Robust Inference on Seasonal Unit Roots via a Bootstrap Applied to OECD Macroeconomic Series.*

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Abstract

Recent experimental results presented in Burridge and Taylor (2001a,b, and 2003) show that, as usually implemented, the Hylleberg *et al.* (1990) seasonal unit root tests can be rather liberal, with true level often substantially higher than nominal level. This effect is due to the presence of any of three things: data-based lag selection in the implementation of the tests, and either or both periodic heteroscedasticity and serial correlation in the driving shocks. Burridge and Taylor (2003) demonstrate that under experimental conditions a carefully implemented bootstrap substantially corrects test level without loss of power. The present study applies their technique to a large number of publicly available series, and demonstrates conclusively that the bootstrap produces less liberal, and, given the experimental results cited above, more reliable inference. We report results for Sweden, the UK and the US, which are typical of the fifteen countries in our panel. Other results, the GAUSS code, and raw data are all available at: `www.staff.city.ac.uk/p.burridge/`

JEL classifications: C12; C15; C22; C52.

Keywords: Seasonal unit roots; bootstrap tests; OECD data.

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1 Introduction

In modelling economic time series, a choice must often be made between use of seasonally adjusted or unadjusted data. Seasonally adjusted data will most likely have been through a procedure which implicitly assumes the presence of unit roots at all seasonal frequencies, in that an annual difference will have been applied. If unadjusted data are available, it is possible to test whether or not such differencing is appropriate, and a summary of the motives for such testing has recently been provided by Rodrigues and Taylor (2003). Following the seminal paper of Hylleberg *et al.* (1990) (HEGY), quarterly seasonally unadjusted economic data may now be routinely tested for unit autoregressive roots at both the zero and seasonal frequencies. However, many such series appear to be driven by serially correlated and periodically heteroscedastic shocks, and Burridge and Taylor (2001a,b) (BTa,b) have recently established that the seasonal unit root tests proposed in HEGY are then too liberal, even with lag augmentation along the lines of the familiar augmented Dickey-Fuller (ADF) test. In Burridge and Taylor (2003) (BTc), following Taylor (1997), it was further demonstrated that data-based lag selection itself is not neutral. The latter result accords with what has been found for the ADF test by Murray and Nelson (2000) and Taylor (2000). Unfortunately, the adverse effects of lag-selection cannot be eliminated merely by referring the HEGY statistics to alternative tables of critical values since the test statistics' sampling distributions would depend, as in the ADF test, on both the underlying model parameters and the method of lag selection. Furthermore, the effects of periodic heteroscedasticity are quite subtle, as shown in BTa, and it is not feasible to produce tables of critical values that would cover all cases. For these reasons, users of the HEGY tests require more robust procedures for their implementation, such as that employed in the present paper.

A bootstrap procedure which substantially eliminates the level-inflation problem in the HEGY tests, at least under controlled experimental conditions, was introduced in BTc. It works, in essence, by providing a superior approximation to the sampling distributions of the various statistics, in any given case, to that available from standard tables. In this paper we apply the HEGY tests to a large number of Swedish, UK and US series, using the bootstrap of BTc to conduct inference. Overall, the results would appear to bear out the experimental findings of BTa,b,c, showing that the bootstrap-based inferences are in practice less liberal than the conventional approach. The results we describe below are extracted from a data base in which the bootstrap is applied to quarterly macroeconomic series for fifteen OECD countries, amounting to some 300 series in all. The full set of results is available at `www.staff.city.ac.uk/p.burridge/`

The paper is organised as follows. In Section 2 we provide a brief outline of the HEGY testing procedure followed by a definition of the bootstrap used. The bootstrap and conventional inferences are compared in Section 3, and Section 4 concludes. Descriptions of the data, plots of the series, and individual test results are provided in Appendices 1 to 3.

2 HEGY Tests and the Bootstrap

BTa,b,c adopt the general set-up of a quarterly series formed as the sum of a deterministic component, d_t, and an autoregressive (AR) process; that is, $x_t = y_t + d_t$, where

$$\begin{aligned} a(L)y_t &= v_t, \quad t = 1, 2, \ldots, N, \\ d_t &= \sum_{s=1}^{4} D_{s,t}\gamma_s + \delta t \\ \phi(L)v_t &= u_t \end{aligned} \tag{2.1}$$

with $a(L)$ a fourth order polynomial in the usual lag operator, L, and $\{D_{s,t}\}_{s=1}^{4}$ a set of conventional seasonal indicator variables. This design allows for seasonally varying intercepts and a global time trend through γ_s, $s = 1, ..., 4$, and δ respectively.[1] The driving shocks $\{v_t\}$ are assumed to follow a stable $AR(m)$ process (which could represent an approximation to a moving average process), whose innovations, $\{u_t\}$, can potentially have both an asymmetric distribution and be periodically heteroscedastic, the latter meaning that the variance of u_t when t lies in season s is σ_s^2, $s = 1, ..., 4$.

To implement the HEGY tests for the presence or otherwise of unit roots at the zero and seasonal spectral frequencies in the polynomial $a(L)$, one estimates the auxiliary regression equation

$$\Delta_4 x_t = \sum_{s=1}^{4} D_{s,t}\gamma_s^* + \delta^* t + \sum_{j=1}^{4} \pi_j x_{j,t-1} + \sum_{j=1}^{m} \phi_j \Delta_4 x_{t-j} + u_t, \tag{2.2}$$

an unrestricted re-parameterisation of (2.1), where $x_{1,t} \equiv (1 + L + L^2 + L^3)\, x_t$, $x_{2,t} \equiv -(1-L + L^2 - L^3)\, x_t$, $x_{3,t} \equiv -L(1-L^2)x_t$, $x_{4,t} \equiv -(1-L^2)x_t$ and $\Delta_4 x_t \equiv x_t - x_{t-4}$. The inclusion

[1] Other forms of d_t are also possible, see Smith and Taylor (1998) for a complete typology.

of seasonal intercepts and a global time trend in (2.2) ensures that the sampling distributions of the estimated coefficients on the transformed level variables, $x_{j,t-1}$, $j = 1, ..., 4$, and their associated t- and F-statistics, are unaffected by γ_s, $s = 1, ..., 4$, and δ of (2.1).

The existence of a zero-frequency unit root, and of unit roots with periods two and four quarters respectively, imply that $\pi_1 = 0$, $\pi_2 = 0$ and $\pi_3 = \pi_4 = 0$, in (2.2). Using an obvious notation, the HEGY-type tests are the regression t-statistics, t_1, t_2, t_3 (one-sided) and t_4 (two-sided), together with the F-statistics, F_{34} for $\pi_3 = \pi_4 = 0$, F_{234} for $\pi_2 = \pi_3 = \pi_4 = 0$, and F_{1234} for $\pi_1 = \pi_2 = \pi_3 = \pi_4 = 0$. The F_{1234} therefore provides an overall test of the null hypothesis that $a(L) = 1 - L^4$, the annual difference operator. Percentiles from approximations to the finite-sample null distributions of these various statistics, obtained by Monte Carlo simulation assuming that $\{v_t\} \sim IN(0, 1)$ and $m = 0$ in (2.1) are given by HEGY (Tables 1a and 1b, pp.226-7), Smith and Taylor (1998, Tables, 1a-1b, p.276) and Ghysels *et al.* (1994, Tables C.1 and C.2, pp.440-41).

The bootstrap we employ is adapted to deal with a null model which is a (possibly) periodically heteroscedastic seasonally non-stationary autoregression with (possibly) serially correlated and (possibly) asymmetric shocks. We handle the nuisance parameters in the dynamics, represented by $\phi(L)$ above, by fitting (2.2) with the lag structure selected by the data-based algorithm proposed by Beaulieu and Miron (1993,pp.318-319). Any periodic heteroscedasticity and/or skewness that may be present is captured in the residuals, which are then re-sampled separately for each season, and re-coloured using the estimated dynamic nuisance parameters, $\hat{\phi}_j$, $j = 1, ..., m$. We do not incorporate the fitted deterministic parameters in the bootstrap samples since, as noted below (2.2), the inclusion of the corresponding deterministic variables in the HEGY test regression fitted to those samples, renders the calculated statistics invariant to such deterministic parameters. Exactly the same estimation procedure, including the lag-selection stage, is then applied to each bootstrap sample. In forming the bootstrap samples, both the zero and seasonal frequency unit roots are imposed, thus avoiding the difficulties with the use of estimated unit roots discussed by Basawa *et al.* (1991).

