# Forecastability of petroleum investments on the NCS

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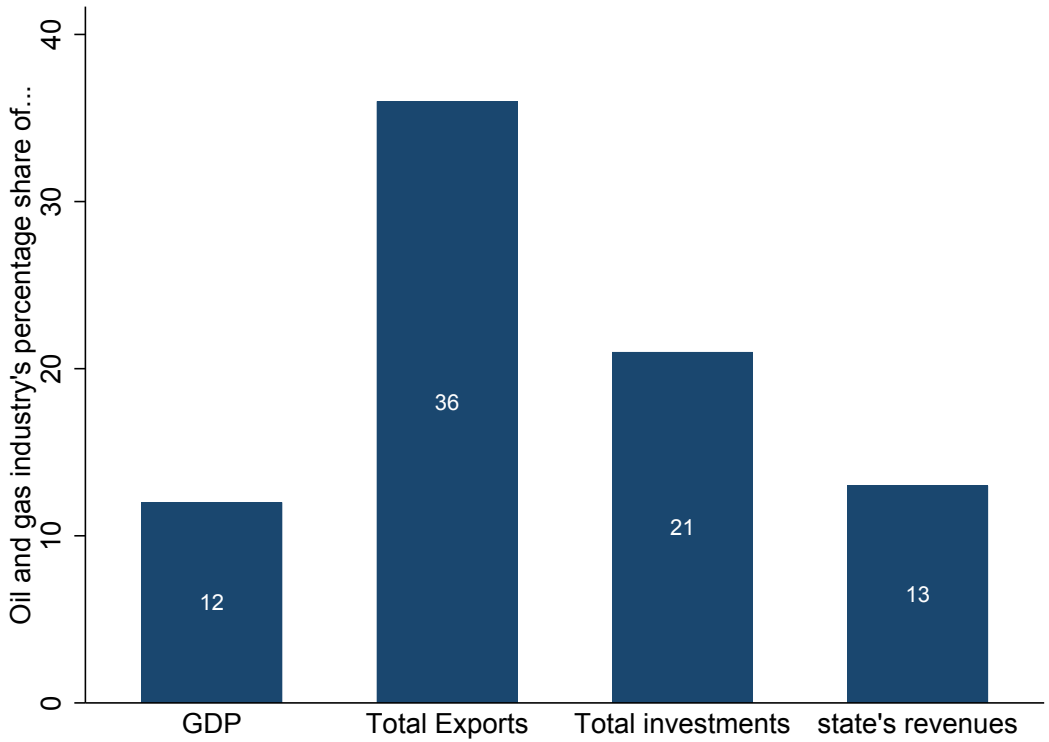
# Introduction

- The oil and gas industry is essential to the Norwegian economy.

Figure: **Revised national budget for 2017**



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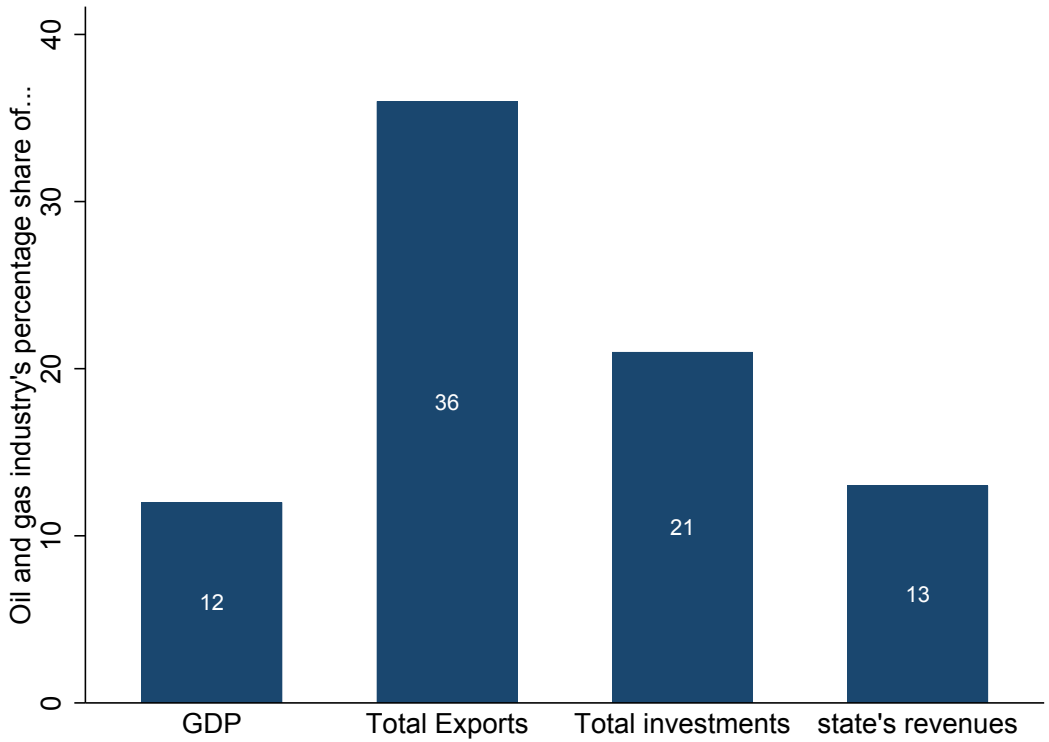

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- The ability to forecast future investment in the oil and gas industry is useful for the Norwegian government and the service & supply industry.
- The Norwegian national budget provides a one-year ahead forecast of aggregate oil and gas investments.

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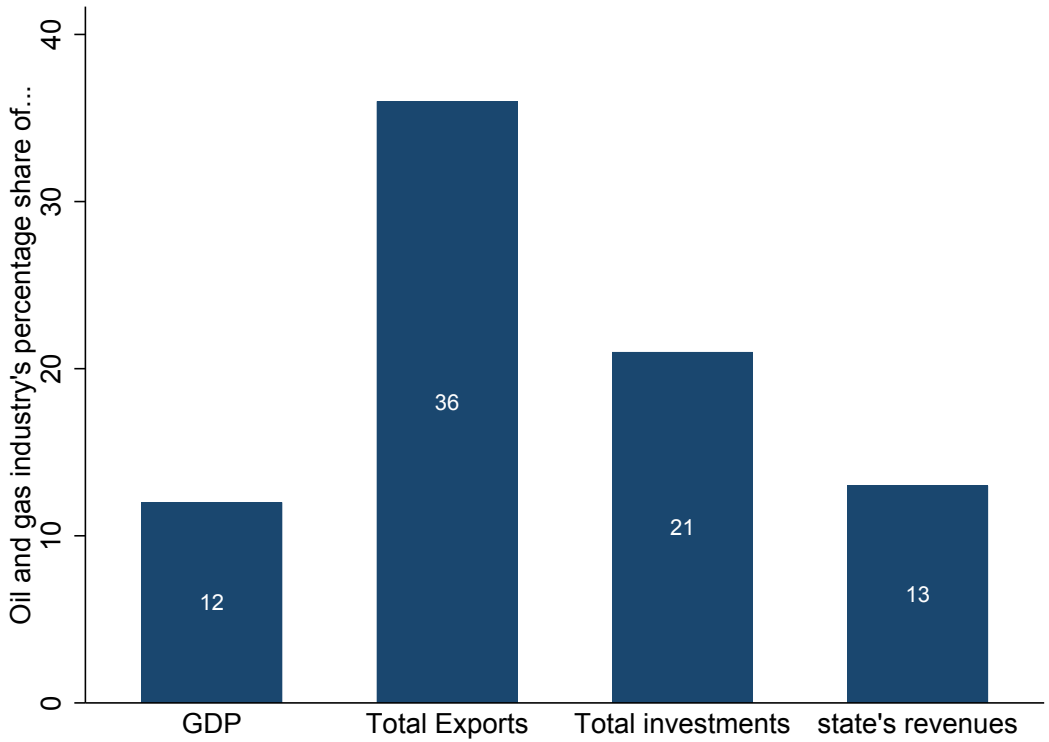

