Alcohol Consumption in European Countries

Time series based tests of convergence

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Consommation d'alcool dans les pays européens : tests de convergence sur séries temporelles

Résumé – Au début des années 60, il existait des différences significatives dans la consommation d'alcool entre pays européens. Pourtant, au cours des quarante dernières années, l'Europe a vu des changements considérables dans la consommation d'alcool. Ces changements concernent, d'une part, les niveaux de consommation de boissons alcoolisées (par individu) et, d'autre part, la structure de cette consommation (c'est-à-dire les parts relatives de bière, de vin et de spiritueux). Parallèlement à la diminution des différences entre pays en ce qui concerne les niveaux de consommation d'alcool, l'augmentation de la part du vin de cette dernière est considérable dans beaucoup de pays. Cela reflète probablement une évolution des goûts des consommateurs vers une structure commune de leurs préférences. Dans cet article, nous utilisons les tests de racine unitaire afin de mettre en évidence si ces derniers changements reflètent ou non un processus de convergence. Les tests statistiques effectués sur des séries temporelles prises deux à deux indiquent qu'il y a très peu d'évidence en faveur de la notion de convergence absolue pour la consommation d'alcool dans les pays européens. En revanche, des processus de rattrapage, c'est-à-dire des différences en diminution dans les niveaux de consommation d'alcool, semblent un trait plus commun pour la consommation d'alcool en Europe, plus particulièrement dans les pays d'Europe du Sud. La notion de convergence stochastique est ensuite testée en appliquant un test de racine unitaire permettant des ruptures structurelles dans l'ensemble des données. La conclusion de cette partie de l'analyse confirme les résultats précédents, c'est-à-dire qu'une convergence stochastique n'est présente que dans environ un tiers des cas, et concerne principalement les pays de l'Europe du Sud.

Mots-clés :
consommation d'alcool,
convergence,
tests de racine unitaire

Alcohol consumption in European countries : time series based tests of convergence

Summary – *In the beginning of the 1960s, significant differences in the alcohol consumption existed among the European countries, but during the last forty years Europe has seen large changes both in the levels of alcohol consumption (per capita) and in the structure (that is, relative shares of beer, wine and spirits) of the consumption of alcoholic beverages. In parallel with narrowing cross-country differences in alcohol consumption levels, especially the share of wine consumption has increased considerably in many countries – probably reflecting consumers' shifting taste towards a common preference structure. In this paper, we use unit root tests in order to provide some evidence whether or not the changing pattern reflects a process of convergence. The time series based tests of convergence indicate that there is very little support to the notion of absolute convergence in alcohol consumption among pairs of the analysed sixteen European countries. Instead, catching-up processes – i.e. diminishing differences in alcohol consumption levels – seem to be a more common feature concerning alcohol consumption in Europe; especially among the Southern European countries. Finally, the notion of stochastic convergence is tested applying a unit root test allowing for structural breaks in the data set, and the conclusion from this part of the analysis confirms the former results, i.e. stochastic convergence is only present in approximately one third of the cases and concerns primarily the Southern European countries.*

Key-words:
alcohol consumption, convergence, unit root tests

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DURING the previous decades a fairly large empirical literature on the determinants of the demand for alcoholic beverages has built up. Particular attention has been paid to the price sensitivity of alcohol demand, mainly because of the implications this has for the effectiveness of taxation of alcohol; see the review by Leung and Phelps (1993), Cook and Tauchen's analysis (1982) on US time series data, Clements and Johnson (1983), Johnson *et al.* (1992) and Walsh (1982) using Australian, Canadian and UK data, respectively. Most of the evidence emanates from single country studies and only a few studies[(1)] have focussed on the international trends in alcohol consumption. As a consequence, some interesting questions for alcohol policies are largely unanswered. Among these are: given differences in tax levels, sales and distribution systems. Are there common trends in the demand for alcohol across countries? Does the increasing internationalization give rise to increasingly similar drinking habits and consumption patterns in Europe?

