Is the average propensity to consume stationary in the long run? Testing panel data for unit roots exploiting the cross-sectional dependence, 1952-2014 *†

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This study applies the Panel Analysis of Nonstationarity in Idiosyncratic and Common components – PANIC – methodology to test for unit roots in the common and idiosyncratic components of the average propensity to consume (APC). We use data of 30 heterogeneous countries from 1952 to 2014 from PWT 9.0, exploiting the cross-sectional dependence. The method tests the unobserved components of the APC instead of the observed series, in which T (the number of time series observations) and N (the number of units) are both quite large. The findings suggest that APC have statistically significant pervasive and idiosyncratic nonstationarity sources in the long run. Further, based on a semiparametric panel factor model which does not rely on the data stationarity condition, the estimates suggest that the marginal propensity to consume is 55 percent on average, accounting for a time-varying common unobserved (and potentially nonstationary) factor. This result implies lower estimates for the fiscal multiplier. As a specification test, we adopt a testing procedure for the absence of common factors introduced by Kneip et al. (2012). We reject the null of the absence of common factors at 1% probability level. The evidence of nonstationary sources in both APC unobserved components suggests that there is little role to be played by intertemporal substitution.

Keywords: Consumption-income ratio; Panel unit root tests; Heterogeneous time trends.
JEL Classification: E21; C23.

Este estudo utiliza testes de não estacionariedade para analisar componentes comuns e idiossincráticos da propensão média a consumir (PMC) de 30 países heterogêneos no período de 1952 a 2014 com dados da PWT 9.0. O método testa os componentes não observados da PMC ao invés de analisar os dados observados, em que T (o número de observações de séries temporais) e N (o número de unidades) podem assumir grandes dimensões. Os resultados sugerem que a PMC apresenta fontes não estacionárias estatisticamente significativas em ambos os componentes. Além disso, com base em um modelo para painel com efeitos fixos variando no tempo, que não depende da condição de estacionariedade dos dados, estimativas eficientes

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e não viesadas sugerem que a propensão marginal a consumir é de 55% em média. Este resultado implica um multiplicador fiscal de menor magnitude na presença de fatores comuns subjacentes aos dados. O teste de dimensionalidade (especificação) indica a rejeição da ausência de fatores comuns a 1% de probabilidade. A evidência de fatores não estacionários em ambos os componentes não observados da PMC sugere que a substituição intertemporal não é um parâmetro crucial nessas economias.

Palavras-chave: Propensão média a consumir; Teste para raiz unitária em painel; Dependência de cross-section.
JEL Classification: E21; C23.
Área ANPEC: **06 - Macroeconomia.**

1 Introduction

Consumption accounts for about 2/3 of the product and constitutes a relatively stable proportion of GDP when compared to private investment in almost all countries. In times of high unemployment, the consumption of households keeps economic activity at a minimum, preventing a recessive spiral of great magnitude. With an unanticipated drop in income, consumption may remain stable for some periods because agents likely maintain its consumption pattern through bank credit.[1]

However, household indebtedness, after exceeding a limit value, can contribute to destabilizing production. In the face of major events, such as the 2008 financial crisis and following the Great Recession, the response to economic shocks of the average propensity to consume (APC) and its magnitude is also related to the size of fiscal policy multiplier.

Counter-cyclical policies and their effectiveness in the economy depend, among other things, on the magnitude of the APC parameter. In addition, the time series and cross-section properties of the APC also have important effects upon the standard of living in the long run because the savings rate and the equilibrium capital stock are typically both functions of it. Cerrato et al. (2013) note that savings ratio is an important issue given the profound imbalances across different countries. Trade deficits can be caused by a decline in saving ratio, along with the government budget deficit.

The APC magnitude and its response to shocks also has strong implications for the elasticity of intertemporal substitution in consumption, a crucial parameter for a wide range of theoretical models involving intertemporal choice. In a theoretical model designed to explain the equity premium, Rodriguez (2006) has argued that the households' consumption process can be decomposed into a transitory and a permanent component. In the same line of reasoning, Quah (1992) has demonstrated that for any integrated time series Y_{it} there is a likely decomposition into a permanent and a transitory component.