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- Can a parsimonious ADL model outperform the national budget forecast?

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- Contributors:
  - Norwegian Petroleum Directorate (NPD)
  - Statistics Norway
  - Ministry of Petroleum and Energy
  - Ministry of Finance

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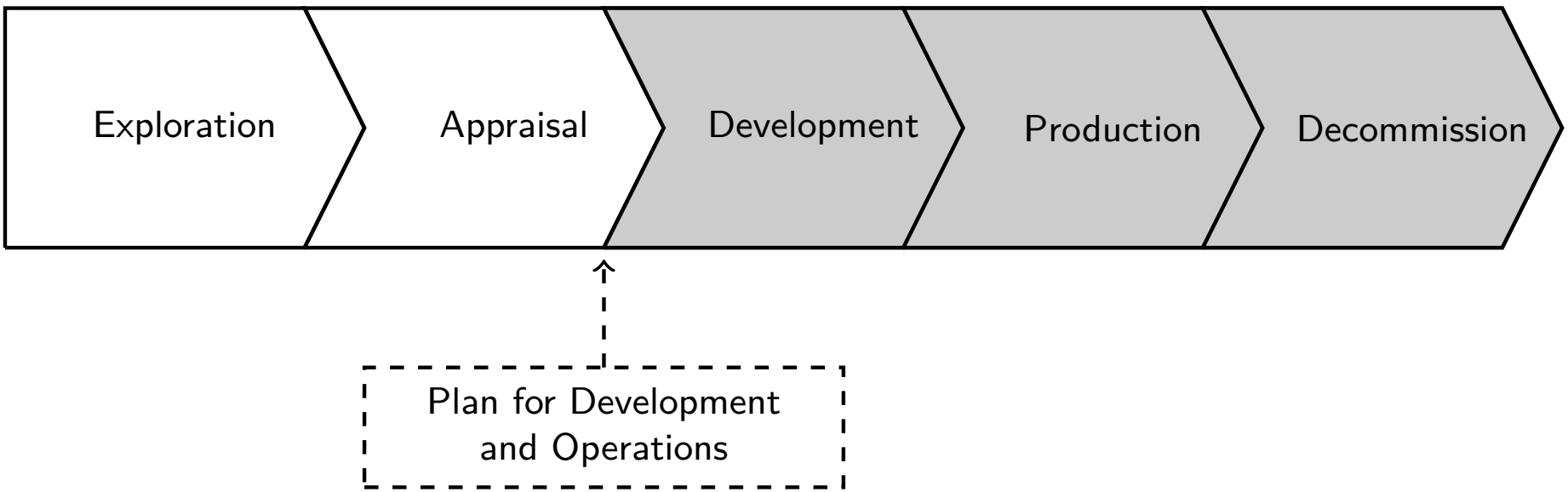

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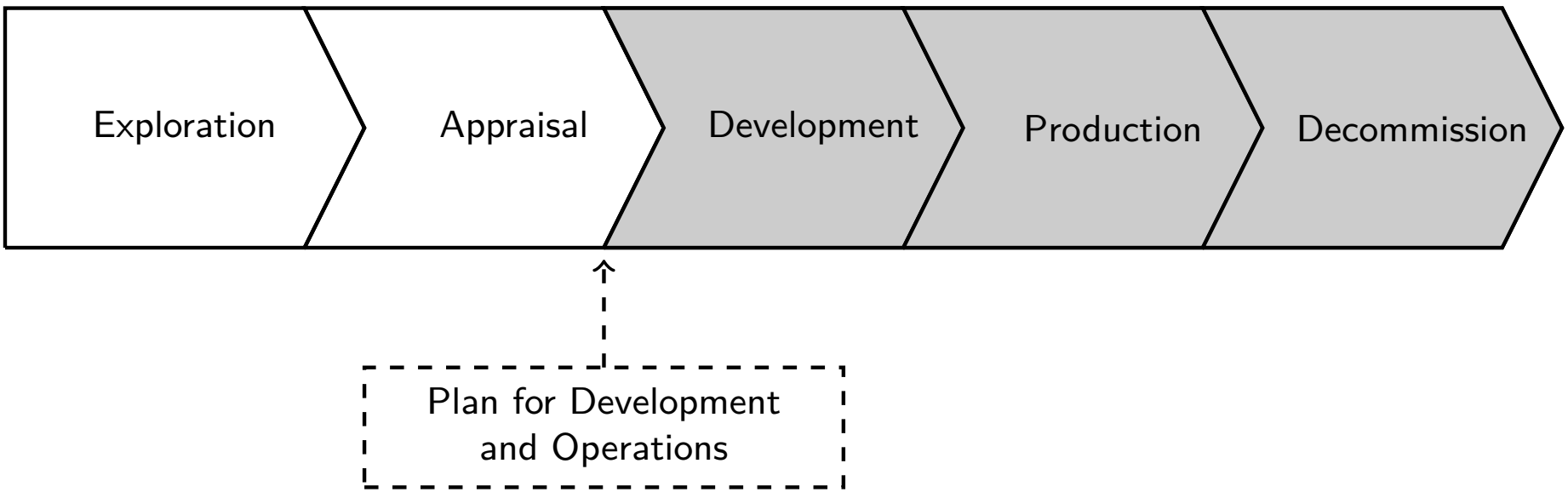

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- Independent variables consist of:
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  - Realized volatility of crude oil price
  - Number of exploration wells (wildcat  appraisal)

