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We are grateful for comments from Janis Berzins, Alex Edmans, Bogdan Stacescu, Adam Winegar, and Danielle Zhang, and from seminar participants at the 14th Workshop on Corporate Governance and Investment at the American University of Sharjah and the EIBA conference at the University of Bremen

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Keywords: ownership, concentration, persistence, dynamics, duration, illiquidity, private firms, family firms, identification, system GMM, register data.

JEL Classifications: G30, G32.

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Abstract

We find that ownership changes much less over time in private firms than in public firms. The average largest shareholder in private (public) Norwegian firms keeps the same stake in 82% (14%) of two consecutive years. In private firms past ownership dominates ownership determinants proposed in the literature, and the estimated relationship depends heavily on whether the economic model and the econometric technique capture the strong ownership persistence. This evidence suggests that lower share liquidity increases ownership duration, and that feedback from economic outcomes to ownership structure is a less severe problem for identification when the firm's shares are illiquid.

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1 Introduction

While the public firm is owned by shareholders who can trade their ownership rights in liquid markets, shareholders of the private firm must trade in illiquid markets. We investigate whether this difference in market liquidity matters for how the firm's ownership structure develops over time. Comparing ownership dynamics in public and private firms, we show new evidence supporting the idea that reduced share liquidity increases ownership duration and makes past ownership an increasingly important determinant of current ownership compared to classic determinants proposed in the literature, such as the firm's growth, performance, risk, and industry. Moreover, we show it is critical to account for the strong persistence of ownership in private firms when ownership is regressed on potential determinants, but also that this very persistence may mitigate concerns for reverse causality when economic outcomes are explained by ownership. These findings are robust to how we measure ownership, how we measure persistence, and to whether we account for possible persistence in the classic determinants of ownership.

The existing research on corporate ownership has mostly considered the cross-section of publicly listed firms (see, for instance, Holderness and Sheehan, 1985; Holderness, 2003, 2009; Edmans, 2014; Edmans and Holderness, 2017). In contrast, we study how ownership develops over time, and we address both public and private firms. Thus, we consider dynamic rather than static properties of ownership, and we investigate illiquidity as a possible source of ownership persistence by contrasting firms with liquid shares to firms with illiquid shares.

Our paper makes three contributions to the literature. First, we report new descriptive evidence showing that the ownership structure of private firms is very persistent. Understanding the ownership dynamics of private firms is important per se because private firms create more value in the economy than public firms do (Kobe, 2012; Michaely and Roberts, 2012; Bøhren et al., 2019). Nevertheless, private firms are much less explored in the corporate governance literature (Edmans and Holderness, 2017). Using

proprietary data for the population of limited-liability firms in Norway during the period 2000-2014, we analyze about 36,000 firms per year and find that the largest equity holding in the firm changes less often in private firms than in public firms. Because private firms go public to attract outside investment and make their shares more easily tradable, the direction of this difference is obvious ex ante. However, the magnitude would be harder to imagine from intuition alone. We find that the difference in ownership persistence is very large. For instance, the average largest shareholder owns the same stake for two consecutive years in 82% of the cases if the firm is private, but only in 14% of the cases if the firm is public. A corresponding pattern emerges if we instead measure ownership concentration by the Herfindahl index for all shareholders in the firm, the equity holding of the CEO, the largest family by ownership, or by the holdings of the officers and directors (i.e., the insiders). This large difference in ownership duration may suggest that, compared with public firms, ownership rights in private firms provide benefits that are considerably more costly to trade.

Our second contribution is to provide new evidence on the determinants of ownership when the shares are illiquid. While the existing literature relates current ownership to firm characteristics in public firms and tends to find a significant relationship (see, for instance, Table 7 in Edmans and Holderness, 2017), we add past ownership as a new determinant and find that past ownership is the dominating determinant of current ownership in private firms. In fact, past ownership washes out the effect of most classic ownership determinants proposed in the literature, also when we include them with several lags. This result resembles the recent finding in the capital structure literature that while leverage varies with firm characteristics according to the established theories in the cross section, leverage is very persistent and only weakly related to firm characteristics in the time series (Flannery and Rangan, 2006; Lemmon et al., 2008; Huang and Ritter, 2009; Faulkender et al., 2012). For instance, Lemmon et al. (2008) summarize their main result by stating that " ... variation in capital structures is primarily determined by factors that remain stable for long periods of time." An important such stable factor over time

in our setting might be the illiquidity of the private firm's shares. Because this illiquidity may produce transaction costs that make it unprofitable for shareholders to adjust their holdings unless classic ownership determinants change dramatically, ownership becomes persistent.

This combination of strong persistence and insensitivity to current and lagged classic determinants might alleviate the common worry for reverse causality when economic outcomes like performance and takeovers are regressed on ownership. The worry is that if ownership depends on economic outcomes, it is difficult to interpret the estimated coefficient for ownership from a causal perspective. Our results suggest, however, that the strong persistence of ownership makes it less controversial to assume that ownership is unaffected by economic outcomes, provided the firm's shares are illiquid. In particular, one may identify the relationship between economic outcomes and ownership without having to rely on unexpected shocks to ownership, which are hard to find, or construct valid instruments for ownership, which may not even exist (Edmans and Holderness, 2017). Instead, one may simply use observed, current ownership and consider it a valid causal variable for current economic outcomes. There may still be an omitted variables problem, however, because persistent variables ignored by the model could make ownership persistent and also affect the economic outcome.

Our third contribution is to show that strong ownership persistence makes the choice of methodology particularly important for a valid inference about ownership determinants. Unlike the existing research on ownership concentration, such as Demsetz and Lehn (1985) and Fahlenbrach and Stulz (2009), we recognize that neither fixed effects nor random effects can properly account for a persistent dependent variable. For instance, the fixed effects method will produce inflated t values, and every coefficient in the relationship between ownership concentration and its determinants will be biased downwards (Nickell, 1981). Therefore, we estimate the relationship using system GMM (i.e., Generalized Method of Moments), which can validly handle this situation (Arellano, 2003).

