Low oil investments and emergence of climate risk: the end is now or just business cycle as usual?
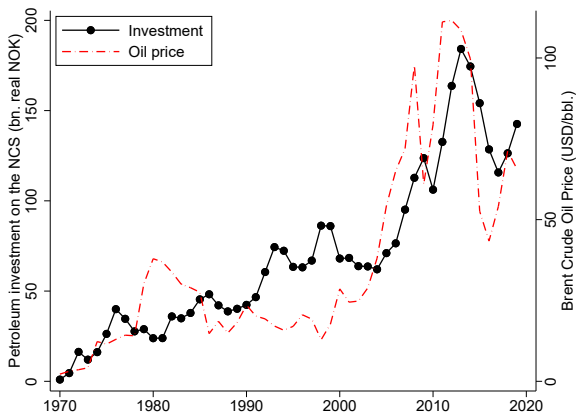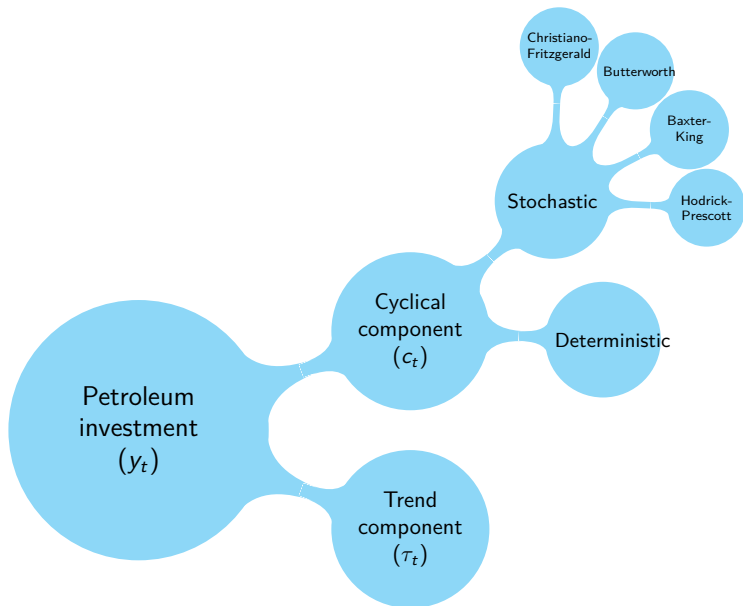
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- Inflation-adjusted petroleum development investments on the NCS between 1970 and 2019.

Methodology

Stationarity test

Variable	No trend				Trend			
	ADF	DF-GLS	PP	KPSS	ADF	DF-GLS	PP	KPSS
Inv	-1.17	-0.33	-0.98	2.19***	-3.65**	-3.44	-2.57	2.19***
lnΔInv	-9.90***	-0.79	-7.01***	0.44*	-9.76***	-2.10	-6.69***	0.44***

- Stationarity test statistics and corresponding significance levels for oil and gas investments on the NCS and logarithmic returns of investments between 1970 and 2019. Tests include: augmented Dickey-Fuller (ADF), Dickey-Fuller Genealized Least Squares (DF-GLS), Phillips-Perron (PP) and Kwiatkowski-Phillips-Schmidt-Shin (KPSS). Trend signifies whether a deterministic component is added in the test. Asterisks denote a significance level of 10 % (*), 5 % (**) and 1 % (***).