Changes in the structure of demand for alcohol are of particular interest as it seems that the observed changes are so large that they may reflect shifting preferences of consumers. Of course, the observed decline, for example, in the share of beer and spirits in alcohol consumption in Northern European countries, is to some extent also due to changes in relative prices, income levels and new consumers entering the market. But the mere magnitude of the changes suggest that changes in consumers' preferences play a role as well. Thus, increasing integration may be contributing to an internationalization of tastes and thereby of consumption patterns.

Within the European Union a process of indirect tax harmonization has taken place during recent years, especially concerning goods like beer, wine, gasoline etc. The main reason for levelling out indirect taxes has been increased intra-EU border trade and furthermore, the creation of a common European market has also facilitated the flow of goods. Consequently, these processes have probably induced some convergence in consumption patterns – including alcohol – across Europe. Additionally, increased tourism among European countries and a tendency towards more internationally oriented marketing and advertising from the major companies in the beverage industry certainly also contribute to the development of similar drinking habits.

The question this paper tries to answer is whether these changes, which are easily observed in international statistics on alcohol consumption, are resulting in a convergence towards a common European structure of alcohol demand. For this purpose we analyse and compare the development in the alcohol demand of 16 European countries. In a previous study, Bentzen *et al.* (1998) use the β–convergence hypothesis, as known

[(1)] Clements and Selvanathan (1987) for the United Kingdom, the United States and Australia; Selvanathan (1991) for 9 OECD countries and Bentzen *et al.* (1998) for the Scandinavian countries.

from the economic growth theory, to provide evidence on the overall convergence in European alcohol demand. Using data for a 30-year-period evidence in favour of the β–convergence hypothesis was found, although when focussing on subperiods, the analysis did not lend unanimous support to the hypothesis. The ambiguous evidence might be due to the potential weaknesses of the β–convergence testing framework, where only end and starting values from a given data set are used in the analysis.

Accordingly, convergence in alcohol consumption is analysed in a pure time series framework which in several important aspects differs from the above-mentioned β–convergence methodology. Firstly, the former results concerning the likelihood of β–convergence taking place in European alcohol consumption are analysed in the 1st section. Data for the overall per capita alcohol consumption over the period 1961 to 1998 is used. Then, the 2nd section deals with a time series based concept of convergence based primarily on unit root tests, where especially Bernard and Durlauf (1995, 1996) have shown how to apply the econometric techniques concerning non-stationary variables to the question of convergence. The empirical results are reported in the following section where a distinction between absolute convergence (in absolute levels of *per capita* alcohol consumption) and a catching-up process – by which is meant differences in consumption levels are diminishing – is introduced. The last section concludes.