This approach has recently been used to investigate the dynamic relationship between the firm's performance and governance (Wintoki et al., 2012) and in several corporate finance settings that resemble ours (Flannery and Rangan, 2006; Cheung and Wei, 2006; Lemmon et al., 2008; Huang and Ritter, 2009; Faulkender et al., 2012; Zhou et al., 2014). Using system GMM as a benchmark also allows us to show that the estimated relationship between ownership and its determinants changes fundamentally if one follows the existing literature and either suppresses past ownership as a determinant in the economic model or estimates a well-specified economic model with regression techniques that cannot validly account for a persistent dependent variable, such as OLS (i.e., ordinary least squares) on pooled data, and techniques that exploit the panel structure of the data, such as FE (i.e., fixed effects). Accordingly, our contribution is not to develop new methodology, but rather to show how known properties of existing methodologies make one approach superior to the alternatives when ownership is persistent.

The Norwegian setting we analyze is characterized by strong protection of investor rights and efficient legal enforcement (La Porta et al., 2000; Spamann, 2010), by firms that are mostly private (Berzins et al., 2019), and by citizens who are unusually wealthy (IMF, 2018) and well educated (OECD, 2016). However, these characteristics may not be critical for the external validity of our findings. That is, the persistent ownership of firms with illiquid shares we find in our sample may be a typical feature of firms with illiquid shares in any nation. The reason is the basic economic mechanism we exploit that the more illiquid the share, the more the shareholder must pay to adjust the equity investment up or down after a shock to ownership determinants. This structural market property reduces the propensity to trade, which in turn increases ownership duration. Accordingly, the specific institutional context may not be important for the prevalence of ownership persistence in firms with illiquid shares, for the opportunity to ignore feedback from economic outcomes to ownership structure in such firms, and for the importance of using a methodology that validly captures ownership persistence.

We state our predictions in Section 2 and present the data and descriptive statistics in Section 3. We outline the empirical methodology in Section 4, estimate the baseline model in Section 5, and show the results of robustness tests in Section 6. We briefly summarize and conclude in Section 7.

2 Predictions

The ownership structure will not influence the firm's behavior in perfect capital markets with no conflicts of interest between principals and agents or between the principals themselves (Jensen and Meckling, 1976). Every shareholder is fully diversified and holds the market portfolio in equilibrium, ownership concentration is higher the smaller the number of investors in the market and the less equal their wealth, and ownership dynamics follows the dynamics of the distribution of wealth among the investors. Thus, the dynamics of the firm's ownership structure is merely an inconsequential effect of shareholder diversification and market equilibrium.

With imperfect capital markets or potential conflicts of interest, however, ownership may have causal effects on firm behavior. This means that ownership concentration may vary across firms at a given point in time and over time for each firm according to the nature of the market imperfection and the peculiarities of the agency conflict. We consider how the dynamics of ownership concentration may depend on the firm's listing status and on characteristics of the firm addressed in the existing literature. We explain the logic behind our four hypotheses (*H1-H4*), followed by a brief discussion of our control variables. The first hypothesis concerns the level of ownership concentration, while the three others concern the dynamics.

The benefits of being publicly listed include better share liquidity, continuous pricing, closer analyst following, and easier access to capital (Derrien and Kecskés, 2007). Also, the potential governance benefit of shareholder exit as a disciplining device is less costly to achieve when the shares are listed (Edmans, 2014). These benefits of being

listed are reaped by all shareholders on a pro rata basis. Because listing involves higher transparency and stronger legal protection of minority shareholders, however, the benefits of ownership reaped by only a few influential shareholders may be harder to sustain when the firm is listed. Accordingly, influential shareholders may find that their total benefits are smaller if the firm goes public (Jensen and Meckling, 1976). Hence, the advantage of being a large shareholder might be greater when the firm stays private. We predict that *ownership concentration is higher in private firms than in public firms (H1).*

Turning from the level to the dynamics of ownership, past ownership concentration will matter for current ownership concentration if ownership is persistent. Such persistence is supported empirically by Barclay and Holderness (1989) in a sample of public firms in the United States, where 96% of the firms with a five percent blockholder also have such a blockholder five years later. Similarly, Berzins et al. (2019) show in a sample of majority-controlled private firms in Norway that the largest equity stake stays constant from one year to the next in 93% of the cases. Moreover, theory suggests that even large changes in ownership determinants will move ownership less the more costly it is to trade the shares. Starting from the null hypotheses that ownership changes are random in frictionless markets, the fact that trading costs (including fixed search costs) are higher the less liquid the shares makes us predict that *ownership concentration is more persistent in private firms than in public firms(H2).*

The logic behind *H2* suggests that because the transaction costs of trading a share are higher in private firms than in public firms, the benefit of the trade, gross of transaction costs, must be correspondingly higher for a profitable trade to occur in private firms. The trade must also be larger once that threshold is reached (O'Hara, 2003). Hence, both the frequency and the size of the trade may depend on the firm's listing status. We predict that *ownership concentration changes more once change happens in private firms than in public firms (H3).*

We will explain in Section 4 why the estimated relationship between a dependent

variable and its determinants will be biased and also inconsistent if the persistence of the dependent variable is ignored. Hence, we predict that *the estimated relationship between ownership concentration and its determinants in private firms will be severely biased if the persistence of ownership concentration is not accounted for (H4).*

We use six control variables to account for the possibility that ownership concentration might be driven by heterogeneous and dynamic firm characteristics. First, because the value of a given equity proportion is higher the larger the firm, the shareholder carries a larger cost of being undiversified when firm size increases (Admati et al., 1994; Himmelberg et al., 1999). Therefore, we expect ownership concentration and *firm size* to be inversely related. Second, the diversification argument suggests that increasing *risk* in the firm decreases optimal ownership concentration (Admati et al., 1994; Himmelberg et al., 1999). In contrast, because the value of monitoring increases with risk, higher risk should go along with higher ownership concentration (Demsetz and Lehn, 1985). These two conflicting effects make the expected relationship between ownership concentration and risk ambiguous.

