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WORKING PAPER

The Environmental Kuznets Curve: some really disturbing Monte Carlo evidence

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ABSTRACT

The Environmental Kuznets Curve hypothesis posits an inverse U-shaped relation between environmental pollution and income. The empirical literature has largely ignored the time series properties of the data used to test the EKC. This paper uses Monte Carlo experiments to analyse whether the order of integration influences the EKC empirical strategy. We show that if the variables used are I(1), the results will spuriously confirm the EKC hypothesis in 40% of the cases. Furthermore, accepting the EKC also influences the critical values for the rejection of no cointegration in the Engle-Granger framework.

KEY WORDS: Environmental Kuznets Curve Hypothesis, I(1), cointegration, monte carlo

JEL: Q20, C22

1. Introduction

The Environmental Kuznets Curve hypothesis (EKC) predicts an inverse U-shaped relationship between environmental pollution and per capita income. This shape is attributed to the scale-, composition, and income (or technique) effects. At first, the increasing scale of economic activity as well as its changing composition from agricultural towards industrial activities generates more pollution. However, as income rises, demand for environmental quality increases and more stringent environmental regulation leads to a replacement of old technologies by environmentally less harmful ones. This technology or income effect, together with the changing composition away from an industrial towards a post-industrial economy puts downward pressure on pollution. Eventually, as income passes some threshold level, the latter effects will start to dominate and environmental quality will increase with growth.

The standard empirical EKC literature captures the scale-, composition, and technique effects through reduced form regressions in a time series or panel framework (see Holtz-Eakin and Selden, 1992; Selden and Song, 1994; Shafik, 1994; Grossman and Krueger, 1995; Stern, 1996; De Bruyn, van den Bergh and Opschoor, 1998; Stern and Common, 2001; Harbaugh, Levinson and Wilson, 2002) such as

$$\ln\left(\frac{E}{P}\right)_t = c + \gamma t + \beta_1 \ln\left(\frac{Y}{P}\right)_t + \beta_2 \ln\left(\frac{Y}{P}\right)_t^2 + \zeta_t \qquad [1].$$

In these regressions the (natural logarithm of the) level of environmental pollution ($\ln\left(\frac{E}{P}\right)$) depends on (the natural logarithm of) per capita GDP ($\ln\left(\frac{Y}{P}\right)$), per capita GDP-squared and a trend (γt). The EKC predicts that $\beta_1 > 0$ and $\beta_2 < 0$. Following Grossman and Krueger (1995) the log of per capita GDP cubed is often added to the regressands. However, most authors who do so do not discuss it in much detail and many estimates have been done without this term.

Some authors have questioned the use of the standard EKC empirical strategy based on the properties of environmental and income time series. Stern and Kaufmann (1999) for instance analyse the order of integration of CO_2, SO_2, CH_4, CFC11, CFC12, N_2O using 4 different tests. Each of their 4 tests confirms that SO_2 emissions are I(1) while 3 out of 4 tests indicate that CH_4 and N_2O are integrated of order 1. Their evidence further suggests one can not accept the hypothesis that CO_2 is not I(1) as 2 out of 4 tests point in this direction. Lee and List (2003) show that their NO_x emissions series is I(1). Perman and Stern (2003) perform both individual and panel unit root tests for SO_2 emissions and per capita GDP for 74 countries using 30 years of data. They conclude that both these variables are integrated in the majority of countries.

This suggests that it is not unreasonable to assume that environmental pollution series are I(1). If per capita GDP is I(1), its square is also I(1) (Granger and Hallman (1988). In line with Nelson and Plosser's (1982) results, Stern and Perman (2003) find evidence that per capita GDP as well as its square are I(1). Hence standard EKC regression results could be spurious if emissions, per capita GDP and GDP squared are not cointegrated (Stern and Common, 2001). Therefore the interpretation of standard EKC empirical results from time series analysis critically hinges on information with respect to the time series properties of the data. Unfortunately, most of the EKC literature ignores or does not report those properties while the literature above suggests that most models are estimated using 3 variables that are likely to be I(1).

This paper continues the line of research that investigates the impact of specific time series properties on the EKC standard empirical strategy. We perform a number of Monte Carlo experiments on independently generated I(1) series which we use to estimate EKC regressions such as [1]. The results cast a dark shadow over the standard EKC empirical strategy in a pure time series framework as we find EKC-like relations in a large number of cases. It is noteworthy that this number is about the same as the number of cases for which Perman and Stern (2003) find support for the EKC using data for 74 countries for sulphur dioxide emissions (SO_2).

Secondly, we analyse the residuals of our regressions to test if the Engle and Granger (1987) cointegration framework is affected by including both the level and the square of a variable in our regressions. Our results suggest that the critical values reported in MacKinnon (1991) to test the null of no cointegration are too small. This seems to be especially the case if estimates reveal an EKC-like relation.

The two basic results of our paper are the following. Firstly results derived from time series analysis of the EKC are not reliable without information with respect to the properties of the time series used. If the estimates were produced from I(1) series, our results suggest that it should not be surprising to find evidence in favour of the EKC. To our knowledge, most empirical papers do not report whether the series are integrated or not. Basically, this means that there is no way to tell if the reported results are due to the EKC or are spurious. This is especially worrying since the spuriousness favours the EKC.

Secondly, if researchers use cointegration analysis, they should be very cautious when interpreting the results in an Engle-Granger framework. The critical values to determine if the null of no cointegration can be rejected are higher if the EKC can not be rejected.

Note that this paper does not argue in favour of or against the EKC. We do not perform tests that would allow accepting or rejecting the EKC. All this paper does is suggesting that EKC regressions could be spurious. Basically, it supports Lee and List's (2003) argument that the analysis of the properties of environmental time series should, following macro-economic literature, become an integral part of environmental economics. As this paper will show, a better understanding of these properties is important to verify theories.

The remainder of this paper is organised as follows: the next section details the Monte Carlo experiments; the third section discusses the results. The final section concludes.

2. Set-up of the Monte Carlo simulations

To look at the behaviour of the EKC empirical framework in the presence of I(1) series we performed a number of Monte Carlo experiments. The basic set-up of these experiments includes two random walks, possibly with drift, z and y:

$$z_t = z_{t-1} + \alpha_z + \sigma_z \zeta_t^z \qquad [2]$$

$$y_t = y_{t-1} + \alpha_y + \sigma_y \zeta_t^y \qquad [3]$$

with $\zeta_t^z \rightarrow \mathrm{N}(0,1)$, $\zeta_t^y \rightarrow \mathrm{N}(0,1)$, $\mathrm{E}[\zeta_t^z, \zeta_t^y] = 0$ (uncorrelated random shocks), volatility parameters $\sigma_z > 0$, $\sigma_y > 0$ and t a time index. As Granger and Hallman (1988) have shown, if a series such as y_t is I(1), this will also hold for y_t^n for n not too large. These series are used to estimate (variants of)

$$z_t = \delta + \gamma t + \beta_1 y_t + \beta_2 y_t^2 + \varepsilon_t \qquad [4]$$

with t a time trend, δ, γ, β_1, and β_2, the parameters to be estimated with OLS and ε_t the error term. Given [2] and [3] and Granger and Hallman's (1988) results with respect to the powers of y_t, equation [4] is only valid if z, y, and y^2 are cointegrated. Using the Engle and Granger (1987) framework, this requires that the estimates from

$$\Delta\hat{\varepsilon}_t = \theta\hat{\varepsilon}_t + \zeta_t^{\varepsilon} \qquad [5]$$

do not yield an estimate of $\theta = 0$, with $\hat{\varepsilon}_t$ the estimated residuals from [4] and ζ_t^{ε} a white-noise error term. Critical values to test this hypothesis have been provided by MacKinnon (1991).

