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Is the consumption-income ratio stationary? Evidence from linear and nonlinear panel unit root tests for OECD and non-OECD countries

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Is the consumption-income ratio stationary? Evidence from linear and nonlinear panel unit root tests for OECD and non-OECD countries

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Abstract

This paper applies recently developed heterogeneous nonlinear and linear panel unit root tests that account for cross-sectional dependence to 24 OECD and 33 non-OECD countries' consumption-income ratios over the period 1951–2003. We apply a recently developed methodology that facilitates the use of panel tests to identify which individual cross-sectional units are stationary and which are nonstationary. This extends evidence provided in the recent literature to consider both linear and nonlinear adjustment in panel unit root tests, to address the issue of cross-sectional dependence, and to substantially expand both time-series and cross sectional dimensions of the data analysed. We find that the majority (65%) of the series are nonstationary with slightly fewer OECD countries' (61%) series exhibiting a unit root than non-OECD countries (68%).

Key words: consumption-income ratio, heterogeneous panel nonlinear unit root test, cross-sectional dependence, OECD and non-OECD countries

JEL classification: C12, C33, D12

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1. Introduction

Economic theory generally suggests that the average propensity to consume (APC) is either constant or converges towards a constant. Hence, one expects the APC to be stationary. However, many empirical studies have presented evidence indicating that it is nonstationary, for example Sarantis and Stewart (1999), hereafter, SS. Arguably the adjustment of consumption (especially durables) is nonlinear and there have been many shocks since the 1950s that would force the APCs of many countries away from their equilibria (or change their equilibria). Hence, we utilise recently developed and heterogeneous panel unit root tests that allow for nonlinear adjustment towards equilibrium and that accommodate cross-sectional dependence. We are not aware of any previous studies that have applied panel unit root tests that address cross-sectional dependence to the APC. Further, we apply these tests to 24 OECD and 33 non-OECD countries over the period 1951 to 2003. We are not aware of any previous studies that apply unit root tests to such a broad range of countries (especially non-OECD) and over such a long time-span. Additionally, we utilise a recently developed procedure that facilitates the identification of which cross-sectional units are stationary and which are nonstationary using panel unit root tests rather than their less powerful time-series counterparts. Hence the novelty of the paper is in the application of nonlinear panel unit root tests that allow for cross-sectional dependence and identify which individual units are stationary/nonstationary to a dataset comprising a large number of countries over a long time-span.

The paper is organized as follows. Section 2 reviews the empirical and theoretical literature and discusses our data. Methods are discussed in Section 3 while the fourth section presents empirical results. Section 5 concludes the paper.

2. Theory and empirics on the APC's stationarity

Economic theory offers insight into whether the APC is stationary or not. Keynes's (1936) Absolute Income Hypothesis (AIH) implies that, as income grows, the APC converges towards a constant marginal propensity to consume (MPC). Assuming positive autonomous consumption and constant growth in aggregate income the aggregate APC should decline at a decreasing rate through time, converging towards the MPC.

Duesenberry's (1949) Relative Income Hypothesis (RIH) postulates that low income earners try to emulate consumption patterns of high income earners and so the former exhibit larger APCs than the latter. If a country's income distribution changes as income rises through time the aggregate APC may be trended, although it will be constant if the income distribution remains unchanged. The habit persistence form of the RIH implies a constant long-run APC provided that consumption grows at a constant rate.

Friedman's (1957) Permanent Income Hypothesis (PIH) may be interpreted as indicating a constant APC provided that the proportionality coefficient and transitory consumption and income are constant through time. Hadjimatheou (1987) notes that an implication of Modigliani's (1986) characterisation of the Life Cycle Hypothesis (LCH) is that a nation's saving rate is independent of its level of per-capita income and positively related to its long-run growth rate. Hence, a country's APC should be constant through time unless its long-run income growth rate changes.

Davidson *et al.* (1978) utilise the microeconomic homogeneity postulate that consumption is homogeneous of degree one in income, which indicates a unit-income elasticity with respect to consumption. This implies that the equilibrium natural logarithm of the APC (LAPC) should be constant through time.

The theory cited above predominantly suggests a constant APC or, if it is trended, that it converges towards a constant. Thus, at least in terms of its mean, the APC should be stationary. Indeed, whilst not strictly bounded by zero and one the APC will never greatly exceed these values and it may, therefore, be regarded as unlikely to diverge without bound. Hence, there are strong theoretical reasons to believe the APC is stationary.

However, much evidence indicates that the APC is nonstationary.[2] For example, SS demonstrate, using linear adjustment panel unit root tests, that LAPC is nonstationaryfor 20 OECD countries over the sample 1955–1994. One explanation is that if the APC declines at a decreasing rate through time (implied by the AIH), LAPC will likely feature a linear trend. These patterns are consistent with Figure 1 which plots the consumption-income ratio (CY and RCY) against income (Y and RY) and its natural log (LCY and LRCY) against the natural log of income (LY and LRY) – where CY, Y, LCY and LY are measured in current prices and RCY, RY, LRCY and LRY are in constant prices. These graphs are given for OECD, Non-OECD and both OECD and Non-OECD (denoted All) countries.[3] Data are obtained from version 6.2 of the Penn World Tables (Heston, Summers and Aten, 2006).[4] Hence, we consider the possibility that LAPC is trend stationary.

Another potential explanation for the nonstationarityof LAPC is that the assumptions required for a constant APC do not hold. For example, if income growth shifts upwards the APC will shift downwards according to the LCH. Shifts in other factors, such as, inflation (Davidson *et al*, 1978), wealth (Hendry and Ungern-Sternberg, 1981), liquidity constraints (Miles, 1992), income uncertainty (Carroll, 1994), demographic factors (Horioka, 1997), interest rates (Hahm, 1998) and fiscal variables (Pesaran, Haque and Sharma, 2000) may also have shifted the APC.[5] Cook (2005), using the same OECD data as SS, finds evidence that LAPC is stationary around a trend with intercept and slope shifts using the Lee and Strazicich (2003) time-series tests.

Whilst substantial changes have happened in many countries since 1950, abrupt structural breaks occurring in one period may not best characterise these changes. For example, Davidson *et al* (1978) argued that the 1973 upward shift in UK inflation caused the *target*

[2] SS cite various papers where the APC is evidently nonstationary.
[3] The OECD countries are: Australia (AUS), Austria (AUT), Belgium (BEL), Canada (CAN), Denmark (DNK), Finland (FIN), France (FRA), Greece (GRC), Iceland (ISL), Ireland (IRL), Italy (ITA), Japan (JPN), Luxembourg (LUX), Mexico (MEX), Netherlands (NLD), New Zealand (NZL), Norway (NOR), Portugal (PRT), Spain (ESP), Sweden (SWE), Switzerland (CHE), Turkey (TUR), United Kingdom (GBR), United States of America (USA). The non-OECD countries are: Argentina (ARG), Bolivia (BOL), Brazil (BRA), Chile (CHL), Colombia (COL), Costa Rica (CRI), Dominican Republic (DOM), Ecuador (ECU), Egypt (EGY), El Salvador (SLV), Ethiopia (ETH), Guatemala (GTM), Honduras (HND), India (IND), Israel (ISR), Kenya (KEN), Mauritius (MUS), Morocco (MAR), Nicaragua (NIC), Nigeria (NGA), Pakistan (PAK), Panama (PAN), Paraguay (PRY), Peru (PER), Philippines (PHL), South Africa (ZAF), Sri Lanka (LKA), Taiwan (TWN), Thailand (THA), Trinidad and Tobago (TTO), Uganda (UGA), Uruguay (URY), Venezuela (VEN).
[4] In Heston *et al* (2006) Y is defined as real GDP per capita (denoted CGDP) in international dollars at current prices; RY as real GDP per capita (RGDPL) in international dollars at 2000 constant prices (Laspeyres); CY as the consumption share of CGDP (CC) measured as a percentage in current prices; RCY as the consumption share of RGDPL (kc) measured as a percentage in 2000 prices.
[5] Changes in income uncertainty alter precautionary savings and, according to the PIH, modify the APC.