Third, the firm's *performance* may matter for ownership concentration because insiders have been shown to sell in good times, possibly because they relinquish control when they are well paid through a high stock price or because they avoid sending negative signals in bad times by not selling (Fahlenbrach and Stulz, 2009). We expect ownership concentration and performance to be inversely related. Fourth, firms with high *growth* opportunities are generally hard to monitor by outsiders, and such firms will optimally have higher ownership concentration than other firms have (Fahlenbrach and Stulz, 2009). These high-equity stakes will be held by insiders, producing strong monitoring incentives for the directors, tight interest alignment for the officers, and credible signals to the outsiders about positive firm prospects. This logic suggests that ownership concentration and growth will be positively related.

Fifth, higher *leverage* may go along with higher ownership concentration. Because

higher leverage means less equity, a given equity proportion represents a smaller monetary amount and hence a lower cost of being undiversified (Demsetz and Lehn, 1985). Therefore, we expect ownership concentration and leverage to be positively related. Finally, high *liquidity* of the firm's assets relative to its short-term obligations gives the agent wider room to expropriate the principal's wealth (Jensen, 1986). Hence, such firms may benefit from close monitoring by the principal or by tight alignment between principals and agents. Because both mechanisms will be stronger the more concentrated the ownership, we expect that ownership concentration and asset liquidity are positively related.

Summarizing this section, we predict that ownership concentration in private firms will be higher than in public firms, more persistent, and change more once change occurs. We expect that the estimated relationship between ownership concentration and its determinants in private firms will be biased unless the economic model and the econometric approach capture the persistence of ownership concentration. We test the latter hypothesis while controlling for the firm's size, risk, performance, growth, leverage, and asset liquidity, which are classic determinants of ownership concentration proposed in the governance literature.

3 Data and summary statistics

We describe the sample selection in Section 3.1 and report summary statistics for the level of ownership concentration in Section 3.2. We document the dynamics of ownership concentration in Section 3.3 and characteristics of the firm in Section 3.4. Because the existing literature on the ownership of private firms is so limited, we choose to report a rather extensive set of descriptive statistics.

3.1 Sample selection

Our sample contains every Norwegian firm with limited liability that passes certain filters during the period 2000-2014. The law mandates a standardized set of accounting statements and governance data certified by a public auditor for all firms regardless of listing status, age, size, and industry. Failure to submit this information within 17 months after fiscal year-end triggers automatic liquidation by the court.[1]

Starting from the population of all firms in Table 1, we apply filters that exclude financial firms in order to avoid the impact of their atypical capital requirements, ownership restrictions, and accounting regulations. We ignore utilities to avoid state-controlled firms with atypical contracting environments, and we exclude firms that cannot be assigned to a main industry. Subsidiaries are ignored because they are often fully owned by the parent and are more like divisions in a governance sense. We use several filters to ensure the firm has consistent accounting and ownership data. For instance, the sum of asset values must equal the sum of debt and equity values, and the sum of equity proportions cannot exceed 100%. We exclude firms with negative book value of equity to avoid unruly financial ratios. To avoid passive firms, we require every firm to have positive sales, operating expenses, and employment. We avoid firms with particularly low separation between ownership and control by excluding single-owner firms, which have maximum ownership concentration by definition. Finally, we exclude the 15% smallest firms by assets and sales.

Table 1

The resulting sample involves 35,707 firms on average per year, a pooled sample over 15 years of 535,099 firm years, and 101,332 unique firms. The sample is 19.6% of the population. The average length of the panel is 5.3 years, with a minimum of 1 year and

[1] Accounting, ownership, and board data are from Experian (www.experian.no), while data on family relationships are from Skattedirektoratet (www.skatteetaten.no), which is a state agency. The data were received in electronic form and organized as one integrated database by the Centre for Corporate Governance Research (www.bi.edu/ccgr).

a maximum of 15 years. Public firms constitute 0.26% of the sample.

3.2 Ownership concentration

Table 2 shows distributional properties of the sample across five different measures of ownership concentration, which are supposed to reflect the owners' power and incentives to involve themselves in the firm's governance. We report the results for private firms in Panel A and for public firms in Panel B. Every measure uses the shareholder's ultimate equity stake, which is the stake owned directly plus stakes owned indirectly through corporate intermediaries.

Table 2

All is ownership concentration measured by the Herfindahl index, which is the sum of every squared equity proportion in the firm. We multiply the index by 100 to ensure it has the same range as the other concentration measures (0-100). The Herfindahl index is closer to its maximum the greater the large equity proportions and the smaller the number of shareholders. The table shows that the average index value in private firms in Panel A is 43, one fourth of the firms have an index value above 50, and one out of a hundred has an index value below 4.

The second concentration measure is the equity proportion of the firm's largest separate shareholder, which we measure by the variable *Largest*. This largest stake in private firms is 49% on average, the median is 50%, at least 34% in three quarters of the firms, and at least 60% in one quarter. These figures reflect that the largest shareholder in a private firm is very powerful. For instance, almost half of them can single-handedly elect the entire board and decide the firm's dividend policy (simple majority), while three out of four can stop a charter amendment (one third negative majority). Thus, private firms are normally majority controlled, even when we have excluded single-owner firms from the sample and have not grouped any owners together, such as family members.

Unlike *All* and *Largest*, the three other concentration measures in Table 2 reflect both

the size of the equity stake and the identity of its owner. Considering first the CEO's ownership, the theoretical reason why such ownership may be beneficial is that it aligns the CEO's interests with the shareholders' interests. Therefore, the equity holding of the CEO increases the agent's incentives to act like a principal and reduces the principal's need to monitor the agent (Morck et al., 1989). We measure this holding by the variable *CEO*. The same argument applies to ownership by the firm's insiders (McConnell and Servaes, 1990). We aggregate these holdings across every insider in the firm (officers and directors) into one stake that we call *Insiders*.