ALCOHOL CONSUMPTION AND THE β–CONVERGENCE HYPOTHESIS

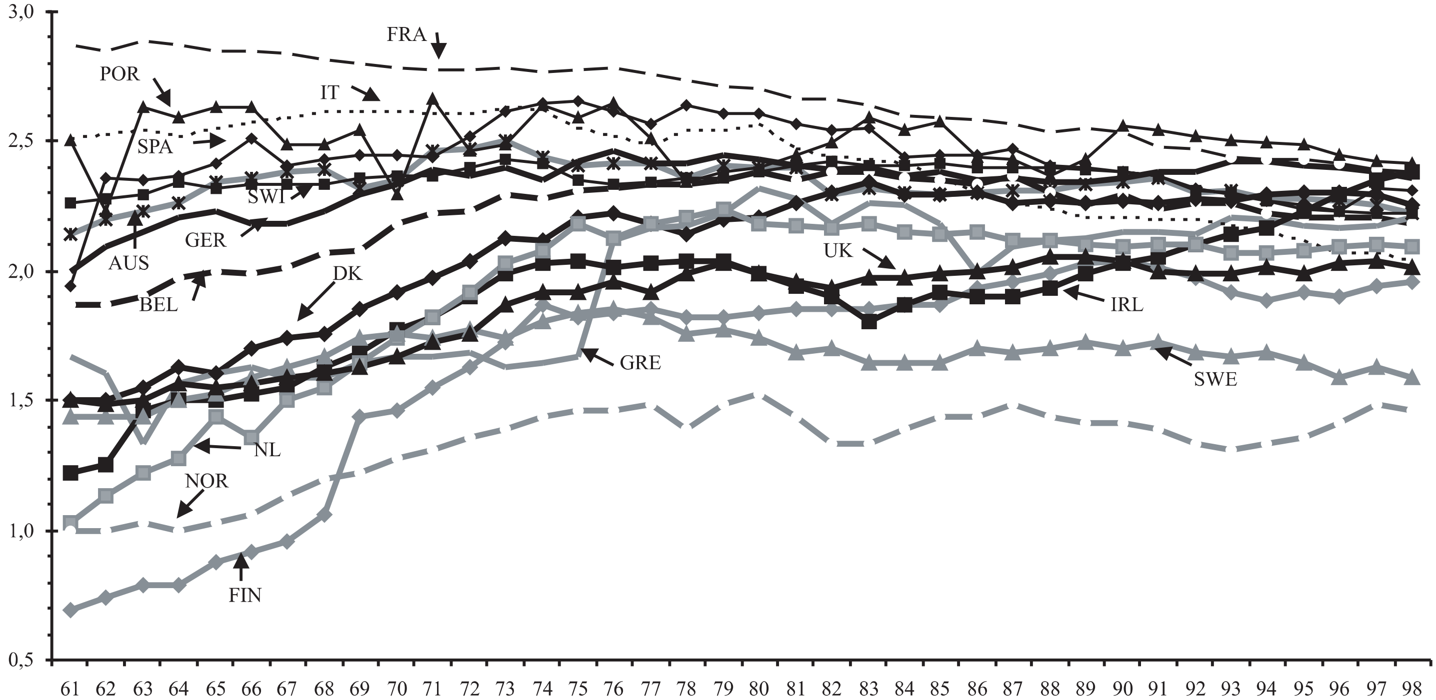
In the following analysis of the changing pattern of alcohol consumption standard tools regarding analysis of convergence are used. Originally, the methodology was developed for studying the convergence of real per capita GDP for a cross-section of economies. In relation to growth issues two main concepts of convergence, called *absolute β–convergence* and *σ–convergence* have been applied[(2)], which have also gained popularity concerning others research areas such as *e.g.* price convergence (Camarero *et al.*, 2000).

Consumption converges in the β–sense if countries with low alcohol consumption levels face higher growth rates in consumption than high-use countries. Denoting per capita alcohol consumption (log values) in country *i* at time *t* by y_{it} the measure of convergence is derived from the following regression, with *t-n* indicating the first period in the sample:

$$y_{it} = \alpha + (1 - \beta)y_{it-n} + \varepsilon_{it} \qquad (1)$$

[(2)] See Sala-i-Martin (1995) for a more formal treatment on the convergence approach in economic growth theory.

Figure 1. **Per capita alcohol consumption 1961-1998 in 16 European countries (log values)**



Note: The countries exhibited as listed in note[3] and the data relate to the total amount of alcohol consumed (measured in litres of pure alcohol).
Source: World Drink Trends, 1999

The estimate of β reveals the rate of convergence where a value close to 1 indicates (absolute) convergence and the opposite conclusion of "no convergence" implies a parameter estimate which does not deviate significantly from zero.

A group of countries is said to exhibit σ–convergence in alcohol consumption if the standard deviation of their per capita alcohol consumption is decreasing over time. If σ_t denotes the standard deviation of y_{it} across the countries at time t, we have that:

$$\sigma_t < \sigma_{t-n} \quad (2)$$

The β–convergence hypothesis concerning alcohol consumption in the European countries has been tested in Bentzen *et al.* (1998) where positive evidence seemed to be present. Using a pooled data set for a number of countries the estimate of β was found to be in accordance with the convergence hypothesis and the σ_t–estimate declining over time, as expected.

