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**Convergence in fiscal pressure
across EU countries***

by

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Abstract

This paper studies the degree of convergence in fiscal pressure registered in the European Union during the 1967-94 period. To that end, we use OECD data and examine both the traditional cross-sectional convergence indicators and the time series analysis of the long-run properties of the data set.

JEL Codes: F42, H20, O52.

Key words: Fiscal coordination, Convergence, European Union.

1.- INTRODUCTION

Increasing integration within the European Union (EU) has called for some fiscal discipline among member countries. Both the Single Market programme and process towards the Economic and Monetary Union (EMU) have acted as incentives for tax harmonization and coordination, since they imply higher factor mobility and greater competition in good markets [see, e. g., Branson (1990) and Emerson *et al.* (1992)].

This paper examines the degree of convergence in fiscal pressure across the EU countries that may have resulted from such harmonization and coordination initiatives. In doing so, our investigation contributes to the general debate over whether a fixed exchange regime increases fiscal policy integration.

To analyse the extent of fiscal integration achievement in the EU we make use of two different methodologies. First, we compute the indicators developed by Barro and Sala-i-Martin (1991 and 1992). This approach constitutes the traditional cross-sectional test for convergence. Second, we use time series analysis in order to study the long-run properties of the fiscal pressure data. Both approaches are applied to data on fiscal pressure gathered by the OECD, covering the 1967-1994 period.

The traditional convergence indicators are presented in section 2, while the time-series analysis is outlined in Section 3. Section 4 reports the empirical results, and some concluding remarks are offered in section 5.

2.- TRADITIONAL CONVERGENCE INDICATORS

Although there are many definitions of convergence in the literature (see, e. g., Quah, 1993), there are two convergence indicators that have been widely used: β -convergence and σ -convergence (see, e. g., Barro and Sala-i-Martin, 1992). The former takes place if it is found that, for a group of countries, those that start out the sample period with below-average incomes tend to grow faster than do countries that start with above-average incomes, whereas the latter is found when there is a decline in the dispersion of income as time passes.

In our case, we will use these indicators to estimate the possible convergence of fiscal pressure and, therefore, we will say that there is β -convergence if we find a negative relation between the average growth rate of such variable and the logarithm of its initial level. On the other hand, σ -convergence will appear when the standard deviation of the logarithm of the fiscal pressure benefits tends to decrease over time.

In this way, if G_{it} represents the level of fiscal pressure of country i in the year t , β -convergence can be analysed through the estimation of the following equation:

$$(1/T)\log(G_{iT}/G_{i0}) = a - b \log(G_{i0})/T + \epsilon_{it} \quad (1)$$

where 0 and T represent the initial and final years, respectively, and ϵ_{it} is an error term. The estimation of the parameter b allows to obtain the annual rate of convergence β , since $b = (1 - e^{-\beta T})$.

3.- TIME-SERIES CONVERGENCE

According to Hall, Robertson and Wickens (1992), from a time series point of view, the relevant notion of convergence consists of the fact that the difference between two series, X_t and Y_t , should become arbitrarily small (or converge to some constant α) as time elapses:

$$\lim_{t \rightarrow \infty} (X_t - Y_t) = \alpha \quad (2)$$

For random series, such as most economic variables, this can be extended by introducing the notion of stochastic convergence:

$$E\{\lim_{t \rightarrow \infty} (X_t - Y_t)\} = \alpha \quad (3)$$

Here, the probability that the two series differ by a specified amount is required to become arbitrarily small. This notion of weak convergence can easily be extended to consider integrated process. In this case, two integrated series would converge if the difference between them were a series with lower order of integration.

Note that if a time series is non-stationary it has the potential for very large variations over time, so that for convergence between two non-stationary variables, cointegration must be a necessary, but not sufficient, condition. Only in this case the differences between the series not have infinite variances.