However, as observed by Bai and Ng (2004), the sum of two different time series can have dynamic properties very diverse from the individual ones. If one is able to assume that $Y_{it} = Y_1 + Y_0$ and if Y_1 is I(1) and Y_0 is I(0), it would be very difficult to determine if unit root exists in Y_{it} based on widely used univariate unit root tests. According to Rodriguez (2006), if a transitory component in consumption empirically exists it highlights the crucial role of the elasticity of intertemporal substitution parameter, relative to alternative theoretical models in which all innovations are assumed to exhibit permanent effects (as modeled by Mehra and Prescott (1985) and the following literature).

Another strand of the literature emphasizes the role of the APC response to innovations and its implications to alternative consumption theories. If the APC can be considered stationary, a

[1]The present study is based upon the notion of unanticipated income shocks that can produce permanent or transitory effects on consumption discussed in Jappelli and Pistaferri (2010). The authors observe that "for working-age individuals, the most important source of uncertainty is labor income."

long run equilibrium exists between income and household consumption, despite negative unanticipated random shocks. Cerrato et al. (2013) argue that a large body of consumption theories predicts that APC converges to a constant in the long run. For example, the Keynesian theory of absolute income, the Duesenberry's relative income hypothesis and Friedman's permanent income hypothesis imply a stationary APC.

The main objective of the present study is to verify whether unobserved common and idiosyncratic components of the APC country-level data presents stationary sources in the long run, exploiting the cross-sectional dependence across units. The emergence of new methods for testing the panel unit root hypothesis (called second generation tests) and the availability of good quality information (PWT 9.0) allow us for testing known hypotheses of consumer behavior that present conflicting results (see below). In addition, we estimate the marginal propensity to consume adopting a new class of panel data model which assume the unobservable heterogeneous effects present a factor structure.

The results of previous studies for samples from 20 to 23 OECD countries are mixed and lead to conflicting conclusions. Sarantis and Stewart (1999) used annual data to test the APC nonstationary hypothesis allowing for unobserved heterogeneity, and conclude that the findings strongly support the hypothesis of nonstationary in all APC series in their OECD sample countries. Gardes and Madre (1990), with panel data for France, reject the hypothesis of Friedman's permanent income.

Cook (2005), using hypothesis testing for univariate series for the same sample countries of Sarantis and Stewart (1999), concludes that the data are stationary. His conclusions contradict the findings of Sarantis and Stewart (1999). More recently, Fallahi (2012) used bootstrap confidence intervals for testing the APC unit root hypothesis and conclude that all the series of the consumption-income ratio are nonstationary for the period 1950-2007 in a sample of 23 OECD countries. Fallahi (2012)'s conclusion is a restatement of the initial assertion of Sarantis and Stewart (1999).

We enter this discussion by taking into account some properties of cross-section and times series data not addressed in the above-mentioned studies that can potentially affect their conclusions (see Baltagi and Pesaran, 2007). The common drawback of all the above-mentioned studies is the potential influence of dependence between observations typically assumed to be nonexistent, which may result in misleading inferences about the properties of panel data series (Bai and Ng, 2004; Bai and Ng, 2002; Pesaran, 2015). If cross-section dependence is present in data, the asymptotic distribution of unit root statistic test is not valid for inference (Cerrato and Sarantis, 2007). The first generation of panel unit root tests are inadequate and could lead to significant size distortions in the presence of neglected cross-section dependence (Baltagi and Pesaran, 2007, p. 229).

There have been unpredictable innovations on income in several countries since 1950, including the Oil Price increases in 1973 and the more recent turmoil caused by the 2008 U.S. financial crisis. There are good reasons to assume that these innovations affect all countries in some specific form and, hence common factors are likely to be present in these data.

To the best of our knowledge, this is the first paper to address the issue of nonstationarity in unobserved components of APC by applying the methods of PANIC introduced by Bai and Ng (2004). The methods employed in the present paper solve three different issues in panel unit root tests. First, the problem of size distortion in the existing tests which leads to over-rejection of the null when the series being tested is the sum of a weak I(1) component and a strong stationary one. Second, the pooled tests based on the residuals are more likely to satisfy the hypothesis of cross-section independence required for pooling. Third, valid pooled tests exploit cross-section information and have more power than univariate unit root standard tests. The tests are conducted in a way that it does not require knowing previously the order of integration of the factors.