We have used a number of different values for α_z, α_y, σ_z, σ_y to test whether these variables had an influence on the results. We allowed the standard deviations to equal 10%, 20% and 30% and growth rates to equal

0%, 2% and 4%. We have used these values to make sure that our assumptions with respect to drift and volatility had no impact on our results. These different parameter values yield 81 different parameter sets.

Both z_0 and y_0 were set at 0. Using [2] and [3] we generated 1,000 values for z and y. We used the last 250 observations to perform the experiments. As the first 750 observations were never used, the impact of the initial conditions z_0 and y_0 is extremely limited if not inexistent.

With respect to the estimates of [4], we have experimented with 2 specifications. First of all, we estimated the full model in eq. [4]. Secondly, we forced the coefficient on the time trend, γ, to equal zero.

For each parameter set and for each specification, we determined the probability that the estimates of [4] revealed EKC-like behaviour; i.e. the number of times out of 100 that the EKC would not have been rejected if the estimates had been obtained from an analysis with and environmental degradation series and per capita GDP. Estimates were said to reveal EKC-like behaviour if β_1 was positive, β_2 negative and if both were individually significant at a 5% level. For each parameter set and model specification, we performed 100 experiments and determined how many times the 100 estimates of [4] revealed EKC-like behaviour. If EKC-like behaviour is not rejected in n cases, $n/100$ equals the probability that the EKC would have been falsely accepted. We repeated this procedure 1,000 times to analyse the behaviour of n over a large number of observations. Because the series are independent, the probability that one cannot reject the EKC should approach zero.

For each of the regressions, we recorded the t-statistic on θ in [5]. This gives a total of 100,000 t-stats. We have used these to test if the critical values for the rejection of no cointegration as reported by MacKinnon (1991) are affected by the fact that the estimates of [4] include the square of an I(1) variable as well as the variable itself. Furthermore, we analysed these statistics in those cases where the results revealed EKC-like behaviour to test if this specific type of outcome has an impact on the critical values.

3. Results

Table 1 shows the mean and standard deviation of the distribution of the number of times the estimates of [4] revealed EKC-like behaviour if a trend was added to the model. With the exception of those cases where there is no drift in the independent variable ($\alpha_y = 0$), the table indicates that in about 35%-40% of the estimates, the EKC would not have been rejected at the 5% confidence level. The standard deviations which are included between brackets below the mean suggest that the various means are not significantly different from one another.

Except when $\alpha_y = 0$, the results hold if the drift in the dependent variable is smaller or larger than the drift in the independent variable. In terms of the EKC, this is especially worrying as it implies that environmental degradation could be increasing at a higher pace than growth of per capita GDP and still, the estimates could reveal EKC-like behaviour. Table 1 further suggests that our results hold irrespective of the values of the standard deviations.

[insert table 1 about here]

Table 1A in appendix shows that these conclusions are not affected if equation [4] did not include a trend. The mean of the number of times the estimates reveal an EKC-like result is quite similar and is not significantly different from the results presented in table 1.

It is quite interesting to compare the means presented in table 1 and 1A with the results for suplur dioxide emissions in 74 countries presented in Perman and Stern (2003). Although one should be very careful comparing results from our Monte Carlo simulations with those from ‘real data’, it is quite striking to note that both methods find a comparable 'EKC acceptance rate'. Perman and Stern (2003) estimate an EKC for each country and report the number of times their estimates confirm the EKC. If they include a time dummy but do not allow for an additional trend, 42 estimates out of 74 (56% of the cases) support the EKC. If they do allow for an additional trend, the EKC can not be rejected in 34 out of 74 estimates (41% of the cases). Confronting these results with our mean in tables 1 and 1A, their finding seem to be in line with the results from our Monte Carlo experiments. Based on our results, it shouldn't be surprising to find their EKC-acceptance rates using real data as they show that the time series they use are I(1) processes.

In order to assess the results for those experiments where the independent variable has a zero drift rate, we should look at what the independent variable respresents. In an EKC framework, the independent variable is per capita GPD. For the majority of developed countries, one would expect a positive drift for this variable. For developing countries on the other hand, the drift rate might be closer to zero. Kaufmann and Stern (2003) or Stern and Common (2001) find that estimates of an EKC for sulphur dioxide emissions do not support an inverse U-shaped relation if they restrict their sample to non-OECD countries. For their OECD group on the other hand, their estimates seem to support an inverse-U. Based on the evidence presented in tables 1 and 1A, this result should not be surprising. If per capita GDP drift of the non-OECD group approaches zero for a large number of countries, the probability that one would not reject the EKC is quite low. If, on the other hand, their OECD group's per capita GDP drift is different from zero, this probability rises and approaches 35%-40%

Turning to the t-statistics on θ in [5], table 2 reports the 1% percentile of the distribution for those cases where the EKC could not be rejected when a trend was included in [4]. Tables 2A and 2B (appendix) show the

5% and 10% levels while tables 3A-3C show the results if no trend was included. With 250 observations, MacKinnon's critical values equal -4.7430 (1%), -4.1678 (5%) and -3.8714 (10%). Table 2 shows that the largest value for the 1% percentile of the distribution of the t-statistic equals -4.7711 and the smallest -4.8871. Both estimates are quite different from those presented by MacKinnon.

If we look at the distribution of the t-statistic if all 100.000 observations are included (table 3), we can see that the 1% percentiles are much closer to MacKinnon's critical values (see table 4A-4B for the 5% and 10% percentiles for the model with trend and 5A-5C for the model without trend).

[Insert table 2 about here]

[Insert table 3 about here]

Table 2 also reports where MacKinnon's critical values are located in the distribution. With the drift of both variables equal to 2% and both standard deviations equal to 20% for instance, the probability that we find a value that is smaller or equal to -4.7430 equals 1.40% in stead of 1%. As the tables in appendix show, similar results hold for the 5% and 10% level of significance. These results seem to suggest that the Engle-Granger cointegration framework would lead the researcher to reject the null of no cointegration in too many cases. To make matters even worse, the evidence presented here suggests that this problem is especially relevant in those cases where the estimates suggest that $\beta_1 > 0$ and $\beta_2 < 0$ (eq. [4]). Hence, even carefully examined empirical results could cause the researcher to accept the EKC and the cointegration relation among the variables even if this is the wrong conclusion. This clearly indicates that bootstrapped standard errors and critical values are strongly preferred in order to determine if a linear combination of the variables is a cointegrating relation.

