**Endogeneity and reverse causality in the study of local state-owned enterprises in Norway. Problems and solutions**

**Online Appendix**

Jan Erling Klausen[[1]](#footnote-1)  
Marte Winsvold[[2]](#footnote-2)

**Reverse causality**

We analyze the impact of various accountability practices on perceived control based on data taken from a web-based survey to all Norwegian municipalities that own at least one SOE. Specifically, we test assumptions about causality between seven indicators of the flow of information from the SOE to elected representatives and chief managers (COs), respectively, and the COs’ evaluation of control (the dependent variable). The results from the ordered logistic regression analysis largely corroborated our assumptions, as the majority of estimates were significant and in the expected direction. However, a distinct limitation of survey-based research is that correlation does not establish causation (Dowding 2016, 142); causal relationships and the causal ordering of the variables cannot be established based on the identification of statistically significant associations alone (Davis 1985, Kleinbaum 1998). In the following, we discuss how the problem of reverse causality may affect the credibility and robustness of our findings, and carry out statistical tests.

Reverse causality means that the analytical model is based on invalid assumptions about the causal ordering of the independent and dependent variables. While the model assumes that variation in a dependent variable (Y) is caused by one or several independent variables (X), it is actually the variable Y that affects X. If so, observed correlation between X and Y cannot be interpreted as a valid indicator in support of the analytical model. The survey method is particularly susceptible to this validity threat, since the values of independent and dependent variables are observed simultaneously.

In the present analysis, reverse causality would imply that the CO’s sense of control affects the structuring of information flows between the SOEs and elected representatives/COs – not the other way around, as assumed by the model. In other words, some COs would perceive to be in control because they themselves have ensured that the said information flows run in the desired directions. It follows logically that a precondition for reverse causality is that COs are actually capable of structuring information flows as they see fit. At first sight, this precondition does not seem to be corroborated by evidence. Because SOEs are independent legal entities, they are not integral parts of the municipal administration and so not subsumed under the COs chain of command. Consequently, the COs do not possess any legal mandate for making interventions in the governance of SOEs. Because the local government act designates the mayor as the legal representative of the municipality, all information from the SOE to the municipality passes through the mayor’s office. The mayor is the municipal owner’s representative in the general assembly (Ltd.) and the corporate assembly (IMCs). Because it seems unlikely from a legal perspective that the COs are in a position to structure the information flows between the SOEs and the municipality, the causal ordering in the analytical model seems appropriate.

An appropriate method for testing assumptions about causal ordering is the *instrumental variables* method (Angrist and Pischke 2015). An “instrument” is a contextually occurring phenomenon that has a causal effect on the independent variable but is uncorrelated with the dependent variable. Furthermore, values on the instrumental variable needs to be randomly assigned so as not to correlate with control variables included in the analytical model. The existence of an instrumental variable allows the researcher to test the causal ordering of the analytical model even when controlled experiments are unfeasible. In the context of the present analysis, there is however no “instrument” that could serve this purpose. Because the instrumental variables method is unavailable for testing the causal ordering of the model, we analyze the feasibility of the reverse causality assumption as regards the COs’ capacity for organizing the accountability process.

Given that COs were actually in a position to structure the information flows in the accountability process through deliberate intervention (the precondition for reverse causality), we would expect systematic differences between long-serving COs and newly employed COs. Because restructuring of procedures for information processing presumably takes time, newly employed managers would have to operate within the accountability regime established by their predecessors. Consequently, the perception of control cannot have affected the accountability practices among newly employed COs. We use data on the tenure of COs to test this assumption. Two reservations to this test must be made. First, as noted, the survey respondent in each municipality was the person responsible for SOE management. In some of the larger municipalities, the respondent would have been someone other than the CO, but regrettably, exact data on the identity of each respondent is unavailable. We have therefore excluded the respondents from the four largest municipalities from the test. The second reservation to this test is that some of the COs could have acted very quickly, in terms of restructuring the accountability process in their new municipality. The survey was conducted in spring 2014, and we have counted as “newly employed” those who became COs in 2013 or 2014.

Table A1 presents bivariate correlations between the COs’ length of service and the seven independent variables denoting the three phases of the accountability process in the analytical model.

*Table A1: CO length of service and indicators of accountability practices. Bivariate correlations (Pearson’s r), p-values*

|  |  |  |  |
| --- | --- | --- | --- |
|  |  | Tenure 0 and 1 | p |
| Information | Politicians informed of goal obtainment | -.11\*\* | .02 |
|  | Administration informed of goal obtainment | .012 | .88 |
|  | Politicians informed of running operations | -.15\*\* | .00 |
|  | Administration informed of running operations | .03 | .69 |
| Discussion | Enterprise goals discussed with politicians | -.12 | .08 |
|  | Enterprise goals discussed with administration | -.03 | .70 |
| Consequence | Noncompliance results in board being fired | .06 | .43 |

\*\* significant at .05-level

The results in table A1 indicates that there are few significant differences between newly employed COs (tenure 0) and longer-serving COs (tenure 1) as regards the structuring of the accountability processes. Furthermore, while there is significant difference between the newly employed and the longer-serving COs as regards the first and the third variable denoting the information phase (*Politicians informed of goal obtainment* and *Politicians informed of running operations*) the differences are only partially congruent with the model for structuring accountability relations that we test in the article. Notably, we would expect longer-serving COs to structure information flows so that politicians to a greater extent receive information about goal obtainment, but the results in table A1 indicates the reverse.