These results can be verified by simply observing the data on *per capita* alcohol consumption which are reproduced in figure 1 – derived from *World Drink Trends,* 1999 – where time series data[(3)] covering the period 1961-1998 are published. The statistics include the consumed quantities of beer, wine and spirits (in litres) and total consumption calculated in litres of 100% pure alcohol equivalents.

According to Carree and Klomp (1997) and Carree *et al.* (2000), the σ–hypothesis can also be formally tested with respect to a given level of significance. The test is based on the estimates of both β and σ from (1) and (2), and their so-called T_3-statistic is calculated as:

$$T_3 = \frac{\sqrt{N}(\hat{\sigma}_{t-n}/\hat{\sigma}_t - 1)}{2\sqrt{1-(1-\hat{\beta})^2}} \quad (3)$$

N is the number of countries and the test statistic has a standard normal distribution under a null hypothesis of "no convergence". The results from applying this test procedure to the data from figure 1 are reported in table 1.

Table 1.
Test values for ($\boldsymbol{\beta}$, $\boldsymbol{\sigma}$)-convergence

Parameter	Estimate
β	0.757 (*s.e.* = 0.096)
$\boldsymbol{\sigma}_t$	0.075
$\boldsymbol{\sigma}_{t-n}$	0.398
T_3-test statistic	8.858

Notes: T_3 calculated from Carree and Klomp (1997).
s.e.: standard error

(3) Austria, Belgium, Denmark, Finland, France, Germany (West), Greece, Ireland, Italy, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom.

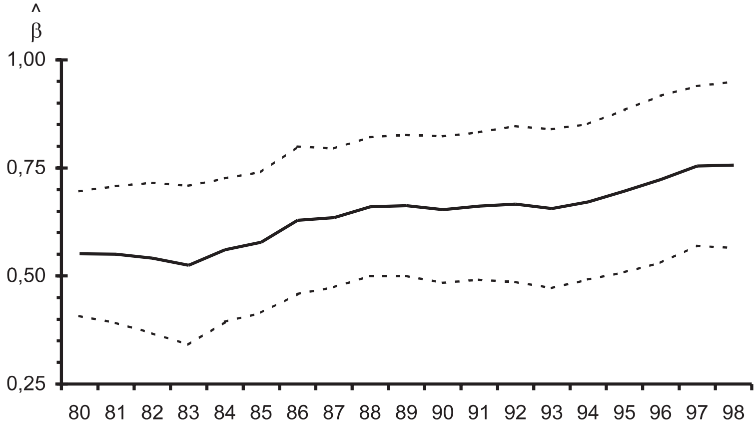
The estimate of β is 0.76 implying some overall convergence in alcohol consumption and additionally, the calculated value of T_3 is very high. Therefore, the empirical evidence also favours the σ–convergence theory as far as the null hypothesis of "no convergence" is significantly rejected.

Testing for convergence by using (β, σ)–methodology can be criticized because only initial and final values of the alcohol consumption levels are used and therefore the resultant parameter estimates may be sensitive to the specific values of these observations. The immediate solution to this problem is to do a set of rolling regressions where (1) is initially estimated for a subsample of the data set, (in the present case using the time span 1961-1980), and successively adding observations one-by-one to the sample, and each time reestimating equation (1) in order to obtain time-varying values of β. Using the average values for 1961-1963 as the initial alcohol consumption levels on the right hand side of (1) results in β-parameter estimates as shown in figure 2.

As the end-point of the subsample is extended from 1980 to 1998, the estimate of the rate of convergence steadily increases which indicates that a process of convergence is taking place. The dotted lines mark the 95% confidence interval with the upper limit only approaching unity and thereby ruling out absolute convergence (β = 1), although the conclusion from the analysis is primarily in favour of convergence.

Note, however, that the increasing β–values are in accordance with the assumption made that the convergence in consumption is induced by the increased tourism, internationally oriented marketing and advertisement of the 1980s and 1990s.

Figure 2.
Estimate of the rate of convergence



Note: The dotted lines indicate the 95% confidence intervals.