4. Conclusion

This paper uses Monte Carlo experiments to analyse how time series properties of a might affect the EKC-empirical strategy. The results are quite surprising. First of all, our results clearly indicate that it should not come as a surprise to find evidence in favour of the EKC if the environmental and per capita GDP time series used in the empirical work are I(1). Our results indicate that one will not be able to reject the EKC in about 40% of the cases. Secondly, the Engle-Granger cointegration framework has some power deficiencies. More problematic in terms of the EKC, however, is the fact that these deficiencies are larger when the estimates reveal an EKC-like pattern.

Most probably, our results can be extended to those estimates that use panel data techniques if the number of cross-sections is small relative to the number of time series observations. However, one of the areas of future research could focus on the way in which a panel environment affects the results of this paper.

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Table 1: mean and standard deviation of the number of times $\beta_1 > 0$, $\beta_2 < 0$ in eq. [4] with $\gamma \neq 0$ $^{(*)}$

		$\sigma_z = 0.10$			$\sigma_z = 0.20$			$\sigma_z = 0.30$		
		$\sigma_y = 0.10$	$\sigma_y = 0.20$	$\sigma_y = 0.30$	$\sigma_y = 0.10$	$\sigma_y = 0.20$	$\sigma_y = 0.30$	$\sigma_y = 0.10$	$\sigma_y = 0.20$	$\sigma_y = 0.30$
$\alpha_z = 0.00$	$\alpha_y = 0.00$	15.3160	15.6360	15.4720	15.3920	15.3760	15.2840	15.7800	15.3920	15.7200
		(3.6361)	(3.8254)	(3.8278)	(3.5373)	(3.6694)	(3.6673)	(3.6531)	(3.683)	(3.3988)
	$\alpha_y = 0.02$	39.9320	36.9840	33.8320	39.8320	37.2480	33.6920	39.8560	37.0000	34.0160
		(4.5969)	(4.5593)	(4.9944)	(4.8788)	(4.8415)	(4.5537)	(4.7865)	(4.8313)	(5.2854)
	$\alpha_y = 0.04$	39.9840	40.4600	39.4680	40.3520	39.7960	38.5160	40.1160	40.6560	38.2560
		(4.7853)	(5.2809)	(5.0802)	(5.1379)	(5.0343)	(4.9675)	(4.776)	(5.1345)	(4.3785)
$\alpha_z = 0.02$	$\alpha_y = 0.00$	15.0120	15.7280	15.7840	15.0240	15.3040	15.2200	15.3640	15.5280	15.4200
		(3.6255)	(3.5338)	(3.594)	(3.9239)	(3.9672)	(3.7109)	(3.5949)	(3.6007)	(3.3623)
	$\alpha_y = 0.02$	39.8960	37.2240	34.1080	39.6400	37.2440	34.0640	39.9640	37.0400	34.1720
		(4.9945)	(4.9905)	(4.8297)	(4.6481)	(4.4838)	(4.659)	(4.7087)	(4.9962)	(4.7658)
	$\alpha_y = 0.04$	39.8680	40.2760	38.7640	40.0200	40.2400	38.4400	40.1400	40.3560	39.1160
		(4.9595)	(4.8338)	(4.6193)	(4.8133)	(4.7801)	(4.9469)	(4.5133)	(4.5032)	(4.827)
$\alpha_z = 0.04$	$\alpha_y = 0.00$	15.0520	15.7600	15.5640	15.6040	15.6680	15.6080	15.3840	15.3760	15.4800
		(3.5206)	(3.9125)	(3.458)	(3.5146)	(3.7978)	(3.5134)	(3.6045)	(3.565)	(3.5806)
	$\alpha_y = 0.02$	39.9640	37.1280	34.3800	39.6200	36.6960	33.8040	39.4760	36.8320	34.0200
		(5.0007)	(4.8445)	(4.5145)	(4.8664)	(4.928)	(4.7413)	(4.8123)	(4.6985)	(4.9564)
	$\alpha_y = 0.04$	39.6080	39.9080	38.7960	40.2760	40.1840	38.6360	40.2600	40.1080	38.5360
		(5.0506)	(5.2949)	(4.7222)	(4.9795)	(4.8733)	(4.9145)	(4.4243)	(5.0864)	(4.8089)

$^{(*)}$standard deviation of the mean given between brackets.

Table 2: 1%-percentile of the distribution of the t-statistic on θ in eq. [5] with trend in [4] and the percentile associated with the MacKinnon 1% critical value (-4.7430) for the observation where estimates reveal EKC-like behaviour.

		$\sigma_z = 0.10$			$\sigma_z = 0.20$			$\sigma_z = 0.30$		
		$\sigma_y = 0.10$	$\sigma_y = 0.20$	$\sigma_y = 0.30$	$\sigma_y = 0.10$	$\sigma_y = 0.20$	$\sigma_y = 0.30$	$\sigma_y = 0.10$	$\sigma_y = 0.20$	$\sigma_y = 0.30$
$\alpha_z = 0.00$	$\alpha_y = 0.00$	-4.7920	-4.8647	-4.8456	-4.8098	-4.8253	-4.7711	-4.8547	-4.8330	-4.8228
		1.20%	1.40%	1.40%	1.40%	1.30%	1.20%	1.40%	1.30%	1.30%
	$\alpha_y = 0.02$	-4.8871	-4.8385	-4.8049	-4.8530	-4.8204	-4.8144	-4.8438	-4.8360	-4.8191
		1.50%	1.40%	1.30%	1.50%	1.30%	1.30%	1.40%	1.30%	1.30%
	$\alpha_y = 0.04$	-4.8105	-4.8603	-4.8446	-4.8083	-4.8382	-4.8662	-4.8292	-4.8308	-4.8471
		1.20%	1.40%	1.40%	1.30%	1.40%	1.50%	1.30%	1.40%	1.40%
$\alpha_z = 0.02$	$\alpha_y = 0.00$	-4.8047	-4.8422	-4.8338	-4.8285	-4.8189	-4.8687	-4.8073	-4.8326	-4.8134
		1.20%	1.40%	1.40%	1.40%	1.40%	1.40%	1.30%	1.40%	1.30%
	$\alpha_y = 0.02$	-4.8683	-4.8470	-4.8112	-4.8439	-4.8449	-4.8074	-4.8563	-4.8243	-4.8192
		1.50%	1.30%	1.30%	1.40%	1.40%	1.30%	1.50%	1.30%	1.30%
	$\alpha_y = 0.04$	-4.8161	-4.8417	-4.8264	-4.8435	-4.8549	-4.8471	-4.8004	-4.8362	-4.8379
		1.30%	1.40%	1.30%	1.30%	1.40%	1.40%	1.30%	1.40%	1.40%
$\alpha_z = 0.04$	$\alpha_y = 0.00$	-4.8190	-4.8105	-4.8252	-4.7985	-4.8312	-4.7797	-4.8445	-4.7810	-4.8364
		1.30%	1.30%	1.30%	1.20%	1.30%	1.10%	1.40%	1.20%	1.40%
	$\alpha_y = 0.02$	-4.8487	-4.8116	-4.8348	-4.8193	-4.8614	-4.8497	-4.8647	-4.8003	-4.8732
		1.40%	1.30%	1.30%	1.30%	1.40%	1.40%	1.40%	1.30%	1.50%
	$\alpha_y = 0.04$	-4.8148	-4.8481	-4.8343	-4.8026	-4.8370	-4.8128	-4.8114	-4.8265	-4.8181
		1.30%	1.40%	1.40%	1.30%	1.40%	1.30%	1.30%	1.40%	1.30%