APC to shift downwards. However, due to slowness of adjustment the *actual* APC only gradually declined throughout the 1970s. Indeed, any durable component in consumption would likely be particularly slow to adjust. Further, financial deregulation that took place in many economies during the late twentieth century was a range of measures implemented over many years. Hence, the consequent changes in the APC would likely occur over several periods rather than just one. Thus, a test allowing for nonlinear adjustment towards a changing target APC may be appropriate than assuming that all countries are subject to intercept and slope shifts in a single period.[6]

The nonlinear test employed here yields adjustment towards equilibrium when the disequilibrium exceeds a particular threshold with little or no adjustment when the disequilibrium is below this threshold. However, a large disequilibrium will generally not be completely eliminated in one period but over many periods. Such nonlinear adjustment is particularly appropriate for the total consumption measures used here which embodies durable expenditures. This is because fixed adjustment costs may mean that consumers tolerate small departures from the equilibrium durable stock, however, once this disequilibrium exceeds a certain level the consumer abruptly adjusts consumption to make the deviation tolerable – see Caballero (1994).

3. Testing methods

This section discusses the nonlinear and linear panel unit root tests as well as the tests for cross-sectional dependence employed here. It also outlines a procedure for using panel unit root tests to determine whether each individual cross-sectional unit in the panel is stationary or nonstationary. In addition, we discuss the method used for identifying whether series are stationary, trend stationary or nonstationary.

3.1 Cerrato et al's (2009) test

Recently Cerrato, de Peretti, Larsson and Sarantis (2009), hereafter CPLS, proposed a nonlinear panel unit root test. This extends Kapetanios et al's (2003) time-series ESTAR test to a panel setting. The test is computed, under the unit root null, by estimating the following auxiliary regression:[7]

$$\Delta y_{it} = a_i + b_i y_{i,t-1}^3 + \gamma_i f_t + u_{it}$$

where y_{it} on the i^{th} cross-section at time t is generated according to the ESTAR model, f_t is a stationary factor accounting for cross-sectional dependence and γ_i are country specific factor loadings. f_t can be approximated by the two factors $\Delta \bar{y}_t = N^{-1}\sum_{j=1}^{N}\Delta y_{jt}$ and $\bar{y}^3{}_{t-1}$, where $\bar{y}^3{}_{t-1} = N^{-1}\sum_{j=1}^{N} y^3{}_{j,t-1}$.

[6] The tests employed by Cook (2005) have only two possible specifications: one shift in both intercept and slope or two shifts in intercept and slope. Many countries' APCs may not be best portrayed by either of these specifications.
[7] Note that in order to apply the test, as mentioned in Cerrato et al (2009), data should be first demeaned.

The following test statistics for each individual time-series are computed:[8]

$$t_{iNL}(N,T) = \frac{y_{i,-1}^{3\,'} M \Delta y_i}{(\Delta y_i' M \Delta y_i)^{1/2} (y_{i,-1}^{3\,'} M y_{i,-1}^{3})^{1/2}}$$

where $\Delta y_i = (\Delta y_{i1}, \Delta y_{i2}, ..., \Delta y_{i,T})'$, $y_{i,-1}^3 = (y_{i,0}^3, y_{i,1}^3, ..., y_{i,T-1}^3)'$, M the projection onto $\delta(X)$, the orthogonal complement of the span of X, $X = (\tau, \Delta\bar{y}, \bar{y}_{-1}^3)'$, $\Delta\bar{y} = (\Delta\bar{y}_1, \Delta\bar{y}_2, \ldots, \Delta\bar{y}_T)'$, $\bar{y}_{-1}^3 = (\bar{y}_0^3, \bar{y}_1^3, \ldots, \bar{y}_{T-1}^3)$, and $\tau' = (1,1,...,1)$.

The panel test is:

$$\bar{t}_{NL}(N,T) = N^{-1} \sum_{i=1}^{N} t_{iNL}(N,T)$$

CPLS tabulate critical values for different dimensions of time-series, T, and cross section, N. Monte Carlo experiments showed that this test has better size and power than the Pesaran (2007) test when the data generating process (DGP) is nonlinear. Further, the model, and therefore the test, can include time trend and autocorrelation in the error terms:

$$\Delta y_{it} = a_i + \alpha_i t + b_i y_{i,t-1}^3 + c_i \bar{y}^3_{t-1} + \sum_{j=0}^{p} d_{ij} \Delta\bar{y}_{t-j} + \sum_{j=1}^{p} \delta_{ij} \Delta y_{it-j} + e_{it}$$

3.2 Pesaran's (2007) test

For comparative purposes we also report Pesaran's (2007) linear adjustment panel unit root test. It uses the following time-series regression which is estimated for each of the N cross-sectional units.

$$\Delta y_{it} = a_i + \alpha_i t + b_i y_{it-1} + c_i \bar{y}_{t-1} + \sum_{j=0}^{p} d_{ij} \Delta\bar{y}_{t-j} + \sum_{j=1}^{p} \delta_{ij} \Delta y_{it-j} + e_{it}$$

when $\alpha_i = 0$ we have the demeaned (intercept only) case and when $\alpha_i \neq 0$ we have the detrended (intercept and trend) case.

The CADF test statistic for each cross-section is the estimated OLS t-ratio corresponding to the coefficient b_i, denoted $t_i(N,T)$. The panel test statistic, $CIPS$, is:

$$CIPS = N^{-1} \sum_{i=1}^{N} t_i(N,T)$$

[8] Note that for the Common Correlated Effect estimator to work we require the factor f_t to be stationary and that this could be restrictive in some empirical applications.

Critical values for $CIPS$ are given in Pesaran (2007).[9]

3.3 Pesaran's (2004) cross-sectional dependence tests

We also apply Pesaran's (2004) CD test for cross-sectional dependence in unbalanced panels to the residuals of N countries' time-series ADF test equations:

$$CD = \sqrt{\frac{2}{N(N-1)}} \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \sqrt{T_{ij}} \hat{\rho}_{ij}^{*}$$

where $\hat{\rho}_{ij}^{*}$ is the simple pairwise correlation coefficient of the residuals for cross-section i and j calculated over the sample period, of size T_{ij}, common to both sections.[10] The statistic has a standard normal distribution asymptotically.

Pesaran (2004) demonstrates that CD is robust to structural breaks and unit roots in the DGP, is correctly sized (even in very small samples) and has satisfactory to high power.[11]

Pesaran (2004) specifies a modified version of a previously existing cross-sectional dependence test (which is also asymptotically standard normal) as:[12]

$$CD_{lm} = \sqrt{\frac{1}{N(N-1)}} \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \left(T_{ij} \hat{\rho}_{ij}^{*2} - 1\right)$$

Pesaran (2004) suggests that CD_{lm} is likely to exhibit substantial size distortion when N is large and T is small and that this size distortion tends to worsen for fixed T as N increases.

3.4 Identification of stationary and nonstationary series in the panel

The strength of panel unit root tests where the null hypothesis is that *all* series in the panel are nonstationary and the alternative is that *at least one* series is stationary, is in the greater confidence in the determination of nonstationary series compared to time-series unit root tests due to the relatively greater power. An arguable drawback of the panel test is that it does not identify which, or how many, series are stationary when one rejects the null. We apply the methodology proposed by Stewart (2010) in the context of panel cointegration tests, modified

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[9] None of our time-series tests were extreme, in terms of the thresholds identified in Pesaran (2007), and the truncated panel test was not required.

[10] The $\hat{\rho}_{ij}^{*}$ need to account for the possibility that the mean of the residuals for each section may not be zero for the common sample period used.

[11] One issue with this test is that it does not account for the possibility that positive and negative correlation coefficients may cancel in the weighted averages calculated in the statistics. Hence, a zero test statistic could be consistent with very large positive and negative correlation coefficients. To gauge the impact of cancelling we also calculate the average magnitude of the correlation coefficients, $\left|\bar{\rho}\right| = \left(\frac{2}{N(N-1)}\right) \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \left|\hat{\rho}_{ij}\right|$.

[12] We adjust the test slightly to allow for the correlation coefficients to be estimated from different sample sizes for different country pairings.

for panel unit root tests. This procedure utilises the improved power of the panel to distinguish which series in the panel are nonstationary and which are stationary.