A **necessary** condition for the existence of σ–convergence is the existence of β–convergence, but β–convergence does not constitute a **sufficient** condition for σ–convergence. If initial low level countries face the far strongest growth rates within a distribution they may override initial high level countries at the end of the period with the consequence that the dispersion between countries may be unchanged (or may even have increased). This is one of several drawbacks of these measures of convergence, and they have recently been critically commented in a number of studies, Bernard and Durlauf (1991, 1995, 1996), Greasley and Oxley (1997), Harris and Trainor (1999). Therefore, a pure time series test methodology seems appropriate to give full evidence on the convergence hypothesis.

TIME SERIES BASED CONCEPTS OF CONVERGENCE

The traditional methodology, as presented in the 1st section, is extended by Bernard and Durlauf (1995, 1996) into a time series testing framework. This is in several respects more appropriate than the cross-section approach which may be very sensitive to the beginning and ending dates in a pooled cross section time series data set, but other problems may also be present, cf. *op. cit.*, especially Bernard and Durlauf (1996), Harris and Trainor (1999). Convergence between *e.g.* country i and country j is now defined as (Bernard and Durlauf, 1996, definition 2):

$$\lim_{k\to\infty} E(Y_{it+k} - Y_{jt+k}\ I_t) = 0 \tag{4}$$

I_t is the information set available at time t, and convergence requires equality of long term forecasts. In an empirical testing strategy it is essential to assess whether $(Y_i - Y_j)$ contains either a non-zero mean or a unit root because this implies that there cannot be convergence, and the series will diverge over time.

The empirical application of this definition of convergence therefore relies on a Dickey-Fuller type of test for a unit root in the difference of the (log) values of per capita alcohol consumption between any two pairs of countries, with t indicating a time trend:

$$\Delta(Y_{it} - Y_{jt}) = \mu + \beta t + \alpha(Y_{it-1} - Y_{jt-1}) + lags \quad of \quad \Delta(Y_{it} - Y_{jt}) + \varepsilon_t \tag{5}$$

In case a unit root is found ($\hat{\alpha}$ = 0) the alcohol consumption in the two countries will be driven by separate stochastic trends and, hence, diverge over time. Furthermore, assuming no unit root is present in (5), the intercept term and the deterministic trend parameter may be insignificant and thus indicate long run convergence. Finally, when $\hat{\beta}$ differs significantly from zero a catching-up process is likely to take place assuming that the initial values of Y_i and Y_j differ in levels.

Thus, a necessary condition for convergence is that the cointegration vector between a given pair of countries is (1, -1). Still, when cointegration is detected but the cointegration vector is deviating from (1, -1), the development in alcohol consumption is driven by the same stochastic trend, but the level of alcohol consumption in the respective countries will not converge (Bernard and Durlauf, 1995). One difficulty involved in the time series approach is that these tests are sensitive to whether transitional processes are taking place in the economy, *i.e.* if alcohol consumption initially starts from some (low) value and has not yet reached a level close to steady-state conditions, then a null hypothesis of "no convergence" tends to be accepted, even when it is false.

In order to take into consideration the potential drawback of the unit root test of equation (5), an alternative test methodology is added to the analysis. Perron (1989, 1997) demonstrates how to allow for structural breaks when testing for unit roots and more specifically, the methodology for the so-called "innovational outlier" model includes the possibility of a one-time change in both the intercept term and the slope of the deterministic trend. The time of the break is determined endogenously and following Perron (1997), the test involves estimating a regression as given by equation (6):

$$\Delta(Y_{it} - \overline{Y}_t) = \mu + \Theta DU_t + \beta t + \gamma DT_t + \delta D(T_b)_t + \alpha(Y_{it-1} - \overline{Y}_{t-1}) + lags \quad of \quad \Delta(Y_{it} - \overline{Y}_t) + \varepsilon_t \quad (6)$$

T_b: break date

DU_t = 1 if $t > T_b$, otherwise 0 (intercept dummy)

$DT_t = t - T_b$ if $t > T_b$, otherwise 0 (slope dummy)

$D(T_b)$ = 1 if $t = T_b + 1$, otherwise 0

A set of regressions for the trend break (T_b) taking on all values of the time span (except the end points, of course) is done in order to minimize the *t*-statistic on α. When the estimate of α is significantly different from zero the unit root null hypothesis is rejected in favour of a trend stationary alternative. The testing procedure is slightly changed compared to equation (5) as the test is performed relative to the average value of alcohol consumption of all countries included in the sample. This methodology of testing for convergence relative to the sample average has also been applied concerning income convergence, *e.g.* Carlino and Mills (1993), Loewy and Papell (1996).