Table 3: 1%-percentile of the distribution of the t-statistic on θ in eq. [5] with trend in [4] and the percentile associated with the MacKinnon 1% critical value (-4.7430) for all observations

		$\sigma_z = 0.10$			$\sigma_z = 0.20$			$\sigma_z = 0.30$		
		$\sigma_y = 0.10$	$\sigma_y = 0.20$	$\sigma_y = 0.30$	$\sigma_y = 0.10$	$\sigma_y = 0.20$	$\sigma_y = 0.30$	$\sigma_y = 0.10$	$\sigma_y = 0.20$	$\sigma_y = 0.30$
$\alpha_z = 0.00$	$\alpha_y = 0.00$	-4.7486	-4.7396	-4.7542	-4.7314	-4.7475	-4.7386	-4.7515	-4.7530	-4.7512
	$\alpha_y = 0.02$	-4.8262	-4.7912	-4.7691	-4.8049	-4.7821	-4.7714	-4.8175	-4.7950	-4.7764
	$\alpha_y = 0.04$	-4.7781	-4.8133	-4.8083	-4.7829	-4.8175	-4.8130	-4.7995	-4.7994	-4.8029
$\alpha_z = 0.02$	$\alpha_y = 0.00$	-4.7463	-4.7475	-4.7525	-4.7510	-4.7429	-4.7334	-4.7419	-4.7350	-4.7482
	$\alpha_y = 0.02$	-4.8254	-4.7830	-4.7690	-4.8160	-4.7953	-4.7656	-4.8148	-4.7954	-4.7520
	$\alpha_y = 0.04$	-4.7956	-4.7892	-4.7923	-4.8029	-4.8073	-4.8085	-4.7777	-4.8132	-4.8035
$\alpha_z = 0.04$	$\alpha_y = 0.00$	-4.7418	-4.7521	-4.7512	-4.7394	-4.7464	-4.7274	-4.7424	-4.7538	-4.7473
	$\alpha_y = 0.02$	-4.8002	-4.7878	-4.7726	-4.8003	-4.8205	-4.7793	-4.8215	-4.7943	-4.7643
	$\alpha_y = 0.04$	-4.7956	-4.8138	-4.8022	-4.7903	-4.8088	-4.7947	-4.7924	-4.7980	-4.7900

Appendix Tables:

Table 1A: mean and standard deviation of the number of times $\beta_1 > 0$, $\beta_2 < 0$ in eq. [4] with $\gamma = 0$ (*)

		$\sigma_z = 0.10$			$\sigma_z = 0.20$			$\sigma_z = 0.30$		
		$\sigma_y = 0.10$	$\sigma_y = 0.20$	$\sigma_y = 0.30$	$\sigma_y = 0.10$	$\sigma_y = 0.20$	$\sigma_y = 0.30$	$\sigma_y = 0.10$	$\sigma_y = 0.20$	$\sigma_y = 0.30$
$\alpha_z = 0.00$	$\alpha_y = 0.00$	15.3520	15.4560	15.5080	15.2680	15.2440	15.2400	15.4440	15.7120	15.4840
		(3.8071)	(3.8993)	(3.9314)	(3.7679)	(3.5387)	(3.3971)	(3.5858)	(3.5733)	(3.5525)
	$\alpha_y = 0.02$	40.9640	36.3720	33.7400	40.7320	36.7200	33.3520	40.7480	36.4480	33.4720
		(4.5929)	(4.3807)	(4.6939)	(4.7841)	(4.8331)	(4.8067)	(5.1442)	(4.6473)	(4.961)
	$\alpha_y = 0.04$	42.1680	40.6080	39.2280	42.6480	40.7840	37.9440	42.5040	41.1560	38.5640
		(4.6917)	(5.1075)	(5.0372)	(5.1776)	(5.2436)	(5.0924)	(4.957)	(5.0535)	(4.6073)
$\alpha_z = 0.02$	$\alpha_y = 0.00$	15.7880	15.9960	15.8760	15.4000	15.6280	15.5440	15.5920	15.5560	15.9080
		(3.5123)	(3.8616)	(3.7337)	(3.7801)	(4.1683)	(3.4699)	(3.5649)	(3.8001)	(3.7561)
	$\alpha_y = 0.02$	41.0320	37.1600	34.5760	41.2840	37.7400	35.2520	41.4440	37.7560	34.7640
		(4.7558)	(4.781)	(4.5377)	(4.6538)	(4.5778)	(4.4726)	(4.8469)	(4.6664)	(5.0536)
	$\alpha_y = 0.04$	43.1040	41.8960	38.4680	43.4880	41.7920	39.1640	43.3320	41.5920	39.8320
		(4.9541)	(5.1645)	(5.1007)	(4.918)	(4.967)	(4.9941)	(4.471)	(4.5081)	(4.8879)
$\alpha_z = 0.04$	$\alpha_y = 0.00$	15.4920	15.2760	15.6920	15.9640	15.9800	16.1280	15.6520	16.1640	15.9040
		(3.6253)	(3.8255)	(3.7924)	(3.8363)	(3.5448)	(3.4501)	(3.5379)	(3.8004)	(3.7081)
	$\alpha_y = 0.02$	40.0320	35.6240	33.2240	41.0000	37.0640	34.4720	40.9480	37.1600	34.9400
		(4.807)	(5.1056)	(4.8052)	(4.9227)	(4.7883)	(4.7972)	(4.7476)	(4.8003)	(5.0675)
	$\alpha_y = 0.04$	43.1160	40.1200	36.8360	43.4640	40.8760	38.4760	43.4480	41.8680	39.2800
		(5.0179)	(4.9269)	(4.6518)	(4.8397)	(4.7875)	(4.872)	(4.5794)	(4.8968)	(4.4453)

(*) standard deviation of the mean given between brackets.

Table 2A: 5%-percentile of the distribution of the t-statistic on θ in eq. [5] with trend in [4] and the percentile associated with the MacKinnon 5% critical value (-4.1678) for the observation where estimates reveal EKC-like behaviour.