Families may be special owners, particularly when the family holds a large stake. The family is an unusually tight group of individuals, the investment in the firm may represent most of the family's wealth, and the family members normally take several governance positions in the firm (Bøhren et al., 2019). This situation suggests that the family's ownership stake may be important for how the firm behaves and performs, particularly when the firm has few owners. We define a family as being the owners in the firm who are related by blood or marriage up to the fourth degree of kinship.[2] The variable *Family* measures the equity stake of the firm's largest family by ownership.

The table shows that the CEO owns 38% of the equity in the average private firm. The largest family owns 64%, and the insiders own 77%. These ownership levels mean that the CEO, who is one of the insiders, can block charter amendments in the average private firm. The insiders as a group and also the largest family by ownership cannot just single-handedly elect the board and set the dividend. They can also amend the charter (two thirds super majority) without the other shareholders' consent. Hence, the shareholders with the best information (the insiders) and the alliance of shareholders with the closest social ties (the family) normally have very strong power and incentives to ensure the private firm is run in their best interest. Also, because the average CEO holds about one third of the firm's equity, the difference between control at the shareholder meeting and

[2]https://www.mec.mo.gov/WebDocs/PDF/Misc/RelationshipChart.pdf.

control in daily operations is generally modest. Finally, these figures reflect that most private firms in our sample are not just majority-controlled, but majority-controlled by a family.

Panel B shows the five concentration measures in public firms. Regardless of the measure, ownership concentration is much lower than in private firms. For instance, while the average largest shareholder owns 49% of the equity in private firms, the corresponding stake is 26% in public firms. This lower equity level means the average largest shareholder in public firms cannot even stop a charter amendment without having voting support from other shareholders. Moreover, while the average CEO holds 38% in private firms, the stake is 2% in public firms. Finally, we formally test hypothesis *H1* by comparing average ownership concentration across the two panels. Consistent with *H1*, ownership concentration is significantly higher ($p < 0.01$) in private firms than in public firms regardless of concentration measure.

Figure 1 shows the relationship between ownership concentration and firm size by deciles for private firms in Panel A and for public firm in Panel B, measuring firm size by sales revenue. The two graphs suggest there is no striking relationship between firm size and ownership concentration in either public or private firms. Thus, ownership concentration depends heavily on the firm's listing status, but not its size.

Figure 1

3.3 Ownership dynamics

The dynamics of ownership may be characterized by how often the firm's shares trade (hypothesis *H2*) and by how many shares are traded (*H3*). Table 3 shows the frequency and magnitude of all changes, positive changes, and negative changes in the firm's ownership concentration, using six alternative lower thresholds for what is considered a change. We measure ownership concentration by the holding of the largest shareholder in Panel A and of the largest family by ownership in Panel B.

Table 3

Panel A shows that no change from one year to the next is the typical case in private firms. For instance, with no lower bound on the magnitude of the change (0.0 in the first row of results), the largest owner of the private firm holds the same stake from one year to the next in 82% of the cases.[3] When a trade does happen, the average change is 9.5 percentage units when the holding increases and -8.9 when it decreases, while the average absolute change is 9.2. Hence, changes in the largest stake are rare, while the trade is quite large once trade occurs, being about one fifth of the largest shareholder's average holding as reported in Table 2. Both the frequency and magnitude of change are similar for decreases and increases. As expected, a higher threshold reduces the frequency of change and increases the size of the change. For instance, increasing the threshold from 0 to 50 percentage units decreases the frequency of change from 18.1% to 0.2%, while the average absolute change increases from 9.2 to 63.7 percentage units.

Changes in ownership are much more common in public firms than in private firms (*H2*), and the change is smaller once it occurs (*H3*). For instance, no change happens in just 14% of all cases in public firms, compared to 82% in private firms. The average absolute change is 7.8 vs. 9.2 percentage units, respectively.

We test *H2* in column 2 by comparing the frequency of no change across private and public firms.[4] The frequency of no change is significantly higher in private firms except under the very highest change threshold. Similarly, we test *H3* in column 5 by comparing the average absolute magnitude of change. This change is significantly higher in private firms except under the two highest change thresholds. Thus, the results in Panel A are consistent with *H2* and *H3*.

Panel B measures ownership concentration by the holding of the firm's largest family by ownership rather than by the largest individual shareholder as in Panel A. Family

[3]The stake remains constant in 76% of all consecutive years (not shown in the table).
[4]We use a two-sided two-sample test of equality of proportions.

ownership may be the better measure in private firms because it treats all owning family members as one shareholder. While Table 2 shows that the largest family's stake is normally considerably larger than the largest individual stake in private firms (64% vs. 49% on average), Table 3 shows that the dynamics of the two concentration measures is very similar. For instance, while the largest separate owner maintains the stake in 82% of the cases and changes it by 9.2 percentage units otherwise, the corresponding figures for the largest family are 80% and 13.0, respectively. Finally, the support for *H2* and *H3* from Panel A continues in Panel B when we make the same statistical tests as in Panel A.[5]

Figure 2 shows the relationship between the private firm's ownership concentration and the firm's age. The figure suggests that the largest individual stake does not vary systematically with the length of time since the firm was founded. The largest family's stake is also rather insensitive to firm age, varying between 60 and 80% as the firm's age varies between 0 and 100 years, peaking when the firm is 30-50 years old.

Figure 2

3.4 Firm characteristics

The six characteristics for private firms reported in Panel A of Table 4 will be used as control variables in our statistical tests. The average firm has *Size* measured by sales of 13.6 million NOK (roughly 1.4 million EUR), while 98% of the firms have sales between 0.1 and 239.7 mill. NOK. *Risk*, measured as the standard deviation of sales per unit of average sales over the past three years (i.e., the coefficient of variation for sales), varies between 1.1 and 0, while the mean is 0.2. Mean *Performance*, measured by real return

[5]Unreported evidence shows a very strong tendency to trade with owners of the same type. For instance, the family trades with another family in almost every case regardless of the threshold. Considering the dominant role of families as the largest owner, however, this pattern follows by necessity. More surprisingly, any other type is also heavily biased towards trading with its own type. For instance, the state trades with the state in 84% of the cases under the 2.5 (10.0) threshold. This evidence supports the idea that certain owner types are attracted to certain firm characteristics, and that the cost of finding a seller or buyer of ownership rights with such characteristics is lower when the shareholder trades with its own type (Edmans, 2014).

on assets, is 8.7%, the mean real sales *Growth* is 4.0%, while the mean leverage is 70%. The current assets of the average firm are 140% higher than the current debt, producing an average *Liquidity* measure of 2.4. Most distributions are reasonably symmetric.