Having detected that the differences do not have infinite variances, it then becomes appropriate to carry out some tests on the cointegrating vectors to see if certain restrictions are satisfied (Ardeni, 1992). In this case, for a system of n

variables, there must be $n-1$ cointegrating vectors. Moreover, the non-zero coefficients in the cointegrating vector should be $(1, -1)$.

To summarise, in all the literature using cointegration between two variables, X_t and Y_t , to test convergence, the following conditions must be tested:

- 1) X_t and Y_t are cointegrated,
- 2) the cointegrating vector is $(1, -1)$, and
- 3) the difference between the two variables is a stochastic variable with a zero mean.

All these tests have been applied extensively to the nominal convergence hypothesis with the main problem being that convergence is a gradual and ongoing process. Testing for cointegration is a powerful way of assessing whether has already occurred. However, if convergence is in process, any tests that assume structural stability will almost certainly be biased to reject convergence for the whole period. Therefore, a measure of convergence that allows for dynamic structural change is needed.

The definition of convergence given in expression (2) would correspond to the concept of stochastic or "hard" convergence. However, it could be the case that both series are not equal in the long run, but proportional. In this case, the series would be cointegrated, but the cointegrating vector would be $(1, -\alpha)$ and both series would have a common trend.

Finally, if conditions 1) and 2) are fulfilled [i. e., if both series are cointegrated, being $(1, -1)$ the cointegrating vector], but the difference between the two series is a stochastic variable with a mean different from zero, this would suggest that the deviation between the series is expected to decrease, but not to

disappear. This case could be defined as "weak" convergence or "catching-up" [see, e. g., Bernard and Durlauf (1995 and 1996) or Oxley and Greasley (1995)]. The latest definition is the appropriate in our context, since fiscal pressure convergence could be an ongoing process. The problem is, therefore, how to test these definitions.

In this paper we focus solely on the long-run properties of the time series. These properties are characterised by the order of integration of the deviation from their deterministic paths (Nelson and Plosser, 1982). In addition, the existence of a structural break over the period considered will be tested.

Let us consider the fiscal pressure variable in country A G_t^A for which the following data generation process is postulated:

$$G_t^A = \theta_0 + \theta_1 tr_t + \xi_t \quad (4)$$

where tr is a deterministic trend variable, θ_0 and θ_1 are constant parameters, and ξ_t is a disturbance term. If ξ_t follows a stationary process, the fiscal pressure variable is called "trend-stationary", but if ξ_t is integrated of order 1, $I(1)$, the fiscal pressure variable is difference-stationary. In the former case, deviations from the deterministic growth path are only temporary and, therefore, an error correction mechanism is present. In the latter case, this mechanism is absent, causing a shock to have a permanent effect on the future level of the fiscal pressure.

Using expression (4), the difference between the fiscal pressure in two countries A and B, can be formulated as follows:

$$G_t^A - G_t^B = (\theta_0 - \gamma_0) + (\theta_1 - \gamma_1) tr_t + (\xi_t - \eta_t) \quad (5)$$

where γ_0 and γ_1 are constant parameters, and η_t is a disturbance term, all referring to data generation process of the fiscal pressure in country B.

As mentioned above, we will distinguish between different levels of convergence (catching-up and long-run convergence), being these levels of convergence closely linked with the concepts of stochastic and deterministic cointegration.

There is a process of catching-up between the level of fiscal pressure of two countries, A and B, when there is a narrowing of the gap between them. Formally, assuming two dates, t and $t+T$, and that $G_t^A > G_t^B$, the definition of catching up implies that

$$E\{G_{t+T}^A - G_{t+T}^B / \zeta_t\} < G_t^A - G_t^B \quad (6)$$

Therefore, the concept of catching-up implies the absence of a unit root in the difference between the two time series. Therefore a stochastic trend would violate the proposition, although the presence of a deterministic trend would not imply the existence of stochastic cointegration between both variables.