		$\sigma_z = 0.10$			$\sigma_z = 0.20$			$\sigma_z = 0.30$		
		$\sigma_y = 0.10$	$\sigma_y = 0.20$	$\sigma_y = 0.30$	$\sigma_y = 0.10$	$\sigma_y = 0.20$	$\sigma_y = 0.30$	$\sigma_y = 0.10$	$\sigma_y = 0.20$	$\sigma_y = 0.30$
$\alpha_z = 0.00$	$\alpha_y = 0.00$	-4.2407	-4.2393	-4.2399	-4.2496	-4.2427	-4.2270	-4.2473	-4.2364	-4.2372
		6.10%	6.10%	6.20%	6.10%	6.00%	5.80%	6.20%	6.00%	6.00%
	$\alpha_y = 0.02$	-4.2758	-4.2676	-4.2460	-4.2711	-4.2599	-4.2502	-4.2645	-4.2463	-4.2483
		6.50%	6.40%	6.10%	6.40%	6.20%	6.20%	6.40%	6.10%	6.10%
	$\alpha_y = 0.04$	-4.2511	-4.2678	-4.2535	-4.2394	-4.2835	-4.2783	-4.2444	-4.2750	-4.2621
		6.20%	6.40%	6.40%	6.00%	6.60%	6.50%	6.10%	6.60%	6.20%
$\alpha_z = 0.02$	$\alpha_y = 0.00$	-4.2342	-4.2573	-4.2486	-4.2561	-4.2483	-4.2446	-4.2325	-4.2459	-4.2368
		5.80%	6.20%	6.10%	6.30%	6.20%	6.10%	5.90%	6.10%	6.00%
	$\alpha_y = 0.02$	-4.2784	-4.2419	-4.2456	-4.2629	-4.2638	-4.2345	-4.2762	-4.2556	-4.2389
		6.60%	6.10%	6.10%	6.50%	6.40%	5.80%	6.60%	6.30%	6.10%
	$\alpha_y = 0.04$	-4.2410	-4.2733	-4.2563	-4.2508	-4.2650	-4.2752	-4.2364	-4.2618	-4.2623
		6.10%	6.50%	6.30%	6.10%	6.40%	6.50%	6.00%	6.30%	6.30%
$\alpha_z = 0.04$	$\alpha_y = 0.00$	-4.2433	-4.2262	-4.2378	-4.2130	-4.2471	-4.2230	-4.2293	-4.2344	-4.2483
		6.10%	5.90%	6.00%	5.70%	6.10%	5.80%	5.90%	6.00%	6.10%
	$\alpha_y = 0.02$	-4.2710	-4.2477	-4.2535	-4.2597	-4.2656	-4.2516	-4.2641	-4.2395	-4.2660
		6.40%	6.20%	6.30%	6.40%	6.20%	6.20%	6.40%	6.10%	6.30%
	$\alpha_y = 0.04$	-4.2418	-4.2673	-4.2600	-4.2477	-4.2653	-4.2680	-4.2398	-4.2514	-4.2649
		6.00%	6.40%	6.20%	6.10%	6.30%	6.40%	6.10%	6.20%	6.40%

Table 2B: 10%-percentile of the distribution of the t-statistic on θ in eq. [5] with trend in [4] and the percentile associated with the MacKinnon 10% critical value (-3.8714) for the observation where estimates reveal EKC-like behaviour.

		$\sigma_z = 0.10$			$\sigma_z = 0.20$			$\sigma_z = 0.30$		
		$\sigma_y = 0.10$	$\sigma_y = 0.20$	$\sigma_y = 0.30$	$\sigma_y = 0.10$	$\sigma_y = 0.20$	$\sigma_y = 0.30$	$\sigma_y = 0.10$	$\sigma_y = 0.20$	$\sigma_y = 0.30$
$\alpha_z = 0.00$	$\alpha_y = 0.00$	-3.9310	-3.9321	-3.9491	-3.9489	-3.9204	-3.9394	-3.9469	-3.9304	-3.9423
		11.30%	11.40%	11.70%	11.80%	11.20%	11.80%	11.70%	11.40%	11.60%
	$\alpha_y = 0.02$	-3.9790	-3.9574	-3.9483	-3.9790	-3.9554	-3.9499	-3.9672	-3.9505	-3.9489
		12.70%	12.10%	11.80%	12.60%	12.10%	11.80%	12.20%	11.90%	11.90%
	$\alpha_y = 0.04$	-3.9533	-3.9724	-3.9742	-3.9462	-3.9827	-3.9741	-3.9529	-3.9823	-3.9644
		12.00%	12.50%	12.50%	11.80%	12.70%	12.40%	12.00%	12.60%	12.20%
$\alpha_z = 0.02$	$\alpha_y = 0.00$	-3.9269	-3.9403	-3.9435	-3.9608	-3.9343	-3.9372	-3.9367	-3.9445	-3.9356
		11.30%	11.50%	11.70%	12.00%	11.70%	11.70%	11.40%	11.50%	11.50%
	$\alpha_y = 0.02$	-3.9727	-3.9521	-3.9500	-3.9742	-3.9655	-3.9329	-3.9730	-3.9625	-3.9437
		12.40%	11.90%	11.90%	12.40%	12.20%	11.50%	12.50%	12.20%	11.60%
	$\alpha_y = 0.04$	-3.9531	-3.9766	-3.9634	-3.9539	-3.9788	-3.9769	-3.9502	-3.9675	-3.9603
		12.10%	12.50%	12.30%	12.10%	12.50%	12.60%	12.00%	12.40%	12.20%
$\alpha_z = 0.04$	$\alpha_y = 0.00$	-3.9380	-3.9251	-3.9411	-3.9317	-3.9382	-3.9404	-3.9194	-3.9410	-3.9441
		11.60%	11.20%	11.70%	11.60%	11.50%	11.80%	11.10%	11.60%	11.80%
	$\alpha_y = 0.02$	-3.9776	-3.9481	-3.9548	-3.9634	-3.9552	-3.9569	-3.9656	-3.9508	-3.9524
		12.60%	11.80%	12.00%	12.20%	12.00%	12.10%	12.30%	11.90%	11.90%
	$\alpha_y = 0.04$	-3.9487	-3.9692	-3.9571	-3.9580	-3.9682	-3.9665	-3.9509	-3.9641	-3.9741
		11.90%	12.40%	12.00%	12.20%	12.40%	12.30%	11.90%	12.30%	12.60%

Table 3A: 1%-percentile of the distribution of the t-statistic on θ in eq. [5] without trend in [4] and the percentile associated with the MacKinnon 1% critical value (-4.3542) for the observation where estimates reveal EKC-like behaviour.