It is worth stressing our treatment of higher-order serial correlation. Our bootstrap is set up to do two things simultaneously: (i) create resampled series from residuals that mimic the relevant properties of the original series' innovations as closely as possible, and (ii) produce resampled test statistic values that will have a sampling distribution as close as possible to that which the originally calculated statistic would have if the null hypothesis were true. Thus we implement a lag-selection algorithm, using the estimated stationary dynamics to produce samples with dynamic structure which mimics that present in the raw series, but *include the lag-selection algorithm in the calculation of the bootstrapped test statistics in order to capture the effects of lag selection on the statistics' sampling distributions.* The complete algorithm may be stated as follows:

Step 1: Specify (i) a maximum lag length, $m_{\max}$, for convenience, a multiple of 4, (ii) the deterministic variables to be included in the test regression, such as seasonal intercepts and a global trend as in (2.2) and in the empirical results summarised below, (iii) the critical value to be used in the lag-selection algorithm (± 1.65 in the results below), (iv) the upper bound on the magnitude of fitted autoregressive lag polynomial roots (.999 in the results below), and finally, (v) the number of bootstrap replications ($40,000$ in the results below).

Step 2: Estimate the test regression, (2.2), having conducted the Beaulieu and Miron (1993) lag-selection procedure, and record the seven HEGY-type statistics, $[t_1, t_2, t_3, t_4, F_{34}, F_{234}, F_{1234}] = [\mathbf{t}', \mathbf{F}']$, say, and store the residuals for each of the four seasons in the columns of the $(n/4 \times 4)$ matrix, $\mathbf{e} = [\mathbf{e}_1|\mathbf{e}_2|\mathbf{e}_3|\mathbf{e}_4]$.

Step 3: Check the magnitudes of the roots of the estimated lag polynomial, $\hat{\phi}(L) = 1 - \sum_{j=1,m} \hat{\phi}_j L^j$, reducing any that exceed 0.999 in magnitude so that the reduced root lies in the same direction in the complex plane, but has magnitude 0.999. If this has been done, generate a report.

Step 4: Draw $n/4$ random samples, with replacement, from the elements of each of the columns of $\mathbf{e}$, and re-combine, preserving the seasonal ordering, into the single sequence, $\mathbf{e}^*$, say. Generate an x^*-sample via the recursion,

$$\hat{\phi}(L)\Delta_4 x_t^* = e_t^*.$$

Step 5: Using the sample, x_t^*, in place of x_t, re-estimate (2.2), again using the Beaulieu and Miron (1993) lag-selection procedure, recording the seven HEGY-type statistics, $[t_1^*, t_2^*, t_3^*, t_4^*, F_{34}^*, F_{234}^*, F_{1234}^*] = [\mathbf{t}^{*\prime}, \mathbf{F}^{*\prime}]$, say, and incrementing the corresponding counter whenever an element of this vector is smaller than the corresponding element of $[\mathbf{t}', \mathbf{F}']$.

Step 6: Perform Steps 4 and 5 a large number of times and report the ratios of the counters to this number; these are the estimated left tail probabilities.

To interpret the reported probabilities, we proceed as follows, taking a nominal significance level of 5% to illustrate. If the probability reported for t_1, t_2, or t_3 is less than or equal to 5% the corresponding null hypothesis is rejected at 5%; if the probability reported for t_4 is less than or equal to 2.5%, or greater than or equal to 97.5%, the null is rejected at 5%; if the probability reported for F_{34}, F_{234}, or F_{1234} is greater than 95% the corresponding null hypothesis is rejected at 5%, and similarly for other significance levels.

For a detailed examination of empirical significance level and power of this bootstrap procedure, by Monte Carlo experimentation, see BTc. However, it is worth noting that the bootstrap procedure loses no appreciable power relative to an infeasible exactly level-corrected test.

3 Comparison of bootstrap and conventional results

The series were tested in logarithms, with allowance for global de-trending and seasonal demeaning; cf. (2.2). In the first instance, all the tests were conducted using a maximum of four lags; however, whenever a non-zero coefficient was fitted to the fourth lag by the lag-selection algorithm, the tests were re-run with maximum lag raised to eight, and in these cases the latter result is the one reported. Table 1 summarises results for the 67 series of various lengths for the UK, US and Sweden. The sample contains series of lengths, 36 (4 series), 60 (5 series), 72 (15 series), 76 (32 series), 80 (1 series), 172 (1 series) and 224 (8 series). The outcomes for the nine longer series are presented separately. The data are described in Appendix 1, plots of the series are given in Appendix 2 and detailed test outcomes are reported in Appendix 3. Table 1 demonstrates the extent of agreement, or the lack of it, between the inferences based on standard critical values at 1, 5 and 10% nominal significance levels, and those using probabilities estimated by the bootstrap described above, for each of the seven test statistics.

Table 1 about here

The standard critical values, not reported here but available on request, were produced using $250,000$ replications of series of the relevant length, with $\{v_t\} \sim IN(0,1)$ and $m = 0$ in (2.1). Thus the inferences drawn using them represent what a researcher would do if such critical values were available. Entries below the leading diagonal in Table 1 represent cases in which the bootstrap is less liberal than use of such standard critical values, while entries above indicate the reverse.

It is immediately apparent that there is a substantial measure of agreement in the inferences drawn, (evidenced by the large diagonal entries) but that the bootstrap is less liberal. There are only four cases out of $7 \times 67 = 469$ tests in which the bootstrap is more liberal. Notably, however, three of these cases relate to the t_3 and t_4 test statistics for which the sampling distributions are known to be potentially very sensitive to higher-order serial correlation and periodic heteroscedasticity, leading to level inflation or deflation depending on the precise pattern manifested in the data; see BTa for details. The joint F_{34} test is much more robust, although there are still 15 out of 67 cases in which different inferences could be drawn. The t_1 results show that for all the longer series, and almost all the shorter ones the zero-frequency unit root null hypothesis is not rejected, while the remaining test results are much more mixed. A striking feature of the t_2, F_{34}, F_{234}, and F_{1234} results is that there tends to be either very strong evidence against the null hypothesis, leading to rejection at the 1% level, or very weak evidence, leading to a failure to reject even at the 10% level.

Inspection of the individual series' results in Appendix 2 reveals that there is just one case in which the lag polynomial fitted to the seasonal differences had one or more roots larger than .999 in modulus. For the series in question, identifier code LHHCONSCAKEBISCCO, the results were in line with the general pattern; that is, the bootstrap provided somewhat more conservative inference than the standard procedures.

Taken together, the bootstrap test outcomes are in line with previous experience. Looking at the final columns of the panels in Table 1, we see that the zero-frequency unit root hypothesis tested by t_1 could be rejected for only 2 of the 67 series, while all the other tests reject their respective null hypotheses in about half the series. Given that the bootstrap eliminates the worst of the size-inflation to which these tests are prone, the results clearly suggest that the annual difference operator should *not* be applied uncritically to the bulk of these series.

4 Conclusions

We have shown that in practice the bootstrapped HEGY test is indeed somewhat less liberal than the usual method, and in light of previous experimental evidence (see BTc), in general more reliable. It has a further practical advantage: it delivers estimated tail probabilities, which are the quantities required for inference, and so the unreliability of tabulated critical values, highlighted by Horowitz and Savin (2000), is not an issue provided we can be confident that the tail probabilities delivered are accurate; see BTc for experimental evidence that this is indeed generally the case. The bootstrap results confirm that seasonal unit roots are much less prevalent in a broad range of macro-economic indicators than are zero-frequency unit roots, and therefore that the desirability of taking annual differences should be considered series-by-series.

The GAUSS code employed for this paper is very easy to use, and with $40,000$ bootstrap samples, takes no more than a minute or so to run on a fast PC. The code is downloadable from `www.staff.city.ac.uk/p.burridge/`.