Table 4

Panel B shows coefficients of correlation between pairs of ownership and firm characteristics in private firms. The table gives no indication of a multicollinearity problem between any pair of firm characteristics (variables 6-11).[6] The table also shows that, while there is strong correlation between ownership concentration measured by *All* (the Herfindahl index for all owners) and *Largest*, the pairwise correlations are smaller between the three measures that reflect not just the size of the holding, but also the identity of its owner (*CEO*, *Family*, *Insiders*). Hence, these three latter measures seem to pick up different owner properties and also differ more from each other than do the first two. We will use the holding of the largest family as the baseline measure of ownership concentration in the statistical tests.

Overall, the descriptive evidence in Section 3 quantifies in several ways how ownership is much more concentrated and persistent in private firms than in public firms. These results are consistent with hypotheses *H1-H3* from Section 2.

4 Methodology

We specify the economic model in Section 4.1, while in Section 4.2 we explain why and how we use system GMM as our baseline econometric approach when testing hypothesis *H4*.

[6]Kennedy (2008) argues that correlation coefficients above roughly 0.80 may cause serious multicollinearity problems.

4.1 The economic model

Given our predictions from Section 2 and properties of the data explained in Section 3, we specify the following dynamic economic model for firm i at time t:

$$OC_{it} = \sum_{j=1}^{3} \alpha_j OC_{i,t-j} + \beta X_{i,t-1} + c_i + u_{it} \tag{1}$$

OC_{it} is ownership concentration, $X_{i,t-1}$ is the vector of independent variables beyond the lagged OC, c_i is the unobservable firm-specific effect, and u_{it} is the idiosyncratic error. The persistence of OC is captured by the persistence parameters $\alpha_j, j = 1, 2, 3$, which allow for up to three lags.

The independent variables in $X_{i,t-1}$ also include year fixed effects and industry indicators. The year fixed effect is potentially important, because the sample period covers both the recent financial crisis and a tax reform, which may both matter for ownership concentration. The unobserved firm fixed effect c_i may vary across firms, but is assumed to be constant over time. This variable captures firm-specific, time-invariant features like "corporate culture" or "business acumen" (Cronqvist et al., 2009).

We lag all independent variables in the X vector one period to reduce autocorrelation in the error term and to reduce potential reverse causation.

4.2 The econometric method

The choice of econometric method should reflect the fact that our panel data are of the type "large N (many firms), small T (few periods)", that our dependent variable is highly persistent, and that there may be omitted variables and reverse causation. The econometric problem is that the independent variable $OC_{i,t-j}$ will be correlated with the error term in a pooled OLS estimation, making $OC_{i,t-j}$ endogenous. This correlation produces biased and inconsistent estimates. Specifically, the t statistics will be inflated, the persistence parameters α_j will be biased upwards, and the coefficients β for the other

independent variables will be biased downwards (Hsiao, 2014).

The firm fixed-effects (FE) model removes the time invariant c_i in (1), mitigating endogeneity due to omitted variables that stay constant over time. However, the FE approach induces correlation with the transformed error term $(u_{it} - \bar{u}_i)$, where $\overline{u}_i$ is the average error term of firm i. This correlation produces FE estimates where all parameters will be biased downwards and the t statistics will be inflated (Nickell, 1981). This problem exists also when N is large, provided T is short (Baltagi, 2013; Hsiao, 2014). Because we have a relatively short T and a very large N, FE will be biased and inconsistent. This problem applies to the random-effects approach as well.

Arellano and Bover (1995) and Blundell and Bond (1998) propose to estimate the coefficients of (1) by system GMM, where (1) appears as one of two components in a system where the second component is an equation of differenced variables:

$$\Delta OC_{it} = \sum_{j=1}^{3} \alpha_j \Delta OC_{i,t-j} + \beta \Delta X_{i,t-1} + \Delta u_{it} \tag{2}$$

where Δ means first difference. The estimated coefficient is an average of the coefficient in level and the coefficient in first difference. By removing the unobserved firm-specific effects c_i from (1), (2) avoids the problem of omitted, time-invariant determinants of OC. The method also solves the endogeneity problem caused by lagged ownership concentration by using instruments $(OC_{t-2} - OC_{t-3})$ that are correlated with $(OC_{t-1} - OC_{t-2})$, but uncorrelated with the error term $(u_{i,t} - u_{i,t-1})$. Thus, $(OC_{t-2} - OC_{t-3})$ is a valid instrument for $(OC_{t-1} - OC_{t-2})$. The method extends to even deeper lags, and former realizations of ownership concentration levels, such as OC_{t-2}, can be used as instruments as well.

Wintoki et al. (2012) find that neglecting the persistence of the dependent variable may create a serious endogeneity bias. Monte Carlo studies of several dynamic estimation alternatives show that system GMM should be chosen when persistence is high (Flannery

and Watson Hankins, 2013). Moreover, system GMM is a better approach than a simple AR(1) when the dependent variable is persistent. While AR(1) requires that the time series be stationary (Tsay, 2010, p. 30), system GMM does not. While AR(1) models the time series properties of only one firm in the panel, system GMM models every firm.

