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Structural breaks and stochastic trends in macroeconomic variables in Norway

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This paper analyses the dynamic properties of several macroeconomic variables in Norway, using different unit root tests and measures of persistence. For none of the variables can we reject the hypothesis of a unit root in favour of a deterministic linear trend alternative. However, when allowing for a structural break in the trend alternative, we can reject the hypothesis of a unit root for unemployment, government consumption, investment and real wage. Most of the Norwegian time series display little persistence. However, for those series that show a high degree of persistence, adjusting for the break in the trend, persistence falls considerably.

I. INTRODUCTION

The failure of Nelson and Plosser (1982) to reject the hypothesis of a unit root in many macroeconomic time series, has challenged the traditional view that fluctuations in economic variables are transitory deviations from a smooth deterministic trend. The existence of a unit root in the time series implies instead that each stochastic shock will have a permanent effect on the series, so that for a pure random walk, all fluctuations will represent permanent changes in the trend. Hence, shocks to a random walk will persist forever. A high degree of persistence has also been taken to imply a relatively important permanent component in the time series. However, the relative magnitude of the permanent component in economic variables has remained controversial (cf. Watson, 1986; Campbell and Mankiw, 1987a, 1987b, 1989 and Cochrane, 1988).

More recently, Perron (1989) and Rappoport and Reichlin (1989), have argued that the persistent effects of the shocks in macroeconomics time series may have been severely exaggerated as the researchers have failed to take into account the fact that there may have been an important structural change in the data. These findings have motivated tests of the unit root hypothesis where the deterministic trend alternative is allowed to have a structural break. However, whereas the tests proposed by Perron (1989) require prior knowledge of the breakpoint, Banerjee *et al.* (1992), among others, have suggested tests of unit roots, that treat the break point as unknown *a priori.* These tests find less support against the unit root hypothesis in favour of the break in trend hypothesis than Perron (1989).

This paper examines the dynamic properties of several macroeconomic variables in Norway, using different unit root tests and measures of persistence that also allow for a possible trend-break. The paper is organized as follows. Section II describes and applies the traditional ADF test and the sequential unit root tests due to Banerjee *et al.* (1992), that allows for an unknown structural break. In Section III, we discuss and apply some different parametric and nonparametric measures of persistence, where we also correct for a structural break. Section IV concludes.

II. TESTS FOR UNIT ROOT AND STRUCTURAL BREAKS

A common practice for determining the underlying process of a time series has been to test the hypothesis that a process is a unit root (random walk) against the alternative that the series is trend-stationary, using the now well known augmented Dickey–Fuller (ADF) test, with the relevant critical values reported in e.g. Fuller (1976). In the ADF test, the alternative is a trend-stationary model. Banerjee *et al.* (1992) suggest instead a sequential test strategy that allows the trend-stationary alternative to have a break that is unknown prior to testing:

$$y_t = \alpha_0 + \alpha_1 t + \alpha_2 DU_t(k) + \sum_{j=1}^{p} \phi_j y_{t-j} + \varepsilon_t$$

$$\Delta y_t = \alpha_0 + \alpha_1 t + \alpha_2 DU_t(k) + \mu y_{t-1} + \sum_{j=1}^{p} \gamma_j \Delta y_{t-j} + \varepsilon_t \qquad (1)$$

where $\mu = \sum_j^{p+1} \phi_j - 1$ and $\gamma_j = -\sum_{k=j+1}^{p} \phi_k, j = 1, 2, \ldots p$ and $DU_t(k)$ is a dummy variable that captures the possible

Table 1. *Variables and definitions*[*]

Series	Definitions	Series	Definitions
GDP	Gross domestic product (mainland Norway)	PR	Productivity (mainland Norway)
C	Private consumption	U	Unemployment rate
G	Government consumption	RWG	Real wage (mainland Norway)
I	Investment (mainland Norway)	CPI	Consumer price index
X	Traditional export	M2	Money supply, M2
M	Traditional import		

Notes: [*] All data are quarterly, seasonally adjusted from 1967Q1 to 1994Q1. All variables are measured in logs, except for the unemployment rate that is measured in levels.
Source: Statistics Norway.