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Table 1: Summary of Test Outcomes

t1

sample sizes 36 – 80

Prob. using tables		≤ 1%	≤ 5%	≤ 10%	> 10%	Total
Bootstrap lower tail prob.	≤ 1%	1				1
	≤ 5%					
	≤ 10%			1		1
	> 10%		1	5	50	56
	Total	1	1	6	50	58

sample sizes 172 and 224

Prob. using tables		≤ 1%	≤ 5%	≤ 10%	> 10%	Total
Bootstrap lower tail prob.	≤ 1%					0
	≤ 5%					0
	≤ 10%					0
	> 10%				9	9
	Total	0	0	0	9	9

t2

sample sizes 36 – 80

Prob. using tables		≤ 1%	≤ 5%	≤ 10%	> 10%	Total
Bootstrap lower tail prob.	≤ 1%	18				18
	≤ 5%	3	3			6
	≤ 10%		3		1	4
	> 10%			4	26	30
	Total	21	6	4	27	58

sample sizes 172 and 224

Prob. using tables		≤ 1%	≤ 5%	≤ 10%	> 10%	Total
Bootstrap lower tail prob.	≤ 1%	3				3
	≤ 5%		2			2
	≤ 10%			1		1
	> 10%			1	2	3
	Total	3	2	2	2	9

t3

sample sizes 36 – 80

Prob. using tables		≤ 1%	≤ 5%	≤ 10%	> 10%	Total
Bootstrap lower tail prob.	≤ 1%	18				18
	≤ 5%	1	7			8
	≤ 10%		3	2		5
	> 10%			5	22	27
	Total	19	10	7	22	58

sample sizes 172 and 224

Prob. using tables		≤ 1%	≤ 5%	≤ 10%	> 10%	Total
Bootstrap lower tail prob.	≤ 1%	3				3
	≤ 5%		1	1		2
	≤ 10%		1	1		2
	> 10%				2	2
	Total	3	2	2	2	9

t4

sample sizes 36 – 80

Prob. using tables		≤ 1%	≤ 5%	≤ 10%	> 10%	Total
Bootstrap two tail prob.	≤ 1%	20	1			21
	≤ 5%	3	1			4
	≤ 10%	1	2		1	4
	> 10%			4	25	29
	Total	24	4	4	26	58

sample sizes 172 and 224

Prob. using tables		≤ 1%	≤ 5%	≤ 10%	> 10%	Total
Bootstrap two tail prob.	≤ 1%	1				1
	≤ 5%	1				1
	≤ 10%		3			3
	> 10%			1	3	4
	Total	2	3	1	3	9

F34

sample sizes 36 – 80

Prob. using tables		≤ 1%	≤ 5%	≤ 10%	> 10%	Total
Bootstrap upper tail prob.	≤ 1%	25				25
	≤ 5%	2	1			3
	≤ 10%	1	4	1		6
	> 10%	1	1	5	17	24
	Total	29	6	6	17	58

sample sizes 172 and 224

Prob. using tables		≤ 1%	≤ 5%	≤ 10%	> 10%	Total
Bootstrap upper tail prob.	≤ 1%	5				5
	≤ 5%		1			1
	≤ 10%		1			1
	> 10%				2	2
	Total	5	2		2	9

F234

sample sizes 36 – 80

Prob. using tables		≤ 1%	≤ 5%	≤ 10%	> 10%	Total
Bootstrap upper tail prob.	≤ 1%	29				29
	≤ 5%	3				3
	≤ 10%	4	2			6
	> 10%		1	4	15	20
	Total	36	3	4	15	58

sample sizes 172 and 224

Prob. using tables		≤ 1%	≤ 5%	≤ 10%	> 10%	Total
Bootstrap upper tail prob.	≤ 1%	5				5
	≤ 5%					
	≤ 10%		2			2
	> 10%			1	1	2
	Total	5	2	1	1	9

F1234

sample sizes 36 – 80

Prob. using tables		≤ 1%	≤ 5%	≤ 10%	> 10%	Total
Bootstrap upper tail prob.	≤ 1%	27				27
	≤ 5%	2	2			4
	≤ 10%	2	2	1		5
	> 10%		3	3	16	22
	Total	31	7	4	16	58

sample sizes 172 and 224

Prob. using tables		≤ 1%	≤ 5%	≤ 10%	> 10%	Total
Bootstrap upper tail prob.	≤ 1%	4				4
	≤ 5%	1				1
	≤ 10%		1			1
	> 10%			1	2	3
	Total	5	1	1	2	9

Appendix 1: Series Definitions

Series appear in alphabetical order. The "series name" is that used in Appendix 3, where detailed results appear; the "contents" column contains a brief description; the "source" is the original source of the data (not where the data were collected by us); "sample size" is self-explanatory. The length of the series range from ten to fifty-six years.

The majority of the data were extracted from DataStream and the "mnemonic" column in the table can be used to locate the exact series. The exceptions are US consumption expenditure, current expenditure, fixed investment, government consumption expenditure & gross investment and personal consumption expenditure (total, clothes & shoes, food, electricity & gas and services) which come from the Bureau of Economic Analysis, www.bea.gov

SWEDEN

Series Name	Contents	Mnemonic	Sample Size	Source
EMPLPRISECCONST	SD EMPLOYMENT: PRIVATE SECTOR - MANUFACTURING VOLN	SDEMMAN.H	Q1/93-Q3/02	Statistic Sweden
EMPLPRISECMANU	SD EMPLOYMENT: PRIVATE SECTOR - CONSTRUCTION VOLN	SDEMCON.H	Q1/93-Q3/02	Statistic Sweden
EXPOGCO	SD EXPORTS OF GOODS CONN	SDGDEXGDC	Q1/83-Q3/02	Statistic Sweden
EXPOGCU	SD EXPORTS OF GOODS CURN	SDGDEXGDA	Q1/83-Q3/02	Statistic Sweden
EXPOGSCO	SD EXPORTS OF GOODS & SERVICES CONN	SDEXNGS.C	Q1/83-Q3/02	Statistic Sweden
EXPOGSCU	SD EXPORTS - GOODS & SERVICES CURN	SD025000A	Q1/83-Q3/02	Statistic Sweden
EXPOSCO	SD EXPORTS OF SERVICES CONN	SDGDEXSRC	Q1/83-Q3/02	Statistic Sweden
EXPOSCU	SD EXPORTS OF SERVICES CURN	SDGDEXSRA	Q1/83-Q3/02	Statistic Sweden
GDPAGRICO	SD GDP - AGRICULTURE, HUNTING, FORESTRY & FISHING CONN	SD030100C	Q1/93-Q3/02	Quarterly National Accounts, copyright OECD
GDPCO	SD GDP CONN	SDGDP...C	Q1/83-Q3/02	Statistic Sweden
GDPCONSTCO	SD GDP - CONSTRUCTION CONN	SD030300C	Q1/93-Q3/02	Quarterly National Accounts, copyright OECD
GOVCONSCU	SD GOVERNMENT CONSUMPTION CURN	SDI91F..A	Q1/83-Q3/02	IMF International Financial Statistics

GOVCONSEXPCO	SD GOVERNMENT CONSUMPTION EXPENDITURECONN	SDCNGOV.C	Q1/83-Q3/02	Quarterly National Accounts, copyright OECD
IMPGCO	SD IMPORTS OF GOODS CONN	SDIMPGDSC	Q1/83-Q3/02	Statistic Sweden
IMPGCU	SD IMPORTS OF GOODS CURN	SDGDIMGDA	Q1/83-Q3/02	Statistic Sweden
IMPGSCO	SD IMPORTS OF GOODS & SERVICES CONN	SDIMNGS.C	Q1/83-Q3/02	Statistic Sweden
IMPGSCU	SD IMPORTS OF GOODS & SERVICES CURN	SDIMNGS.A	Q1/83-Q3/02	Statistic Sweden
IMPSCO	SD IMPORTS OF SERVICES CONN	SDIMPSRVC	Q1/83-Q3/02	Statistic Sweden
IMPSCU	SD IMPORTS OF SERVICES CURN	SDGDIMSRA	Q1/83-Q3/02	Statistic Sweden
PRICONSCU	SD PRIVATE CONSUMPTION CURN	SDI96F..A	Q1/83-Q3/02	IMF International Financial Statistics
PRICONSEXPCO	SD PRIVATE CONSUMPTION EXPENDITURE CONN	SDCNPER.C	Q1/83-Q3/02	Statistic Sweden
PRIFINCONSCO	SD PRIVATE FINAL CONSUMPTION (ESA 95) (NSA) CONN	SDESPN95C	Q1/83-Q3/02	EUROSTAT