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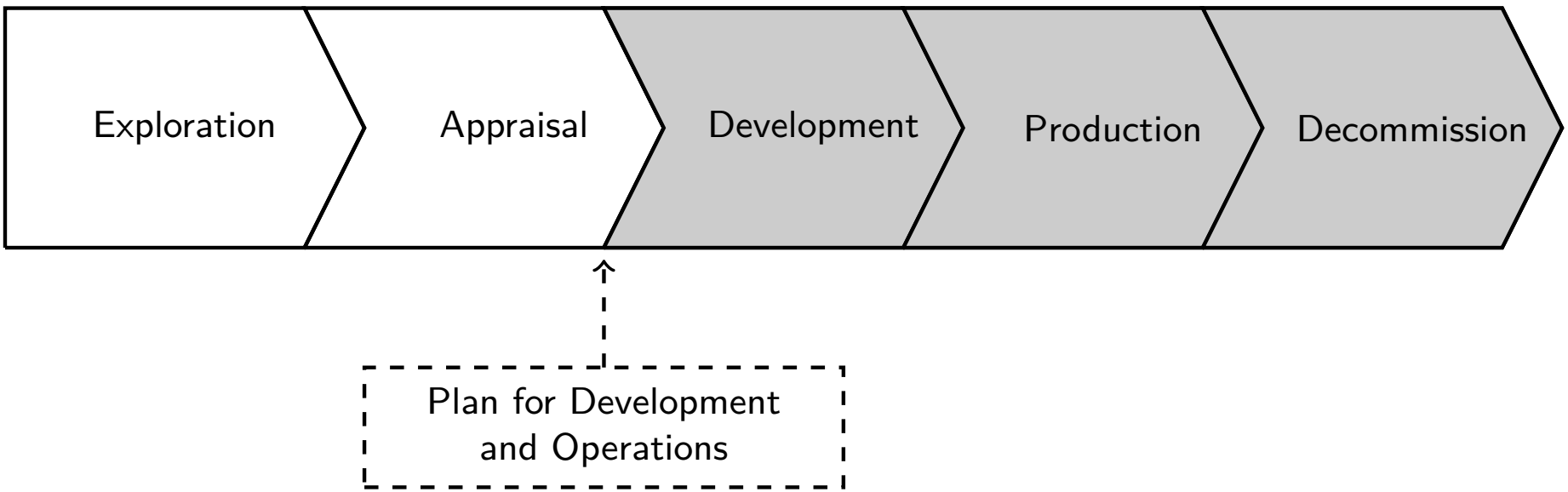

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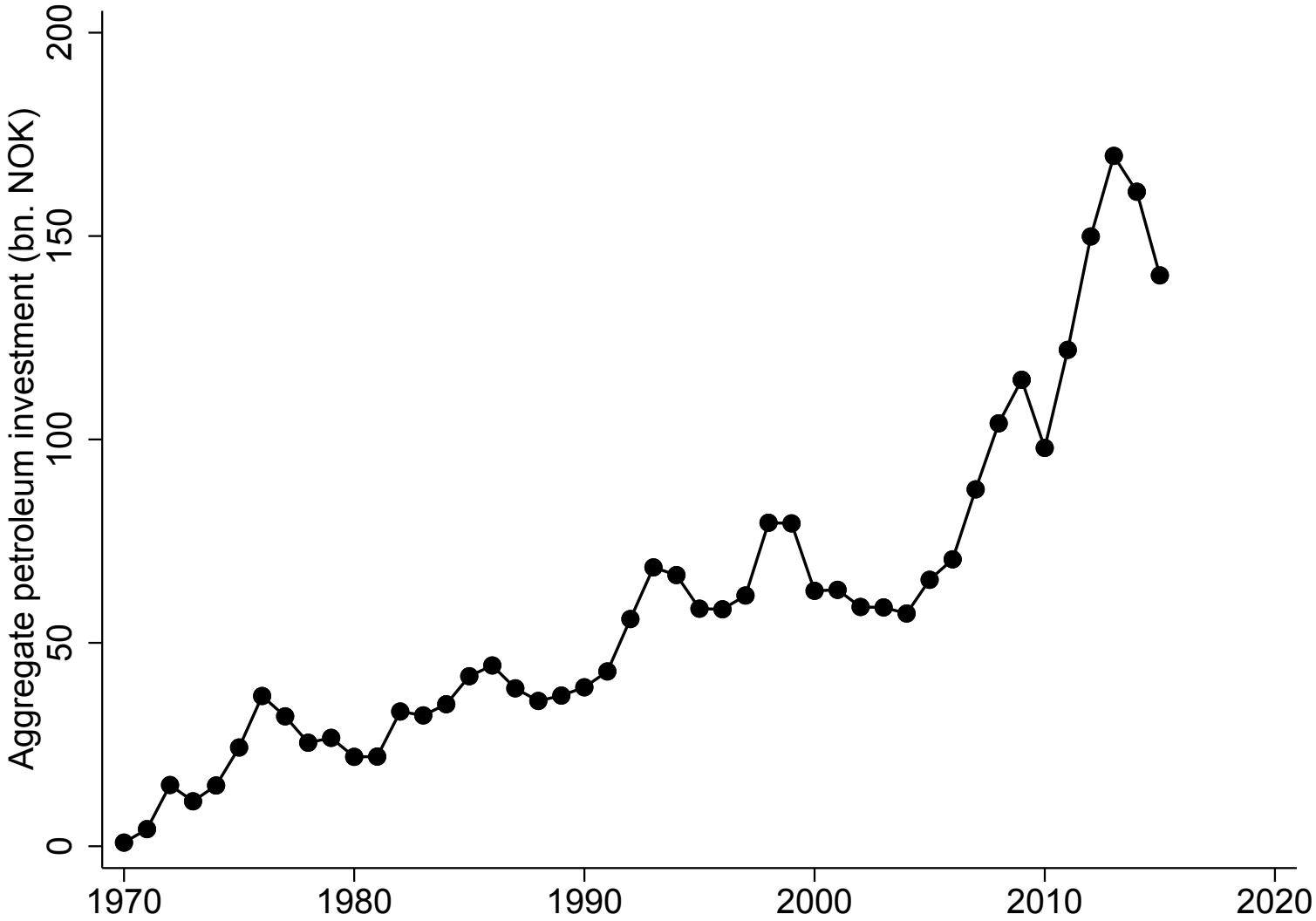