As seen from equation (6) the trend-stationarity alternative is more "flexible" than the Dickey-Fuller type of test in (5), with the latter involving a bias towards acceptance of a "no convergence" hypothesis. Including potential structural changes in the deterministic components of (6) reduces this problem, but it is also a weaker form of convergence test, usually designated as **stochastic convergence**, only requiring the log of relative alcohol consumption levels to be trend stationary. A recent application in the context of output convergence is found in Li and Papell (1999).

EMPIRICAL TESTING OF BIVARIATE CONVERGENCE

In order to carry out the tests described above, the data presented in figure 1 are used in the analysis. In addition, tests involving subgroups of the countries have been performed. In defining the subgroups some descriptive statistics of the alcohol consumption levels are presented; see table 2.

Table 2.
Per capita consumption of alcohol, annual averages 1961-1998

	Litres (100% alcohol)	Share of Wine (%)
Group I: Wine countries		
France	14.58	75
Greece	8.45	52
Italy	11.36	92
Portugal	12.22	77
Switzerland	10.47	51
Spain	11.63	56
Group II: Beer countries		
Austria	10.36	38
Belgium	9.26	24
Denmark	8.32	21
Germany	10.42	25
Ireland	6.87	12
Netherlands	7.18	18
UK	6.56	14
Group III: Spirits countries		
Finland	5.56	12
Norway	3.81	13
Sweden	5.37	21
Total	8.83	45

Notes: When calculating the share of wine the alcohol content is assumed to be 12% for wine. The standard error of the total, unweighted average (8.83 litres) is 3.20 litres.

Source: World Drink Trends, 1999

The 16 European countries are divided into three groups based on the following procedure. The unweighted average of per capita alcohol consumption is 8.83 litres (table 2) for the whole sample period 1961-1998 and the three Nordic countries differ more than one standard deviation from the overall average and hence – as also the share of spirits is relatively high for these countries – they form one of the groups. The other countries are divided into two groups according to the share of wine in total alcohol consumption, where a share above 50% defines the first group. Note that the resulting breakdown presented in table 2 more or less corresponds with geography, *i.e.* the South, the Central and the Nordic regions have their own characteristics with respect to "alcohol culture".

Table 3. **Test statistics for the convergence/catching-up hypothesis**

	Unit root test		Intercept and trend terms in the DF-test		
	DF/ADF	PP	$\hat{\mu}$	$\hat{\beta}$	
France/Greece	-3.98*	-4.18*	0.55*	-0.01*	Catching-up
France/Portugal	-4.94*	-5.15*	0.34*	-0.01*	Catching-up
France/Germany	-3.26**	-3.40**	0.18*	-0.005*	Catching-up
Greece/Italy	-3.90*	-4.07*	-0.33*	0.01*	Catching-up
Greece/Portugal	-4.39*	-4.54*	-0.36*	0.005*	Catching-up
Greece/Spain	-3.35**	-3.51**	-0.20*	0.004*	Catching-up
Greece/Austria	-3.57*	-3.72*	-0.16*	0.004*	Catching-up
Greece/Germany	-4.23*	-4.41*	-0.12*	0	-
Italy/Portugal	-3.78*	-3.91*	0.12*	-0.01*	-
Italy/Germany	-4.37*	-3.70*	0.44*	-0.02*	-
Italy/Norway	-3.45**	-2.73	0.80*	-0.01*	-
Portugal/Switzerland	-4.60*	-4.80*	0.12*	0	-
Portugal/Spain	-3.53*	-3.62*	-0.016	-0.002	Convergence
Portugal/Austria	-4.49*	-4.68*	0.10**	0	-
Portugal/Germany	-4.34*	-4.52*	0.18*	-0.004*	Catching-up
Portugal/Sweden	-3.59*	-3.65*	0.45*	-0.001	-
Austria/Germany	-3.84*	-3.25**	0.08*	-0.004*	-
Austria/Sweden	-3.38**	-3.55*	0.37*	-0.002*	-
Belgium/Denmark	-4.31*	-4.49*	0.27*	-0.01*	Catching-up
Belgium/Spain	-3.40**	3.65*	-0.26*	0.007*	Catching-up
Spain/UK	-4.78*	-4.98*	-0.60*	0.01*	(Catching-up)
Spain/Norway	-4.10*	-4.33*	-0.87*	0.009*	-