We explain the procedure within the context of Pesaran's (2007) test although we also apply it using the CPLS test. If the N individual sections' t-ratios, $t_i(N,T)$, are ranked in descending order a set of N panel unit root statistics, $CIPS$, can be calculated for panels containing the first individual unit, the first and second units and so on…. The first $CIPS$ statistic will be based on a panel of one individual cross-sectional unit, which has the largest value of $t_i(N,T)$ in the panel, and, therefore, will be least likely to reject the unit root null. Similarly, the second test statistic will be based on a panel of the two individual cross-sectional units with the two largest values of $t_i(N,T)$ in the panel, which will be the second least likely panel statistic to reject the null. In contrast, the N^{th} $CIPS$ statistic will incorporate all the individual units in the panel and would be the most likely to reject the unit root null. Based on this set of N ordered panel statistics one can identify the individual cross-section where the panel test statistic first rejects the unit root null. If we let this test statistic contain M+1 cross-sectional units then the previous panel unit root test that contained M units, did not reject the null that *all* units in this panel are nonstationary. This implies that it is the $M+1^{th}$ cross-sectional unit, and only the $M+1^{th}$ unit, that is stationary in the panel of M+1 individuals. Our confidence in this result is as strong as our certainty of the power of the test for the panel involving M cross-sections: if there is high power we can have confidence in the test's rejection that any series in the panel are stationary. Further, because the time-series t-ratio for $M+2^{th}$ individual unit is less than that for the $M+1^{th}$ unit, we know that had we replaced the latter by the former in the panel unit root test containing the M+1 cross-sections, it would also reject the null. This implies that the series for units M+1 and M+2 are stationary. Indeed, it implies that units M+1, M+2, …, N are all stationary. Hence, using this set of ordered panel unit root tests identifies the first M series as nonstationary and the remaining (N – M) units' series as stationary.

This method of identifying the order of integration of the units in the panel is superior to using the individual $t_i(N,T)$ statistics for two reasons. First, the panel test has superior power when N > 1, hence for M > 1 the panel method will have greater power than using individual unit root tests. Secondly, using statistics based upon a panel of one unit with accommodation for cross-sectional dependence is clearly inappropriate because if there is only one cross-sectional unit there can be no cross-sectional dependence between units. In this case using standard time-series unit root tests (without adjustment for cross-sectional dependence) would be appropriate. However, these time-series tests still have lower power than the panel test and hence one should have more confidence in the panel test's inference compared to that of the time-series test.[13]

3.5 Determining whether series are stationary, trend stationary or nonstationary

We distinguish between the hypotheses of a unit root, stationarity and trend stationarity as follows. If, using the test for demeaned data (intercept only), the unit root null hypothesis is rejected, the series is stationary. However, if the null is not rejected, the unit root test is applied to the demeaned and detrended data (intercept and trend). If the null hypothesis of this

[13] In our application we use an adjustment for cross-sectional dependence based on the averages of all N series in the panel and not solely the subset of units actually employed in constructing each test. We assume that this does not have an adverse influence on the test's results.

test is rejected the series is trend stationary, whereas if the null is not rejected the variable has a unit root.

4. Results

Table 1 presents the tests for cross-sectional dependence based upon the residuals of time-series ADF tests applied to each country's series. The tests are applied to all combinations of both OECD and Non-OECD country groupings, both LCY and LRCY series and ADF test equations including just an intercept and both an intercept and trend. For all eight combinations the magnitudes of both CD and CD_{lm} statistics exceed their 5% critical values.[14] This unambiguously indicates the presence of cross-sectional dependence and justifies our use of panel unit root tests that account for such dependence.

Table 2 reports the results of Pesaran's (2007) cross-sectionally augmented time-series (column headed Time-series) and panel unit root (headed Panel) tests for LCY for OECD countries. The time-series tests are listed in descending order of size with those statistics least likely to reject the unit root null appearing higher up in the table. The panel statistic reported in the first row is a panel test including only one country (USA for the intercept only case and Mexico for the intercept and trend case). The panel statistic given in the second row is the panel test incorporating the first two countries listed in the table (USA and UK for the intercept only case and Mexico and Canada for the intercept and trend case). As we move down each row of the table another country (specified in the row) is added to the panel test until we reach the last row which contains the test statistic for the whole panel of, in this instance, 24 OECD countries. Comparing these statistics to their corresponding 5% critical values (headed 5% CV) we observe that, for the intercept only case, the panel tests for first 20 countries cannot reject the unit root null while the null is rejected for the last 4 countries. Hence, following the methodology discussed in Section 3.4, we conclude that LCY is stationary for Sweden, Iceland, Italy and Australia and nonstationary for the remaining 20 OECD countries.

To determine the form of nonstationarity we examine the panel test results for the case where both an intercept and trend are included in the test equations. We find that the first 12 panel tests cannot reject the unit root null whereas a unit root is rejected for the last 12 countries. Excluding the 4 countries that were found to be stationary (based on the intercept only case) from this latter group we therefore conclude that LCY is trend stationary for the following 8 OECD countries: Netherlands, UK, Turkey, Ireland, Spain, Austria, Denmark and New Zealand. Hence, LCY has a unit root for the remaining 12 OECD countries.

Pesaran's (2007) panel test results for LRCY for OECD countries are reported in Table 3. In this case 5 countries' series are stationary (Australia, Italy, New Zealand, Turkey and Iceland), none are trend stationary (given that LRCY for Iceland and New Zealand are stationary based upon the intercept only case) and the remaining 19 countries' series are nonstationary. The OECD countries where LRCY is stationary are either stationary or trend stationary for LCY, except for Sweden, which is stationary for LCY and nonstationary for LRCY. In general, there is less evidence against nonstationarity for LRCY than LCY in

[14] In all cases $\left|\bar{\hat{\rho}}\right| > \bar{\hat{\rho}}$, suggesting that the correlations between some residuals are negative and others are positive, causing some cancelling of the correlation coefficients using the CD statistic.

OECD countries using Pesaran's (2007) test and at least half the OECD countries' LAPCs are nonstationary.

The results from Pesaran's (2007) tests for non-OECD countries are reported in Tables 4 and 5 for LCY and LRCY, respectively. LCY is stationary for 12 of the 33 countries, trend stationary for a further 4 and nonstationary for the remaining 17 countries. Whereas LRCY is stationary for only 5 non-OECD countries, trend stationary for a further 2 and nonstationary for 26. Similar to the results for the OECD more countries are nonstationary for LRCY than LCY in non-OECD countries.[15] Also, like the OECD countries' results, at least half of non-OECD countries' LAPCs are nonstationary.

The results of CPLS's nonlinear unit root test applied to OECD countries are reported for LCY and LRCY in Table 6 and 7, respectively. For LCY (LRCY) 8 (2) out of 24 LAPCs exhibit nonlinear mean reversion and a further 6 (4) feature nonlinear adjustment towards a trend. The remaining 10 (18) countries' LCYs (LRCYs) are nonstationary. Table 8 and 9 present the results of CPLS's test applied to non-OECD countries for LCY and LRCY, respectively. For LCY (LRCY) 4 (6) out of 33 countries exhibit nonlinear mean reversion and a further 6 (3) feature nonlinear adjustment towards a trend. The remaining 23 (24) countries' LCYs (LRCYs) are nonstationary. As for the results from Pesaran's test more countries' series are nonstationary for LRCY than LCY when using the nonlinear test. For OECD and non-OECD countries both tests indicate that the majority of LAPCs are nonstationary. While fewer OECD countries' series are nonstationary using CPLS's tests compared to Pesaran's (2007) the reverse is true for non-OECD countries. Approximately the same number of series is nonstationary for both tests.