Conversely, long-run convergence is a more demanding level of convergence that can be formally defined as follows:

$$\lim_{t \rightarrow \infty} E\{G_{t+T}^A - G_{t+T}^B / \zeta_t\} = 0 \quad (7)$$

Hence, long-run convergence implies the absence of a unit root and a time

trend in the deterministic process. In this case, a sufficient condition for convergence would imply both stochastic and deterministic cointegration between the two series.

4.- EMPIRICAL RESULTS

4.1. Data

In this paper we have used data on total fiscal revenue (TFR) and Gross Domestic Product (GDP) collected by the Organisation for Economic Co-operation and Development (OECD). We compute fiscal pressure as the TFR/GDP ratio. Our sample covers the period 1967-94 (the latest available), and the countries under study are all the 15 members of the EU (i. e., Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden, and the United Kingdom).

4.2.- Traditional convergence indicators

Figure 1 shows the standard deviation of the cross section of the logarithm of fiscal pressure. As can be seen, after a first period where the dispersion increases from 0.063 in 1967 to 0.086 in 1979, it eventually decreases to 0.052 in 1994, having a momentary increase in 1987 and a decrease in 1992. Therefore, there is evidence of a tendency towards σ -convergence after 1979.

Concerning β -convergence, Table 1 reports the estimations of equation (1) for the sample periods mentioned above. Columns 2 and 3 show the estimation results of the cross-section by ordinary least squares (OLS), whereas columns 4

to 6 and 7 to 9 offer the results of panel data estimation of the fixed and random effects models, respectively.

Estimation results by OLS confirm the conclusions drawn from the σ -convergence analysis, a 2% annual divergence during the period 1967-79, a 4% annual convergence is attained for the period 1979-94. The convergence rate for the whole of the sample is around 2%. However, the hypothesis that β has been constant along the whole sample is rejected using the likelihood ratio test ($RV = 27.73$, significant at the 1% level).

When we perform panel data estimations (which is suitable given the nonequal individual effects as suggested by the F test values of Table 1, column 6 -all of them significant at the usual levels), results hardly change for the subperiods considered. Something similar happens when we estimate the random effect model. However, the values of the Hausman tests imply that the individual effects are correlated with the regressors and therefore the results obtained are not consistent, being the fixed effect model the proper estimation method.

4.3.- Time-series convergence

To test for unit roots, we have used the non-parametric tests proposed by Phillips and Perron (1988), which are robust to heteroscedasticity, deviations from normality and various forms of serial correlation in the univariate representation of the variables under the unit root null hypothesis. In Table 2 the statistics are reported for the levels and first differences. As one can see, the test statistics are highly supportive of a single unit root in each of the series, except for the case of Portugal, which is stationary.

When we apply the Phillips-Perron tests to the difference of fiscal pressure with respect to Germany, we also find that all the series are $I(1)$, except for Austria where the difference in fiscal pressure is a stationary variable and therefore can be taken as evidence of convergence between Austria and Germany (see Table 3).

Next, the test by Perron (1994) is applied to the difference of fiscal pressure with respect to Germany. This test allows us to distinguish between series that are $I(1)$ and series that are stationary around a trend with a structural change. In the latter case there will not be convergence, while in the former case we will find catching up. As can be seen in Table 4, there is evidence of catching up for Belgium, Italy, Portugal, Spain (only during the 1967-90 period), Sweden and United Kingdom.

Table 5 offers the results of the test suggested by Perron and Vogelsang (1992a,b), which test for a unit root allowing for the possibility of a change in the level of the series. We consider the so called "additive outlier model" (AOM), which is best suited if the change takes place gradually. As can be seen, for the cases of Austria and Finland, the series are found to be stationary with a structural change. For Austria, this result partially confirms the results from the Phillips-Perron tests. However, from the Perron-Vogelsang test we find that the difference of fiscal pressure with respect to Germany is stationary around two means different from zero, suggesting that the cointegrating vector is not $(1, -1)$ but $(1, -\alpha)$, and therefore there are common trends in the individual series.