Table 2. *ADF and sequential unit root tests,* $p = 4$[*†]

Series	ADF	(A) Break in the slope of the trend			(B) Break in the level of the trend		
	t_{ADF}	k^*	$F^A_{DU-k^*}$	$t^A_{ADF-k^*}$	k^*	$F^B_{DU-k^*}$	$t^B_{ADF-k^*}$
GDP	−1.36	1986Q1	6.09	−2.84	1988Q1	11.59	−3.38
C	−2.20	1986QI	9.07	−3.78	1988Q2	14.04	−4.34
G	−0.23	1982Q1	18.44[b]	−4.25[c]	1975Q2	9.09	−2.31
I	−0.76	1986Q3	11.19	−3.31	1988Q2	25.90[a]	−4.02
X	−2.50	1982Q4	9.30	−3.89	1974Q2	16.33[c]	−3.97
M	−3.04	1986Q1	2.04	−3.31	1988Q2	8.11	−4.23
PR	−1.57	1984Q4	6.00	−2.93	1986Q2	5.03	−2.60
U	−2.30	1986Q2	6.23	−3.40	1988Q2	19.36[b]	−4.87[b]
RWG	−1.64	1977Q4	8.45	−3.30	1973Q3	11.70	−3.66
CPI	0.42	1987Q2	19.25[a]	−3.65	1988Q2	6.01	−0.83
M2	1.57	1987Q4	16.29[c]	−3.10	1988Q2	18.78[b]	−0.81

Note: [*] For a definition of the variables, see Table 1.
† k^* indicates the break date suggested by $F^{A,B}_{DU-k^*}$.
[a] Rejection of the unit root hypothesis at the 2.5% level.
[b] Rejection of the unit root hypothesis at the 5% level.
[c] Rejection of the unit root hypothesis at the 10% level.

change in the trend in period k. The change in the trend is either modelled as a single break in the *slope* of the trend, (case A) or as a single break in the *level* of the trend (case B). In case (A), $DU_t(k) = t - k$ if $t > k$, 0 otherwise, whereas in case (B), $DU_t(k) = 1$ if $t > k$, 0 otherwise. We compute two test statistics for case A; $F^A_{DU-k^*}$; the maximum F-value for testing the null hypothesis, $\alpha_2 = 0$ over all sequentially computed F-statistics, and $t^A_{ADF-k^*}$; the $t(k)_{ADF}$ value corresponding to the k-value (k^*) chosen by the maximum F-statistic $F^A_{DU-k^*}$ in Equation 1. Similar statistics are computed for case (B). The finite sample critical values and the empirical size and nominal power of the test statistics are established by Monte Carlo simulation in Banerjee *et al.* (1992).[1]

Empirical evidence

A definition of the variables with their respective abbreviations are presented in Table 1. Table 2 reports the traditional ADF test, (t_{ADF}), together with the sequential F-test (F_{DU-k^*}) and t-test (t_{ADF-k^*}). We follow Banerjee *et al.* (1992) and set the trimming parameter for the sequential tests, $k_0 = 16$ (15% of the sample). As the data are quarterly, we base the calculations on a fourth order autoregressions ($p = 4$). However, Schwert (1989) among others, has shown that the results of the unit root tests will be sensitive to the serial dependence in the error term, and higher order AR lags may be more appropriate for capturing the serial correlation in the data. Also, an extra number of regressors will not affect the size of the unit root tests, although its power may decrease. To investigate whether the results are sensitive to the choice of p, we construct the tests using $p = 8$ by the end of this section. These results are reported in Table 3.

Using the standard full sample, unit root test t_{ADF}, we cannot reject the unit root null for any of the variables at the 10% level. However, we can reject the hypothesis that all variables are integrated of second order $I(2)$, against the hypothesis that they are $I(1)$ (these results are not reported here). Despite the fact that the sequential tests have higher power against the trend-break alternatives, there is only

[1] Zivot and Andrews (1992) have also developed an asymptotic distribution theory for a 'breaking trend alternative' that is quite similar to that of Banerjee *et al.* (1992).