5. Conclusion

Applying the method suggested by Stewart (2010) we utilize the greater power of panel unit root tests, relative to time-series tests, to determine whether the individual cross-sectional units in the panel are (trend) stationary or not. Considering all 228 tests conducted for OECD and non-OECD countries, both LCY and LRCY and using both linear and nonlinear panel unit root tests we find that the majority (149 or 65%) indicate that LAPC is nonstationary. Thus, a minority of the results are consistent with the theoretical expectation of reversion to a mean or trend while the majority are in line with previous empirical findings of nonstationarity. However, this inference of a large percentage of nonstationary LAPCs is not theoretically implausible. For example, Molana (1989) suggests that an alternative to the "extreme" assumption that consumption has a unit-income elasticity is that consumption is homogeneous of degree one in life-time resources (income and wealth). If this latter hypothesis is true the LAPC will be nonstationary. This would suggest that consumption does not form an irreducible cointegrating vector solely with income – see Davidson (1998).[16] Many theories suggest that variables beyond income determine equilibrium consumption which, if these variables are nonstationary, indicates that their inclusion in the consumption function may be necessary to achieve cointegration.

We find that 59 out of 96 (61%) OECD countries' tests indicate nonstationarity whereas 90 of the 132 (68%) non-OECD countries' results are nonstationary. Hence, there is slightly more

[15] All countries that are stationary or trend stationary for LCY are stationary or trend stationary for LRCY, except for Thailand which is trend stationary for LRCY and nonstationary for LCY.

[16] An irreducible cointegrating vector is one that is cointegrated and the removal of any one variable from the vector causes the loss of cointegration.

evidence of nonstationarity in non-OECD than OECD countries. Further, 62 of the 114 (54%) tests for LCY indicate nonstationarity compared to 87 out of 114 (76%) for LRCY. Hence, there is notably more evidence of nonstationarity for LRCY compared to LCY. Pesaran's (2007) and CPLS's tests indicate virtually the same number of series are nonstationarity (out of 114), being 74 (65%) and 75 (66%), respectively. However, these two tests do not provide exactly the same inference for every country and every measure of LAPC. Nevertheless, regardless of the test used, the measure employed or whether one considers OECD or non-OECD countries, the majority (but not all) of countries' series is nonstationary.

Our results contrast with SS who found, using linear reversion panel unit root tests that do not account for cross-sectional dependence, that all 20 OECD countries' LAPCs are nonstationary. Given that our OECD sample contains many of the countries in their sample we believe that our larger sample size, span of data and the use of tests that address cross-sectional dependence explains the difference in results and suggests that our inferences are more reliable in terms of greater power. Our results also contrast with Cooke (2005) who, applying time-series tests using the same data as SS, find that all OECD countries' LAPCs are stationary around a shift in mean and/or trend. Our use of CPLS's test allows nonlinear adjustments and permits large abrupt changes, that could look like breaks, but that do not need to be confined to a single jump in one period. This would arguably be most appropriate for large adjustments due to, for example, financial deregulation taking place over several periods rather than in a single period. Once again we believe our results are more reliable due to the greater sample size and span as well as the form of test employed.

The results for non-OECD countries are, as far as we are aware, the first to be presented and therefore provide a reference and benchmark for future analyses of consumer behaviour in these countries. This is also the first application of a method that solely employs the relatively powerful panel unit root tests (and not time-series tests) to identify which cross-sectional units are stationary and nonstationary.

References

Caballero, R. J. (1994). "Notes on the theory and evidence on aggregate purchases of durable goods", *Oxford Review of Economic Policy*, Vol. 10, pp. 107 – 117.

Carroll, C. D. (1994). "How Does Future Income Affect Current Consumption?", *Quarterly Journal of Economics*, Vol. 109, pp. 111-147.

Cerrato, M., de Peretti, C., Larsson, R. and Sarantis, N. (2009). 'A nonlinear panel unit root test under cross-sectiondependence', Discussion Paper 2009-28, Department of Economics, University of Glasgow.

Cook, S. (2005). "The stationarity of consumption–income ratios: Evidence from minimum LM unit root testing", *Economics Letters*, Vol. 89, pp. 55 – 60.

Davidson, J., (1998). "Structural relations, cointegration and identification: some simple results and their application", *Journal of Econometrics*, 87, 87 – 113.

Davidson, J. E. H., Hendry, D. F, Sbra, F. and Yeo, S. (1978). "Econometric Modelling of the Aggregate Time-Series Relationship Between Consumers' Expenditure and Income in the United Kingdom", *Economic Journal*, Vol. 80, pp. 661 – 692.

Duesenberry, J. S. (1949). *Income, Saving and the Theory of Consumer Behaviour*. Harvard University Press, Cambridge, Mass..

Friedman, M. (1957). *A Theory of the Consumption Function*. Princeton University Press, Princeton, N.J..

Hadjimatheou, G. (1987). *Consumer Economics After Keynes: Theory and Evidence of the Consumption Function*. Wheatsheaf Books.

Hahm, J. (1998). "Consumption Adjustment to Real Interest Rates: Intertemporal Substitution Revisited", *Journal of Economic Dynamics and Control*, Vol. 22, pp. 293 – 320.

Hendry, D. F. and Ungern-Sternberg, T. (1981). "Liquidity and Inflation Effects on Consumers' Expenditure". In Deaton Angus S (ed.), *Essays in the Theory and Measurement of Consumer Behaviour in Honour of Sir Richard Stone*, Cambridge University Press, pp. 237 – 260.

Heston, A., Summers, R. and Aten, B. (2006). Penn World Table Version 6.2, Center for International Comparisons of Production, Income and Prices at the University of Pennsylvania.

Horioka, C. Y. (1997). "A Cointegration Analysis of the Impact of the Age Structure of the Population on the Household Saving rate", *Review of Economics and Statistics*, Vol. 79, pp. 511 – 516.

Kapetanios, G., Shin, Y. and Snell, A. (2003). "Testing for a Unit Root in the Nonlinear STAR Framework", *Journal of Econometrics*, Vol. 112, pp. 359 – 379.

Keynes, J. M. (1936). *The General Theory of Employment, Interest and Money*. MacMillan, London.

Lee, J. and Strazicich, M. (2003). "Minimum LM Unit Root Test with Two Structural Breaks", *Review of Economics and Statistics*, Vol. 85, pp. 1082 – 1089.

Miles, D. (1992). "Housing Markets, Consumption and Financial Liberalisation in the Major Economies", *European Economic Review*, Vol. 36, pp. 1093 – 1136.

Modigliani, F. (1986). "Life Cycle, Individual Thrift, and the Wealth of Nations", *American Economic Review*, Vol. 76, pp. 1 – 19.

Molana, H. (1989). "Wealth, Allocation, Capital Gains and Private Expenditure in the UK", *Scottish Journal of Political Economy*, Vol. 36, pp. 209 – 237.

Pesaran M. H. (2004). "General Diagnostic Tests for Cross-sectionDependence in Panels" Centre for Economic Studies and Ifo Institute for Economic Research CESifo working paper no. 1229.