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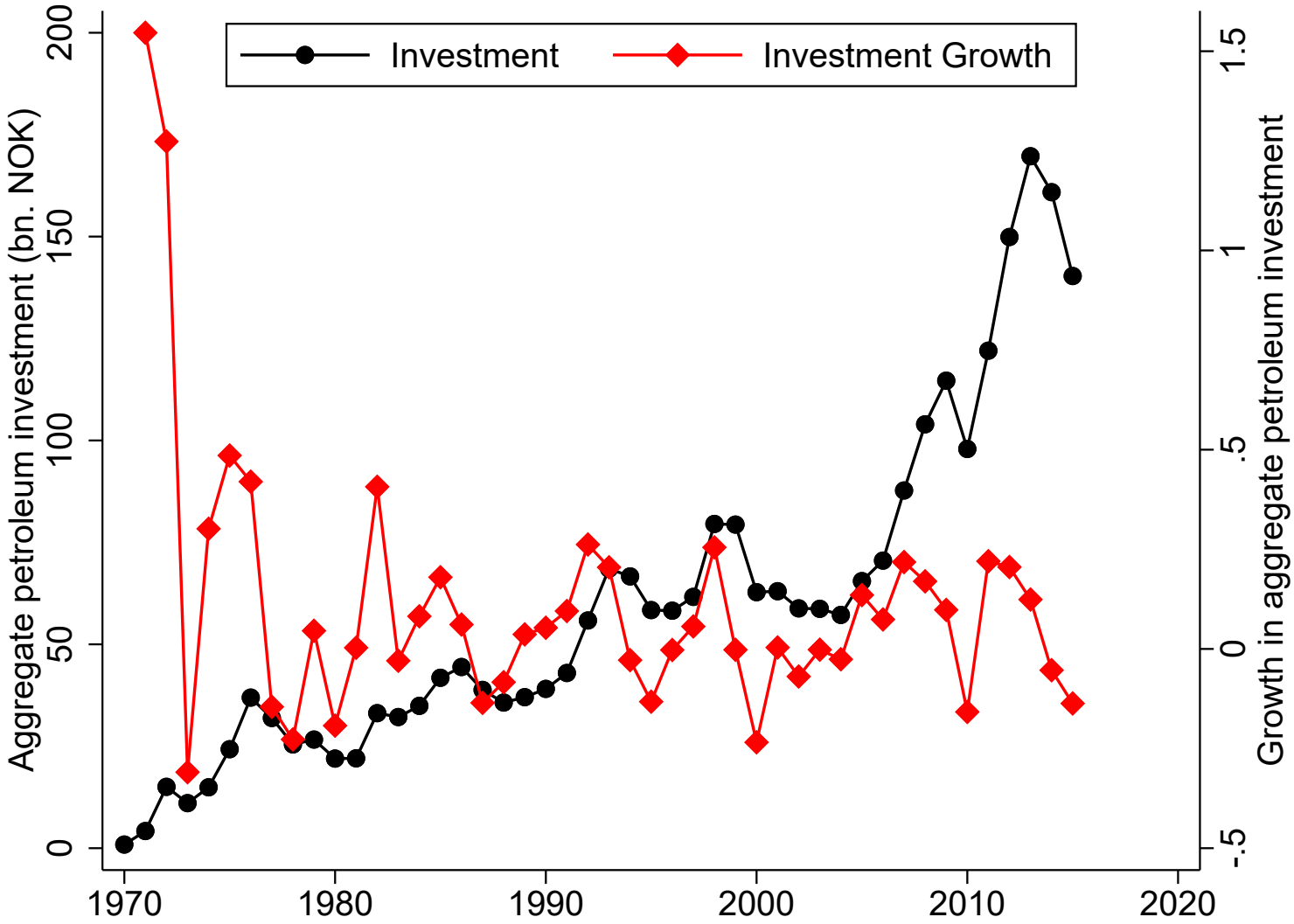

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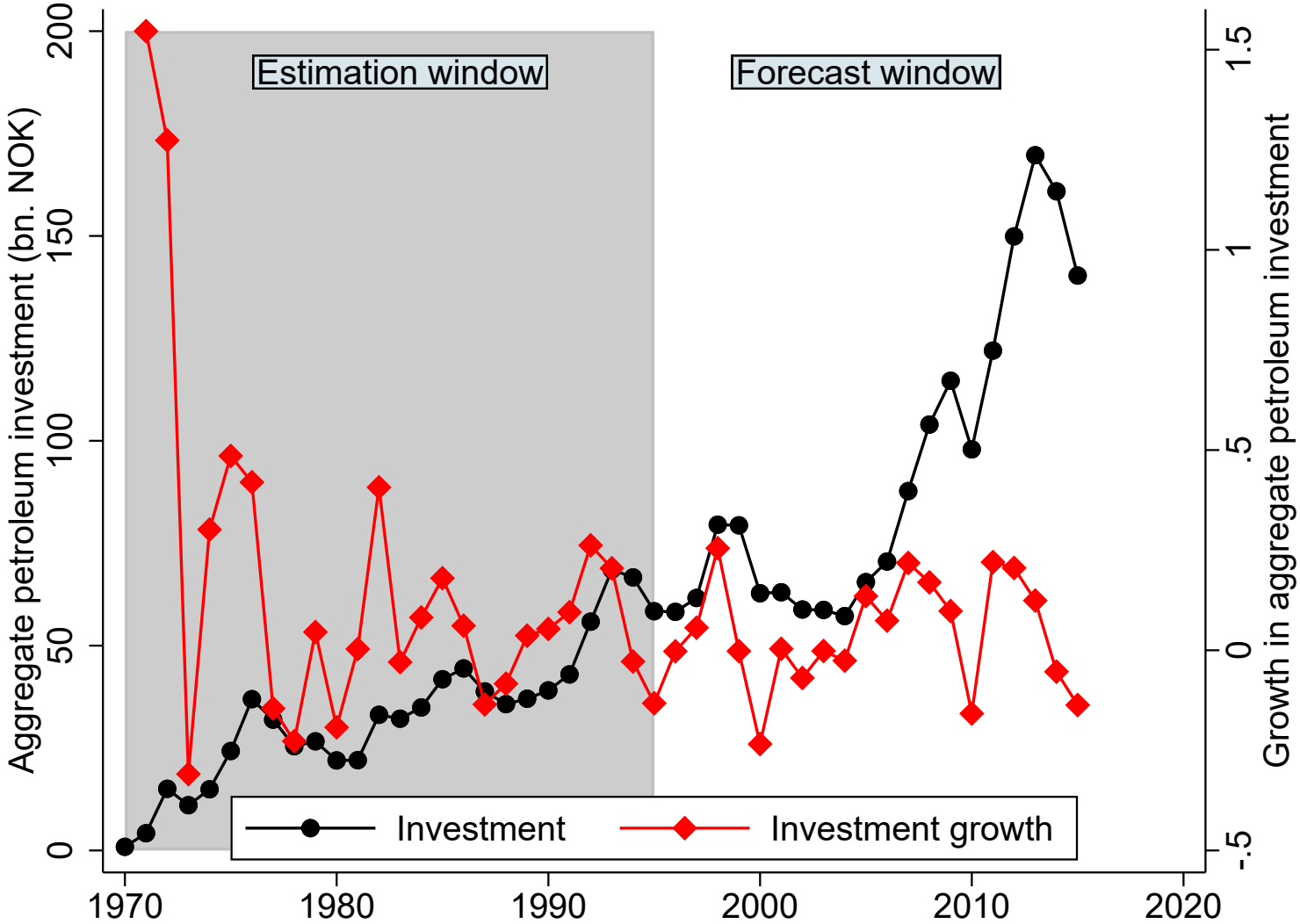