The present study provides four main contributions to this literature. First, the selected variables come from a newly organized database, which is a valuable source of information for macroeconomic analysis: the Penn World Table 9.0, described in detail in Feenstra et. al. (2015). Second, instead of assuming the cross-sectional independence, we follow Pesaran (2015) in testing this hypothesis in a larger panel data, extending the sample of countries initially studied by Sarantis and Stewart (1999) and Cook (2005).

Third, the method employed is able to distinguish between pervasive and idiosyncratic sources of nonstationarity in data exploiting the comovement of the series and its cross-sectional dependence. Lastly, based on a semiparametric panel factor model which does not rely on the data stationarity condition, we obtain an unbiased and efficient estimate of the marginal propensity to consume, accounting for a time-varying common unobserved (and potentially nonstationary) factor. All these additions are absent in previous related studies.

Cerrato et al. (2013) also test for nonstationarity in the APC using data ranging from 1951-2003 of 24 OECD countries and 33 non-OECD countries applying methods that address cross-sectional dependence. Despite using very different methods, based on the unit root test for panels suggested by Pesaran (2007), their conclusions are in line with the results presented in the present paper.

In relation to Cerrato et al. (2013), beyond the above mentioned contributions, we adopt both larger T and N along with a different approach based on a factor structure that is able to evaluate the nonstationarity properties of common and idiosyncratic unobserved factors in panel data instead to test the observed series itself. The main drawback of the Cerrato et al. (2013) is to apply a nonlinear unit root test to panel data only *assuming* a specific type of nonlinearity in the series, without performing tests to evaluate such hypothesis.

The remainder of the paper is organized as follows: Section 2 briefly presents the methodology and describes the data used in the paper. Section 3 presents the results and discusses the main findings, while Section 4 concludes the paper.

2 Methodology and data description

2.1 Data description

The average propensity to consume in the economy is measured by the (log of) consumption-income ratio of each country in the sample ranging from 1951 to 2014 (yearly frequency). For comparison purposes, we initially adopt the same sample countries (N=20) of Sarantis and Stewart (1999). This sample was also used by Cook (2005) consisting of Australia (AUS), Austria (AUT), Belgium (BEL), Canada (CAN), Denmark (DNK), Finland (FIN), France (FRA), Germany (DEU), Greece (GRC), Iceland (ISL), Ireland (IRL), Italy (ITA), Japan (JPN), Netherlands (NLD), Norway (NOR), Spain (SPA), Sweden (SWE), Switzerland (CHE), England (GBR) and United States (USA). In the second stage of the present paper, we extend the original sample by including 10 additional countries from OECD and developing economies.

The initial idea is to compare the results obtained in the two above-mentioned papers so that they can then be extended to an expanded sample of countries, whose data are available in the Penn World Table 9.0 (PWT 9.0). We obtain both real household consumption (in dollars, 2011 prices, **rconna**) and the real output (in dollars, 2011 prices, **rgdpna**) from the PWT9.0 website:
https://www.rug.nl/ggdc/productivity/pwt/. Table 1 presents the complete list of 30 countries for which the analysis is carried out in the present study.

Table 1: Extended sample of countries, based on PWT 9.0 database.

Country name	*isocode*	*Country name*	*isocode*	*Country name*	*isocode*
1. Australia	AUS	11. Ireland	IRL	21. Cyprus	CYP
2. Austria	AUT	12. Italy	ITA	22. Luxembourg	LUX
3. Belgium	BEL	13. Japan	JPN	23. Philippines	PHL
4. Canada	CAN	14. Netherlands	NLD	24. South Africa	ZAF
5. Denmark	DNK	15. Norway	NOR	25. Portugal	PRT
6. Finland	FIN	16. Spain	ESP	26. Turkish	TUR
7. France	FRA	17. Sweden	SWE	27. Brazil	BRA
8. Germany	DEU	18. Switzerland	CHE	28. China	CHN
9. Greece	GRC	19. England	GBR	29. India	IND
10. Iceland	ISL	20. United States	USA	30. Pakistan	PAK

According to the availability of data in PWT 9.0 for the period 1952-2014, our extended sample consists of 30 countries: 16 European Union countries (EU-28), plus Japan, the United States, Canada, Australia, three countries of the European Free Trade Association (EFTA): Iceland, Norway and Switzerland, and 6 developing countries (Philippines, South Africa, Brazil, China, India and Pakistan). Hence, our extended sample has N*T=30*63=1890 observations in total.