Table 3. *ADF and sequential unit root tests, $p = 8$*

Series	ADF t_{ADF}	(A) Break in the slope of the trend k^*	$F^A_{DU-k^*}$	$t^A_{ADF-k^*}$	(B) Break in the level of the trend k^*	$F^B_{DU-k^*}$	$t^B_{ADF-k^*}$
GDP	−1.75	1986QI	7.37	−3.26	1988Q1	13.14	−3.72
C	−1.71	1985Q4	9.80	−3.60	1988Q1	14.20	−3.71
G	−0.48	1982Q3	17.63[b]	−4.22[c]	1975Q2	9.07	−2.48
1	−1.77	1986Q3	18.34[b]	−4.68[b]	1988Q2	22.78[a]	−4.40
X	−1.71	1982Q3	6.95	−3.09	1974Q3	15.97	−3.31
M	−2.89	1986Q2	2.35	−3.24	1988Q2	6.87	−3.90
PR	−1.15	1985Q2	3.69	−2.24	1987Q2	5.73	−2.50
U	−2.18	1986Q2	8.14	−3.63	1988Q2	18.00[c]	−4.52[c]
RWG	−1.06	1976Q4	34.30[a]	−5.30[a]	1973Q2	19.76[b]	−3.79
CPI	1.04	1987Q1	12.96	−2.67	1988Q2	3.89	−0.02
M2	1.04	1988QI	15.99[c]	−3.22	1988Q2	16.93[c]	−0.53

Note: [*] For a definition of the variables, see Table 1.
[+] k^* indicates the break date suggested by $F^{A,B}_{DU-k^*}$.
[a] Rejection of the unit root hypothesis at the 2.5% level.
[b] Rejection of the unit root hypothesis at the 5% level.
[c] Rejection of the unit root hypothesis at the 10% level.

substantial evidence against the null hypothesis of a unit root for a few variables. For case A (the break in the slope alternative), $F^A_{DU-k^*}$, is significant at the 2.5% level for prices, at the 5% level for government consumption and at the 10% level for M2. However, based on $t^A_{ADF-k^*}$, the unit root null hypothesis can only be rejected against the stationary trend-break alternative at the 10% level for government consumption. For case B (the break in the level alternative), $F^B_{DU-k^*}$, is significant at the 2.5% level for investment, at the 5% level for M2 and unemployment, and at the 10% level for export. However, based on $t^B_{ADF-k^*}$, the unit root hypothesis can only be rejected at the 5% level for the unemployment rate. Hence, there seems to be clear evidence against the unit root hypothesis only for the unemployment rate and government consumption, although there are some evidence of changing coefficients of some form for some more variables.

Using now $p = 8$, the conclusions from the ADF-tests do not change much, although some of the coefficients have varied. However, we can no longer reject the hypothesis that prices and M2 are $I(2)$ at the 2.5% level (these results are not reported here). Based on the sequential tests, for case A, $F^A_{DU-k^*}$, is now also significant at the 2.5% level for real wages, and at the 5% level for investment, but we can no longer reject the hypothesis of a unit root in prices. Based on $t^A_{ADF-k^*}$, we can reject the unit root null hypothesis in favour of the stationary trend-break alternative for real wages, investment and government consumption, at the 2.5, 5 and 10% level respectively. For case B, $F^B_{DU-k^*}$, is now also significant at the 5% level for real wages, but we can no longer reject the unit root hypothesis for export. However, based on $t^B_{ADF-k^*}$, the null hypothesis of a unit root can still only be rejected for the unemployment rate, although now only at the 10% level.

Hence, overall there seem to be clear evidence that, we can reject the hypothesis of a unit root for government consumption, investment, real wages and unemployment, in favour of the break in the slope or level of the trend alternative. The trend shifts occurred in 1976Q4 for real wages, 1982Q1 (Q3) for government consumption, 1986Q3 for investment and in 1988Q2 for unemployment. Several periods may have been important in explaining these breaks. The lowering of the growth rate for investment and the upward shift in the unemployment rate, both occurred in a period of financial crisis and recession in the late 1980s in Norway.[2] The preceding years had been characterized by a huge consumption and investment boom, that was primarily set off by the financial deregulation in the middle 1980s. The shift in the trend for real wages in 1976/1977 and the lowering of growth rates in government consumption in 1982, reflects the end of an adjustment period after the build up of the new productive petroleum sector in the preceding years. From 1982, government policies were also changing, as a conservative party took over after several years of labour government.