		$\sigma_z = 0.10$			$\sigma_z = 0.20$			$\sigma_z = 0.30$		
		$\sigma_y = 0.10$	$\sigma_y = 0.20$	$\sigma_y = 0.30$	$\sigma_y = 0.10$	$\sigma_y = 0.20$	$\sigma_y = 0.30$	$\sigma_y = 0.10$	$\sigma_y = 0.20$	$\sigma_y = 0.30$
$\alpha_z = 0.00$	$\alpha_y = 0.00$	-4.3783	-4.4024	-4.4161	-4.4433	-4.3578	-4.3612	-4.3730	-4.4182	-4.3689
		1.10%	1.20%	1.20%	1.30%	1.10%	1.10%	1.10%	1.20%	1.10%
	$\alpha_y = 0.02$	-4.5317	-4.4300	-4.4246	-4.5052	-4.4611	-4.4033	-4.5120	-4.4742	-4.4089
		1.60%	1.30%	1.30%	1.60%	1.30%	1.20%	1.70%	1.50%	1.20%
	$\alpha_y = 0.04$	-4.4661	-4.5193	-4.4514	-4.4857	-4.4967	-4.4656	-4.5103	-4.4905	-4.4447
		1.50%	1.60%	1.40%	1.50%	1.60%	1.50%	1.60%	1.60%	1.40%
$\alpha_z = 0.02$	$\alpha_y = 0.00$	-4.3354	-4.2837	-4.3575	-4.3925	-4.4325	-4.4053	-4.3884	-4.4110	-4.4105
		1.00%	0.90%	1.10%	1.10%	1.20%	1.20%	1.20%	1.20%	1.30%
	$\alpha_y = 0.02$	-4.5904	-4.5184	-4.4088	-4.5331	-4.5239	-4.4180	-4.5327	-4.4928	-4.4168
		1.90%	1.60%	1.20%	1.80%	1.70%	1.30%	1.80%	1.50%	1.30%
	$\alpha_y = 0.04$	-4.4983	-4.5582	-4.5197	-4.5306	-4.5475	-4.5341	-4.4977	-4.5244	-4.5438
		1.60%	1.90%	1.60%	1.70%	1.70%	1.70%	1.50%	1.80%	1.70%
$\alpha_z = 0.04$	$\alpha_y = 0.00$	-4.1495	-4.0949	-4.1615	-4.2783	-4.3086	-4.2891	-4.3660	-4.3631	-4.3327
		0.60%	0.60%	0.70%	0.90%	1.00%	0.90%	1.10%	1.10%	1.00%
	$\alpha_y = 0.02$	-4.5591	-4.4500	-4.3073	-4.5547	-4.4956	-4.4181	-4.5398	-4.4846	-4.4423
		1.80%	1.40%	0.90%	1.90%	1.50%	1.20%	1.80%	1.50%	1.30%
	$\alpha_y = 0.04$	-4.5492	-4.5721	-4.5271	-4.5183	-4.5619	-4.5381	-4.5086	-4.5405	-4.5367
		1.80%	1.80%	1.60%	1.70%	1.90%	1.80%	1.60%	1.80%	1.70%

Table 3B: 5%-percentile of the distribution of the t-statistic on θ in eq. [5] without trend in [4] and the percentile associated with the MacKinnon 5% critical value (-3.7767) for the observation where estimates reveal EKC-like behaviour.

		$\sigma_z = 0.10$			$\sigma_z = 0.20$			$\sigma_z = 0.30$		
		$\sigma_y = 0.10$	$\sigma_y = 0.20$	$\sigma_y = 0.30$	$\sigma_y = 0.10$	$\sigma_y = 0.20$	$\sigma_y = 0.30$	$\sigma_y = 0.10$	$\sigma_y = 0.20$	$\sigma_y = 0.30$
$\alpha_z = 0.00$	$\alpha_y = 0.00$	-4.2407	-4.2393	-4.2399	-4.2496	-4.2427	-4.2270	-4.2473	-4.2364	-4.2372
		5.10%	5.30%	5.30%	5.60%	5.20%	5.40%	5.10%	5.50%	5.00%
	$\alpha_y = 0.02$	-4.2758	-4.2676	-4.2460	-4.2711	-4.2599	-4.2502	-4.2645	-4.2463	-4.2483
		7.40%	6.30%	5.80%	7.10%	6.30%	5.60%	6.90%	6.10%	5.90%
	$\alpha_y = 0.04$	-4.2511	-4.2678	-4.2535	-4.2394	-4.2835	-4.2783	-4.2444	-4.2750	-4.2621
		7.20%	7.10%	6.70%	6.90%	7.20%	6.80%	7.00%	7.20%	6.40%
$\alpha_z = 0.02$	$\alpha_y = 0.00$	-4.2342	-4.2573	-4.2486	-4.2561	-4.2483	-4.2446	-4.2325	-4.2459	-4.2368
		3.50%	3.30%	3.80%	5.00%	4.60%	4.80%	5.20%	5.20%	5.20%
	$\alpha_y = 0.02$	-4.2784	-4.2419	-4.2456	-4.2629	-4.2638	-4.2345	-4.2762	-4.2556	-4.2389
		7.80%	6.00%	4.80%	7.70%	6.70%	5.60%	7.60%	6.60%	5.70%
	$\alpha_y = 0.04$	-4.2410	-4.2733	-4.2563	-4.2508	-4.2650	-4.2752	-4.2364	-4.2618	-4.2623
		7.40%	7.80%	6.80%	7.40%	7.80%	7.20%	7.00%	7.60%	7.20%
$\alpha_z = 0.04$	$\alpha_y = 0.00$	-4.2433	-4.2262	-4.2378	-4.2130	-4.2471	-4.2230	-4.2293	-4.2344	-4.2483
		2.50%	2.30%	2.50%	3.30%	3.40%	3.40%	4.00%	4.20%	4.10%
	$\alpha_y = 0.02$	-4.2710	-4.2477	-4.2535	-4.2597	-4.2656	-4.2516	-4.2641	-4.2395	-4.2660
		7.70%	5.30%	4.00%	7.70%	6.10%	4.90%	7.60%	6.30%	5.50%
	$\alpha_y = 0.04$	-4.2418	-4.2673	-4.2600	-4.2477	-4.2653	-4.2680	-4.2398	-4.2514	-4.2649
		7.80%	7.80%	6.60%	7.50%	7.90%	7.00%	7.30%	7.40%	7.10%

Table 3C: 10%-percentile of the distribution of the t-statistic on θ in eq. [5] without trend in [4] and the percentile associated with the MacKinnon 10% critical value (-3.4769) for the observation where estimates reveal EKC-like behaviour.