On the other hand, the results in table A1 indicates that municipalities with longer-serving COs to a lesser extent than those with newly employed COs keep politicians informed about running operations. Because this finding supports the assumption that longer-serving COs tend to structure the accountability process in accordance with our model, we cannot discount the reverse causality assumption based on the results reported in table A1 alone. We therefore carry out a logistic regression analysis similar to the one reported in the article (table 4), on the subsample of newly employed COs. The results are reported in table A2.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *Table A2. COs’ Assessments of Municipal Control over Ownership Positions. Ordered logistic regression. N = 59* | | | | |
|  |  | Odds ratio | z | P>z |
| Information | Politicians informed of goal obtainment | 6.51\*\*\* | 2.44 | 0.014 |
|  | Administration informed of goal obtainment | .19\* | -1.77 | 0.077 |
|  | Politicians informed of running operations | .68 | -0.55 | 0.585 |
|  | Administration informed of running operations | 6.01\* | 1.66 | 0.098 |
| Discussion | Enterprise goals discussed with politicians | 1.91\*\*\* | 2.65 | 0.008 |
|  | Enterprise goals discussed with administration | .76 | -1.03 | 0.305 |
| Consequence | Noncompliance results in board being fired | 1.57\*\* | 2.14 | 0.032 |
|  | Number of administrative employees | 1.06 | 0.14 | 0.886 |
|  | Number of SOEs (ln) | .61 | -1.11 | 0.267 |
|  | Net operating result per capita | 1.06 | 1.01 | 0.312 |
|  | Political fragmentation (Herfindahl index) | 3.79\* | 1.76 | 0.079 |
|  | Pseudo *R*2 | 0.15 |  |  |

*Notes:*, \*p<0.10, \*\**p* < 0.05, \*\*\**p* < 0.01.

The results reported in table A2 should be interpreted with caution, as the analysis is carried out on a very small sample (N=59) and some of the effects are only significant at a 0.1 level. We note however that the results by and large corroborate the results of the analysis carried out on the full sample (N=169) as reported in the main text of the article (table 4). The directionality of all the estimates are the same, and the effects that were found to be statistically significant in the analysis of the full sample are either significant or approaching significance in the analysis of the restricted sample as well. The fact that the results of the main analysis holds out even in the analysis of the restricted sample attenuates the assumption of reverse causality.

As a final test of robustness, we included the COs’ tenure as a control variable in the analysis carried out in the main text of the article (table 4), as we suspect tenure to be a confounder. Table A3 reports on the results from estimation of three models: (1) the model reported in table 4; (2) a model where CO tenure is included as a continuous variable (number of years since employment in the current position); and (3) a model where CO tenure is included as a dichotomous variable similar to table A1.

*Table A3. Managers’ Assessments of Municipal Control over Ownership Positions. Ordered logistic regression. Odds ratios (P>z).*

|  |  |  |  |
| --- | --- | --- | --- |
|  | Model 1 | Model 2 | Model 3 |
| Tenure of CO | - | 1.00 | 1.31 |
| Politicians informed of goal obtainment | 2.09\* | 2.44\* | 2.13\* |
| Admin. informed of goal obtainment | 0.37 | .42 | .39 |
| Politicians informed of running ops. | 1.53 | 1.31 | 1.52 |
| Admin. informed of running ops. | 4.98\*\* | 4.15\* | 4.65\*\* |
| Enterprise goals discussed with pol. | 1.70\*\* | 1.72\*\* | 1.74\*\* |
| Enterprise goals discussed with admin. | 0.87 | .88 | .88 |
| Noncompliance results in board fired | 1.38\*\* | 1.38\* | 1.36\*\* |
| Number of administrative employees | 1.14 | 1.01 | 1.10 |
| Number of SOEs (ln) | 0.96 | .94 | .96 |
| Net operating result per capita | 1.01 | 1.01 | 1.02 |
| Political fragmentation (H. index) | 4.12\* | 3.72\* | 4.15\* |
| Pseudo *R*2 | 0.102 | 0.102 | 0.102 |

*Notes:*, \**p* < 0.05, \*\**p* < 0.01.

The results in table A3 indicates that the correlation between accountability systems and the perception of control is not affected by the tenure of the CO. In other words, newly employed COs who operate in accountability systems not designed by themselves do not assess accountability in the three phases differently than longer-serving COs.

Overall, the test results corroborate the theoretical assumptions about the causal ordering of the independent and dependent variables in our analytical model. The fact that legally independent SOEs are not subsumed under the CO’s chain of command lends further support to the assumption that it is the structure of the accountability system that shapes the sense of control, and not the other way around.

**References**

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1. University of Oslo. Email: j.e.klausen@stv.uio.no [↑](#footnote-ref-1)
2. University of Oslo. Email: m.s.winsvold@stv.uio.no [↑](#footnote-ref-2)