The traditional panel data model assumes that the unobserved factors are fixed in time, but when T is large this assumption in often implausible. Recently, Kneip et al. (2012) suggested a factor structure model which allows estimating the parameter of interest accounting for time-varying underlying (stationary as well as nonstationary) common factors. We adopt the semiparametric approach of Kneip et al. (2012) to estimate the marginal propensity to consume (MPC). Hence, our results for MPC parameter account for time-varying unobserved common factors in the relationship between the (log of) per capita consumption and the (log of) per capita real GNP. We obtain per capita consumption and per capita income using the population levels extracted from PTW9.0 database.

2.2 Cross-sectional independence and unit root tests in panels

Consider the following panel data model, given by:

$$y_{it} = \alpha_i + \beta_i x_{it} + \lambda_t + u_{it}, \text{for } i = 1,2,\ldots,N;\ t = 1,2,\ldots,T, \tag{1}$$

where i refers to the cross-section dimension and t is the time period, λ_t is a parameter which measure the business cycle effects, x_{it} is a k x 1 vector of observed regressors, for each i, u_{it} $\sim$ IID(0,σ^2_{iu}) for all t. The null of cross-sectional independence of the errors are based on the pair-wise correlation coefficient of the residuals ($\hat{\rho}_{ij}$), for the (i,j) units assuming homogeneous or heterogeneous slopes. Based on (1), we adopt the scaled version of the Lagrange multiplier statistic suggested by Breusch and Pagan (1980) designed to test the null of cross-section independence when both N and T are large, given by:

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

Additionally, we also apply the more recently developed CD statistic proposed by Pesaran (2015), designed for testing the null of cross-sectional independence when both N and T tend to infinity at the same rate.[2] The CD statistic is given by:

[2]Pesaran (2015) demonstrates that the CD statistic have good power in the small sample even if some regressors

$$CD = \sqrt{\frac{2T}{N(N-1)}} \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} (\hat{\rho}_{ij}) \tag{3}$$

where $\hat{\rho}_{ij}$ is the sample estimate of the pair-wise correlation of the OLS residuals, given by:

$$\hat{\rho}_{ij} = \frac{\sum\limits_{i=1}^{T} e_{it} e_{jt}}{(\sum\limits_{i=1}^{T} e_{it}^2)^{1/2} (\sum\limits_{i=1}^{T} e_{jt}^2)^{1/2}} \tag{4}$$

where e_{it} is the the OLS estimate of u_{it} obtained from (1). The assumption of cross-section independence may be reasonable for small N (10 or fewer observations), but it seems unrealistic for larger cross-section and times series data. The first generation of unit root panel tests assume the independence of observations and the most used statistical tests are based on Im et al. (2003) and Levin et al. (2002).

The initial objective of unit root panel tests development is to gain greater power when compared to univariate unit root tests by considering both the cross-section and times series dimension of data. The power of the unit root tests in panel data is greater than the power of the unit root tests in univariate time series variables because these tests exploit both the time series and cross-sectional dimension of the data (Bai and Ng, 2004; Cerrato and Sarantis, 2007).

An additional feature of the first generation of unit root tests for panel models is the possibility of introducing unobserved heterogeneity between countries, cities or regions, etc. Consider N countries over T periods of time. Let the variable y_{it} be the average propensity to consume (log of the consumption-income ratio), which is generated by an autoregressive process, described by:

$$y_{it} = (1-\phi_i)\mu_i + \phi_i y_{i,t-1} + u_{it},\ i = 1,\ldots,N,\ t = 1,\ldots,T, \tag{5}$$

where initial values y_{i0} are given, and μ_i are unobserved factors, which may vary from country to country but change very little over time (roughly constant). In this model, the null hypothesis of unit root, $\phi_i = 1$, can be tested against the alternative, $\phi_i < 1$. This model is representative of the first generation of unit root tests in panel data typically assuming the independence between the observations, taking into account the (time-invariant) unobserved heterogeneity in the sample.