		$\sigma_z = 0.10$			$\sigma_z = 0.20$			$\sigma_z = 0.30$		
		$\sigma_y = 0.10$	$\sigma_y = 0.20$	$\sigma_y = 0.30$	$\sigma_y = 0.10$	$\sigma_y = 0.20$	$\sigma_y = 0.30$	$\sigma_y = 0.10$	$\sigma_y = 0.20$	$\sigma_y = 0.30$
$\alpha_z = 0.00$	$\alpha_y = 0.00$	-3.9310	-3.9321	-3.9491	-3.9489	-3.9204	-3.9394	-3.9469	-3.9304	-3.9423
		10.20%	10.00%	10.00%	10.50%	10.10%	10.30%	9.90%	10.70%	9.80%
	$\alpha_y = 0.02$	-3.9790	-3.9574	-3.9483	-3.9790	-3.9554	-3.9499	-3.9672	-3.9505	-3.9489
		14.10%	12.00%	11.10%	13.80%	12.40%	10.80%	13.30%	12.30%	11.40%
	$\alpha_y = 0.04$	-3.9533	-3.9724	-3.9742	-3.9462	-3.9827	-3.9741	-3.9529	-3.9823	-3.9644
		13.70%	13.70%	13.10%	13.60%	13.90%	12.80%	13.70%	13.80%	12.80%
$\alpha_z = 0.02$	$\alpha_y = 0.00$	-3.9269	-3.9403	-3.9435	-3.9608	-3.9343	-3.9372	-3.9367	-3.9445	-3.9356
		6.30%	6.00%	6.70%	9.10%	8.70%	8.80%	10.00%	9.70%	10.10%
	$\alpha_y = 0.02$	-3.9727	-3.9521	-3.9500	-3.9742	-3.9655	-3.9329	-3.9730	-3.9625	-3.9437
		14.70%	11.00%	9.00%	14.50%	12.40%	10.60%	14.30%	12.50%	11.00%
	$\alpha_y = 0.04$	-3.9531	-3.9766	-3.9634	-3.9539	-3.9788	-3.9769	-3.9502	-3.9675	-3.9603
		14.10%	14.70%	12.90%	14.10%	14.50%	13.50%	13.70%	14.50%	13.50%
$\alpha_z = 0.04$	$\alpha_y = 0.00$	-3.9380	-3.9251	-3.9411	-3.9317	-3.9382	-3.9404	-3.9194	-3.9410	-3.9441
		4.70%	4.40%	4.70%	6.10%	6.30%	6.20%	7.70%	8.10%	7.70%
	$\alpha_y = 0.02$	-3.9776	-3.9481	-3.9548	-3.9634	-3.9552	-3.9569	-3.9656	-3.9508	-3.9524
		14.20%	9.70%	7.40%	14.50%	11.00%	8.90%	14.50%	11.60%	10.20%
	$\alpha_y = 0.04$	-3.9487	-3.9692	-3.9571	-3.9580	-3.9682	-3.9665	-3.9509	-3.9641	-3.9741
		14.70%	14.30%	12.10%	14.50%	14.60%	12.70%	14.20%	14.50%	13.20%

Table 4A: 5%-percentile of the distribution of the t-statistic on θ in eq. [5] with trend in [4] and the percentile associated with the MacKinnon 5% critical value (-4.1678) for all observations

		$\sigma_z = 0.10$			$\sigma_z = 0.20$			$\sigma_z = 0.30$		
		$\sigma_y = 0.10$	$\sigma_y = 0.20$	$\sigma_y = 0.30$	$\sigma_y = 0.10$	$\sigma_y = 0.20$	$\sigma_y = 0.30$	$\sigma_y = 0.10$	$\sigma_y = 0.20$	$\sigma_y = 0.30$
$\alpha_z = 0.00$	$\alpha_y = 0.00$	-4.1617	-4.1524	-4.1619	-4.1516	-4.1595	-4.1546	-4.1584	-4.1710	-4.1549
	$\alpha_y = 0.02$	-4.2367	-4.2040	-4.1840	-4.2361	-4.2074	-4.1914	-4.2426	-4.1936	-4.1863
	$\alpha_y = 0.04$	-4.2180	-4.2383	-4.2197	-4.2184	-4.2469	-4.2325	-4.2183	-4.2370	-4.2248
$\alpha_z = 0.02$	$\alpha_y = 0.00$	-4.1606	-4.1616	-4.1639	-4.1598	-4.1550	-4.1479	-4.1542	-4.1560	-4.1506
	$\alpha_y = 0.02$	-4.2406	-4.2035	-4.1926	-4.2312	-4.2111	-4.1823	-4.2403	-4.2084	-4.1848
	$\alpha_y = 0.04$	-4.2211	-4.2355	-4.2205	-4.2224	-4.2287	-4.2220	-4.2125	-4.2349	-4.2219
$\alpha_z = 0.04$	$\alpha_y = 0.00$	-4.1556	-4.1583	-4.1627	-4.1513	-4.1584	-4.1634	-4.1479	-4.1613	-4.1583
	$\alpha_y = 0.02$	-4.2365	-4.2026	-4.1816	-4.2364	-4.2086	-4.1903	-4.2417	-4.2019	-4.1807
	$\alpha_y = 0.04$	-4.2265	-4.2310	-4.2302	-4.2225	-4.2338	-4.2282	-4.2205	-4.2214	-4.2260

Table 4B: 10%-percentile of the distribution of the t-statistic on θ in eq. [5] with trend in [4] and the percentile associated with the MacKinnon 10% critical value (-3.8714) for all observations

		$\sigma_z = 0.10$			$\sigma_z = 0.20$			$\sigma_z = 0.30$		
		$\sigma_y = 0.10$	$\sigma_y = 0.20$	$\sigma_y = 0.30$	$\sigma_y = 0.10$	$\sigma_y = 0.20$	$\sigma_y = 0.30$	$\sigma_y = 0.10$	$\sigma_y = 0.20$	$\sigma_y = 0.30$
$\alpha_z = 0.00$	$\alpha_y = 0.00$	-3.8564	-3.8535	-3.8540	-3.8578	-3.8595	-3.8570	-3.8556	-3.8620	-3.8577
	$\alpha_y = 0.02$	-3.9440	-3.9039	-3.8829	-3.9419	-3.9100	-3.8877	-3.9404	-3.8986	-3.8894
	$\alpha_y = 0.04$	-3.9246	-3.9386	-3.9312	-3.9283	-3.9487	-3.9308	-3.9251	-3.9417	-3.9252
$\alpha_z = 0.02$	$\alpha_y = 0.00$	-3.8592	-3.8542	-3.8587	-3.8593	-3.8501	-3.8488	-3.8510	-3.8600	-3.8539
	$\alpha_y = 0.02$	-3.9355	-3.9075	-3.8868	-3.9338	-3.9085	-3.8799	-3.9440	-3.9107	-3.8838
	$\alpha_y = 0.04$	-3.9274	-3.9428	-3.9231	-3.9328	-3.9385	-3.9298	-3.9203	-3.9414	-3.9236
$\alpha_z = 0.04$	$\alpha_y = 0.00$	-3.8565	-3.8603	-3.8577	-3.8556	-3.8560	-3.8662	-3.8494	-3.8570	-3.8564
	$\alpha_y = 0.02$	-3.9405	-3.9056	-3.8832	-3.9381	-3.9026	-3.8886	-3.9432	-3.9073	-3.8796
	$\alpha_y = 0.04$	-3.9289	-3.9381	-3.9325	-3.9284	-3.9374	-3.9265	-3.9273	-3.9318	-3.9293