In contrast, Wooldridge (2010) argues that simple, pooled OLS can be validly used to estimate (1). In fact, he argues that a large cross section and a short panel length jointly allow the researcher to be agnostic about persistence when choosing the econometric approach (Wooldridge, 2010, p. 197). If the conditions of no endogeneity and no multicollinearity are met, OLS with pooled data produces consistent and asymptotically normal estimators. If the data satisfy the requirements of no heteroscedasticity and no autocorrelation as well, the OLS estimator will also be efficient. Wooldridge suggests tests for endogeneity and for autocorrelation. To check for violation of the exogeneity assumption $E\left(X'_{i,t-1}u_{it}\right) = 0$, we run the OLS regression $u_{it} = \sum_s a_s OC_{i,t-s} + bX_{i,t-1} + e_{it}$, where u_{it} is the OLS residual from regression (1). A t test will reveal if the null hypothesis $b = 0$ is violated, where b is a vector of coefficients. We call this the endogeneity test, and we report only the explained variance R^2 in the interest of economy. To test if the errors are heteroscedastic ($E\left(u_i u'_i\right) \neq \sigma^2 I_T$) and serially correlated, we run the OLS regression $u_{it} = d + \rho_1 u_{i,t-1} + g_{it}$. A t test will reveal if $\rho_1 = 0$. We call this the autocorrelation test. Notice, however, that Wooldridge's method does not remove bias completely, because $OC_{i,t-1}$ is still correlated with the unobserved firm fixed effect c_i.

We conclude that the system GMM seems well suited to the data characteristics of our sample. We choose this method as the baseline approach and implement it with the two-step GMM estimator corrected for finite sample variance (Windmeijer, 2005). We estimate the model on all sample firms and on the subsample of firms that experience ownership changes from one period to the next, where we know ownership is less persistent than in other firms. We recognize that system GMM is not a panacea, but it seems the best approach in our setting. Nevertheless, we will investigate the importance of the

methodology choice by also estimating the baseline model with FE and pooled OLS.

5 Statistical tests of the baseline model

Given the evidence in the preceding sections, we limit ourselves to private firms from now on because we want to explore how strong ownership persistence makes the choice of methodology particularly important for a valid inference about ownership determinants (hypothesis *H4*).Table 5 shows the results of estimating the baseline model (1) on the full sample of private firms (*All firms*) and on the subsample of private firms where ownership changes during the year (*Firms with ownership change*). We perform three alternative estimations on the full sample that include lagged ownership concentration of one, two, and three years, respectively.

Table 5

The overall model fit is satisfactory in every case, because the Wald test rejects the hypothesis that the independent variables as a group are unrelated to ownership. Because the autocorrelation in the residuals disappears when we include three lags (the p-value for AR(4) is 0.313), three lags are required in the baseline economic model in order to draw valid conclusions from the estimation. Thus, only specification (3) passes the autocorrelation test in the sample of all firms, where all three lags of ownership concentration matter for current ownership concentration. This evidence is consistent with *H4*. The first lag is by far the most important one with a persistence parameter of 0.818, and the sum of the three persistence parameters is 0.895.

The coefficients for firm characteristics in specification (3) are statistically significant for size, performance, and leverage, but the positive sign for size and the negative sign for leverage are inconsistent with the hypothesized relationship. No other firm characteristic relates significantly to ownership concentration.

Considering the much smaller subsample of firms where ownership changes in speci-

fication (4), the story is different. The persistence parameter is much lower (0.248), and we need only one lag in the economic model to remove autocorrelation in the residuals (AR(2) = 0.751). Moreover, leverage is the only significant firm characteristic, but only at the 10% level, and the sign is inconsistent with the prediction.

Overall, the estimates in Table 5 suggest that, while past ownership concentration is a very important determinant of current ownership concentration, the firm characteristics proposed in the literature are not. The strong effect of past ownership on current ownership in the baseline model, which is consistent with the strong persistence documented in Section 3, suggests that the methodological choice will be important for a valid inference the determinants of ownership.

6 Robustness

In Section 6.1 we investigate whether the baseline relationship from Section 5 is sensitive to how we measure ownership concentration and to whether the holding is close to a control threshold. In Section 6.2 we address hypothesis *H4* by analyzing what happens if we, instead of using the baseline approach, use either statistical tests that do not properly handle persistent dependent variables or if we use economic models that ignore persistence.

6.1 Alternative measures of ownership concentration

The five alternative ownership concentration measures from Table 2 are all very persistent. In fact, unreported system GMM regressions of current ownership on past ownership, industry dummies, and time dummies show that the sum of persistence parameters across three lags varies between a minimum of 0.716 (the holding of the CEO) and a maximum of 0.936 (the Herfindahl index), while the average is 0.870.[7] Thus, strong persistence

[7]Not surprisingly, the corresponding persistence parameters are much smaller in public firms, varying between a minimum of 0.288 (largest family) and a maximum of 0.659 (the Herfindahl Index). The average is 0.502, and only the Herfindahl index has a significant second lag.

prevails regardless of the concentration measure used. On the other hand, the large spread in correlation coefficients between the alternative concentration measures in Panel B of Table 4 suggests the measures may reflect different properties of the ownership structure. Although we use the stake of the largest family by ownership as the baseline measure, the holding of the largest individual (separate) owner is more common in the literature, probably because data on family relationships are difficult to collect. Table 6 reestimates the baseline model (1) in Panel A, measuring ownership concentration by the largest separate owner's holding, the Herfindahl index for all owners, the stake of the insiders, and CEO ownership, respectively.

Table 6

The estimates suggest that the story from Table 5 survives when we measure ownership concentration by the largest separate owner's stake: Past ownership is a very important determinant of current ownership, and only past ownership matters for current ownership in firms where ownership changes. For the three remaining concentration measures, the estimates for lagged ownership are fully consistent with those in Table 5, except that lagged CEO ownership is unrelated to current CEO ownership in the change subsample. This latter result is questionable, however, because Arellano and Bond (1991) show that GMM is unreliable when the persistence parameter is below an absolute value of 0.20. Moreover, the AR values reflect that the error terms are correlated. The results for the control variables are less consistent across these three concentration measures. For instance, the coefficient for size in the sample of all firms is as predicted under the Herfindahl index, insignificant under insider ownership, and positive under CEO ownership.