UK

Series Name	**Contents**	**Mnemonic**	**Sample Size**	**Source**
CONSEXPCO	UK CONSUMERS EXPENDITURE(DISC.) CONN	UKCONEXPC	Q1/83-Q1/98	Office for National Statistic
CONSEXPCU	UK CONSUMERS EXPENDITURE(DISC.) CURN	UKCONEXPA	Q1/83-Q1/98	Office for National Statistic
ELECSALE	UK SALES OF ELECTRICITY TO CONSUMERS - TOTAL NADJ	UKSALELCF	Q1/83-Q3/02	Office for National Statistic
EMPLOYMENT	UK EMPLOYMENT - SERVICES VOLN	UKOEM011P	Q1/87-Q3/02	Main Economic Index, copyright OECD
EXPOGCU	UK BOP: GOODS - EXPORTS CURN	UKOBP031A	Q1/83-Q2/02	Main Economic Index, copyright OECD
FINEXPGSCO	UK FINAL EXPEND. ON GOODS & SERVICES (MARKET PRICES)(DISC.) CONN	UKFINSLSC	Q1/83-Q1/98	Office for National Statistic

GDPCONST	UK GDP BY OUTPUT : CONSTRUCTION VOLA	UKGDQB..	Q1/83-Q3/02	Office for National Statistic
GDPOUTPUT	UK GDP BY OUTPUT: TOTAL SERVICES VOLA	UKGDQS..	Q1/83-Q4/02	Office for National Statistic
GDPSERV	UK GDP BY OUTPUT: TOTAL SERVICES VOLA	UKGDQS..	Q1/83-Q4/02	Office for National Statistic
GOVEXCONCU	UK CENTRAL GOVT.CURRENT EXPEND. - FINAL CONSUMPTION(DISC.) CURN	UKCGEGSVA	Q1/83-Q1/98	Office for National Statistic
GOVEXPCU	UK GOVERNMENT EXPENDITURE CURN	UKI82...A	Q1/83-Q1/98	IMF International Financial Statistics
HHCONSAIRCO	UK HOUSEHOLD CONSUMPTION - AIR TRAVEL (USE UKAWUB..)(DISC.) CONN	UKCCGX..C	Q1/83-Q2/01	Office for National Statistic
HHCONSALCOCO	UK HOUSEHOLD CONSUMPTION - ALCOHOLIC DRINK TOTAL CONN	UKCCFU..C	Q1/83-Q3/02	Office for National Statistic
HHCONSAUDIOCU	UK HOUSEHOLD CONSUMPTION - AUDIO	UKCDGH..A	Q1/83-Q2/01	Office for National Statistic
HHCONSCAKEBISCCO	UK HOUSEHOLD CONSUMPTION - FOOD CAKES & BISCUITS(DISC.) CONN	UKCCXY..C	Q1/83-Q2/01	Office for National Statistic
HHCONSCIGCU	UK HOUSEHOLD CONSUMPTION - CIGARETTES(DISC.) CURN	UKCDDA..A	Q1/83-Q2/01	Office for National Statistic
HHCONSCLOTHCU	UK HOUSEHOLD CONSUMPTION - CLOTHING EXC. FOOTWEAR(DISC.) CURN	UKCCEA..A	Q1/83-Q2/01	Office for National Statistic
HHCONSDIYCU	UK HOUSEHOLD CONSMPTN - DIY GOODS(USE UKATKH.+UKADGN.)(DISC.) CURN	UKCDDI..A	Q1/83-Q2/01	Office for National Statistic
HHCONSDOMSERCO	UK HOUSEHOLD CONSUMPTION - DOMESTIC SERVICES(DISC.) CONN	UKCAQV..C	Q1/83-Q2/01	Office for National Statistic
HHCONSFUELPOWCU	UK HOUSEHOLD CONSUMPTION - FUEL & POWER TOTAL(DISC.) CURN	UKCDDP..A	Q1/83-Q2/01	Office for National Statistic
HHCONSMEALACCCU	UK HOUSEHOLD CONSUMPTION -	UKCCPF..A	Q1/83-Q2/01	Office for National

	MEALS & ACCOMMODATION(DISC.) CURN			Statistic
HHCONSPOSTTELECO	UK HOUSEHOLD CONSUMPTION - POST & TELECOMMUNICATIONS(DISC.) CONN	UKCCNB..C	Q1/83-Q2/02	Office for National Statistic
HHCONSRAILCO	UK HOUSEHOLD CONSUMPTION - BRITISH RAIL FARES(DISC.) CONN	UKCCMZ..C	Q1/83-Q2/01	Office for National Statistic
HHCONSSEATRAVCO	UK HOUSEHOLD CONSUMPTION - SEA TRAVEL(DISC.) CONN	UKCARA..C	Q3/83-Q2/01	Office for National Statistic
HHCONSSPIRCU	UK HOUSEHOLD CONSUMPTION - SPIRITS CURN	UKCDCX..A	Q1/83-Q2/01	Office for National Statistic
HHCONSTOYSPOCU	UK HOUSEHOLD CONSUMPTION - SPORTS & TOYS(DISC.) CURN	UKCDEK..A	Q1/83-Q2/01	Office for National Statistic
HHCONSTRAVCU	UK HOUSEHOLD CONSUMPTION - TRAVEL (USEUKADGW..)(DISC.) CURN	UKCCNX..A	Q1/83-Q2/01	Office for National Statistic
HHCONSWINECU	UK HOUSEHOLD CONSUMPTION - WINE(DISC.)CURN	UKCCQN..A	Q1/83-Q2/01	Office for National Statistic
HHFINCONSEXPCO	UK HOUSEHOLD EXPEND.:TOTAL HOUSEHOLD FINAL CONSMPTN.EXPENDIT	UKABPF..C	Q1/83-Q3/02	Office for National Statistic
IMPGCU	UK BOP: GOODS - IMPORTS CURN	UKOBP043A	Q1/83-Q2/02	Main Economic Index, copyright OECD

<u>US</u>

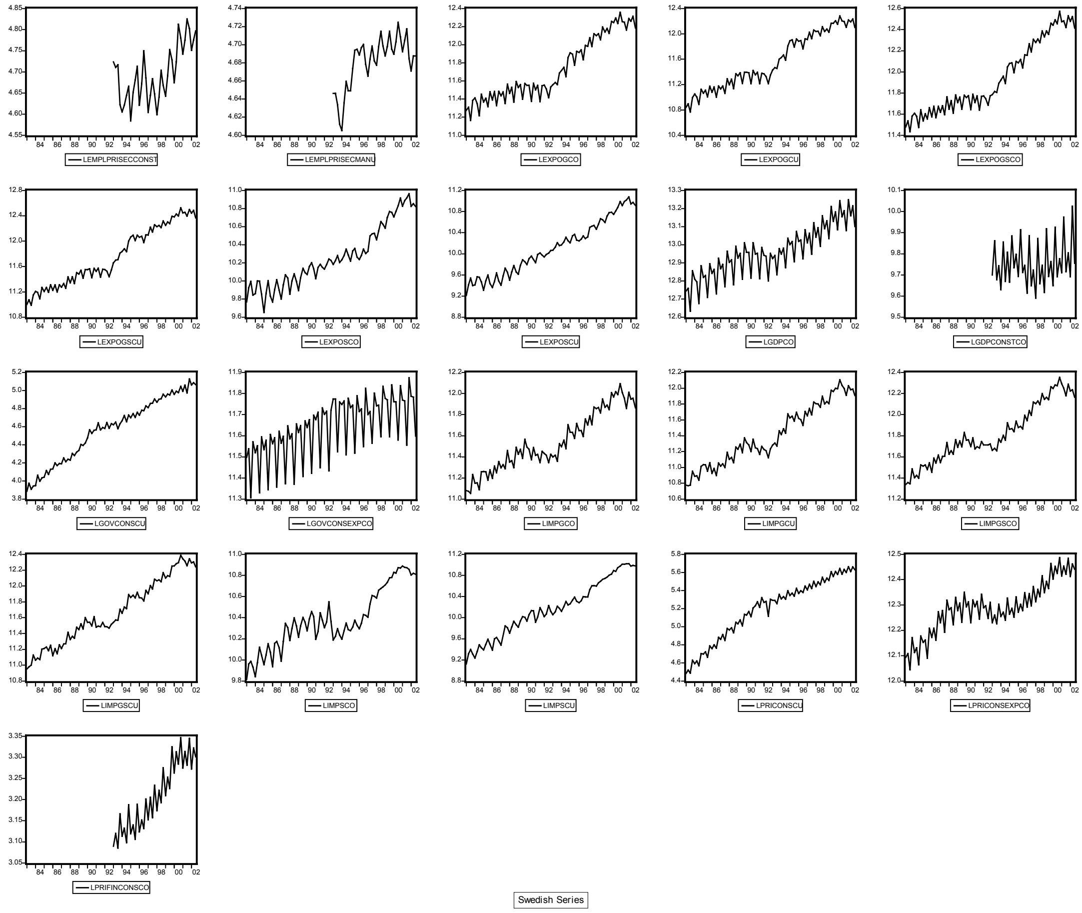
Series Name	**Contents**	**Mnemonic**	**Sample Size**	**Source**
CONSEXP	Consumption expenditures	From net so NA	Q1/46-Q4/01	Bureau of Economic Analysis, USDOC
CUREXP	Current expenditures	From net so NA	Q1/46-Q4/01	Bureau of Economic Analysis, USDOC
EXPOGCU	US EXPORTS - GOODS CURN	USEXPRMCA	Q1/83-Q4/01	Bureau of Economic Analysis, USDOC
EXPOGSCU	US EXPORTS OF GOODS & SERVICES CURN	USEXPGSVA	Q1/83-Q4/01	Bureau of Economic Analysis,