5.- CONCLUDING REMARKS

This paper has examined the degree of convergence in fiscal pressure registered in the EU during the 1967-94 period. We have used data from OECD for the 15 member countries that form the European Union.

First, the two most commonly used convergence indicators have been computed: β -convergence and σ -convergence. The results of both indicators suggest that there has been certain convergence in fiscal pressure during the 1979-94 period, while important divergence was found for the years 1967-79.

Second, we study the long-run properties of the time series. Our results indicate evidence of catching up for Belgium, Italy, Portugal, Spain (only during the 1967-90 period), Sweden and United Kingdom, as well as long-run convergence between Austria and Finland with Germany.

These results, in turn, suggest that some countries have been carrying out a stronger effort, as far as fiscal pressure is concerned, in order to make their situation converge with that of other countries where the expenditure was much more significant. This effort can contribute to facilitate factor mobility within Europe and can have important implications for the speed of growth in each European country and the EU at large (see, e. g., Razin and Yuen, 1996).

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Figure 1: Dispersion of fiscal pressure across EU countries

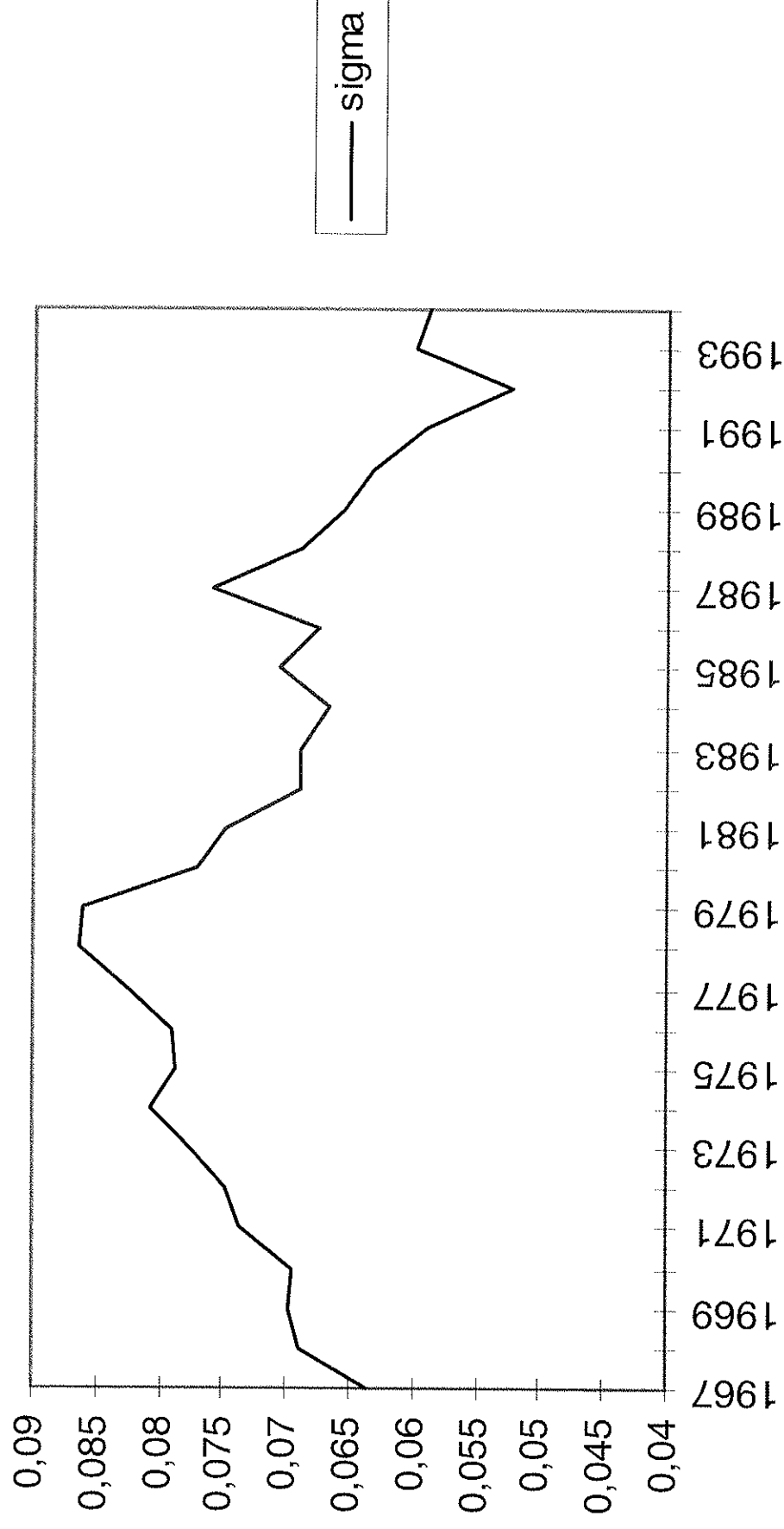