Table 5A: 1%-percentile of the distribution of the t-statistic on θ in eq. [5] without trend in [4] and the percentile associated with the MacKinnon 1% critical value (-4.3542) for all observations

		$\sigma_z = 0.10$			$\sigma_z = 0.20$			$\sigma_z = 0.30$		
		$\sigma_y = 0.10$	$\sigma_y = 0.20$	$\sigma_y = 0.30$	$\sigma_y = 0.10$	$\sigma_y = 0.20$	$\sigma_y = 0.30$	$\sigma_y = 0.10$	$\sigma_y = 0.20$	$\sigma_y = 0.30$
$\alpha_z = 0.00$	$\alpha_y = 0.00$	-4.2964	-4.3147	-4.3096	-4.2967	-4.2992	-4.2951	-4.2936	-4.3133	-4.3048
	$\alpha_y = 0.02$	-4.4700	-4.3894	-4.3618	-4.4706	-4.3833	-4.3524	-4.4761	-4.4068	-4.3449
	$\alpha_y = 0.04$	-4.4583	-4.4724	-4.4275	-4.4617	-4.4782	-4.4361	-4.4676	-4.4505	-4.4175
$\alpha_z = 0.02$	$\alpha_y = 0.00$	-4.1204	-4.1077	-4.1415	-4.2557	-4.2222	-4.2301	-4.2742	-4.2657	-4.2916
	$\alpha_y = 0.02$	-4.4469	-4.3472	-4.2376	-4.4470	-4.3808	-4.3117	-4.4688	-4.3860	-4.3277
	$\alpha_y = 0.04$	-4.4490	-4.4525	-4.3816	-4.4674	-4.4455	-4.4167	-4.4561	-4.4700	-4.4388
$\alpha_z = 0.04$	$\alpha_y = 0.00$	-4.0246	-4.0200	-4.0351	-4.1238	-4.1305	-4.1359	-4.2183	-4.2031	-4.1947
	$\alpha_y = 0.02$	-4.4217	-4.2815	-4.1565	-4.4496	-4.3297	-4.2585	-4.4478	-4.3483	-4.2934
	$\alpha_y = 0.04$	-4.4797	-4.4112	-4.3469	-4.4584	-4.4578	-4.3851	-4.4630	-4.4471	-4.4122

Table 5B: 5%-percentile of the distribution of the t-statistic on θ in eq. [5] without trend in [4] and the percentile associated with the MacKinnon 5% critical value (-3.7767) for all observations

		$\sigma_z = 0.10$			$\sigma_z = 0.20$			$\sigma_z = 0.30$		
		$\sigma_y = 0.10$	$\sigma_y = 0.20$	$\sigma_y = 0.30$	$\sigma_y = 0.10$	$\sigma_y = 0.20$	$\sigma_y = 0.30$	$\sigma_y = 0.10$	$\sigma_y = 0.20$	$\sigma_y = 0.30$
$\alpha_z = 0.00$	$\alpha_y = 0.00$	-3.7001	-3.7002	-3.6952	-3.7036	-3.7025	-3.7023	-3.6972	-3.7127	-3.7119
	$\alpha_y = 0.02$	-3.8917	-3.8041	-3.7709	-3.8829	-3.8102	-3.7532	-3.8845	-3.7997	-3.7664
	$\alpha_y = 0.04$	-3.8959	-3.8843	-3.8521	-3.8879	-3.8942	-3.8480	-3.8926	-3.8837	-3.8432
$\alpha_z = 0.02$	$\alpha_y = 0.00$	-3.4675	-3.4696	-3.4627	-3.6063	-3.6068	-3.6056	-3.6611	-3.6560	-3.6592
	$\alpha_y = 0.02$	-3.8533	-3.7013	-3.5997	-3.8732	-3.7711	-3.6965	-3.8952	-3.7874	-3.7286
	$\alpha_y = 0.04$	-3.8805	-3.8619	-3.7700	-3.8914	-3.8714	-3.8293	-3.8823	-3.8790	-3.8424
$\alpha_z = 0.04$	$\alpha_y = 0.00$	-3.3680	-3.3597	-3.3701	-3.4549	-3.4548	-3.4622	-3.5601	-3.5671	-3.5539
	$\alpha_y = 0.02$	-3.8336	-3.6463	-3.5161	-3.8556	-3.6940	-3.6080	-3.8706	-3.7390	-3.6741
	$\alpha_y = 0.04$	-3.8864	-3.8261	-3.7291	-3.8811	-3.8570	-3.7758	-3.8867	-3.8621	-3.8111

Table 5C: 10%-percentile of the distribution of the t-statistic on θ in eq. [5] without trend in [4] and the percentile associated with the MacKinnon 10% critical value (-3.4769) for all observations

		$\sigma_z = 0.10$			$\sigma_z = 0.20$			$\sigma_z = 0.30$		
		$\sigma_y = 0.10$	$\sigma_y = 0.20$	$\sigma_y = 0.30$	$\sigma_y = 0.10$	$\sigma_y = 0.20$	$\sigma_y = 0.30$	$\sigma_y = 0.10$	$\sigma_y = 0.20$	$\sigma_y = 0.30$
$\alpha_z = 0.00$	$\alpha_y = 0.00$	-3.38749	-3.38759	-3.38415	-3.38913	-3.39093	-3.39027	-3.38712	-3.404	-3.39858
	$\alpha_y = 0.02$	-3.59759	-3.49606	-3.45994	-3.58963	-3.50537	-3.44886	-3.58828	-3.5024	-3.45588
	$\alpha_y = 0.04$	-3.60019	-3.58867	-3.54773	-3.6033	-3.59263	-3.54155	-3.59826	-3.59321	-3.54313
$\alpha_z = 0.02$	$\alpha_y = 0.00$	-3.12044	-3.12203	-3.11394	-3.28202	-3.27534	-3.27598	-3.33901	-3.3385	-3.33395
	$\alpha_y = 0.02$	-3.55715	-3.37121	-3.26604	-3.57314	-3.45924	-3.37485	-3.58887	-3.47914	-3.41666
	$\alpha_y = 0.04$	-3.59146	-3.56137	-3.46087	-3.59756	-3.57733	-3.51762	-3.59489	-3.58271	-3.53492
$\alpha_z = 0.04$	$\alpha_y = 0.00$	-3.00716	-3.01355	-3.01805	-3.11584	-3.11311	-3.11666	-3.22016	-3.22513	-3.21638
	$\alpha_y = 0.02$	-3.51939	-3.30897	-3.17773	-3.55096	-3.37011	-3.26782	-3.56645	-3.4167	-3.33945
	$\alpha_y = 0.04$	-3.59235	-3.52236	-3.40635	-3.59238	-3.55844	-3.45932	-3.59773	-3.5713	-3.50064

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