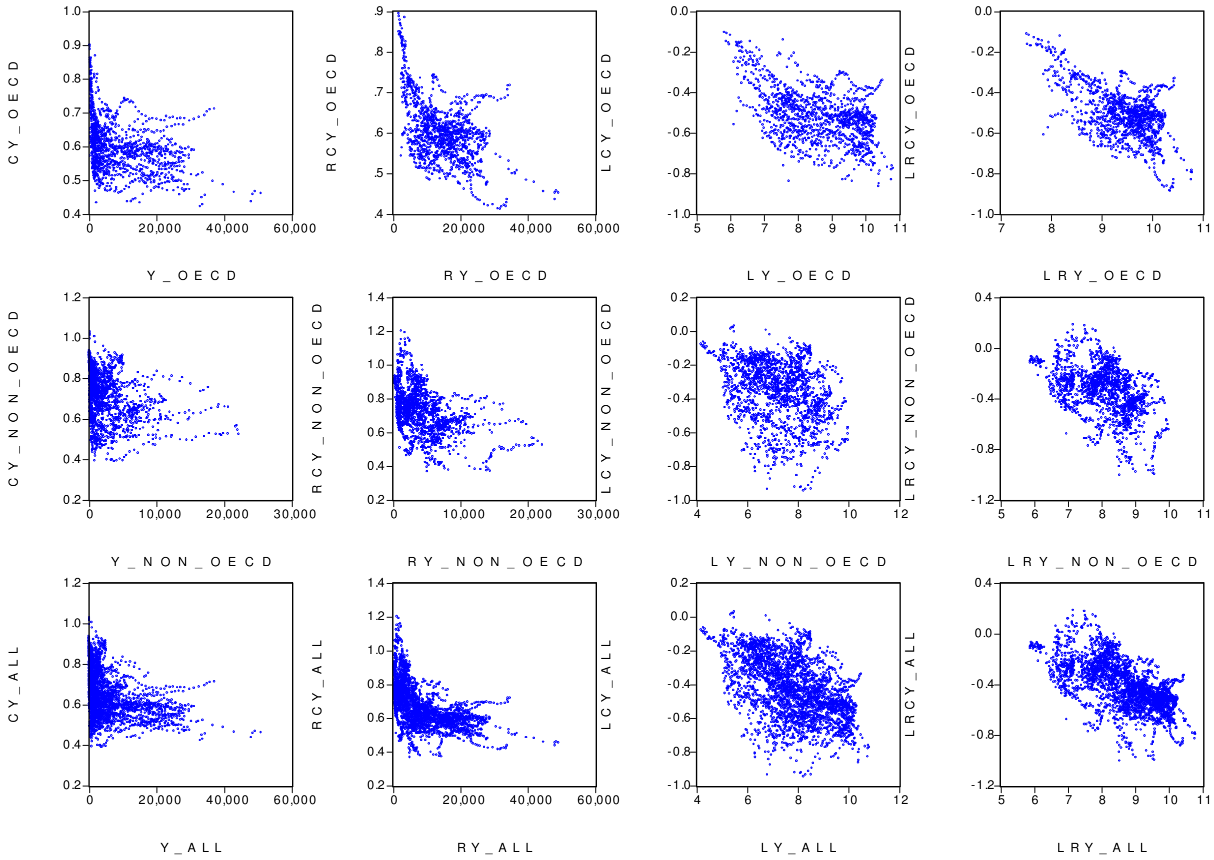
Pesaran, M. H. (2007). "A simple panel unit roor test in the presence of cross-sectiondependence", *Journal of Applied Econometrics*, Vol. 22, pp. 265–312.

Pesaran, M. H., Haque, N. U. and Sharma, S. (2000). "Neglected Heterogeneity and Dynamics in Cross Country Savings Regressions". In (eds) J. Krishnakumar and E. Ronchetti, *Panel Data Econometrics - Future Direction: Papers in Honour of Professor Pietro Balestra.* In the series, "Contributions to Economic Analysis", Elsevier Science, pp. 53 – 82.

Sarantis, N. and Stewart, C. (1999). "Is the Consumption-Income Ratio Stationary? Evidence from Panel Unit Root Tests", *Economics Letters*, Vol. 64, pp. 309 – 314.

Stewart C. (2010). "Using panel cointegration tests to determine whether individual cross-sectional units are cointegrated", mimeo, London Metropolitan University.

Figure 1: APC Scatter Plots



These figures plot the (log of the) current price consumption-income ratio, CY (LCY), against (the log of) current income, Y (LY) and the (log of the) constant price consumption-income ratio, LCY (LRCY), against (the log of the) constant price income, RY (LRY), for OECD, non-OECD and both OECD and non-OECD (denoted all) countries.

Table 1: Cross-section dependence tests

	OECD		Non OECD	
	LCY	LRCY	LCY	LRCY
Intercept only				
$\bar{\hat{\rho}}$	0.132	0.069	0.058	0.031
$\lvert\bar{\hat{\rho}}\rvert$	0.183	0.144	0.136	0.128
CD	15.771	8.299	9.548	5.137
CD_{lm}	17.978	7.784	8.667	4.600
Intercept and trend				
$\bar{\hat{\rho}}$	0.145	0.069	0.069	0.028
$\lvert\bar{\hat{\rho}}\rvert$	0.193	0.145	0.142	0.130
CD	17.381	8.280	11.385	4.646
CD_{lm}	20.742	7.462	10.404	5.487

CD, CD_{lm}, the average correlation coefficient, $\bar{\hat{\rho}}$, and the average magnitude of the correlation coefficient, $\lvert\bar{\hat{\rho}}\rvert$, are reported. These are based upon the residuals from standard ADF test equations for the $\left(\frac{N(N-1)}{2}\right)$ country pairings of OECD and non-OECD countries, respectively. The SBC is used to determine the lag length for the ADF regressions (allowing 0 to 3 lags) potentially causing sample sizes for the residual series to differ. Correlation coefficients are calculated using the common sample for each residual series pairing and sample sizes used for different pairings are potentially different. The critical values for both CD and CD_{lm} are ± 1.96.

Table 2: Pesaran's (2007) test (OECD countries, LCY)

Intercept only				Intercept and Trend			
Country	**Time-series**	**Panel**	**5% CV**	**Country**	**Time-series**	**Panel**	**5% CV**
USA	-0.609	-0.609	-3.280	**MEX**	-1.623	-1.623	-3.790
GBR	-0.710	-0.660	-3.174	**CAN**	-2.254	-1.939	-3.684
IRL	-0.910	-0.743	-3.069	**LUX**	-2.343	-2.073	-3.579
GRC	-1.135	-0.841	-2.963	**NOR**	-2.406	-2.157	-3.473
MEX	-1.726	-1.018	-2.858	**CHE**	-2.420	-2.209	-3.368
DNK	-1.755	-1.141	-2.752	**FRA**	-2.673	-2.287	-3.262
LUX	-1.771	-1.231	-2.647	**BEL**	-2.753	-2.353	-3.157
PRT	-1.952	-1.321	-2.541	**USA**	-2.852	-2.416	-3.051
FRA	-2.338	-1.434	-2.436	**PRT**	-2.859	-2.465	-2.946
JPN	-2.364	-1.527	-2.330	**JPN**	-3.290	-2.547	-2.840
CHE	-2.404	-1.607	-2.314	**GRC**	-3.561	-2.639	-2.824
CAN	-2.438	-1.676	-2.298	**FIN**	-3.608	-2.720	-2.808
BEL	-2.451	-1.736	-2.282	**NLD**	-3.650	***-2.792***	-2.792
FIN	-2.476	-1.789	-2.266	**GBR**	-3.656	***-2.853***	-2.776
AUT	-2.629	-1.845	-2.250	**TUR**	-3.784	***-2.915***	-2.760
NOR	-2.647	-1.895	-2.240	**IRL**	-3.906	***-2.977***	-2.750
TUR	-2.904	-1.954	-2.230	**ESP**	-4.118	***-3.044***	-2.740
ESP	-3.064	-2.016	-2.220	**SWE**	-4.310	***-3.115***	-2.730
NLD	-3.566	-2.097	-2.210	**AUT**	-4.502	***-3.188***	-2.720
NZL	-3.810	-2.183	-2.200	**DNK**	-4.544	***-3.256***	-2.710
SWE	-3.844	***-2.262***	-2.196	**ISL**	-4.700	***-3.324***	-2.704
ISL	-4.305	***-2.355***	-2.192	**ITA**	-5.146	***-3.407***	-2.698
ITA	-4.463	***-2.447***	-2.188	**NZL**	-5.490	***-3.498***	-2.692
AUS	-5.400	***-2.570***	-2.184	**AUS**	-5.839	***-3.595***	-2.686

This table reports $t_i(N,T)$, column headed Time-series, and CIPS, headed Panel. The panel test in row i includes the first i countries with the panel statistic in row 24 involving all 24 countries. The number of lags used in the individual country test equations is determined using SBC. The maximum available sample is 1951 – 2003 which with 0 and 1 lags after differencing gives the individual country time-series sample sizes of 52 and 51 observations, respectively. 5% critical values are reported in the columns headed 5% CV. For the intercept only case the critical value in the first row is taken from Table 1b in Pesaran (2007) and corresponds to an individual time-series test with T=50 and N=20. The panel critical values reported in rows 10, 15, 20 (and implicitly 30) are taken from Table 2b in Pesaran (2007) all for T = 50 and with N = 10, 15, 20 (and 30), respectively. The intervening critical values are calculated using linear interpolation. For the intercept and trend case critical values are taken from Tables 1c and 2c from Pesaran (2007) with intervening values also calculated using linear interpolation. A panel statistic highlighted with bold italic emphasis indicates rejection of the unit root null at the 5% level.