Finally, for the series where we cannot reject the unit root hypothesis, we test whether we can reject the notion of a constant drift in favour of a shift in the drift rate in the series. That is, we restrict case B so that $\mu = 0$ and $\alpha_1 = 0$ in Equation 1, and test whether there has been a single shift in the *mean growth* rate. In this restricted case, we compute $t^B_{DU-k^*}$, which is the minimum absolute t-statistics on the coefficient on $DU_t(k)$. Finite sample critical values are again taken from Banerjee *et al.* (1992). Only for money and prices can the null-hypothesis of constant drift be rejected in favour of a shift in the drift rate at the 2.5% and 10% level respectively ($t^B_{DU-k^*}$ equal to −5.61 for M2 and −3.07 for prices). The shift in the drift occurred in 1988Q2 for both variables.

[2] Bianchi and Zoega (1994) also find the timing of the shift in the mean rate of unemployment in Norway to be in 1988.

III. MEASURES OF PERSISTENCE

Another way of tackling the issue of distinguishing between a unit root and a trend-stationary process, has been to analyse *how* much long-term forecasts respond to initial shocks, that is, *how* persistent are the effects of shocks to the macro-economic time series. In order to analyse persistence, it is useful to start from the moving average representation of the first differences of a variable y_t, *The Wold moving average representation*, implies that any difference-stationary process can be written as an infinite moving average:

$$\Delta y_t = \alpha_1 + A(L)\varepsilon_t$$
$$A(L) = \sum_{i=0}^{\infty} A_i L^i \qquad A_0 = 1 \tag{2}$$

where the ε_t's are uncorrelated random innovations with variance σ^2, and $\sum_i i \mid A_i \mid < \infty$. Campbell and Mankiw (1987a) suggested that the sum of the moving average coefficients, denoted $A(1)$, would be a good measure of persistence as it measures the ultimate effect to an immediate effect of a shock to a variable. In the limiting case of a random walk, $A(1) = 1$, whereas in the case of a stationarity, $A(1) = 0$.

Cochrane (1988) proposed another measure of persistence that could be estimated nonparametrically. The idea is that if y_t follows a random walk, $y_t = y_{t-1} + \varepsilon_t$, with ε_t defined as above, the variance of the k-differences of y_t grows linearly with the variance of the innovation ε_t, $\operatorname{var}(y_t - y_{t-k}) = k\sigma^2$. If y_t is instead defined as a (trend) stationary process, $y_t = \phi y_{t-1} + \varepsilon_t$, the variance of its k-differences approaches a constant twice the unconditional variance of the series; var $(y_t - y_{t-k}) \to 2\operatorname{var}(y_t) = 2\sigma^2/(1-\phi^2)$. Cochrane (1988) suggested that $1/k$ times the ratio of the variance of the k period differences to the variance of the one period differences would be a good measure of persistence, which could also be written as:

$$V^k = \frac{1}{k}\frac{\operatorname{var}(y_t - y_{t-k})}{\operatorname{var}(y_t - y_{t-1})} = 1 + 2\sum_{j=1}^{k-1}\left(1 - \frac{j}{k}\right)\rho_j \tag{3}$$

where, $\rho_j \equiv C_j/C_0 \equiv \operatorname{cov}(\Delta y_t, \Delta y_{t-j})/\operatorname{var}(\Delta y_t)$ is the jth autocorrelation of the process. In the limit, V^k provides a natural measure of persisterice, as it can be expressed as the two side infinite sum of autocorrelations, $V \equiv \lim_{k\to\infty} V^k = \sum_{-\infty}^{\infty} \rho_j$, where now V equals 1 if y_t is a random walk, and converges to zero if y_t is stationary.

A(l) and V have also been interpreted in terms of the relative importance of the permanent component (random walk) in any decomposition like the Beveridge and Nelson (1981) decomposition. However according to Quah (1992), the measures of persistence as those presented above, will not identify the *magnitude* of the permanent component. Regardless of the magnitude found of V at frequency zero, the permanent component in every integrated time series can be taken to be arbitrarily smooth. Only for a random walk can the interpretation of the spectral density at frequency zero indicate the size of the permanent component.

To determine $A(1)$, we have to decide on the appropriate truncation of the ARMA lags. Cochrane (1988) emphasizes that fitting low-order models to the first differences of a variable, may give too much weight to the short run dynamics, thereby systematically overestimating the permanent component in the observed series. We therefore estimate two different ARMA models, one low order and one high order. The low order ARMA models are chosen to be the 'best fit' models based on among other the Schwarz and Akaike criteria. For the high order models, we specify from 8 to 20 AR lags, depending on the white noise properties of the data (details on estimation can be obtained from the author on request).