When the hypothesis of cross-section independence is rejected in a statistical test, one can use the methodology introduced by Bai and Ng (2004) for testing unit roots in common and idiosyncratic components separately. In this case, the dependence structure between the observations is consistently used to infer the properties of the common factors to all countries and also on the idiosyncratic component of each observation.

In a context of cross-section dependence, consider X_{it} the (log of) average propensity to consume in the country i in the period t whose data generating process is given by:

$$X_{it} = c_i + \beta_i t + \lambda_i^{'} F_t + e_{it},\ t = 1,\ldots,T. \tag{6}$$

$$F_{mt} = \alpha_m F_{mt-1} + u_{mt},\ m = 1,\ldots,r. \tag{7}$$

$$e_{it} = \rho_i e_{it-1} + \varepsilon_{it},\ i = 1,\ldots,N, \tag{8}$$

where c_i and β_i describe the trend of data and λ_i is the vector of factor weight. The m common component of the data is considered stationary if the null hypothesis $\alpha_m = 1$ is rejected against the alternative hypothesis $\alpha_m < 1$ for $m = 1,\ldots,r$.

are weakly exogenous and/or are stationary or nonstationary.

The idiosyncratic component of the countries, e_{it}, which is independent of the observations, is considered stationary if the null hypothesis $\rho_i = 1$ is rejected against the alternative hypothesis $\rho_i < 1$ for some i of the sample. According to Bai and Ng (2004), a series X_{it} can be considered nonstationary if one or more of its common factors are nonstationary, or the idiosyncratic component e_{it} is nonstationary, or both conditions are met.

Under the null hypothesis that $\rho_i = 1$, Bai and Ng (2004) derive the test statistic given by:

$$DF^c_{(\hat{e})}(i) = \frac{\sum_{t=2}^{T} \hat{e}_{it-1}\Delta\hat{e}_{it}}{(\hat{\sigma}^2_{\varepsilon i}\sum_{t=2}^{T}\hat{e}^2_{it-1})^{1/2}} \tag{9}$$

where $\hat{\sigma}^2_{\varepsilon i} = \sum_{t=2}^{T}(\Delta\hat{e}_{it} - \hat{b}_i\hat{e}_{it-1})^2/T-1$ and $\hat{b}_i$ is the OLS estimator when regressing $\Delta\hat{e}_{it}$ on $\hat{e}_{it-1}$. And, the Dickey-Fuller statistic for testing the null hypothesis that $\alpha_m = 1$ based on $\hat{F}_t$ with demeaning is given by:

$$DF^c_{(\hat{F})} = \frac{\sum_{t=2}^{T}(\hat{F}_{t-1} - \bar{\hat{F}})\Delta\hat{F}_t}{(\hat{\sigma}^2_u\sum_{t=2}^{T}(\hat{F}_{t-1} - \bar{\hat{F}})^2)^{1/2}} \tag{10}$$

where $\bar{\hat{F}} = \sum_{t=2}^{T}\hat{F}_t/(T-1)$ and $\hat{b}_i$ is the OLS estimator when regressing $\Delta\hat{e}_{it}$ on $\hat{e}_{it-1}$. The empirical strategy of this method is based on analyzing the properties of both unobserved factors preserving their order of integration, applying the principal components method on the first difference of the data. This means that no prior information is required on the order of integration of the series before the estimation of these components. After all, we can test the unit root hypothesis in both of them. The number of factors required to describe the data is determined by the information criterion developed by Bai and Ng (2002).

After knowing that APC cannot be considered stationary, we are interested in estimating the marginal propensity to consume for the sample of 30 heterogeneous countries, a widely used parameter in macroeconomic models. Since we do not find evidence to reject the null of nonstationarity, we adopt a semiparametric estimator that does not rely on the stationarity condition in data. The panel factor model suggested by Kneip et al. (2012) can be specified as:

$$y_{it} = \sum_{j=1}^{P} x_{it}\beta + \upsilon_i(t) + \varepsilon_{it} \tag{11}$$

where y_{it} is the (log of) per capita consumption and x_{it} (log of) per capita real GNP in our extended sample of countries. Further, the time-varying individual effects $\upsilon_i(t)$ have a structure of common nonparametric basis functions $f_1 t, \ldots, f_d t$, such that:

$$\upsilon_i(t) = \sum_{l=1}^{d} \lambda_{il} f_l t. \tag{12}$$

where d is the unknown factor dimension. We use $d = 1$ obtained from the BIC3 criterion of Bai and Ng (2002). The proposed model based on a factor structure may include strongly positively autocorrelated stationary as well as nonstationary factors. Kneip et al. (2012) suggest to approximating the time-varying individual effects $\upsilon_i(t)$ by smooth nonparametric functions. Thus, the model (12) becomes a semiparametric model and its estimation procedure involves a two-step procedure described in Kneip et al. (2012).