				USDOC
EXPOSCU	US EXPORTS - SERVICES CURN	USEXS...A	Q1/83-Q4/01	Bureau of Economic Analysis, USDOC
FIXINVEST	Fixed investment	From net so NA	Q1/46-Q4/01	Bureau of Economic Analysis, USDOC
GDPCU	US GDP - GROSS DOMESTIC PRODUCT CURN	USGDP...A	Q1/83-Q4/01	Bureau of Economic Analysis, USDOC
GOVCONSEXPGROINVEST	Government consumption expenditures and gross investment	From net so NA	Q1/46-Q4/01	Bureau of Economic Analysis, USDOC
IMPGCU	US IMPORTS - GOODS CURN	USIMPTMCA	Q1/83-Q4/01	Bureau of Economic Analysis, USDOC
IMPGSCU	US IMPORTS OF GOODS & SERVICES CURN	USIMPGSVA	Q1/83-Q4/01	Bureau of Economic Analysis, USDOC
IMPSCU	US IMPORTS - SERVICES CURN	USIMS...A	Q1/83-Q4/01	Bureau of Economic Analysis, USDOC
NETEXPOGSCU	US NET EXPORTS OF GOODS & SERVICES CURN	USBALGSVA	Q1/83-Q4/01	Bureau of Economic Analysis, USDOC
PERCONSEXP	Personal consumption expenditures	From net so NA	Q1/46-Q4/01	Bureau of Economic Analysis, USDOC
PERCONSEXPDURCU	US PERSONAL CONSUMPTION EXPENDITURES - DURABLE GOODS CURN	USCNDURBA	Q1/83-Q4/01	Bureau of Economic Analysis, USDOC
PERCONSEXPNDURCU	US PERSONAL CONSUMPTION EXPENDITURES - NONDURABLES CURN	USCNNONDA	Q1/83-Q4/01	Bureau of Economic Analysis, USDOC
PERCONSEXPSERV	Personal consumption expenditures: Services	From net so NA	Q1/46-Q4/01	Bureau of Economic Analysis, USDOC
PERCONSEXPCLOFOOT	Personal consumption expenditures: Clothing and shoes	From net so NA	Q1/46-Q4/01	Bureau of Economic Analysis, USDOC
PERCONSEXPELECGAS	Personal consumption expenditures: Electricity and gas	From net so NA	Q1/59-Q4/01	Bureau of Economic Analysis, USDOC

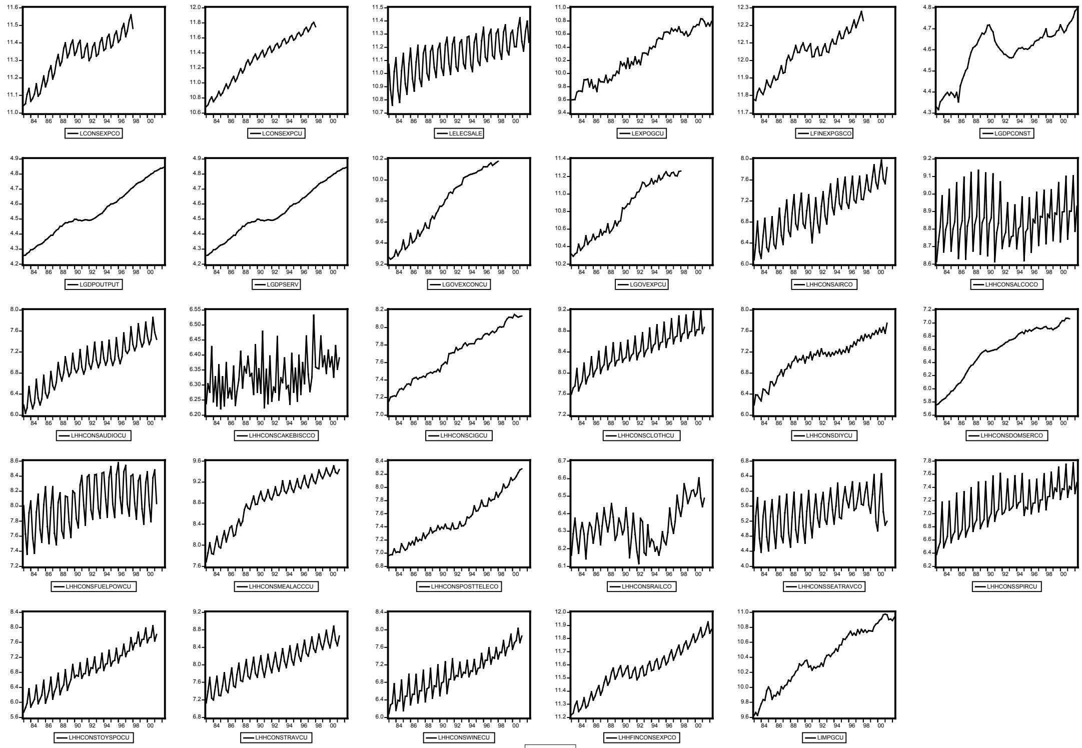
PERCONSEXPFOOD	Personal consumption expenditures: Food	From net so NA	Q1/46-Q4/01	Bureau of Economic Analysis, USDOC
PRICONS	US WES: ECONOMIC SITUATION - PRIVATE CONSUMPTION, USA NADJ	USIFGSPNR	Q1/89-Q4/02	IFO

Appendix 2: Plots of Series

Note: the “L” prefix denotes the logarithm.