Notes: The critical value is -3.53 at a 5% level of significance (indicated by an * in the table), and -3.20 at the 10% significance level (**), according to MacKinnon (1991). The test also includes a deterministic trend to allow for an alternative hypothesis of trend stationarity. The augmented Dickey-Fuller (ADF) test statistics have been derived from applying a suitable lag length (0, 1 or 2) in the unit root test in order to whiten the errors. A trend also included in the Phillips-Perron (PP) unit root test and this has been computed using correction for first order autocorrelation. The same critical values as used for the DF-test are valid concerning the PP-test.

The Dickey-Fuller (DF) test of bivariate convergence is performed for all combinations of the 16 countries in table 2 resulting in a total of 120 cases. Only in 22 of these cases we find evidence concerning rejection of the "no cointegration" hypothesis from equation (5) and hence making these cases consistent with *e.g.* a convergence hypothesis or a catching-up hypothesis. The DF-test statistic is reported in table 3. In addition, an alternative unit root test, the PP-test, is performed in these cases in order to verify the results from the DF-tests as these were found to be sensitive to the lag length included in (5), where the PP-test rests on milder assumptions concerning the distribution of the error terms.

The PP-tests confirm the conclusions based on DF-tests implying stationarity of the bivariate differences in alcohol consumption for all the 22 cases, except the pair Italy-Norway.

When a non-zero intercept term appears in (5) the condition for absolute convergence is violated even when the unit root hypothesis is rejected – which is taking place in 21 of the pairs from table 3. Absolute convergence only seems to take place between Portugal and Spain as both the intercept term and the trend are found to be insignificant and as these neighbour countries may be expected to share many similarities, also concerning alcohol consumption, the result is also in accordance with *a priori* expectations.

When both the intercept term and the trend parameter are found to differ significantly from zero it implies that for these countries alcohol consumption will not converge towards some given absolute levels, but instead catching-up processes may occur as the differences are diminishing. Of course, divergence is also a possible path of development and therefore these cases are not indicated by "catching-up" in table 3. From these unit root tests of convergence it seems obvious that the overwhelming part of the empirical evidence in support of convergence or rather catching-up relates to the countries in Southern Europe.

The test results as reported in table 3 from the pure time series based analysis may be sensitive with respect to transitional processes taking place in alcohol consumption. It may for example seem surprising that no convergence or catching-up is found between France and Spain. Until the mid 1970s there were relatively large differences between the alcohol consumption levels of these countries, but since then the per capita amounts of alcohol consumed have developed in similar directions and earlier differences seem to have vanished. In such cases it is appropriate to apply unit root tests allowing for structural breaks as discussed in the former section.

These tests for stochastic convergence are done using equation (6) with the results reported in table 4. The first part of the table refers to the test values where the national per capita alcohol consumption levels are tested for convergence relative to the overall sample average; in the second part the test is performed against the respective group averages.