The evaluation of model specification is an important step for an empirical analysis. Thus, we adopt a formal hypothesis testing procedure to examine the existence of common factors based on a test statistic introduced by Kneip et al. (2012). The dimensionality test of Kneip et al. (2012) is given by the following test statistic:

$$J_{KSS} = \frac{n.tr(\hat{\Sigma}_w) - (n-1)(T-1)\hat{\sigma}^2}{\sqrt{2n}(T-1)\hat{\sigma}^2} \sim N(0,1). \quad (13)$$

where $\hat{\Sigma}_w$ is the covariance matrix of the within residuals, n is the number of time-varying individual effects, T is the sample size and $\hat{\sigma}^2$ is a variance estimator. We reject H0: $d = 0$ against $d > 0$ at a significance level α if the $J_{KSS} > z_{1-\alpha}$, where $z_{1-\alpha}$ is the $(1-\alpha)$-quantile of the normal distribution.

3 Results and discussion

This section present the results for the first generation of unit root tests for panel data, based on the assumption of independence across units. Table 2 presents the results based on the method suggested by Im et. al. (2003). The results are based on Eq. (1) with constant and also with constant and trend. The maximum lag length is $k = 10$ and the optimal lag is selected by the SIC criterion.

Table 2: Im. et al. unit root tests - Eq. (5).

	Dependent variable: log(C/GNP)	*const.*	*const. and trend*
$N = 20$	z-statistic	-0.37942	-0.85459
		(0.3522)	(0.1964)
$N = 30$	z-statistic	-1.5642*	-2.2686**
		(0.0589)	(0.01164)

***P*-values** are in parenthesis.

From the above results, as shown by the *p*-value of each model, we conclude that the null hypothesis of a unit root cannot be rejected at conventional probability levels (1% or 5%) for the sample originally used by Sarantis and Stewart (1999). This preliminary result indicates that negative shocks on the average propensity to consume, such as the 2008 financial crisis is likely to produce a permanent effect on its path in the long run. This is the main finding of Sarantis and Stewart (1999). However, their results can be sensitive to the dimension of *N* countries in their sample. Hence, we apply the methods of Im test. et. (2003) to the expanded sample of countries ($N = 30$).

Therefore, by increasing the number of countries and also the time periods, i.e., for a larger set of information, there is suggestive evidence that the null nonstationarity can be rejected at 5% probability. This result contrasts with those obtained by Fallahi (2012) and Sarantis and Stewart (1999), who conclude that the APC is nonstationary in most countries. These findings support the conclusions of Cook (2005).

However, the more fundamental assumption of the test introduced by Im et. al. (2003) and also by Levin et al. (2002) is cross-sectional independence: the elements outside the main diagonal of the variance-covariance matrix of the residuals are zero. When this assumption is not met, the distribution of test statistics obtained by the authors is no longer valid (Cerrato and Sarantis, 2007). This hypothesis of independence is hardly met when analyzing the joint behavior of many economies that may share unobserved common factors.

Table 3 presents the results for the null hypothesis of cross-section independence, based on the LM statistic of Breusch and Pagan (1980) and also on the *CD* statistic, suggested by Pesaran (2015). According to both statistical tests, the null hypothesis of cross-section independence is rejected at 1% probability level.

Table 3: LM test statistic and Pesaran's cross-section independence test.

Sample used	CD_{lm} *statistic*	*CD statistic*
$N = 20$	1226.800***	26.817***
	(0.0000)	(0.0000)
$N = 30$	1484.700***	20.597***
	(0.0000)	(0.0000)

(***) Sig. at 1%.