Table 3: Pesaran's (2007) test (OECD countries, LRCY)

Intercept only				Intercept and Trend			
Country	**Time-series**	**Panel**	**5% CV**	**Country**	**Time-series**	**Panel**	**5% CV**
GBR	-0.593	-0.593	-3.280	**LUX**	-0.792	-0.792	-3.790
GRC	-0.828	-0.711	-3.174	**GBR**	-1.021	-0.907	-3.684
MEX	-1.230	-0.884	-3.069	**IRL**	-1.167	-0.993	-3.579
LUX	-1.234	-0.971	-2.963	**MEX**	-1.215	-1.049	-3.473
IRL	-1.267	-1.030	-2.858	**NLD**	-1.381	-1.115	-3.368
NOR	-1.350	-1.084	-2.752	**GRC**	-1.838	-1.236	-3.262
NLD	-1.835	-1.191	-2.647	**PRT**	-2.307	-1.389	-3.157
PRT	-1.846	-1.273	-2.541	**FIN**	-2.388	-1.514	-3.051
FIN	-1.892	-1.342	-2.436	**CHE**	-2.448	-1.617	-2.946
SWE	-2.273	-1.435	-2.330	**JPN**	-2.533	-1.709	-2.840
CHE	-2.384	-1.521	-2.314	**NOR**	-2.576	-1.788	-2.824
DNK	-2.727	-1.622	-2.298	**USA**	-2.927	-1.883	-2.808
BEL	-2.731	-1.707	-2.282	**CAN**	-2.987	-1.968	-2.792
JPN	-2.824	-1.787	-2.266	**ESP**	-3.260	-2.060	-2.776
USA	-3.002	-1.868	-2.250	**FRA**	-3.311	-2.143	-2.760
CAN	-3.003	-1.939	-2.240	**AUS**	-3.316	-2.217	-2.750
FRA	-3.224	-2.014	-2.230	**BEL**	-3.421	-2.288	-2.740
ESP	-3.292	-2.085	-2.220	**TUR**	-3.507	-2.355	-2.730
AUT	-3.439	-2.157	-2.210	**DNK**	-3.865	-2.435	-2.720
AUS	-3.465	***-2.222***	-2.200	**AUT**	-4.025	-2.514	-2.710
ITA	-3.528	***-2.284***	-2.196	**SWE**	-4.399	-2.604	-2.704
NZL	-3.568	***-2.343***	-2.192	**ITA**	-4.543	-2.692	-2.698
TUR	-3.765	***-2.404***	-2.188	**ISL**	-4.596	***-2.775***	-2.692
ISL	-4.705	***-2.500***	-2.184	**NZL**	-5.308	***-2.880***	-2.686

See Table 2 notes.

Table 4: Pesaran's (2007) test (Non-OECD countries, LCY)

Intercept only				Intercept and Trend			
Country	**Time-series**	**Panel**	**5% CV**	**Country**	**Time-series**	**Panel**	**5% CV**
COL	0.575	0.575	-3.270	**PER**	-1.209	-1.209	-3.800
IND	-1.135	-0.280	-3.166	**THA**	-1.713	-1.461	-3.693
PER	-1.492	-0.684	-3.061	**COL**	-1.786	-1.569	-3.587
BRA	-1.534	-0.897	-2.957	**TWN**	-1.858	-1.642	-3.480
ECU	-1.615	-1.040	-2.852	**NIC**	-2.122	-1.738	-3.373
ISR	-1.898	-1.183	-2.748	**IND**	-2.150	-1.806	-3.267
THA	-1.917	-1.288	-2.643	**PAK**	-2.307	-1.878	-3.160
NIC	-2.101	-1.390	-2.539	**ARG**	-2.529	-1.959	-3.053
KEN	-2.314	-1.492	-2.434	**BOL**	-2.590	-2.029	-2.947
PAK	-2.364	-1.580	-2.330	**ISR**	-2.764	-2.103	-2.840
TWN	-2.366	-1.651	-2.314	**PHL**	-2.804	-2.167	-2.824
CRI	-2.552	-1.726	-2.298	**BRA**	-3.103	-2.245	-2.808
BOL	-2.57	-1.791	-2.282	**URY**	-3.162	-2.315	-2.792
PHL	-2.603	-1.849	-2.266	**KEN**	-3.240	-2.381	-2.776
ARG	-2.701	-1.906	-2.250	**LKA**	-3.269	-2.440	-2.760
TTO	-2.701	-1.956	-2.240	**TTO**	-3.288	-2.493	-2.750
LKA	-2.814	-2.006	-2.230	**ECU**	-3.441	-2.549	-2.740
VEN	-2.854	-2.053	-2.220	**GTM**	-3.460	-2.600	-2.730
NGA	-2.995	-2.103	-2.210	**VEN**	-3.462	-2.645	-2.720
CHL	-3.019	-2.149	-2.200	**DOM**	-3.565	-2.691	-2.710
PAN	-3.061	-2.192	-2.196	**CHL**	-3.726	***-2.740***	-2.704
URY	-3.264	***-2.241***	-2.192	**NGA**	-3.769	***-2.787***	-2.698
GTM	-3.317	***-2.287***	-2.188	**HND**	-4.122	***-2.845***	-2.692
SLV	-3.322	***-2.331***	-2.184	**ZAF**	-4.169	***-2.900***	-2.686
UGA	-3.411	***-2.374***	-2.180	**PAN**	-4.322	***-2.957***	-2.680
DOM	-3.629	***-2.422***	-2.176	**CRI**	-4.357	***-3.011***	-2.674
MAR	-3.672	***-2.468***	-2.172	**EGY**	-4.433	***-3.064***	-2.668
PRY	-3.677	***-2.512***	-2.168	**PRY**	-4.670	***-3.121***	-2.662
EGY	-3.733	***-2.554***	-2.164	**MAR**	-4.812	***-3.179***	-2.656
HND	-4.048	***-2.603***	-2.160	**ETH**	-5.255	***-3.249***	-2.650
ETH	-4.287	***-2.658***	-2.155	**UGA**	-5.313	***-3.315***	-2.645
ZAF	-4.467	***-2.714***	-2.150	**SLV**	-5.344	***-3.379***	-2.640
MUS	-5.608	***-2.802***	-2.145	**MUS**	-5.927	***-3.456***	-2.635

See Table 2 notes, except critical values from Pesaran's (2007) Table 1b and 1c for T = 50 and N = 30 are reported in the first row. In addition, critical values for T = 50 and N = 50 from Pesaran's Table 2b and 2c are also implicitly used to calculate the reported critical values.

Table 5: Pesaran's (2007) test (Non-OECD countries, LRCY)