The regulatory regime implies that the relationship between ownership concentration and owner power is not proportional. In particular, the voting thresholds of 1/3 (blocking minority), 1/2 (simple majority), and 2/3 (super majority) suggest that certain ownership concentrations are more important than others for owner power. We investigate if these

thresholds matter by alternatively estimating the baseline model on subsamples where the holding of the largest family by ownership is less than 1/3, between 1/3 and 1/2, between 1/2 and 2/3, and between 2/3 and 1/1, respectively. These samples include observations where the largest holding passes no voting threshold, one threshold, two thresholds, and all thresholds, respectively. Panel B of table Table 6 shows the results.

The estimates are consistent with those in Table 5. Thus, the relationship between ownership concentration and its determinants as specified in the baseline model is insensitive to whether the holding of the largest family by ownership gives formal control of a certain type. Because persistence is particularly strong when the largest holding is above the 1/3 threshold, however, the tendency to maintain a high stake is even more pronounced when the stake gives at least negative control.[8]

6.2 Alternative econometric methods and economic models

We first show what happens if we use either OLS on the pooled data set or a panel approach with fixed effects (FE) at the firm level as the econometric method to estimate the baseline economic model in our setting of a large cross section, a short time period, and a persistent dependent variable. The standard of comparison is the baseline economic model estimated with system GMM from Table 5. Subsequently, we show the effect of neglecting the persistence of ownership altogether in the economic model. Finally, we show what happens if we account for not just persistence in ownership concentration, but also for persistence in the control variables.

Table 7 shows the results using OLS and FE to estimate the baseline model as specified in (1) (3), (5), and (7). We cluster standard errors at the firm level in order to

[8]Figure 1 and the baseline model with three lags estimated on the full sample in Table 5 suggest that firm size may matter for ownership concentration. To account for possible nonlinearities in this relationship, we have estimated the baseline model in four different subsamples based on firm size, where sales are at least 1, 10, 50, and 100 mill. NOK, respectively. Unreported results show that the estimates are insensitive to whether we test the baseline model in the full sample or in separate subsamples defined by firm size. Thus, the proportional control for firm size used in the baseline model produces the same results as when we account for firm size more elaborately.

reduce heteroscedasticity (Wooldridge, 2010).

Table 7

Apparently, the results look promising because many coefficients are statistically significant, particularly under OLS. Looking closer, however, the results are driven by bias predicted by the econometric theory discussed in Section 4.2. Consider first the specifications that account for lagged ownership, which are (1) and (3) under OLS and (5) and (7) under FE. Three problems occur. First, both specifications estimated under FE fail the endogeneity test and also the autocorrelation test. Second, both specifications under OLS fail the autocorrelation test. Third, and as predicted from econometric theory, the persistence parameters are biased downwards under FE and upwards under OLS compared to the unbiased baseline specification. For instance, while the sum of the three unbiased persistence parameters is 0.895 in specification (3) of Table 5, the corresponding sum in specification (5) of Table 7 is only 0.544. Finally, the OLS coefficients for firm characteristics are smaller than in Table 5, and the coefficient for size even switches from positive to negative. Again, this pattern is in line with the theoretical result that these coefficients will all be biased downwards. Therefore, despite the agnosticism of Wooldridge (2010) discussed in Section 4, the OLS results demonstrate how the bias problem remains in our sample even with a very large N.

Turning next to what happens if we suppress ownership persistence in the economic model, system GMM cannot be used, because there is no lagged dependent variable in the equation. Instead, we use OLS and FE and show the results in specifications (2) and (4) under OLS, and (6) and (8) for FE. Every specification fails the autocorrelation test, and the FE model also fails the endogeneity test at the 6% significance level. This situation means the bias and inconsistency are even stronger than when we use the same econometric technique, but include lagged ownership (specifications (1) (3), (5), and (7)). These results demonstrate that ignoring the persistence of ownership produces invalid

relationships for any relevant econometric method. [9]

Finally, one may suspect that the strong persistence in the dependent variable is driven by persistence in the control variables (i.e., size, risk, performance, growth, leverage, and liquidity). Unreported regressions show that the control variables are indeed persistent, although their persistence is smaller than for ownership concentration and is also heterogeneous across the control variables. For instance, the sum of persistence coefficients across two lags (the third lag is very seldom significant) varies between a maximum of 0.885 for firm size and a minimum of 0.335 for performance, the average being 0.575. To check whether persistent control variables matter for our main findings, we expand the baseline model by the control variables at their second lag (they are already lagged one period in the baseline model). The estimates are shown in Table 8. We report the findings across the five alternative ownership concentration measures.

Table 8

Considering first the results when ownership concentration is measured as the largest family's stake, the estimates are almost identical to those of the baseline model (3) in Table 5. The four remaining concentration measures in Table 8 produce very similar results. This evidence means that the ability of lagged ownership to explain current ownership remains strong even when we account for the sometimes large persistence in the other explanatory variables. These findings suggest that the firm's ownership is very stable due to very stable structural components in the firm's environment. We suggest that one such stable component is the illiquidity of the private firm's shares. This illiquidity makes it particularly costly for shareholders to adjust their ownership stakes when the classic ownership determinants proposed in the literature change from one period to the next.

Overall, our robustness tests have shown that the strong, positive relationship be-

[9] We have also used the random-effects approach, which we estimate with the generalized least-squares method. The biases we find correspond to those under OLS and FE.

tween current and past ownership in the baseline model is very robust to how we measure ownership concentration, to whether we include all firms or just firms with an ownership change, and to whether the ownership stake gives formal control of a particular type. Firm characteristics beyond past ownership are almost always insignificant when we consider only the firms where ownership changes. The baseline results are also insensitive to possible non-linear relationships between ownership concentration and firm size, and to whether we account for persistence in firm characteristics beyond past ownership.

The estimated relationship between ownership concentration and its determinants is severly biased if we either suppress past ownership in the economic model or estimate a well-specified economic model with regression techniques that cannot validly handle a persistent dependent variable. This evidence is consistent with hypothesis *H4*.