Figure: Crude oil price

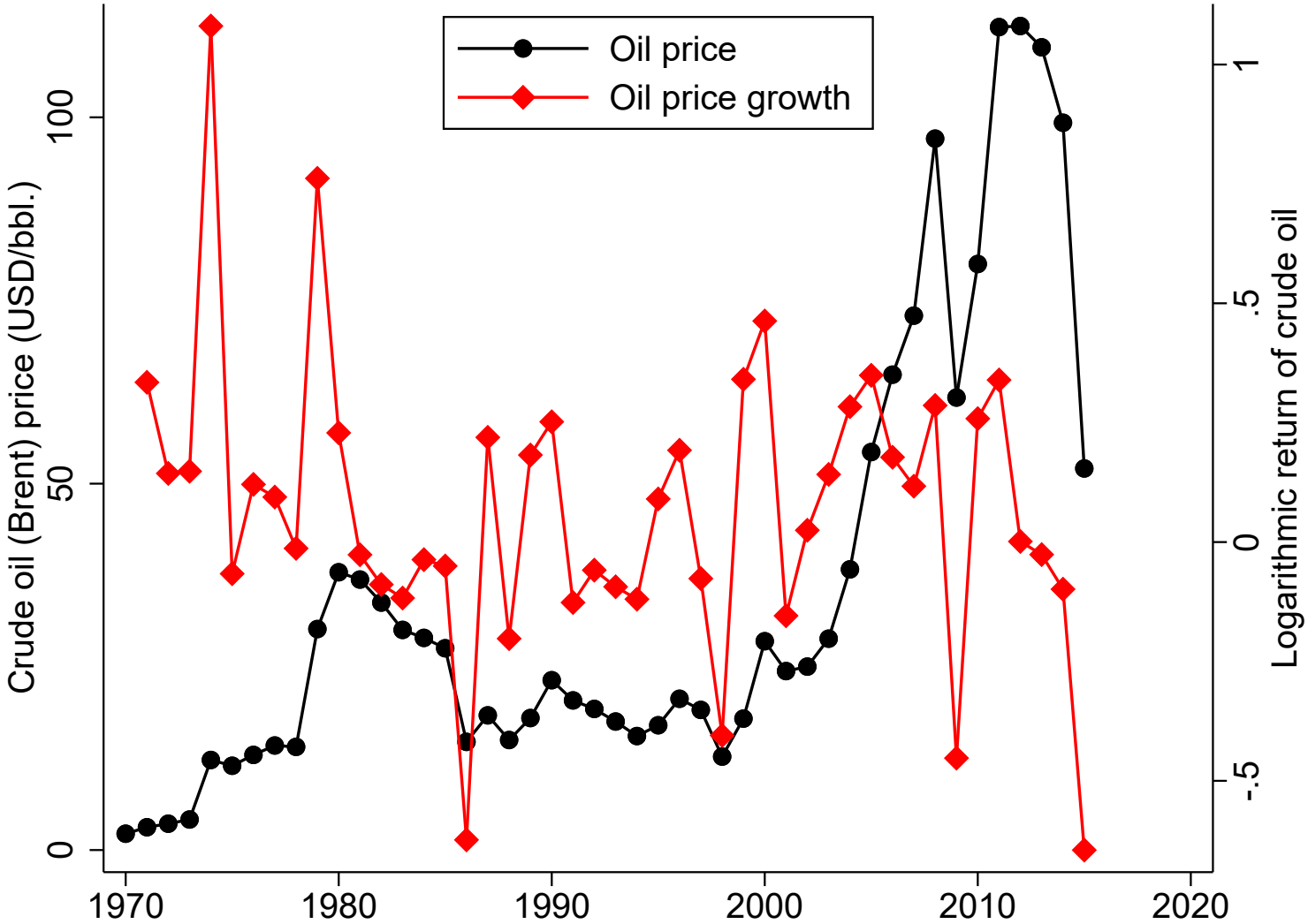


Figure: Realized volatility

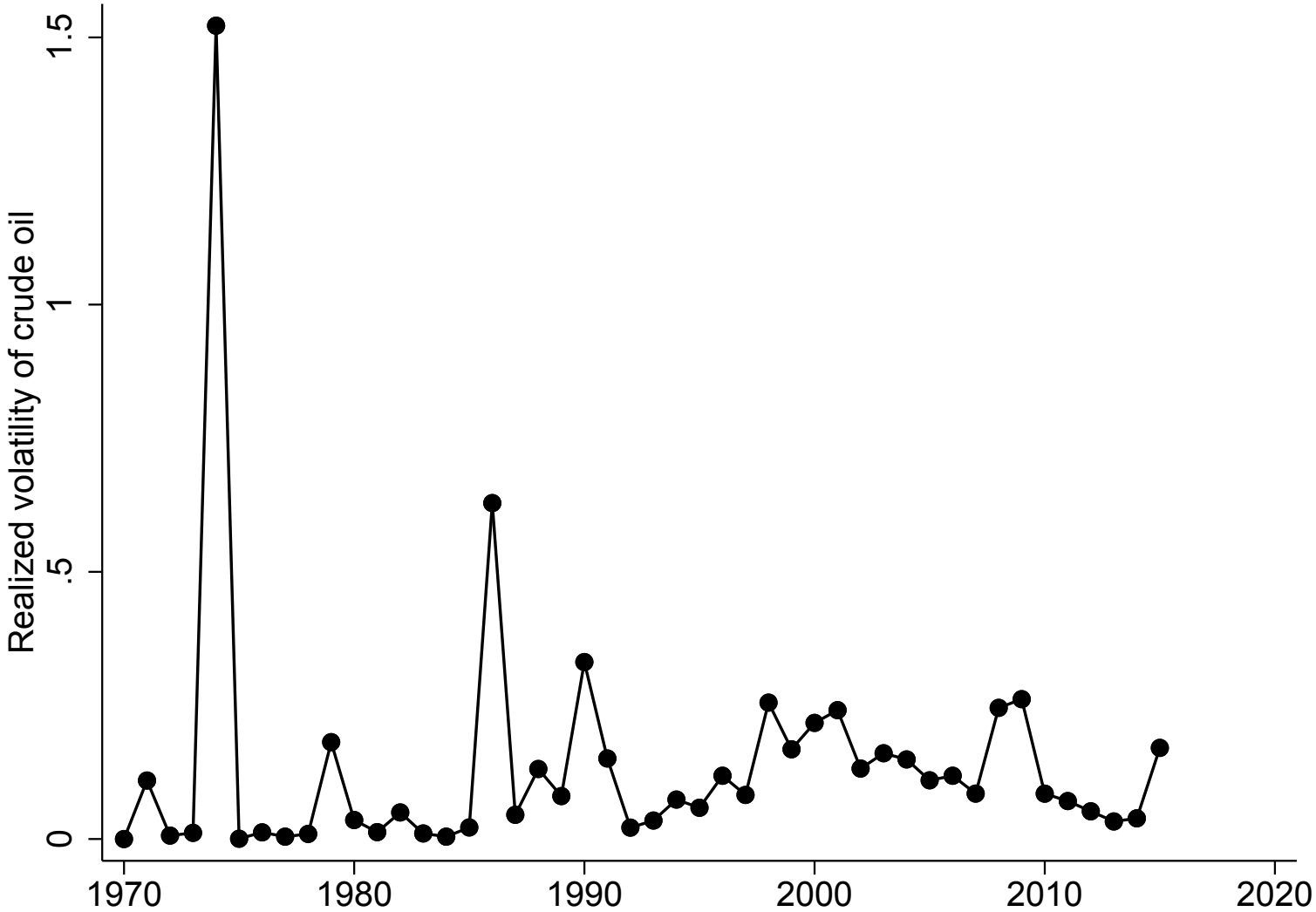
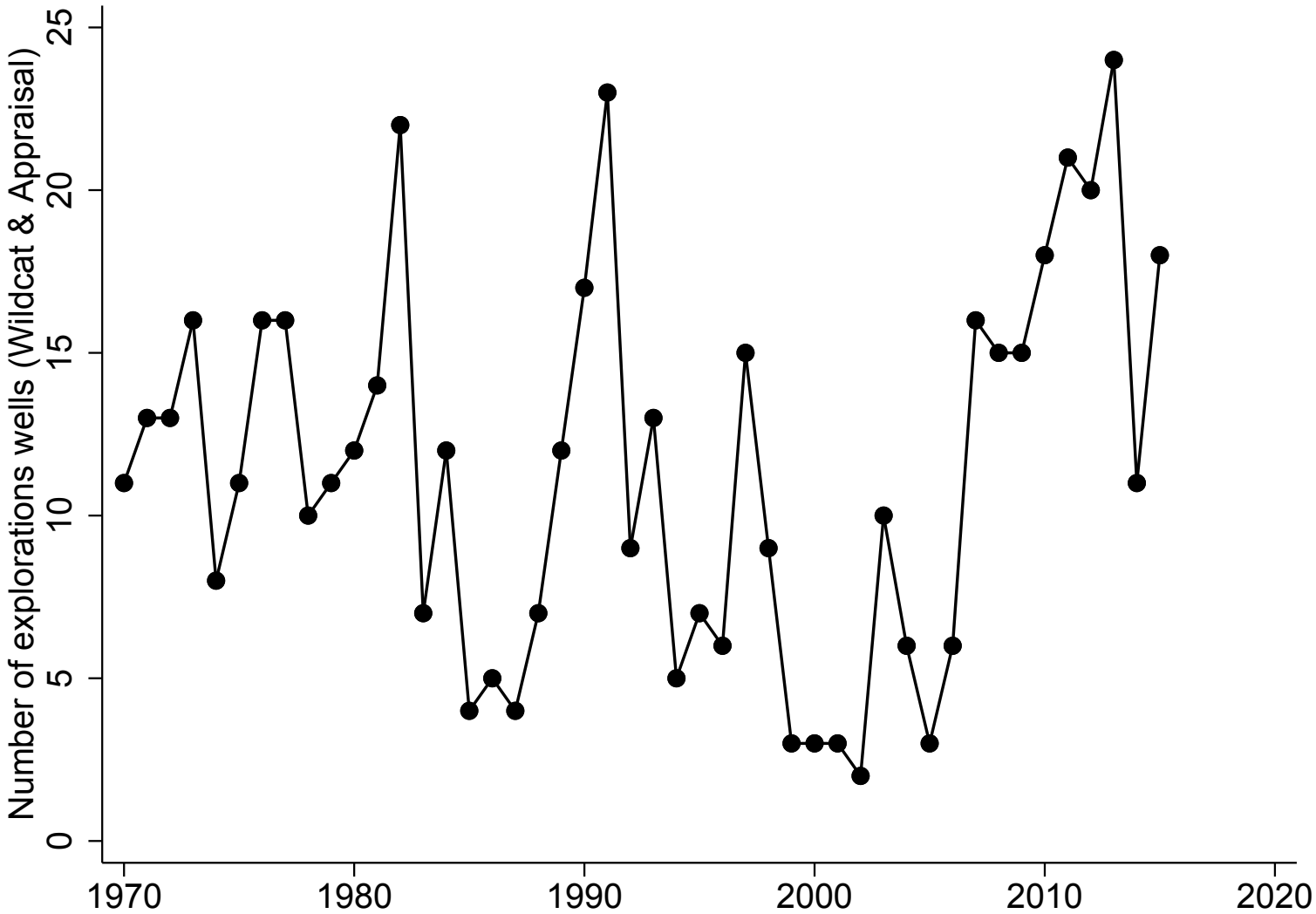


Figure: Exploration wells



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$$y_t \equiv \ln(Investment_t) - \ln(Investment_{t-1}) \tag{1}$$

$$y_t = \alpha + \sum_{i=1}^{p} \beta_i y_{t-i} + \sum_{j=0}^{q} \left( \sum_{k=1}^{r} \gamma_{jk} x_{jt-k} \right) + u_t \tag{2}$$

$$\text{Number of models tested} = m + \sum_{i=1}^{q} m^{i+1} \binom{q}{i} = 500 \tag{3}$$

# Results

Table: Regression result

| **Independent variable** | $\Delta \ln(Investment_t)$ |
|---|---|
| $\Delta \ln(Investment_{t-1})$ | 0.278*** |
| | -2.82 |
| $\Delta \ln(Investment_{t-2})$ | -0.194 |
| | (-1.64) |
| $\Delta \ln(Investment_{t-3})$ | 0.280*** |
| | -3.56 |
| $\Delta \ln(CrudeOil_{t-1})$ | 0.075 |
| | -0.86 |
| $\Delta \ln(CrudeOil_{t-2})$ | 0.151* |
| | -1.81 |
| $\Delta \ln(RealizedVolatility_{t-1})$ | -0.039*** |
| | (-3.47) |
| Constant | 0.011 |
| | -0.41 |
| N | 42 |
| R2 | 0.425 |