Intercept only				Intercept and Trend			
Country	**Time-series**	**Panel**	**5% CV**	**Country**	**Time-series**	**Panel**	**5% CV**
COL	0.251	0.251	-3.270	**ISR**	-0.436	-0.436	-3.800
ISR	-0.594	-0.172	-3.166	**TWN**	-1.003	-0.720	-3.693
TWN	-0.981	-0.441	-3.061	**PER**	-1.460	-0.966	-3.587
BRA	-1.610	-0.734	-2.957	**DOM**	-1.867	-1.192	-3.480
DOM	-1.637	-0.914	-2.852	**BOL**	-2.032	-1.360	-3.373
PER	-1.647	-1.036	-2.748	**EGY**	-2.051	-1.475	-3.267
NIC	-1.735	-1.136	-2.643	**VEN**	-2.063	-1.559	-3.160
VEN	-1.813	-1.221	-2.539	**URY**	-2.098	-1.626	-3.053
CRI	-1.947	-1.301	-2.434	**CRI**	-2.171	-1.687	-2.947
IND	-1.981	-1.369	-2.330	**NIC**	-2.188	-1.737	-2.840
THA	-1.985	-1.425	-2.314	**COL**	-2.192	-1.778	-2.824
URY	-2.029	-1.476	-2.298	**ECU**	-2.519	-1.840	-2.808
EGY	-2.058	-1.520	-2.282	**LKA**	-2.553	-1.895	-2.792
PHL	-2.091	-1.561	-2.266	**GTM**	-2.603	-1.945	-2.776
TTO	-2.205	-1.604	-2.250	**ARG**	-2.628	-1.991	-2.760
ETH	-2.297	-1.647	-2.240	**PHL**	-2.639	-2.031	-2.750
BOL	-2.355	-1.689	-2.230	**PAK**	-2.649	-2.068	-2.740
CHL	-2.490	-1.734	-2.220	**MUS**	-2.708	-2.103	-2.730
GTM	-2.604	-1.779	-2.210	**CHL**	-2.834	-2.142	-2.720
UGA	-2.652	-1.823	-2.200	**TTO**	-2.840	-2.177	-2.710
ARG	-2.660	-1.863	-2.196	**IND**	-2.899	-2.211	-2.704
ECU	-2.695	-1.901	-2.192	**BRA**	-3.003	-2.247	-2.698
KEN	-2.705	-1.936	-2.188	**PAN**	-3.221	-2.289	-2.692
PAK	-2.853	-1.974	-2.184	**UGA**	-3.530	-2.341	-2.686
LKA	-2.902	-2.011	-2.180	**KEN**	-3.555	-2.390	-2.680
MUS	-2.949	-2.047	-2.176	**ZAF**	-3.572	-2.435	-2.674
ZAF	-3.134	-2.087	-2.172	**NGA**	-3.620	-2.479	-2.668
PRY	-3.195	-2.127	-2.168	**SLV**	-3.801	-2.526	-2.662
NGA	-3.203	***-2.164***	-2.164	**MAR**	-3.966	-2.576	-2.656
PAN	-3.372	***-2.204***	-2.160	**PRY**	-4.180	-2.629	-2.650
SLV	-3.860	***-2.258***	-2.155	**THA**	-4.313	***-2.684***	-2.645
MAR	-3.946	***-2.310***	-2.150	**ETH**	-4.634	***-2.745***	-2.640
HND	-4.998	***-2.392***	-2.145	**HND**	-5.285	***-2.822***	-2.635

See Table 2 and Table 4 notes.

Table 6: CPLS's test (OECD countries, LCY)

Intercept				Intercept and trend			
Country	**Time-series**	**Panel**	**5% CV**	**Country**	**Time-series**	**Panel**	**5% CV**
USA	-0.109	-0.109	-3.040	**MEX**	-1.510	-1.510	-3.470
GRC	-1.554	-0.832	-2.942	**NOR**	-1.600	-1.555	-3.551
IRL	-1.558	-1.074	-2.844	**CAN**	-1.640	-1.583	-3.433
PRT	-1.681	-1.226	-2.747	**USA**	-2.070	-1.705	-3.315
GBR	-1.717	-1.324	-2.649	**SWE**	-2.220	-1.808	-3.197
LUX	-1.769	-1.398	-2.551	**PRT**	-2.290	-1.888	-3.079
ITA	-1.836	-1.461	-2.453	**CHE**	-2.330	-1.951	-2.961
ISL	-1.881	-1.513	-2.356	**GBR**	-2.330	-1.999	-2.843
MEX	-2.191	-1.588	-2.258	**FIN**	-2.600	-2.066	-2.725
CAN	-2.201	-1.650	-2.160	**ISL**	-2.620	-2.121	-2.607
FRA	-2.261	-1.705	-2.144	**LUX**	-2.860	-2.188	-2.588
CHE	-2.305	-1.755	-2.128	**GRC**	-2.940	-2.251	-2.568
NLD	-2.445	-1.808	-2.112	**BEL**	-3.180	-2.322	-2.549
TUR	-2.639	-1.868	-2.096	**JAP**	-3.280	-2.391	-2.530
NOR	-3.098	-1.950	-2.080	**ESP**	-3.330	-2.453	-2.510
DNK	-3.124	-2.023	-2.074	**NLD**	-3.430	***-2.514***	-2.503
BEL	-3.158	***-2.090***	-2.068	**FRA**	-3.440	***-2.569***	-2.496
SWE	-3.762	***-2.183***	-2.062	**AUT**	-3.820	***-2.638***	-2.489
NZL	-3.788	***-2.267***	-2.056	**ITA**	-3.840	***-2.702***	-2.481
FIN	-3.807	***-2.344***	-2.050	**DNK**	-4.130	***-2.773***	-2.474
JAP	-3.991	***-2.423***	-2.045	**TUR**	-4.870	***-2.873***	-2.468
AUT	-4.001	***-2.494***	-2.040	**AUS**	-4.970	***-2.968***	-2.462
ESP	-4.969	***-2.602***	-2.035	**IRL**	-5.470	***-3.077***	-2.456
AUS	-5.245	***-2.712***	-2.030	**NZL**	-7.220	***-3.250***	-2.450

This table reports the unit root test results using cross-sectional means in the regression for both individual countries (in the column headed Time-series) and panel (Panel). The panel test reported in row i uses a panel of the first i countries. The number of lags used in the individual country test equations is determined using SBC. The maximum available sample is 1951 – 2003. 5% critical values based on CPLS are reported in the columns headed 5% CV. For the intercept only case the critical value in the first row is taken from Table 11 in CPLS and corresponds to an individual time-series test with T=50 and N=20. The panel critical values reported in rows 10, 15, 20 (and implicitly 30) are taken from Table 12 in CPLS all for T = 50 and with N = 10, 15, 20 (and 30), respectively. The intervening critical values are calculated using linear interpolation. For the intercept and trend case we generated critical values for row 1 (a time-series test with N=24 and T=50) and row 24 (a panel test with N=24 and T=50), the latter we denote CV_{24}. To obtain the intervening values we applied the growth rate (as a country is added to the panel) of the critical values for the intercept only case to the first critical value for intercept and trend and repeated this recursively to obtain initial critical values for all panel sizes including an initial value for the whole panel, denoted I_{24}. We then multiplied all of these initial values by (CV_{24}/I_{24}) to obtain the reported critical values. A panel statistic highlighted with bold italic emphasis indicates rejection of the unit root null.

Table 7: CPLS's test (OECD countries, LRCY)

Intercept				Intercept and trend			
Country	**Time-series**	**Panel**	**5% CV**	**Country**	**Time-series**	**Panel**	**5% CV**
PRT	-0.877	-0.877	-3.040	**GBR**	-1.501	-1.501	-3.470
SWE	-0.993	-0.935	-2.942	**IRL**	-1.530	-1.516	-3.551
GBR	-1.002	-0.957	-2.844	**NLD**	-1.550	-1.527	-3.433
ITA	-1.177	-1.012	-2.747	**SWE**	-1.640	-1.555	-3.315
IRL	-1.209	-1.052	-2.649	**ITA**	-1.900	-1.624	-3.197
NOR	-1.286	-1.091	-2.551	**GRC**	-2.200	-1.720	-3.079
NLD	-1.376	-1.131	-2.453	**CHE**	-2.360	-1.812	-2.961
GRC	-1.442	-1.170	-2.356	**BEL**	-2.560	-1.905	-2.843
MEX	-1.601	-1.218	-2.258	**JAP**	-2.600	-1.982	-2.725
JAP	-1.694	-1.266	-2.160	**USA**	-2.660	-2.050	-2.607
USA	-1.740	-1.309	-2.144	**MEX**	-2.700	-2.109	-2.588
CHE	-1.758	-1.346	-2.128	**CAN**	-2.740	-2.162	-2.568
CAN	-2.005	-1.397	-2.112	**PRT**	-2.800	-2.211	-2.549
LUX	-2.273	-1.460	-2.096	**FIN**	-2.970	-2.265	-2.530
BEL	-2.441	-1.525	-2.080	**AUS**	-3.060	-2.318	-2.510
AUT	-2.741	-1.601	-2.074	**DNK**	-3.060	-2.364	-2.503
DNK	-2.831	-1.673	-2.068	**NZL**	-3.089	-2.407	-2.496
FIN	-2.831	-1.738	-2.062	**AUT**	-3.180	-2.450	-2.489
ESP	-2.863	-1.797	-2.056	**NOR**	-3.490	***-2.505***	-2.481
AUS	-3.191	-1.867	-2.050	**ISL**	-3.900	***-2.575***	-2.474
NZL	-3.191	-1.930	-2.045	**LUX**	-3.940	***-2.640***	-2.468
FRA	-3.318	-1.993	-2.040	**FRA**	-4.250	***-2.713***	-2.462
ISL	-3.839	***-2.073***	-2.035	**ESP**	-4.330	***-2.783***	-2.456
TUR	-3.895	***-2.149***	-2.030	**TUR**	-5.490	***-2.896***	-2.450

See Table 6 notes.

