR model with iid N (0, σ^2) innovations is used to construct pseudo samples of size equal to the actual size of the series. This process is then repeated 5000 times to obtain the critical values for the finite sample distributions from the sorted vector of the replicated statistics. The critical values calculated for the test statistics are given in Tables III through V.

The results of the panel unit root tests, reported in Table III, show very strong evidence against the unit root null. For the full sample of 45 countries, the t-statistic on α is much larger than the 1% critical value for this panel. For a panel of 18 countries that includes those countries for which either the ADF tests or sequential break tests or both show some evidence against the unit root null, the critical value is again well above the calculated 1% critical value for that panel. Even for the panel of the "unit root" 27 countries that includes the countries for which the ADF and sequential break tests provide no evidence against the unit root null, the null can be rejected at the 5% level.

Using Dornbusch's definition[4] of extreme, high, and moderate inflation, the countries are grouped into a number of panels reported in Table III. Applying this definition to the average annual inflation rate in the countries in our sample, over the period of the data, Argentina, Bolivia and Peru are defined as extreme inflation countries; Israel and Uruguay as high inflation countries; and Colombia, Ecuador, Jamaica, Mexico and Suriname as moderate inflation countries. The unit root null is rejected in favor of stationarity for all 8 panels formed using these definitions: at the 1% level for 4 panels, at the 5% level for 3 panels and at the 10% level for 1 panel.

Table III
Panel Unit Root Tests-Selected Panels

Countries			*Critical Values*		
	α	t_α	*1%*	*5%*	*10%*
All 45 countries	-0.18	-23.14	-16.76	-14.97	-14.08
"Unit root" 27 countries	-0.05	-8.85	-9.46	-8.84	-8.49
Other 18 countries	-0.13	-12.64	-8.79	-7.99	-7.57
Exclude 3 extreme inflation countries (42 countries)	-0.05	-12.67	-11.93	-11.11	-10.60
Exclude 3 extreme and 2 high inflation countries (40 countries)	-0.06	-12.87	-11.84	-11.00	-10.50
Exclude 3 extreme, 2 high, and 5 moderate inflation countries (35 Countries)	-0.05	-10.40	-10.88	-10.13	-9.72
3 extreme, 2 high and 5 moderate inflation countries (10 countries)	-0.12	-9.44	-6.48	-5.82	-5.49
2 high and 5 moderate inflation countries (7 countries)	-0.04	-5.32	-5.62	-4.99	-4.65
3 extreme inflation countries	-0.22	-7.30	-4.54	-3.93	-3.62
2 high inflation countries	-0.05	-3.60	-4.12	-3.47	-3.18
5 moderate inflation countries	-0.04	-4.35	-5.15	-4.47	-4.14

The unit root null is rejected in favor of stationarity in all panels: at the 1% level for 6 panels, 5% level for 4 panels and 10% level for 1 panel.

To investigate the question of the stationarity of inflation rates using panel tests even further, two more groups of panels formed from the countries in the sample are examined: In the first group, countries are classified by income level[5] over the period of the study. The results for these panels are reported in Table IV. The unit root null is rejected in favor of stationarity in all 5 panels: at the 1% level for 3 panels, 5% level for 1 panel and 10% level for 1 panel.

The second group of panels classifies countries on the basis of indebteness[6] over the period of the study. The strong relation between inflation and indebtedness is widely accepted and emphasized by many studies such as Ball and Mankiw (1995), and Boskin et al. (1987) among others. In the group of extreme, high and moderate inflation countries used in this paper, 6 countries are severely indebted, 2 are moderately indebted and 1 is less indebted. The results of the panel unit root tests on this group of panels are reported in Table V. The unit root null is rejected in favor of stationarity for all 5 panels: at the 1% level for 3 panels, 5% level for 1 panel and 10% level for 1 panel.

Table IV
Panel Unit Root Tests-Selected Panels Countries Classified by Income Level

Countries	α	t_α	*Critical Values*		
			1%	*5%*	*10%*
High income countries (22 countries)	-0.053	-8.98	-9.25	-8.39	-7.93
Middle income countries (18 countries)	-0.140	-12.91	-8.67	-7.89	-7.52
Upper Middle income countries (6 countries)	-0.100	-6.32	-5.41	-4.78	-4.44
Lower Middle income countries (12 countries)	-0.126	-9.23	-7.15	-6.51	-6.18
Low income countries (5 countries)	-0.071	-4.18	-5.09	-4.45	-4.13

The unit root null is rejected in favor of stationarity in all panels: at the 1% level for 3 panels, 5% level for 1 panel and 10% level for 1 panel.

Table V
Panel Unit Root Tests - Selected Panels Countries Classified By Indebtedness

Countries	α	t_α	*Critical Values*		
			1%	*5%*	*10%*
All countries in debt (23 countries)	-0.150	-14.62	-10.12	-9.18	-8.70
Severely indebted countries (7 countries)	-0.105	-7.14	-5.61	-4.98	-4.71
Moderately indebted countries (11 countries)	-0.065	-6.56	-6.49	-5.86	-5.52
Less indebted countries (5 countries)	-0.067	-4.36	-5.12	-4.46	-4.16
Countries not in debt (22 countries)	-0.053	-9.00	-9.25	-8.39	-7.93

The unit root null is rejected in favor of stationarity in all panels: at the 1% level for 3 panels, 5% level for 1 panel and 10% level for 1 panel.

It is worth noting that the unit root null is consistently rejected in favor of stationary alternatives in all the panels considered. Thus panel unit root tests provide much stronger evidence against the presence of a unit root in inflation rates.

3. CONCLUSION

The paper tests for a unit root in inflation rates using a sample of 45 different countries. Univariate ADF tests and KPSS tests are first estimated to provide a benchmark. This does not provide much evidence against the unit root null. Perron and Vogelsang's test is then used to account for a possible structural change in the series. Little evidence is still obtained against the presence of a unit root in inflation rates. Finally, cross-section variation is used to improve the power of the unit root test. By applying Levin and Lin-type panel unit root tests, the unit root null is rejected in favor of stationary alternatives in the panel of all 45 countries as well as in all the other panels examined. This provides evidence that inflation rates generally have low persistence and that shocks only affect them in a temporary manner.

Notes

1. The possible presence of seasonal unit roots in the data has been addressed.
2. As shown by Campbell and Perron (1991) and Ng and Perron (1995), this procedure has better size and power properties than methods that select k based on information criteria.
3. Im, Pesaran and Shin (2003) develop a panel unit root test in which α is allowed to vary across countries and test the unit root null hypothesis against the alternative that at least one of the series in the panel is stationary. This paper follows the Lin et al. (2002) procedure to check into the stationarity of the whole panel.
4. Dornbusch (1993) describes inflation as moderate in the 15-30% per annum range, high in the 30-100% range, and extreme in the 100-1000% range.
5. The World Development Report (1996) defines low income countries as those having a GNP per capita of $725 or less; lower middle income countries as those having a GNP per capita ranging from $726 to $2,895; upper middle income countries as those having a GNP per capita ranging from $2,896 to $8,955; and high income countries as those whose GNP per capita is $8,956 or more.
6. Using the classification of the World Development Report (1996): Severely indebted countries are those in which either the present value of debt service to GNP is greater than 80% or the present value of debt service to exports is greater than 220 %; moderately indebted countries are those in which either ratio is greater than 60 % but does not reach critical levels. All other low and middle-income economies are less indebted.

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