Table 2: Phillips-Perron unit root tests^{a,b}

Fiscal pressure (1967-1994)

Variable	I(2) vs. I(1)			I(1) vs. I(0)		
	Phillips-Perron Test ^b			Phillips-Perron Test ^b		
	$z(t_{\alpha})$	$z(t_{\alpha}^*)$	$z(t_{\alpha})$	$z(t_{\alpha})$	$z(t_{\alpha}^*)$	$z(t_{\alpha})$
Belgium	-4.41**	-3.98	-3.29	-1.08	-2.15	2.15
Denmark	-4.77**	-4.76	-4.22	-3.07	-2.35	1.90
Germany	-6.75**	-6.38	-5.56	-2.25	-2.08	1.87
France	-4.25*	-4.10	-3.39	-0.93	-1.12	2.30
Ireland	-5.55**	-5.52	-5.13	-2.64	-1.42	-1.31
Italy	-5.77**	-5.47	-4.81	-2.86	-0.33	1.57
Luxembourg	-6.55**	-6.29	-5.62	-1.58	-1.43	1.49
Netherl.	-5.48**	-5.10	-4.55	-2.31	-2.23	1.74
U.K.	-4.74**	-4.74	-4.74	-2.47	-2.61	0.03
Spain	-6.90**	-6.92	-3.67	-3.31	0.41	4.71
Portugal	-6.50**	-6.48	-5.08	-3.87*	-0.64	2.54
Austria	-5.29**	-5.13	-4.43	-1.84	-1.43	-1.99
Finland	-6.09**	-6.02	-5.59	-2.62	-0.62	1.34
Greece	-5.12**	-4.87	-3.81	-2.36	-0.43	3.01
Sweden	-3.96*	-3.87	-3.66	-1.54	-1.96	-1.26

NOTES:

- a. * and ** denote significance at the 5% and 1% levels, respectively.
- b. The Phillips and Perron test has been calculated using the long-run variance estimator as proposed in Andrews (1991) and Andrews y Monahan (1992). The critical values are taken from Fuller (1976), table 8.5.2.c.

Critical values:

	5%:	1%:
$z(t_{\alpha})$	-3.60	-4.38
$z(t_{\alpha}^*)$	-3.00	-3.75
$z(t_{\alpha})$	-1.95	-2.66

Table 3: Phillips-Perron unit root tests^{a,b}

Difference in fiscal pressure with respect to Germany (1967-1994)