Table 8: CPLS's test (Non-OECD countries, LCY)

Intercept				Intercept and trend			
Country	**Time-series**	**Panel**	**5% CV**	**Country**	**Time-series**	**Panel**	**5% CV**
COL	-0.374	-0.374	-3.060	**ISR**	-0.840	-0.840	-3.480
IND	-0.814	-0.594	-2.960	**ARG**	-1.230	-1.035	-3.592
ISR	-0.936	-0.708	-2.860	**THA**	-1.240	-1.103	-3.471
THA	-0.984	-0.777	-2.760	**PHL**	-1.380	-1.173	-3.350
ECU	-1.164	-0.854	-2.660	**URY**	-1.730	-1.284	-3.228
BRA	-1.248	-0.920	-2.560	**BRA**	-1.840	-1.377	-3.107
PHL	-1.251	-0.967	-2.460	**TTO**	-1.890	-1.450	-2.986
ARG	-1.333	-1.013	-2.360	**ECU**	-1.900	-1.506	-2.864
KEN	-1.362	-1.052	-2.260	**TWN**	-1.960	-1.557	-2.743
TWN	-1.463	-1.093	-2.160	**PER**	-2.000	-1.601	-2.621
URY	-1.466	-1.127	-2.144	**COL**	-2.300	-1.665	-2.602
NIC	-1.597	-1.166	-2.128	**PRY**	-2.390	-1.725	-2.583
BOL	-1.639	-1.202	-2.112	**IND**	-2.580	-1.791	-2.563
PER	-1.761	-1.242	-2.096	**EGY**	-2.600	-1.849	-2.544
TTO	-1.978	-1.291	-2.080	**PAK**	-2.660	-1.903	-2.524
NGA	-2.065	-1.340	-2.074	**DOM**	-2.840	-1.961	-2.517
PAK	-2.268	-1.394	-2.068	**HND**	-2.840	-2.013	-2.510
EGY	-2.417	-1.451	-2.062	**CRI**	-3.020	-2.069	-2.503
PAN	-2.469	-1.505	-2.056	**BOL**	-3.180	-2.127	-2.495
GTM	-2.554	-1.557	-2.050	**CHL**	-3.450	-2.194	-2.488
HND	-2.576	-1.606	-2.045	**SLV**	-3.480	-2.255	-2.482
PRY	-2.594	-1.651	-2.040	**LKA**	-3.540	-2.313	-2.476
DOM	-2.633	-1.693	-2.035	**NGA**	-3.640	-2.371	-2.470
CRI	-2.644	-1.733	-2.030	**GTM**	-3.730	-2.428	-2.464
MAR	-2.674	-1.771	-2.025	**VEN**	-3.850	***-2.484***	-2.458
ZAF	-2.899	-1.814	-2.020	**PAN**	-3.890	***-2.538***	-2.452
SLV	-3.143	-1.863	-2.015	**KEN**	-3.900	***-2.589***	-2.445
CHL	-3.300	-1.915	-2.010	**ZAF**	-3.930	***-2.637***	-2.439
ETH	-3.457	-1.968	-2.005	**MAR**	-3.950	***-2.682***	-2.433
VEN	-3.579	***-2.021***	-2.000	**NIC**	-4.280	***-2.735***	-2.427
LKA	-3.629	***-2.073***	-1.998	**ETH**	-4.550	***-2.794***	-2.425
UGA	-4.353	***-2.145***	-1.996	**UGA**	-5.140	***-2.867***	-2.422
MUS	-5.899	***-2.258***	-1.994	**MUS**	-6.230	***-2.969***	-2.420

See Table 6 notes, except that critical from CPLS's Table 11 for T = 50 and N = 30 is reported in the first row for the intercept only case. In addition, the critical values for T = 50 and N = 50 from Table 12 are also implicitly used to calculate the reported critical values for the intercept only case. For the intercept and trend tests we simulated the critical values for the first and last row of the table and employed the procedure discussed in Table 6 to calculate the intervening critical values.

Table 9: CPLS's test (Non-OECD countries, LRCY)

Intercept				Intercept and trend			
Country	**Time-series**	**Panel**	**5% CV**	**Country**	**Time-series**	**Panel**	**5% CV**
COL	-0.637	-0.637	-3.060	**ISR**	-0.930	-0.930	-3.480
ISR	-0.736	-0.687	-2.960	**BOL**	-0.950	-0.940	-3.592
NGA	-0.802	-0.725	-2.860	**COL**	-1.086	-0.989	-3.471
BRA	-0.828	-0.751	-2.760	**CRI**	-1.440	-1.102	-3.350
PER	-0.876	-0.776	-2.660	**ECU**	-1.450	-1.171	-3.228
BOL	-1.198	-0.846	-2.560	**URY**	-1.450	-1.218	-3.107
TWN	-1.421	-0.928	-2.460	**ARG**	-1.690	-1.285	-2.986
CRI	-1.697	-1.024	-2.360	**BRA**	-1.710	-1.338	-2.864
ARG	-1.699	-1.099	-2.260	**PER**	-1.910	-1.402	-2.743
IND	-1.784	-1.168	-2.160	**TWN**	-2.130	-1.475	-2.621
MUS	-1.976	-1.241	-2.144	**SLV**	-2.220	-1.542	-2.602
UGA	-1.993	-1.304	-2.128	**DOM**	-2.230	-1.600	-2.583
ETH	-2.022	-1.359	-2.112	**ETH**	-2.400	-1.661	-2.563
ECU	-2.027	-1.407	-2.096	**GTM**	-2.660	-1.733	-2.544
DOM	-2.148	-1.456	-2.080	**TTO**	-2.710	-1.798	-2.524
NIC	-2.161	-1.500	-2.074	**PHL**	-2.790	-1.860	-2.517
EGY	-2.459	-1.557	-2.068	**ZAF**	-2.970	-1.925	-2.510
PHL	-2.501	-1.609	-2.062	**PAK**	-2.980	-1.984	-2.503
TTO	-2.614	-1.662	-2.056	**IND**	-2.990	-2.037	-2.495
PRY	-2.687	-1.713	-2.050	**CHL**	-3.080	-2.089	-2.488
VEN	-2.769	-1.764	-2.045	**PRY**	-3.120	-2.138	-2.482
URY	-2.798	-1.811	-2.040	**UGA**	-3.160	-2.184	-2.476
ZAF	-2.801	-1.854	-2.035	**LKA**	-3.290	-2.232	-2.470
THA	-3.314	-1.914	-2.030	**VEN**	-3.380	-2.280	-2.464
KEN	-3.335	-1.971	-2.025	**THA**	-3.460	-2.327	-2.458
LKA	-3.335	-2.024	-2.020	**NGA**	-3.610	-2.377	-2.452
GTM	-3.491	-2.078	-2.015	**MUS**	-3.620	-2.423	-2.445
SLV	-3.519	***-2.130***	-2.010	**HND**	-3.880	***-2.475***	-2.439
CHL	-3.602	***-2.180***	-2.005	**EGY**	-3.890	***-2.524***	-2.433
PAN	-4.203	***-2.248***	-2.000	**KEN**	-4.060	***-2.575***	-2.427
HND	-4.381	***-2.317***	-1.998	**NIC**	-4.100	***-2.624***	-2.425
PAK	-4.448	***-2.383***	-1.996	**MAR**	-4.290	***-2.676***	-2.422
MAR	-4.573	***-2.450***	-1.994	**PAN**	-4.940	***-2.745***	-2.420

See Table 6 and 8 notes.