A nonparametric estimator of V^k in Equation 3 can be found by replacing the population autocorrelations (ρ_j) with the sample autocorrelations (r_j). As k increases with the sample size, the estimator ($\hat{V}^k$) consistently estimates V. With sample autocorrelations in Equation 3, $\hat{V}^k$ is asymptotically equal to the Bartlett estimator of the spectral density at frequency zero with its standard error given by (Priestley, 1982, p. 463):

$$SE\left[\hat{V}^k\right] = \left(\hat{V}^k\right)\left(\frac{4}{3T/k}\right)^{\frac{1}{2}} \tag{4}$$

In small samples, $\hat{V}^k$ can be biased and the asymptotic standard errors may incorrectly estimate the actual standard errors. For a random walk with drift, the mean value of $\hat{V}^k$ is approximately $(T - k + 1)/T$ rather than 1. To correct for this downward bias for a random walk, we follow Cochrane (1988) and Campbell and Mankiw (1987a), and multiply r_j with $T/(T - k + 1)$. Note however that simulations in Cochrane (1988) showed that when the series have a small random walk component or are trend-stationary, there may be an upward bias in $\hat{V}$ as an estimate of the random walk component.

In finite samples, the appropriate k has to be chosen. Although a high k is preferable, choosing a too high k may give excess trend reversion, as when k get closer to the sample size the estimator will approach zero. If on the other hand a too low k is chosen, too few autocorrelations will be included, and patterns of trend reversion found in the higher autocorrelations will not be detected. Perron (1993) and the references he sites, argue that the exact mean square error of the estimated V^k is minimized using a large value of k when V is small and a small value of k, when V is large. For this reason we consider a set of values of k corresponding to $k =$ 10, 20, 40 and 60.

Perron (1993), emphasized that when a series is stationary around a trend with a break in the slope (case A above), the sample autocorrelations will not consistently estimate the population autocorrelations. To correct for this bias, we also follow Perron (1993) and use Δx_t, instead of Δy_t in the

Table 4. *Measures of persistence**†

Series	$\hat{V}^k$ $k = 10$	$k = 20$	$t = 40$	$k = 60$	$\hat{V}^k_{DU}$ $k = 10$	$k = 40$	$A(1)$‡ High-order	Low-order
GDP	0.42	0.45	0.50	0.67	0.30	0.19	0.66	0.72
	(0.15)	(0.22)	(0.35)	(0.58)	(0.15)	(0.14)		
C	0.77	0.73	0.71	1.05	0.63	0.31	0.89	0.99
	(0.27)	(0.36)	(0.50)	(0.90)	(0.22)	(0.22)		
G	0.76	1.26	2.31	3.19	0.25	0.12	1.20	0.77
	(0.27)	(0.62)	(1.62)	(2.73)	(0.08)	(0.08)		
I	1.62	1.93	2.39	3.44	0.92	0.47	1.20	1.17
	(0.57)	(0.95)	(1.67)	(1.88)	(0.32)	(0.33)		
X	0.62	0.49	0.54	0.54	0.59	0.80	0.60	0.90
	(0.22)	(0.24)	(0.38)	(0.46)	(0.21)	(0.56)		
M	1.03	0.75	0.38	0.47	1.01	0.37	0.66	1.28
	(0.36)	(0.37)	(0.26)	(0.40)	(0.35)	(0.26)		
PR	0.30	0.34	0.54	0.80	0.25	0.37	0.57	0.46
	(0.10)	(0.17)	(0.38)	(0.68)	(0.09)	(0.26)		
U	1.43	1.18	0.97	1.22	1.23	0.61	0.87	1.26
	(0.50)	(0.58)	(0.68)	(1.05)	(0.43)	(0.43)		
RWG	0.51	0.49	0.46	0.56	0.44	0.26	0.94	0.83
	(0.18)	(0.24)	(0.32)	(0.48)	(0.16)	(0.18)		
CPI	4.84	7.30	12.02	14.87	3.09	3.59	3.62	4.43
	(1.69)	(3.61)	(8.41)	(12.74)	(1.08)	(2.51)		
M2	3.37	5.36	8.44	11.70	1.33	1.03	3.81	4.07
	(1.18)	(2.65)	(5.90)	(10.02)	(0.47)	(0.72)		