Deterministic trend: Functional form

- Model 1: $\tau = \beta_0 + \beta_1 t + \varepsilon_t$
- Model 2: $\tau = \beta_0 + \beta_1 t^2 + \varepsilon_t$
- Model 3: $\tau = \beta_0 + \beta_1 t^4 + \varepsilon_t$
- Model 4: $\tau = \beta_0 + \beta_1 t + \beta_2 t^2 + \varepsilon_t$
- Model 5: $\tau = \beta_0 + \beta_1 t + \beta_2 t^3 + \varepsilon_t$
- Model 6: $\tau = \beta_0 + \beta_1 t^2 + \beta_2 t^3 + \varepsilon_t$
- Model 7: $\tau = \beta_0 + \beta_1 t + \beta_2 t^2 + \beta_3 t^3 + \varepsilon_t$

Deterministic trend: Functional form

Specification	AIC	HQIC	BIC
Model 1	438.3	439.76	442.13
Model 2	431.45*	432.91*	435.28*
Model 3	443.21	444.67	447.04
Model 4	431.86	434.05	437.6
Model 5	431.54	433.73	437.28
Model 6	432.57	434.75	438.31
Model 7	433.54	436.45	441.19

- Model specification of deterministic trend based on Akaike (1974), Hannan-Quinn and Schwarz's (1978) Bayesian information criteria. The L.H.S variable is the inflation adjusted petroleum investments on the NCS from 1970 to 2019. The R.H.S consists of a linear (t), squared ($t2$) and cubed ($t3$) time-period terms. Asterisk (*) denotes the optimal model.

Deterministic trend: Business cycle
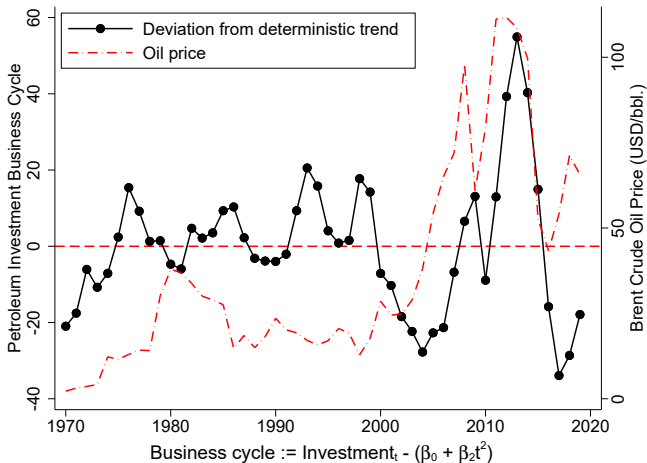
Business cycle := Investment$_t$ - $(\beta_0 + \beta_2 t^2)$

Deterministic trend: Summary statistics of business cycle

Table: Summary statistics for length of business cycle

	Mean	**Std. Dev.**	**Skew.**	**Kurt.**	**Min**	**Max**	**N**
Recession	4.4	1.34	-0.11	1.4	3	6	5
Expansion	5	3.67	0.85	2.66	1	11	5
P2P	9.25	5.12	0.43	1.85	4	16	4
T2T	9.4	3.21	0.41	1.83	6	14	5

- Based on this approach, the length of last recession was shorter than the average recession.
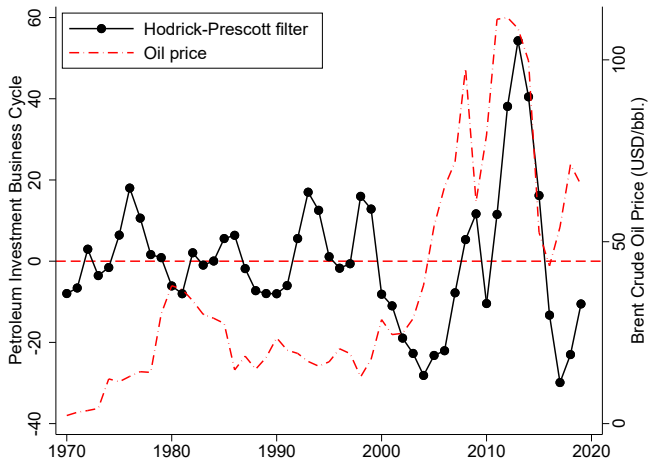
Table: Summary statistics for length of business cycle