***P*-values** are in parenthesis.

Both tests for cross-section independence unambiguously indicate rejection of the null hypothesis at 1% probability level to the sample countries used by Sarantis and Stewart (1999) and the extended sample with 30 heterogeneous countries. Above results are the main motives to adopt the methods introduced by Bai and Ng (2004) in the present paper.

The results of the LM and CD tests indicate that the methods adopted by Sarantis and Stewart (1999) and Cook (2005) may lead to false conclusions about whether the APC is stationary or not. In the following, we present the results of statistical tests based on the method introduced by Bai and Ng (2004) which accounts for cross-section dependence in deciding whether a panel times-series data present nonstationary factors or not.

Table 4 presents the results for the null hypothesis of a unit root in the common and idiosyncratic components of the series for original ($N = 20$) and the extended sample of countries ($N = 30$). We set the maximum number of factors at 8 and the maximum lag length is 4. Besides, we follow Bai and Ng (2002) to determine the number of factors using BIC3. According to both calculated statistical values, the null hypothesis of pervasive nonstationarity and idiosyncratic nonstationarity cannot be rejected in the sample of 30 countries at 5% probability level.

For the smaller sample, there is evidence against the null of nonstationarity in the common component of data at 5% probability level. But the null of nonstationary cannot be rejected for the idiosyncratic components. Since the nonstationarity property of the APC observed series is generated by both common and idiosyncratic components, this last result indicate that the APC in the sample of 20 countries cannot be considered stationary yet.

Table 4: Bai and Ng panel unit root tests for common and idiosyncratic components.

	Null hypothesis	*Statistic*	*Critical value (5%)*	*r*
$N = 20$	$\rho_i = 1$	0.9944	-1.96	1
	$\alpha_m = 1$	-3.1676**	-2.86	1
$N = 30$	$\rho_i = 1$	0.9661	-1.96	1
	$\alpha_m = 1$	0.0030	-2.86	1

(**) Sig. at 5%.

We perform an additional exercise estimating the marginal propensity to consume of the countries accounting for the potential influence of cross-sectional dependence in data and a time-varying nonstationary common factor. As the *CD* and *LM* statistics have shown, there is substantial evidence of cross-section dependence underlying these data.

For comparison purposes, we adopt both the first difference (FD) specification model widely used in the panel literature dealing with high persistent series and the semiparametric factor panel model which take into account the time-varying common factor underlying these data. We use FGLS estimator along with FD specification model because we have nonstationary data and potentially heteroskedastic and serially correlated idiosyncratic errors.