Notes: *For a definition of the variables, see Table 1.
† Standard errors in parentheses below.
‡ For the high-order models, we choose between 8 and 20 AR lags depending on the white noise properties. For the low-order models, we specify processes up to ARMA(3,3), and thereafter select the 'best fit' model based on among other the Akaike and the Schwarz criteria.

formula for V^k in Equation 3, where Δx_t is defined as the residual in the following expression:

$$\Delta y_t = \alpha_1 + \alpha_2 DU_t + \Delta x_t \tag{5}$$

where $DU_t = 1(t > k^*)$. Note that Equation 5 is written in this form so that under the hypothesis of a break in the slope of the trend, Equation 5 corresponds to: $y_t = \alpha_0 + \alpha_1 t + \alpha_2 DB_t +$ noise, where now $DB_t = (t - k^*)1(t > k^*)$ (as in case A in Section II). k^* is the estimated break date. We pick all dates for k^* from Table 2, except for real wages, where the date of the most significant break in the slope of the trend is found when $p = 8$ in Table 3. For the other variables, the estimated dates do not change much whether we use $p = 4$ or $p = 8$. The test statistic is denoted $\hat{v}^k_{DU}$, and we report values for $k = 10$, and 40.

Empirical evidence

In Table 4 we estimate persistence defined by $\hat{v}^k$, $\hat{v}^k_{DU}$ and $A(1)$. Based on these results for $\hat{v}^k$, GDP, consumption, export, import, productivity and read wage show little evidence of persistence, all having most of their values well below unity. However, in light of the criticisms by among other Quah (1992), we have no direct evidence as to whether we can reject the unit root hypothesis or not. Unemployment has values of $\hat{V}^k$ that fluctuates around one, whereas government consumption, investment, CPI and M2 all show considerable evidence of persistence with $\hat{V}^k$ increasing rapidly with k. Although the estimates of $A(1)$ show values that differ slightly from some of the values of $\hat{V}^k$, they do not turn around the main findings supported by the V-ratio.

All of the variables that have values of $\hat{V}^k$ and $A(1)$ in excess of one, (government consumption, investment, unemployment, CPI and M2) are also those variables that showed either evidence of being represented by a linear trend with a break (government consumption, investment and unemployment) or by an $I(1)$ process with changing drift (CPI and M2). Correcting for the bias of having a break in the slope of the trend, for the variables that rejected the unit root in favour of a break in the slope in the trend (investment and government consumption), persistence measured by $\hat{V}^k_{DU}$ falls well below unity. Unemployment was found to be trend-stationary around a trend with a break in the *level* in Section II. Allowing for a possible break in the *slope* of the trend reduces nevertheless $\hat{V}^k_{DU}$ somewhat, but only for $k > 10$ is $\hat{V}^k_{DU}$ below unity. In the end, only CPI and M2 show clear evidence of persistence as $\hat{V}^k_{DU}$ exceeds one for all k.

For real wage, $\hat{V}^k$ is below unity already before we correct for the break in the trend. Adjusting for the break in the trend, $\hat{V}^k_{DU}$ falls even further. However, in contrast to the other variables that experience a shift in the trend in the middle/end 1980s, real wage has a significant break point early in the sample (1976). For most of the sample, the variable is thereafter stationary around a deterministic trend, which is appropriately captured by the autocorrelation structure of $\hat{V}^k$.

Finally, note that as suggested above, for most of the variables, low order ARMA models give a higher value of $A(1)$ than the high order AR models. However, there are three main exceptions, government consumption, investment and real wages. Interestingly, these are the variables where we could reject unit root hypothesis in favour of the trend with a break in the slope alternative hypothesis above.

IV. CONCLUSIONS

Based on the traditional ADF unit root test, for none of the Norwegian macroeconomic variables analysed here, can we reject the unit root hypothesis in favour of a deterministic linear trend. However, when allowing the slope or the level of the trend alternative to have a break, we can reject the hypothesis of a unit root for unemployment rate, government consumption, investment and real wage. For prices and M2, I cannot reject the hypotheses that there has been shift in the mean growth rate of the variables. Generally, the Norwegian time series display little persistence. However, of those series that show the highest persistence (government consumption, investment, unemployment, prices and M2), persistence falls considerably when we adjust for a break in the series. In the end, only CPI and M2 show clear evidence of persistence.

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