Applying the Perron test for endogenously determined structural breaks the unit root null hypothesis can be rejected in favour of a trend stationary alternative (stochastic convergence) in only five of the sixteen cases when testing relative to the overall average – and using either a 5% or a 10% level of significance. Repeating the same test procedure relative to the group averages – *i.e.* the wine, beer and spirits countries, respectively – the same number of significant cases is obtained. The Perron test is also applied to all combinations or pairs of countries, similar to the DF-test presented in table 3, but this does not fundamentally influence the results already presented and therefore these test values are not exhibited. In 26 of the 120 cases the null of a unit root was rejected in favour of a stochastic convergence alternative at the 5% level of significance. As expected, this is at higher number of cases than obtained from the DF-test exhibited in table 3 as the inclusion of structural breaks allows for some flexibility in the testing procedure, although the critical values for the Perron test are also somewhat higher compared to the critical values used in DF-test, cf. the notes to table 3 and table 4.

Table 4. **Test statistics for stochastic convergence hypothesis**

	Overall average			Group average		
Country	T_b	t_α	k	T_b	t_α	k
Group I: Wine countries						
France	69	-5.41**	0	84	-5.03	3
Greece	71	-4.19	5	83	-4.65	0
Italy	73	-4.9	2	72	-5.11	2
Portugal	74	-5.88*	3	76	-5.58*	3
Sweden	69	-3.9	5	83	-4.08	0
Spain	76	-5.41**	4	70	-5.12	0
Group II: Beer countries						
Austria	72	-4.47	0	72	-3.68	0
Belgium	79	-4.89	0	80	-5.70*	0
Denmark	79	-3.58	3	85	-6.20*	3
Germany	89	-4.72	0	70	-4.77	1
Ireland	78	-3.33	0	78	-3.07	0
Netherlands	75	-7.36*	0	77	-7.06*	0
United Kingdom	77	-3.99	3	91	-3.81	0
Group III: Spirits countries						
Finland	67	-6.04*	0	67	-6.61*	1
Norway	79	-5.11	5	89	-3.45	0
Sweden	76	-5.07	3	81	-5.21	4

Notes: The critical value is -5.59 at a 5% level of significance (indicated by an * in the table), and -5.29 at the 10% significance level (**), according Perron (1997). The number of lags included in (6) is indicated by the k-value.

Consequently, extending the DF-unit-root-test of convergence related to equation (5) to the Perron-methodology allowing for structural breaks does not alter the former conclusion, *i.e.* the strongest evidence in favour of catching-up processes is found among alcohol consumption levels in the European countries; absolute convergence is only present in one of the cases (Spain/Portugal).

CONCLUSIONS

During the last forty years Europe has seen large changes both in the levels of alcohol consumption (per capita) and in the structure (that is, relative shares of beer, wine and spirits) of the consumption of alcoholic beverages. In parallel with narrowing cross-country differences in alcohol consumption levels, especially the share of wine consumption has increased considerably in many countries. One explanation of this pattern of events could be that they are reflecting consumers' shifting tastes towards a common preferences structure. This could be due to new consumers (young cohorts and in many countries also women) entering the market with different preferences than previous generations or to shifts in the preferences of consumers already in the market. Clearly, changes in relative prices and in relative income differences between countries is likely to have contributed to the changing pattern observed.

In this paper we have provided some evidence concerning whether or not the changing pattern reflects a process of convergence. For this purpose we use time series based tests of convergence. Their main advantage is that they are not as sensitive to the starting and finishing values in the data as the cross-section based tests are.

The DF unit root tests indicate that there is very little support to the notion of absolute convergence in alcohol consumption among pairs of the analysed 16 European countries. Instead, catching-up processes, *i.e.* diminishing differences in alcohol consumption levels, seem to be a more common feature concerning alcohol consumption in Europe, especially among the Southern European countries. Finally, the notion of **stochastic convergence** is tested applying a unit root test allowing for structural breaks in the data set, following Perron (1989, 1997). National per capita consumption levels are tested relative to the overall European alcohol consumption levels and the test is extended to three subgroups of the countries – representing wine, beer and spirits countries, respectively. The conclusion from this part of the analysis confirms the former results, *i.e.* stochastic convergence is only present in maximum one third of the cases and concerns primarily the Southern European countries.

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