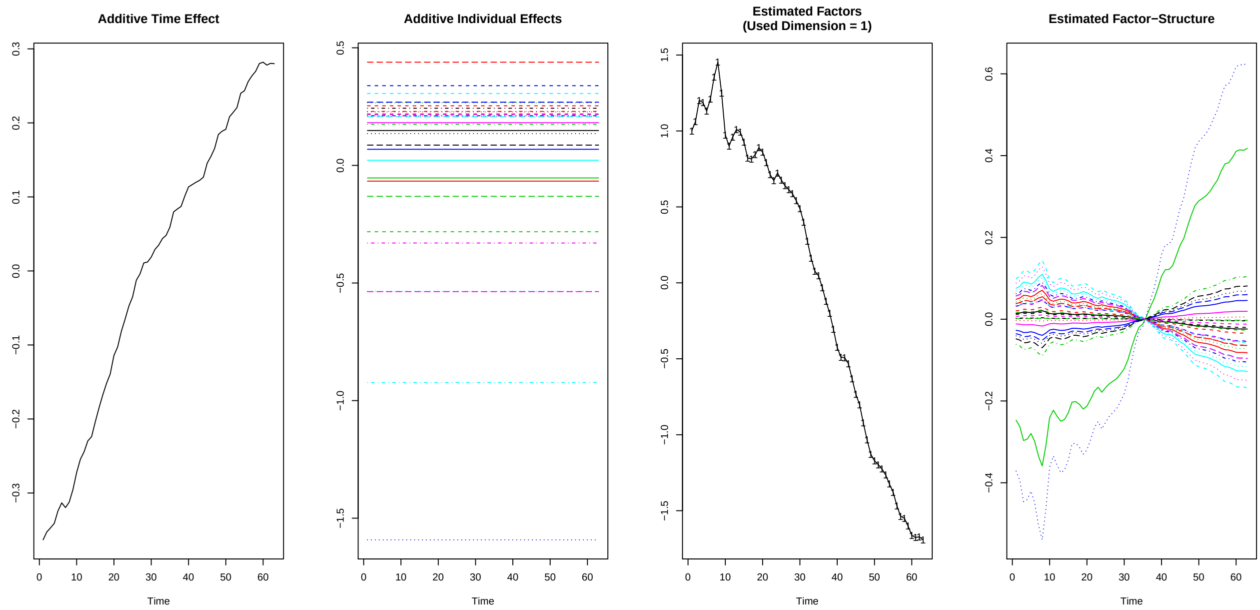

Figure 1: Time-varying common factor and the estimated factor structure, 1952-2014. $N = 30$.

Table 5 presents contrasting results to the value of marginal propensity to consume. Assuming that there is no cross-section dependence in these sample of countries, the MPC is 76.8% on average. However, the unbiased and efficient estimate of 55% generated by the semiparametric factor panel model shows that the parameter of interest is very lower than FD specification model delivered.

Jappelli and Pistaferri (2014) estimate the marginal propensity to consume in Italy at 48% on average. Thus, the unbiased result we present seems to be very close to other studies. In contrast, Stockhammer and Wildauer (2016) adopt FD specification model by assuming cross-section independence between countries and their findings to the MPC in OECD countries seem to be very higher when compared to our semiparametric estimates.

Table 5: FD specification model – FGLS (1) and time-varying common factor model (11).

Variable	*FD-FGLS*	*time-varying common factor*
Intercept	——	4.0400***
	——	(4.260)
log(per capita GNP)	0.76801***	0.5490***
	(378.15)	(5.58)
R^2	0.999	0.998
Total observations	1890	1890

Notes: *** Significant at 1% probability level; t-statistics are into brackets.

Summing up, two major messages emerge from the above results. First, the null of nonstationarity into the pervasive and idiosyncratic components of the APC series cannot be rejected at any conventional level of significance. This finding implies that allowing the APC to be the sum of two separate components does not imply stationarity, has been assumed by Rodriguez (2006). The empirical findings suggest that the elasticity of substitution plays a very little or insignificant role in consumption.

Second, the unbiased marginal propensity to consume of the countries is lower than the FD model delivered based on cross-section independence assumption. In average, the unbiased marginal propensity to consume is 55%.

These findings imply that the fiscal multiplier is likely to be lower than some authors have found based on cross-section independence assumption when this feature is present in data. Besides, as an explanation for APC to be nonstationary, Molana (1989) have suggested that consumption is homogeneous of degree one in lifetime resources referring to income and wealth.

This may explain why most of the works find APC nonstationary in countries: it suggests that consumption does not form a cointegrating vector solely with income. Indeed, Keynesian theories suggest that variables beyond income determine equilibrium consumption in countries (e.g., personal income inequality, housing wealth, financial wealth and household debt) (see Stockhammer and Wildauer, 2016).

Table 6 shows the results for the specification test in which we test the absence of common factors ($d = 0$) against the existence of common factors in countries ($d > 0$). We reject the absence of common factors at 1% and 5% probability levels. Hence, we conclude that our specified model describes reasonably the data at hand.

Table 6: Testing for the existence of common factors - Eq. (13).

Calculated statistic	*Critical value*
316.56***	2.33

*** Significant at 1% probability level.

4 Conclusions

The main objective of the present study is to test for the unit root hypothesis in the common and idiosyncratic components of the average propensity to consume (APC) by using data of 30 heterogeneous countries from 1952 to 2014, exploiting the cross-sectional dependence as a natural characteristic of the data.

We perform an additional exercise by comparing the estimates from the FD model based on the cross-sectional independence assumption – and also based on the assumption that unobserved effects are fixed in time – to the Kneip et al. (2012) semiparametric estimator accounting for the time-varying common (with a potentially nonstationary) factor underlying these data.

The main findings suggest that APC presents statistically significant pervasive and idiosyncratic nonstationarity sources in the long run. Further, the marginal propensity to consume is 55 percent on average, accounting for a time-varying common unobserved (and potentially nonstationary) factor. This finding implies a lower fiscal multiplier than have been found in correlated studies.

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