Table: **Loss functions & Diebold-Mariano test**

| | RMSE | MAE | ME | Hit rate | MZ-$r^2$ |
|---|---|---|---|---|---|
| | | Forecast models | | | |
| National budget | 0.1406 | 0.1181 | -0.0112 | 0.5 | 0.13 |
| | (0.20;0.96) | (0.23;0.78) | | | |
| AIC | 0.0982 | 0.0849 | -0.0087 | 0.7 | 0.49 |
| | (0.02;0.01) | (0.00;0.11) | | | |
| AICc | 0.1217 | 0.0972 | -0.0086 | 0.55 | 0.17 |
| | (0.01;0.29) | (0.00;0.47) | | | |
| HQIC | 0.1046 | 0.0895 | -0.0134 | 0.65 | 0.41 |
| | (0.04;0.06) | (0.02;0.24) | | | |
| BIC | 0.1115 | 0.0926 | -0.0178 | 0.6 | 0.32 |
| | (0.05;0.11) | (0.01;0.33) | | | |
| Adj. R2 | 0.106 | 0.0888 | 0.0004 | 0.75 | 0.38 |
| | (0.02;0.00) | (0.01;0.07) | | | |
| Combined | 0.1038 | 0.0858 | -0.0096 | 0.65 | 0.45 |
| | (0.02;0.02) | (0.00;0.14) | | | |
| | | Benchmark models | | | |
| Extrapolation | 0.1671 | 0.1378 | -0.0002 | 0.6 | 0.04 |
| No Change | 0.1398 | 0.1122 | 0.0438 | 0 | 0 |

Table: **Hansen-Lunde Model Confidence Set procedure**

| Iteration | RMSE | | MAE | |
|---|---|---|---|---|
| | T-Max | TR | T-Max | TR |
| 1 | Extrapolation | Extrapolation | Extrapolation | Extrapolation |
| 2 | NB | NB | NB | NB |
| 3 | No Change | No Change | No Change | No Change |
| 4 | AICc | AICc | AICc | AICc |
| 5 | | BIC | | |