	Mean	Std. Dev.	Skew.	Kurt.	Min	Max	N
Recession	2.75	1.16	0.51	3.16	1	5	8
Expansion	3.13	1.96	0.06	1.58	1	6	8
P2P	5.86	2.54	1.29	3.42	4	11	7
T2T	5.88	2.23	-0.82	2.22	2	8	8

- Based on this approach, the length of last recession was longer than the average recession, but not the longest.
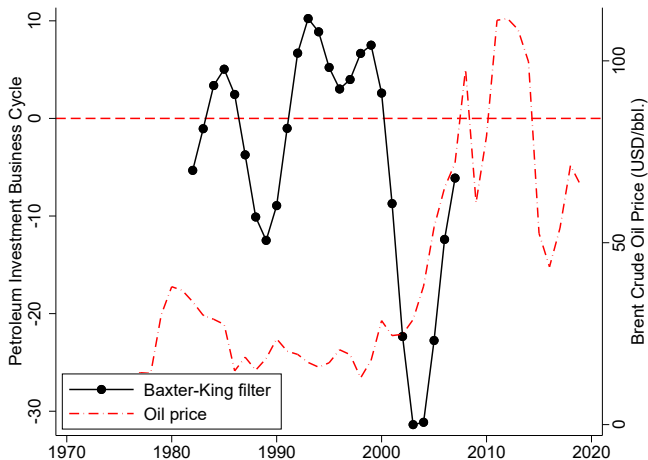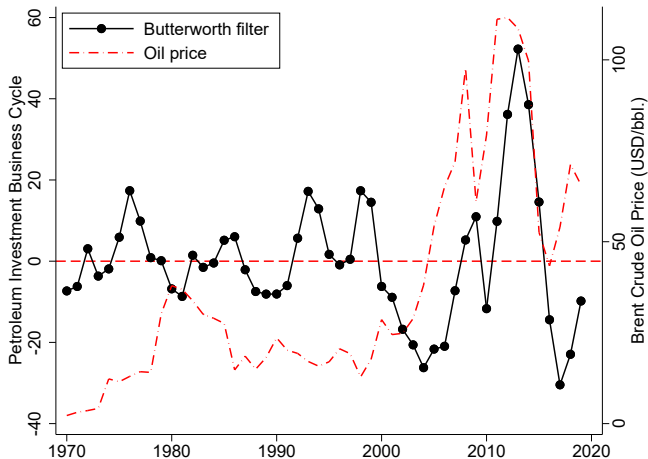
Stochastic trend: Baxter-King - Business cycle

Stochastic trend: Baxter-King - Summary statistics

Table: Summary statistics for length of business cycle

	Mean	**Std. Dev.**	**Skew.**	**Kurt.**	**Min**	**Max**	**N**
Recession	3.5	0.71	0	1	3	4	2
Expansion	7	4.24	0	1	4	10	2
P2P	8	.	.	.	8	8	1
T2T	10.5	4.95	0	1	7	14	2

Stochastic trend: Butterworth - Summary statistics

Table: Summary statistics for length of business cycle

	Mean	Std. Dev.	Skew.	Kurt.	Min	Max	N
Recession	2.88	1.25	0.24	2.4	1	5	8
Expansion	3	1.93	0.26	1.73	1	6	8
P2P	5.86	2.54	1.29	3.42	4	11	7
T2T	5.88	2.23	-0.82	2.22	2	8	8

- Based on this approach, the length of last recession was longer than the average recession, but not the longest.