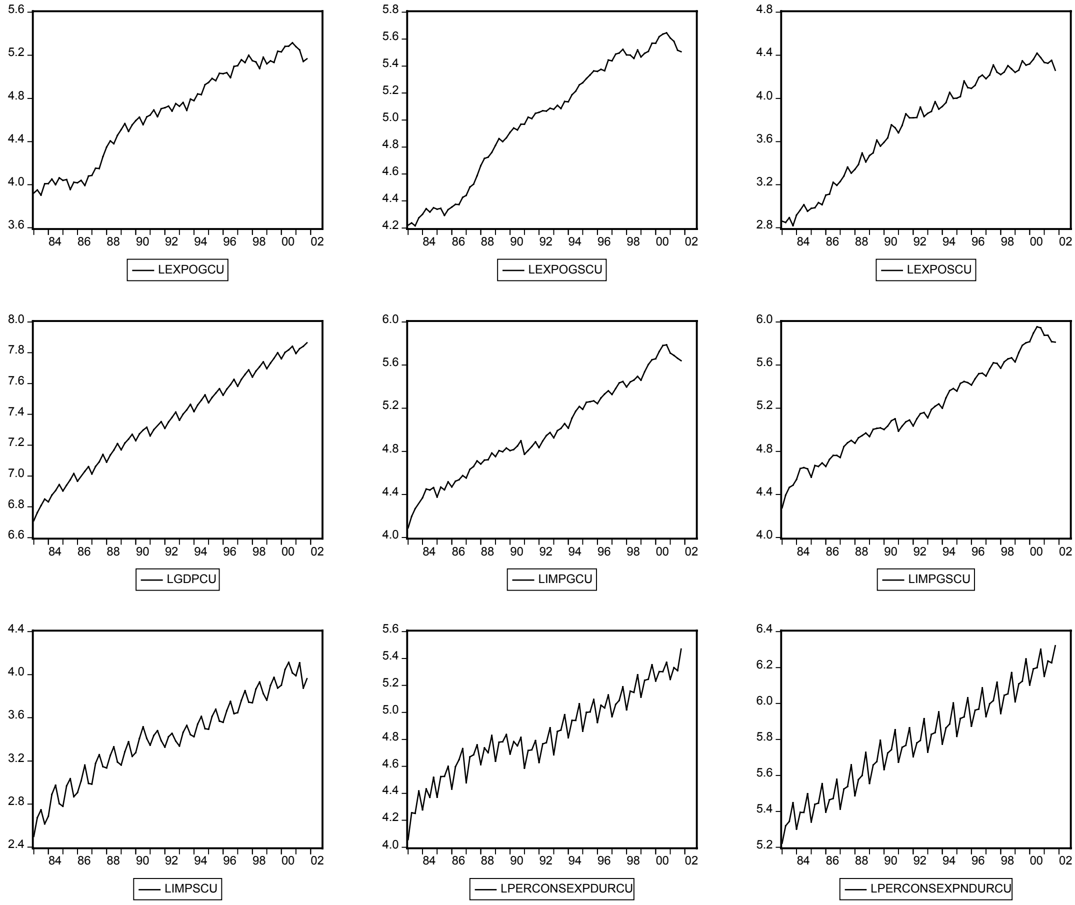
Swedish Series



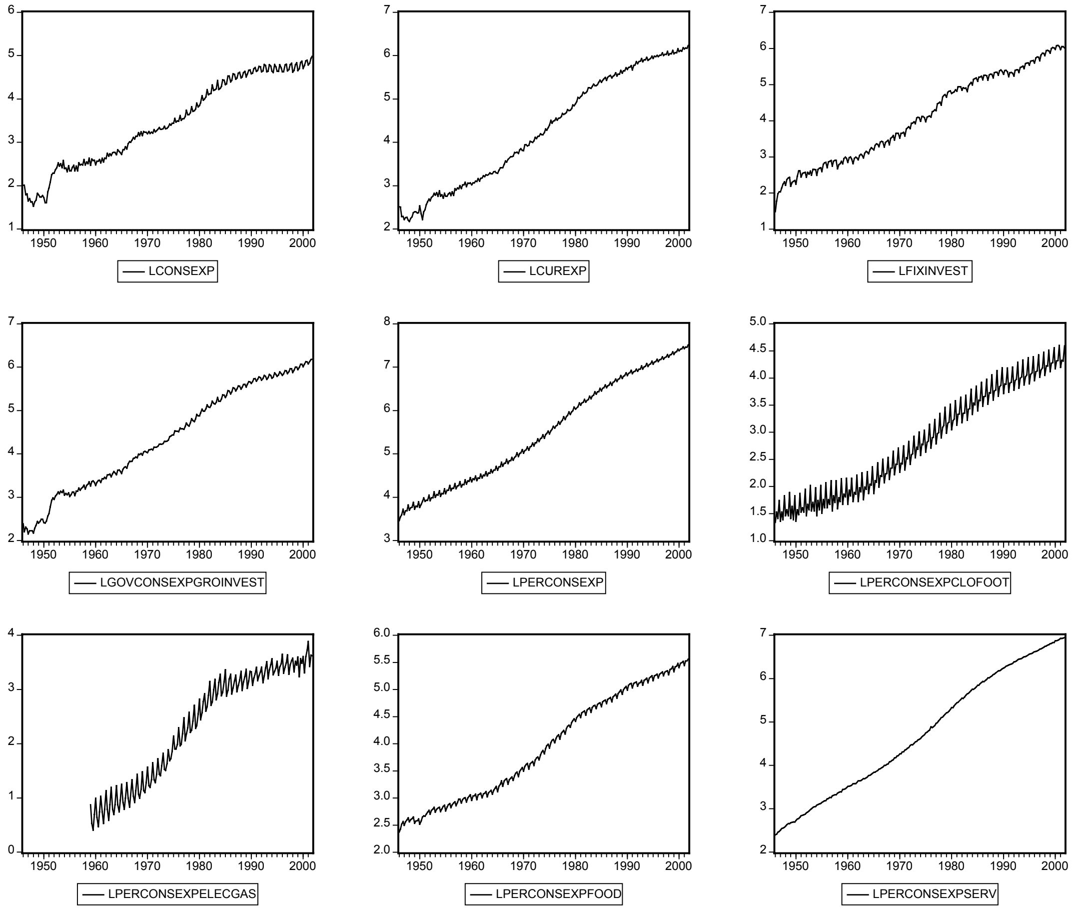
LCONSEXPCO
LCONSEXPCU
LELECSALE
LEXPOGCU
LFINEXPGSCO
LGDPCONST
LGDPOUTPUT
LGDPSERV
LGOVEXCONCU
LGOVEXPCU
LHHCONSAIRCO
LHHCONSALCOCO
LHHCONSAUDIOCU
LHHCONSCAKEBISCCO
LHHCONSCIGCU
LHHCONSCLOTHCU
LHHCONSDIYCU
LHHCONSDOMSERCO
LHHCONSFUELPOWCU
LHHCONSMEALACCCU
LHHCONSPOSTTELECO
LHHCONSRAILCO
LHHCONSSEATRAVCO
LHHCONSSPIRCU
LHHCONSTOYSPOCU
LHHCONSTRAVCU
LHHCONSWINECU
LHHFINCONSEXPCO
LIMPGCU

UK Series

US shorter series



US longer series



Appendix 3: Detailed Test Outcomes

The series name, with an "L" prefix to denote the logarithm, is followed by the estimated lag polynomial, a row containing t1, t2, t3, t4, F34, F234, F1234, in order, and a row containing the corresponding bootstrap *left* tail probability. ***, **, and * indicate significance at nominal 1%, 5%, 10% levels respectively. T1, t2 and t3 are left-tailed tests, t4 is two tailed, and the three F tests are right tailed.

All tests were conducted with seasonal demeaning and global detrending, with maximum lag equal to 4, unless otherwise stated, when maximum lag equalled 8.

N=36, SWEDEN

LEMPLPRISECCONST fitted lag coeffs = 0.4103 0.0000 -0.2418 0.0000

-1.1996	-1.8864	-5.101***	0.4486	14.46***	10.1617***	9.3448**
0.8499	0.3393	0.003***	0.8833	0.98**	0.914*	0.8952

LEMPLPRISECMANU fitted lag coeffs = 0.0000 -0.5200 0.3641 0.0000

-2.7417	-1.5113	-2.5643	-3.273***	9.80***	21.0259***	19.8367***
0.3743	0.6640	0.2024	0.002***	0.89	0.98**	0.955**

LGDPCONSTCO fitted lag coeffs = 0.5185 0.0000 0.0000 0.0000

-1.7099	-1.1697	-3.0083*	0.4925	4.7298	3.7277	3.2632
0.7072	0.6798	0.1507	0.8846	0.7200	0.5196	0.3213

LPRIFINCONSCO fitted lag coeffs = 0.0000 0.0000 0.0000 0.0000

-2.3396	-3.15**	-2.9610*	-2.084**	8.20**	18.214***	17.6413***
0.4589	0.06*	0.1749	0.0386*	0.9408*	0.999***	0.999***

N=60, UK

LCONSEXPCO fitted lag coeffs = 0.4241 0.0000 0.0000 0.0000

-2.97	-2.82**	-2.99*	-2.81***	9.38***	8.59***	11.14***
0.17	0.10*	0.13	0.05*	0.96**	0.94*	0.98**

LCONSEXPCU fitted lag coeffs = 0.4706 0.0000 0.0000 0.0000

-2.71	-2.24	-3.71**	-1.19	7.94**	7.02**	7.92**
0.26	0.22	0.03**	0.36	0.94*	0.89	0.92*

LFINEXPGSCO fitted lag coeffs = 0.0000 0.0000 0.2792 0.0000

-3.17*	-2.73*	-3.94**	-4.20***	25.43***	31.60***	38.11***
0.11	0.12	0.02**	0.00***	1.00***	1.00***	1.00***

LGOVEXCONCU fitted lag coeffs = 0.3943 0.0000 0.0000 0.0000

0.16	-1.52	-2.20	-0.53	2.57	2.52	1.91
0.99	0.52	0.38	0.55	0.46	0.40	0.11

LGOVEXPCU fitted lag coeffs = 0.0000 0.0000 0.2953 0.0000

-1.69	-1.36	-4.35***	-3.58***	23.55***	19.18***	14.74***
0.70	0.62	0.01***	0.00***	1.00***	1.00***	1.00***