Figure: **Forecast accuracy of national budget**

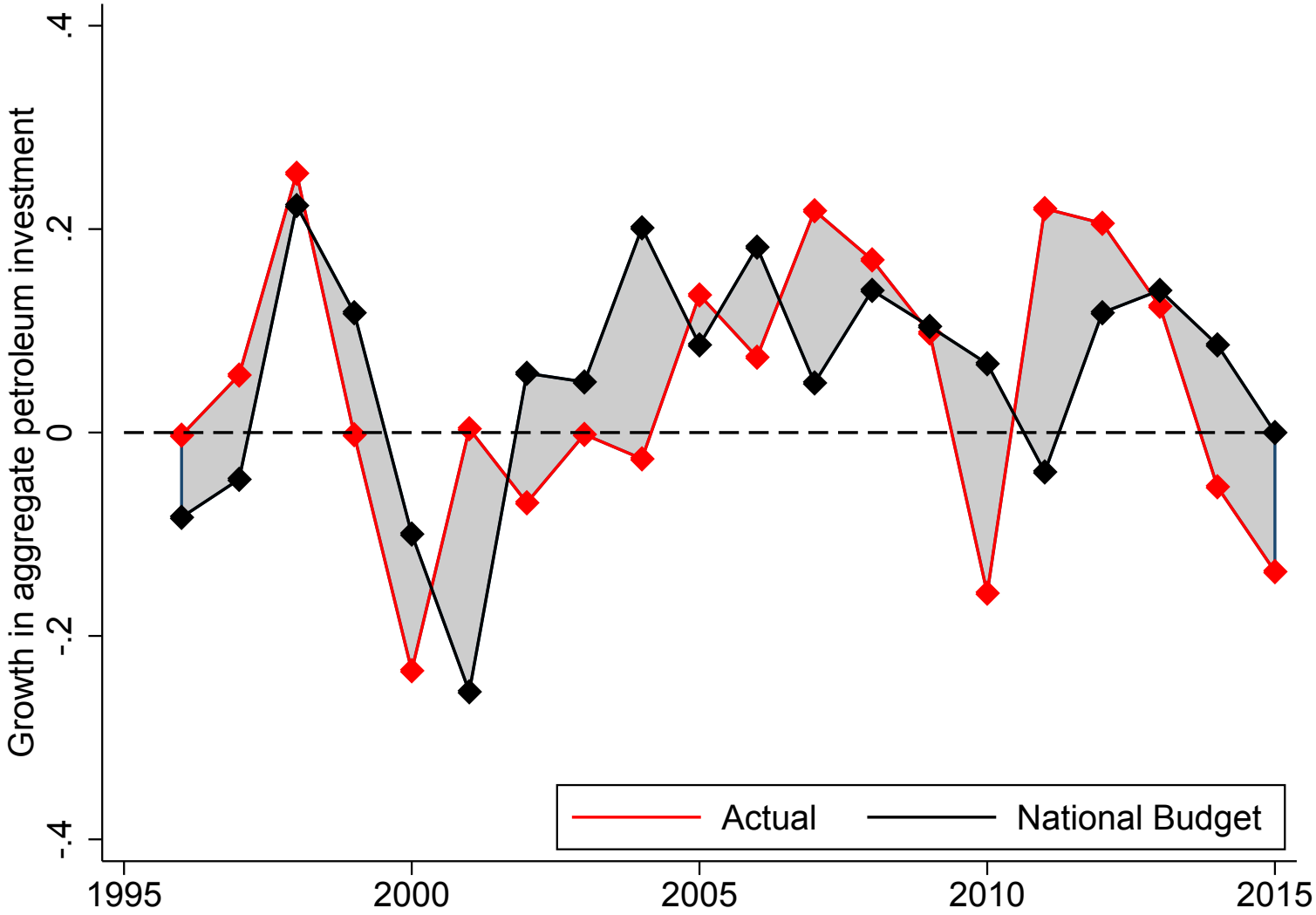


Figure: **Forecast accuracy of AIC specified ADL**

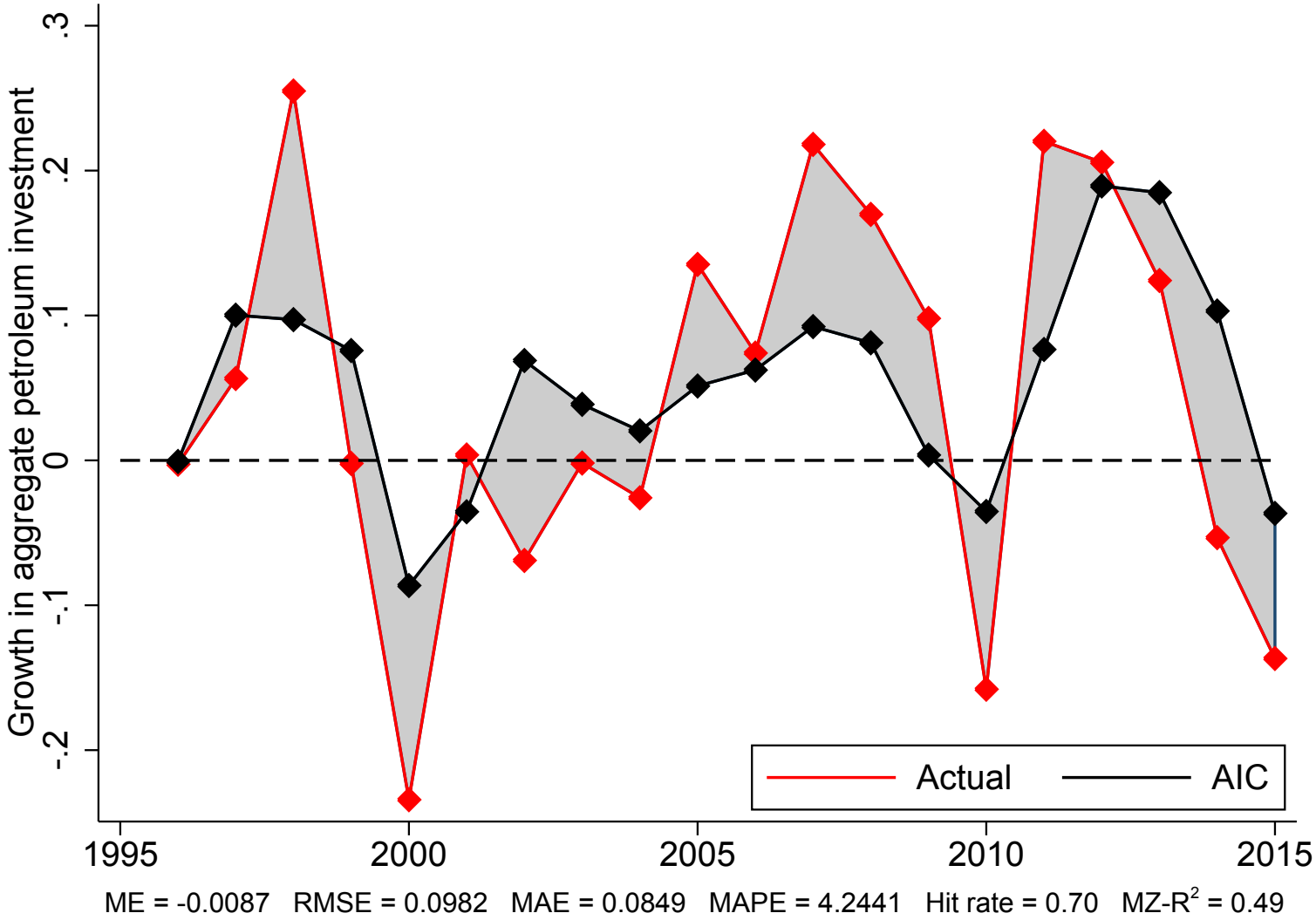
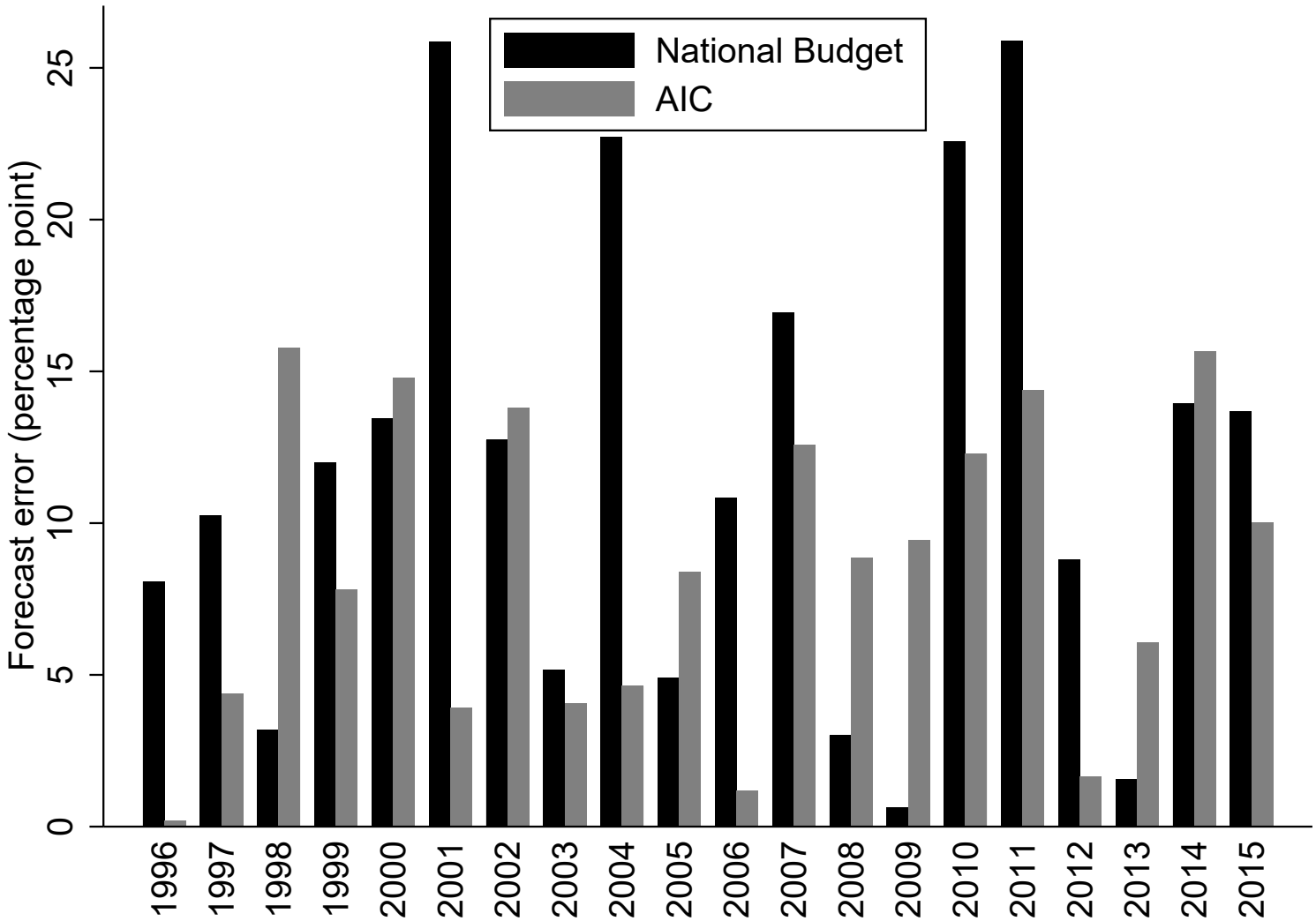


Figure: **Comparison between national budget & ADL**



# Summary

- Findings:
  - National budget does not significantly outperform the benchmark models.
  - Autoregresive Distributed Lag models tend to significantly outperform the National budget and both benchmark models.
- Implications:
  - Growth in oil and gas investment on the NCS can be forecasted.
  - Oil price, realized volatility of oil price and number of exploration wells as predictors of investment growth provide insight.

# Q&A

Thank you for your attention!
(Any questions?)