Variable	I(2) vs. I(1)			I(1) vs. I(0)		
	Phillips-Perron Test ^b			Phillips-Perron Test ^b		
	$z(t_{\alpha})$	$z(t_{\alpha}^*)$	$z(t_{\alpha})$	$z(t_{\alpha})$	$z(t_{\alpha}^*)$	$z(t_{\alpha})$
Austria	-7.39**	-7.39	-7.35	-3.67*	-2.28	-0.38
Belgium	-6.90**	-6.80	-6.61	-1.93	-1.64	0.25
Denmark	-5.77**	-5.80	-5.63	-2.78	-2.19	0.32
Spain	-5.01**	-4.96	-4.29	-2.69	-0.05	-1.57
Finland	-6.86**	-6.66	-6.53	-2.53	-1.20	-1.02
France	-4.85**	-4.85	-4.83	-1.90	-1.14	-0.17
Greece	-6.27**	-5.80	-5.42	-2.26	-5.31	-1.13
Netherl.	-7.05**	-6.94	-6.81	-4.45	-2.45	-0.04
Ireland	-6.54**	-6.54	-6.52	-2.55	-1.91	-1.26
Italy	-5.94**	-5.43	-5.31	-2.45	-1.37	-0.99
Luxembur g	-6.55	-6.44	-6.16	-2.00	-1.55	-0.73
Portugal	-5.54	-5.53	-5.26	-3.14	-0.84	-1.35
U.K.	-4.83	-4.85	-4.73	-2.39	-1.99	-1.58
Sweden	-4.53*	-4.50	-4.46	-1.91	-1.83	-0.05

NOTES:

- a. * and ** denote significance at the 5% and 1% levels, respectively.
- b. The Phillips and Perron test has been calculated using the long-run variance estimator as proposed in Andrews (1991) and Andrews y Monahan (1992). The critical values are taken from Fuller (1976), table 8.5.2.c.

Critical values:

	5%:	1%:
$z(t_{\alpha})$	-3.60	-4.38
$z(t_{\alpha}^*)$	-3.00	-3.75
$z(t_{\alpha})$	-1.95	-2.66

Table 4

Variable	Model	T_b	k	$\hat{\beta}$	$\hat{\delta}$	$\hat{\epsilon}$	$\hat{\alpha}$	$\hat{t}_{\alpha}$
Belgium	IOM-C	1985	5	-0.01 (-6.31)	0.02 (2.48)	-0.57 (-5.64)	-2.31	-6.31***
Spain	IOM-A ^a	1989	5	-0.004 (-3.80)	-0.03 (-3.32)	0.02 (2.90)	0.54	-324
	AOM-B ^b	1976	1	0.002 (3.85)			-0.67	-5.51**
Italy	AOM-C	1979	0	0.004 (4.15)		0.12 (5.68)	-0.09	-5.19*
	AOM-B	1976	0	0.006 (4.56)			0.16	-4.78
Portugal	AOM-B	1974	2	0.002 (1.10)			-0.35	-4.89**
U.K.	AOM-A	1981	2	0.004 (6.17)		-0.06 (-5.04)	-0.41	-4.96*
	AOM-C	1980	2	0.005 (5.39)		-0.03 (-1.53)	-0.49	-5.34*
Sweden	IOM-A	1989	1	-0.004 (-4.91)	-0.06 (-4.18)	0.04 (4.58)	0.33	-5.04*

NOTES:

- a. The period is 1967-1994.
b. The period is 1967-1990.
c. *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively.

Critical values:

Model:	1%	5%	10%	Source:
AOM-A:	-5.71	-5.16	-4.86	Vogelsang and Perron (1994), table 1A
AOM-C:	-6.16	-5.49	-5.18	Vogelsang and Perron (1994), table 2A
AOM-B:	-5.45	-4.83	-4.48	Perron (1994), table 3A
IOM-A:	-5.92	-5.23	-4.92	Perron (1994), table 1A
IOM-C:	-6.32	-5.59	-5.29	Perron (1994), table 2A

Table 5

Variable	Model	T_b	k	δ	α	$\hat{\epsilon}_\alpha$
Selection criterion: t-sig (Kmax = 5)						
Austria	AOM	1976	0	-0.001 (-4.58)	0.18	-5.46***
Finlan.	AOM	1987	5	-0.08 (-10.26)	-0.98 (10.26)	-5.52

NOTES:

t statistics in brackets

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

Critical values:

Model:	1%	5%	10%	Source:
AOM-A:	-5.28	-4.76	-4.45	Perron and Vogelsang (1992a), table 1

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