N=72

UK

LHHCONSAIRCO fitted lag coeffs = 0.4621 0.0000 0.0000 0.0000

-2.66	-2.06	-2.68	-0.39	3.65	3.83	5.07
0.27	0.24	0.17	0.62	0.69	0.71	0.76

LHHCONSAUDIOCU fitted lag coeffs = 0.2854 0.0000 0.0000 0.0000

-1.91	-2.18	-3.82**	-1.59	8.49**	7.02**	6.60**
0.62	0.25	0.02**	0.19	0.96**	0.92*	0.89

LHHCONSCIGCU fitted lag coeffs = 0.4570 0.0000 0.0000 0.0000

-2.87	-1.89	-3.16*	-1.11	5.64*	4.88	6.52*
0.20	0.32	0.08*	0.37	0.86	0.80	0.87

LHHCONSCLOTHCU fitted lag coeffs = 0.0000 0.0000 0.1694 0.0000

-4.25***	-1.54	-3.64**	-3.33***	15.88***	12.69***	21.62***
0.01***	0.54	0.04**	0.00***	1.00***	1.00***	1.00***

LHHCONSDIYCU fitted lag coeffs = 0.0000 0.2820 0.0000 0.0000

-3.32*	-4.77***	-3.50**	-1.61	7.32**	15.26***	16.78***
0.08*	0.00***	0.09*	0.07	0.93*	1.00***	1.00***

LHHCONSDOMSERCO fitted lag coeffs = 0.0000 0.0000 0.0000 0.0000

-2.20	-3.59***	-5.06***	-4.99***	46.42***	98.72***	82.98***
0.52	0.01***	0.00***	0.00***	1.00***	1.00***	1.00***

LHHCONSFUELPOWCU fitted lag coeffs = 0.3304 0.0000 0.0000 0.0000

-1.48	-2.06	-4.82***	1.08	12.19***	9.92***	7.87**
0.80	0.28	0.00***	0.92	0.99***	0.98**	0.95**

LHHCONSMEALACCCU fitted lag coeffs = 0.3292 0.0000 0.0000 0.0000

-1.71	-2.86**	-3.01*	-1.61	5.83*	5.83*	6.47*

0.71	0.09*	0.12	0.20	0.87	0.83	0.90*

LHHCONSPOSTTELECO fitted lag coeffs = 0.000 0.000 0.2273 0.000

-1.79	-3.44***	-4.05***	-3.88***	22.62***	31.95***	24.32***
0.67	0.03**	0.01***	0.00***	1.00***	1.00***	1.00***

LHHCONSRAILCO fitted lag coeffs = -0.2316 0.0000 0.4169 0.0000

-1.63	-3.03**	-4.49***	-4.06***	17.58***	15.61***	12.42***
0.76	0.05**	0.00***	0.00***	0.99***	0.99***	0.99***

LHHCONSSEATRAVCO fitted lag coeffs = 0.0000 0.0000 0.0000 0.0000

-1.43	-3.80***	-2.39	-1.66	4.59	9.39***	7.27**
0.84	0.01***	0.34	0.07	0.78	0.99***	0.94*

LHHCONSTOYSPOCU fitted lag coeffs = 0.3333 0.0000 0.0000 0.0000

-2.32	-2.55*	-1.70	-1.45	2.49	3.78	4.79
0.41	0.13	0.59	0.23	0.46	0.65	0.70

LHHCONSTRAVCU fitted lag coeffs = 0.2522 0.0000 0.0000 0.0000

-2.23	-1.73	-3.51**	-0.89	6.51*	5.32*	5.36
0.45	0.44	0.05**	0.37	0.90*	0.82	0.78

LHHCONSWINECU fitted lag coeffs = 0.2245 0.0000 0.0000 0.0000

-0.53	-0.80	-1.66	-1.35	2.28	1.72	1.36
0.96	0.82	0.63	0.23	0.40	0.22	0.05

LHHCONSCAKEBISCCO fitted lag coeffs = 0.0000 -0.2501 0.0000 0.5448 0.0000 0.0000 0.0000 0.2907

- Root limit exceeded, so imposed in the BS

-3.28*	-3.64***	-5.36***	0.28	14.42***	11.77***	9.13***
0.13	0.01***	0.00***	0.57	0.94*	0.94*	0.90*

N=76,

SWEDEN

LEXPOGCO fitted lag coeffs = 0.0000 0.0000 0.2237 0.0000

-2.2431	-2.3652	-5.102***	-4.176***	31.09***	27.1774***	23.7351***
0.4328	0.1937	.0006***	.0001***	1.00***	1.00***	1.00***

LEXPOGCU fitted lag coeffs = 0.2238 0.0000 0.0000 0.0000

-2.5534	-2.1232	-4.34***	-3.177***	14.47***	11.3468***	11.8311***

0.2981	0.2695	0.006***	0.0132**	0.998***	0.995***	0.997***

LEXPOGSCO fitted lag coeffs = 0.0000 0.0000 0.1886 0.0000

-2.0885	-2.4734	-5.129***	-3.664***	28.47***	25.1923***	21.9288***
0.5148	0.1620	.0007***	.0003***	1.00***	1.00***	1.00***

LEXPOGSCU fitted lag coeffs = 0.1971 0.0000 0.0000 0.0000

-2.5886	-2.3530	-3.931**	-3.352***	13.38***	10.9194***	11.8461***
0.2835	0.1913	.0174**	0.0076**	0.997***	0.994***	0.998***

LEXPOSCO fitted lag coeffs = 0.0000 0.2843 0.0000 -0.2258 0.0000 0.0000 0.0000 0.0000

-0.0807	-3.77***	-1.9977	-2.74**	6.33*	11.70***	8.82***
.9840	.0213**	.5785	.0082**	.8123	.99***	.9238*

LEXPOSCU fitted lag coeffs = .2633 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

-1.4734	-2.51*	-2.87	-1.40	5.25	5.66*	5.32
.8020	.1883	.2044	.2324	.7810	.8081	.7219

LGDPCO fitted lag coeffs = 0.3474 0.3314 0.0000 0.0000

-2.6165	-1.9886	-1.4027	-2.1277*	3.2464	3.4915	4.6441
0.2755	0.3023	0.7151	0.1007	0.5550	0.5646	0.6589

LGOVCONSCU fitted lag coeffs = 0.5627 0.0000 0.0000 0.0000

-2.2029	-0.1214	-2.3445	-1.2038	3.5033	2.3391	3.0140
0.4912	0.9367	0.2692	0.3816	0.6605	0.4054	0.3609

LGOVCONSEXPCO fitted lag coeffs = 0.2337 0.0000 0.0000 0.0000

-1.4236	-2.2610	-1.5500	-1.2172	1.9401	2.9549	2.8735
0.8176	0.2275	0.6804	0.2479	0.3373	0.4772	0.3179

LIMPGCO fitted lag coeffs = 0.0000 0.0000 0.0000 0.0000

-1.7862	-3.84***	-4.213***	-5.054***	35.67***	62.0862***	47.4164***
0.7174	.0063***	0.0107**	0.00***	1.00***	1.00***	1.00***

LIMPGCU fitted lag coeffs = 0.0000 0.0000 0.0000 0.0000

3.099*	-4.16***	-6.021***	-4.757***	56.15***	105.160***	81.2210***
0.1470	.0027***	0.00***	0.00***	1.00***	1.00***	1.00***

LIMPGSCO fitted lag coeffs = 0.0000 0.0000 0.0000 0.0000

-1.6054	-3.63***	-4.436***	-4.846***	36.66***	54.9298***	41.6994***
0.7915	0.012**	.0059***	.0001***	1.00***	1.00***	1.00***

LIMPGSCU fitted lag coeffs = 0.0000 0.0000 0.0000 0.0000

-3.0964*	-3.98***	-6.425***	-4.536***	60.53***	93.567***	71.9299***
0.1469	.0041***	0.00***	.0001***	1.00***	1.00***	1.00***

LIMPSCO fitted lag coeffs = 0.5653 0.0000 -0.1644 0.0000

-1.0739	-2.50	-1.7063	-0.9381	1.8526	3.2209	2.7852
0.9182	0.096*	0.4812	0.5743	0.3215	0.6102	0.2564