Stochastic trend: Christiano-Fitzgerald - Summary statistics

Table: Summary statistics for length of business cycle

	Mean	Std. Dev.	Skew.	Kurt.	Min	Max	N
Recession	5.5	2.38	1.03	2.22	4	9	4
Expansion	6.25	3.2	1.08	2.28	4	11	4
P2P	12.33	6.66	0.69	1.5	8	20	3
T2T	11.75	3.3	-0.13	1.28	8	15	4

- Based on this approach, the length of last recession was shorter than the average recession.
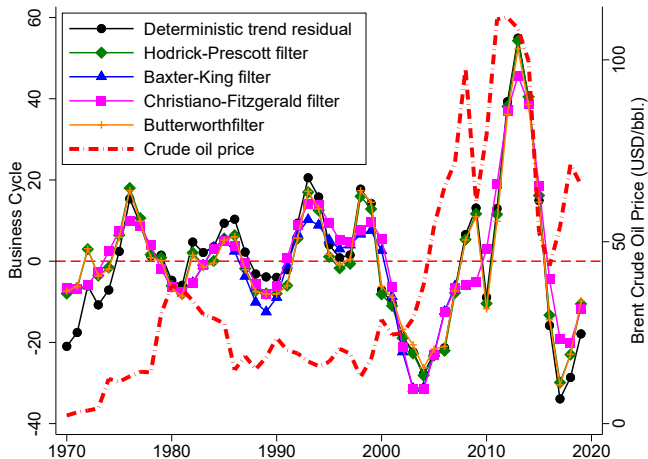
Severity of recession

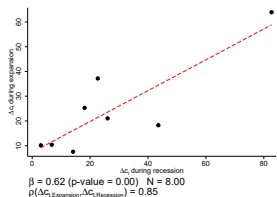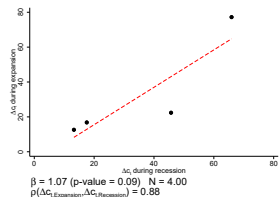- Scatter plot between ΔC_t during recession and ΔC_t during preceeding expansion.

(a) **DT**

(b) **HP**

(c) **BW**

(d) **CF**

Severity of recession
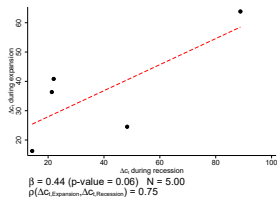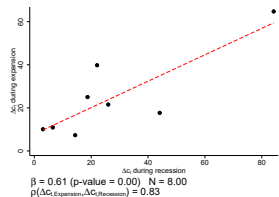
Approach	ρ	β	N
Deterministic trend	0.7521	0.4418*	5
Hodrick-Prescott filter	0.8345	0.6129***	8
Baxter-King filter	1	0.5136	2
Christiano-Fitzgerald filter	0.8803	1.0726*	4
Butterworth filter	0.8545	0.6229***	8

- OLS β coefficient from regressing absolute change in cyclical component during expansion (trough to peak) on absolute change during subsequent recession:
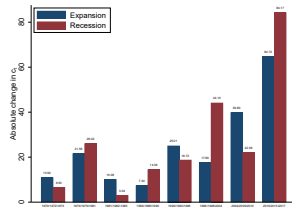
$$\Delta C_{t,Expansion} = \beta_0 + \beta_1 \Delta C_{t,Recession} + \varepsilon_t$$

Asterisks denote a significance level of 10% (*), 5% (**) and 1% (***). Correlation coefficient between the dependent and independent variable is also reported.
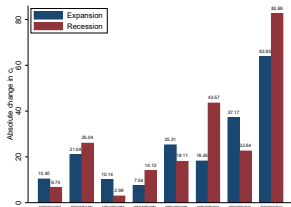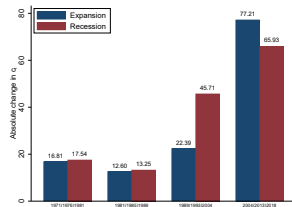
Severity of recession
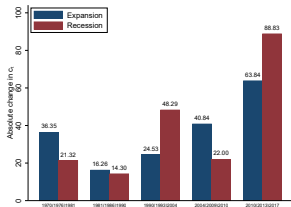
(e) **DT**

(f) **HP**

(g) **BW**

(h) **CF**

Conclusion

- The last recession in the Norwegian petroleum industry was not the longest.
- The last recession was the most severe, however it was preceded by the largest expansion.