LIMPSCU fitted lag coeffs = 0.4028 0.0000 0.0000 0.0000

-1.7716	-2.4903	-1.8570	-1.2118	2.4223	3.5084	3.7244
0.6969	0.1368	0.5021	0.3233	0.4437	0.6277	0.5128

LPRICONSCU fitted lag coeffs = 0.0000 0.2791 -0.2930 0.0000

-1.8796	-5.88***	-2.5883	-0.2273	3.3523	19.3558***	16.6252***
0.6676	0.00***	0.2891	0.6021	0.5693	0.999***	0.998***

LPRICONSEXPCO fitted lag coeffs = 0.3869 0.0000 0.1800 0.0000

-2.7425	-2.3653	-2.2289	-1.2856	3.3124	3.9804	5.5094
0.2039	0.2151	0.3942	0.2171	0.5921	0.6518	0.7958

N=76, UK

LHHFINCONSEXPCO fitted lag coeffs = 0.5199 0.0000 0.0000 0.0000

-2.82	-2.53*	-3.55**	-1.36	7.37**	6.94**	8.31**
0.21	0.12	0.04**	0.32	0.94*	0.93*	0.96**

LIMPGCU fitted lag coeffs = 0.0000 0.0000 0.0000 0.0000

-2.66	-5.03***	-4.43***	-4.63***	30.76***	75.33***	58.57***
0.29	0.00***	0.01***	0.00***	1.00***	1.00***	1.00***

LHHCONSSPIRCU fitted lag coeffs = 0.3616 0.2337 -0.2152 0.0000

-2.17	-2.11	-0.83	-0.75	0.62	1.98	2.92
0.53	0.20	0.86	0.56	0.07	0.28	0.29

LEXPOGCU fitted lag coeffs = 0.0000 0.0000 0.0000 0.0000

-2.09	-2.93**	-5.65***	-4.84***	47.61***	51.79***	39.69***
0.57	0.05**	0.00***	0.00***	1.00***	1.00***	1.00***

LGDPCONST fitted lag coeffs = -0.3520 0.2858 0.0000 0.0000

-2.78	-4.87***	-3.24*	-4.96***	23.33***	23.14***	21.84***
0.29	0.00***	0.10*	0.00***	1.00***	1.00***	1.00***

LHHCONSALCOCO fitted lag coeffs = 0.0000 0.0000 0.0000 0.2572 0.0000 0.0000 0.0000 0.0000

-1.25	-2.16	-2.51	-2.00*	5.78*	5.81*	4.54
0.86	0.24	0.28	0.06	0.85	0.88	0.66

LELECSALE fitted lag coeffs = 0.2399 0.0000 0.0000 -0.2381 0.0000 0.0000 0.0000 0.0000

-3.39**	-2.44	-2.49	0.72	3.35	4.28	5.98*
0.19	0.25	0.41	0.84	0.49	0.58	0.67

N=76
US

LIMPSCU fitted lag coeffs = 0.0000 0.5344 0.0000 -0.3957 0.0000 0.0000 0.0000 0.0000

-2.18	-0.76	-1.84	-1.76	3.13	4.55	4.55
0.60	0.82	0.60	0.04*	0.53	0.63	0.51

LEXPOGCU fitted lag coeffs = 0.4595 0.0000 -0.2602 0.0000

-0.24	-3.60***	-2.78	-1.91*	5.82*	8.17***	6.18*
0.98	0.01***	0.14	0.27	0.84	0.94*	0.78

LEXPOGSCU fitted lag coeffs = 0.4189 0.0000 -0.2576 0.0000

0.30	-3.67***	-2.94	-2.08*	6.66**	8.98***	6.75**
0.99	0.01***	0.12	0.22	0.88	0.95**	0.83

LEXPOSCU fitted lag coeffs = 0.0000 0.2244 -0.2268 0.0000

1.05	-4.28***	-3.66**	-2.68**	11.56***	26.27***	21.10***
1.00	0.00***	0.07*	0.03*	0.99***	1.00***	1.00***

LGDPCU fitted lag coeffs = 0.0000 0.0000 0.0000 0.0000

-1.27	-4.46***	-3.38**	-5.79***	32.95***	96.89***	73.79***
0.89	0.00***	0.06*	0.00***	1.00***	1.00***	1.00***

LIMPGCU fitted lag coeffs = 0.0000 0.0000 0.0000 0.0000

-2.92	-4.18***	-5.25***	-5.39***	54.27***	105.12***	82.50***
0.20	0.00***	0.00***	0.00***	1.00***	1.00***	1.00***

LIMPGSCU fitted lag coeffs = 0.0000 0.0000 0.0000 0.0000

-3.15*	-4.45***	-4.84***	-5.04***	43.43***	110.66***	86.11***
0.13	0.00***	0.00***	0.00***	1.00***	1.00***	1.00***

LPERCONSEXPDURCU fitted lag coeffs = 0.0000 0.0000 0.2756 0.0000

-2.93	-3.25**	-5.55***	-2.67**	25.20***	24.66***	23.10***
0.16	0.05**	0.00***	0.00***	1.00***	1.00***	1.00***

LPERCONSEXPNDURCU fitted lag coeffs = 0.000 0.2151 0.0000 0.0000

-2.97	-5.41***	-3.25*	-2.93***	10.46***	26.88***	26.30***
0.16	0.00***	0.11	0.01**	0.99***	1.00***	1.00***

N=80
UK

LGDPSERV fitted lag coeffs = -0.4944 0.3939 0.0000 0.0000

-2.70	-6.28***	-2.57	-5.60***	23.49***	28.74***	25.96***
0.26	0.00***	0.21	0.00***	1.00***	1.00***	1.00***

N=172
US

LPERCONSEXPELECGAS fitted lag coeffs = 0.3585 0.2237 0.00 -0.2510 0.0000 0.2867 0.0000 0.0000

-0.59	-3.10**	-1.81	-0.61	1.83	4.46	3.42
0.95	0.04**	0.60	0.42	0.28	0.73	0.43

N=224
US

LCUREXP fitted lag coeffs = 0.3242 0.0000 0.0000 0.0000

-0.81	-4.13***	-6.18***	-2.68**	22.70***	20.39***	15.54***
0.96	0.00***	0.00***	0.03*	1.00***	1.00***	1.00***

LPERCONSEXPFOOD fitted lag coeffs = 0.3412 0.1851 -0.1528 0.0000

-1.94	-5.05***	-5.42***	-2.86**	18.77***	25.58***	20.51***
0.63	0.00***	0.00***	0.03*	1.00***	1.00***	1.00***

LPERCONSEXPSERV fitted lag coeffs = 0.4697 0.0000 0.0000 0.0000

-0.92	-5.32***	-6.48***	-2.21*	23.44***	24.68***	18.83***
0.95	0.00***	0.00***	0.11	1.00***	1.00***	1.00***

- LCONSEXP fitted lag coeffs = 0.4744 0.2864 0.0000 -0.2992 0.0000 0.1487 0.0000 0.0000

-2.23	-2.93**	-1.88	-2.44**	4.91	5.99**	5.80*
0.47	0.05**	0.54	0.04*	0.81	0.92*	0.89

LFIXINVEST fitted lag coeffs = 0.7026 -0.3148 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

-1.75	-2.83*	-3.15*	-5.38***	21.01***	16.49***	13.34***
0.73	0.06*	0.04**	0.00***	1.00***	1.00***	1.00***

- LGOVCONSEXPGROINVEST fitted lag coeffs = 0.6632 0.0000 0.0000 -0.1951 0.0000 0.0000 0.1117 0.0000

-2.29	-2.61*	-3.37**	-3.53***	11.50***	9.67***	8.73***
0.45	0.12	0.07*	0.01**	1.00***	0.99***	0.98**

- LPERCONSEXP fitted lag coeffs = 0.5558 0.1766 0.0000 -0.3652 0.1890 0.0000 0.1531 0.0000

-2.21	-1.63	-3.24*	-1.78	6.81**	5.26*	5.26
0.46	0.47	0.10*	0.18	0.92*	0.86	0.83

- LPERCONSEXPCLOFOOT fitted lag coeffs = 0.2838 0.3592 0.0000 -0.4794 0.2107 0.1715 0.0000 -0.1070

-2.49	-1.68	-3.81**	-1.40	8.31**	6.43**	6.69**
0.37	0.46	0.04**	0.21	0.95**	0.91*	0.91*