7 Summary and conclusions

This paper is the first to analyze the dynamics of ownership in the population of private firms, which have less liquid shares than public firms have. We find that past ownership is the dominating determinant of current ownership in private firms, particularly if we consider only firms where ownership changes. Past ownership even washes out the effect of most ownership determinants proposed in the literature, such as the firm's current and lagged size, risk, performance, and growth. We suggest that this insensitivity is due to the illiquidity of the private firm's shares, which is a very stable characteristic of the firm's environment. This illiquidity makes it particularly costly for shareholders to adjust their ownership stakes when ownership determinants proposed in the literature change from one period to the next.

The strong persistence of ownership should alleviate the worry about possible feedback from the firm's economic outcomes to the firm's ownership structure. Our findings suggest that the researcher may identify this relationship by simply using observed, current ownership as an explanatory variable of economic outcomes, provided the firm's

shares are illiquid and that there is no serious omitted variables problem.

We find that the estimated relationship between ownership concentration and its determinants in firms with illiquid shares becomes heavily biased if one suppresses past ownership as an independent variable in the economic model. This problem also occurs if one estimates a well-specified economic model with regression techniques that do not validly account for the persistence of ownership.

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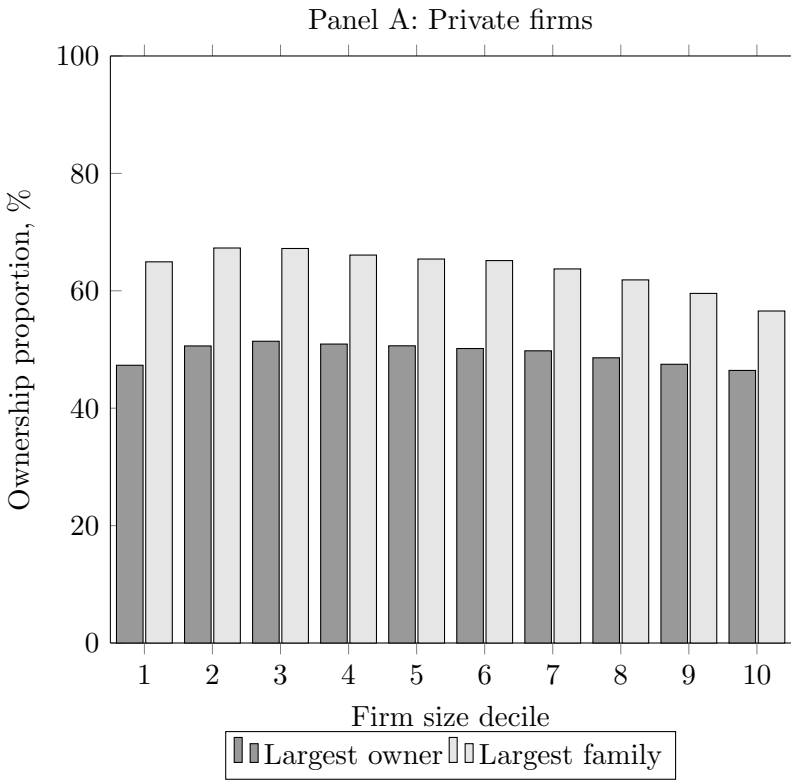

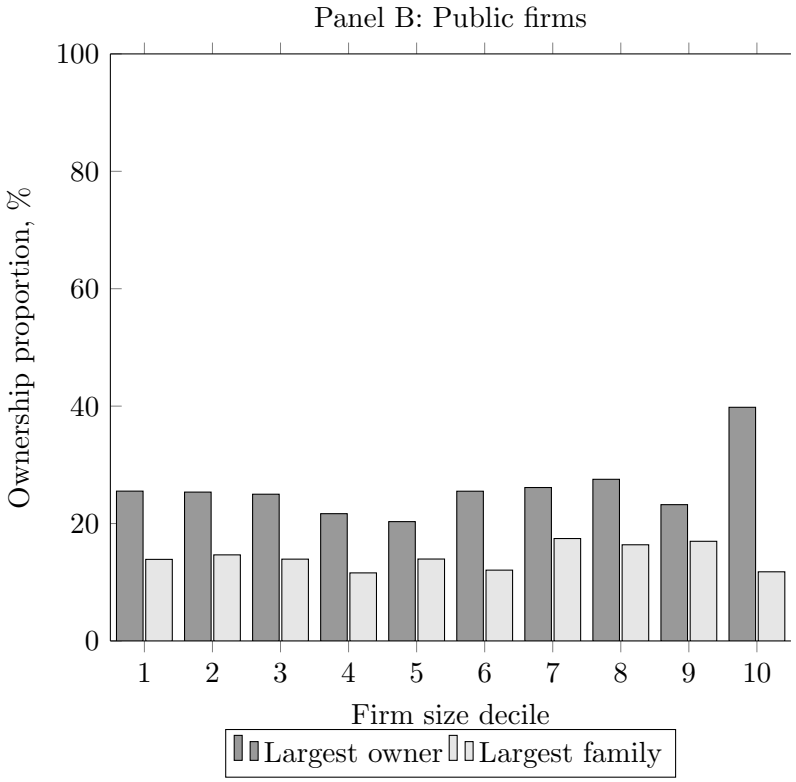

Figure 1. This figure shows the average ownership concentration by firm size deciles in private firms (Panel A) and public firms (Panel B). *Firm size* is measured by sales revenue. *Largest owner* is the ultimate ownership proportion of the largest separate shareholder in the firm, while *Largest family* is the largest ultimate, aggregate ownership proportion of shareholders in the firm related by blood or marriage. The sample is all Norwegian firms with limited liability in 2000-2014 that have consistent accounting figures, multiple owners, positive sales and employment, that are not financials, utilities, subsidiaries, or multi-sector firms, and that are not among the 15% smallest firms by assets and sales. The variables are winsorized by 1% in both tails.

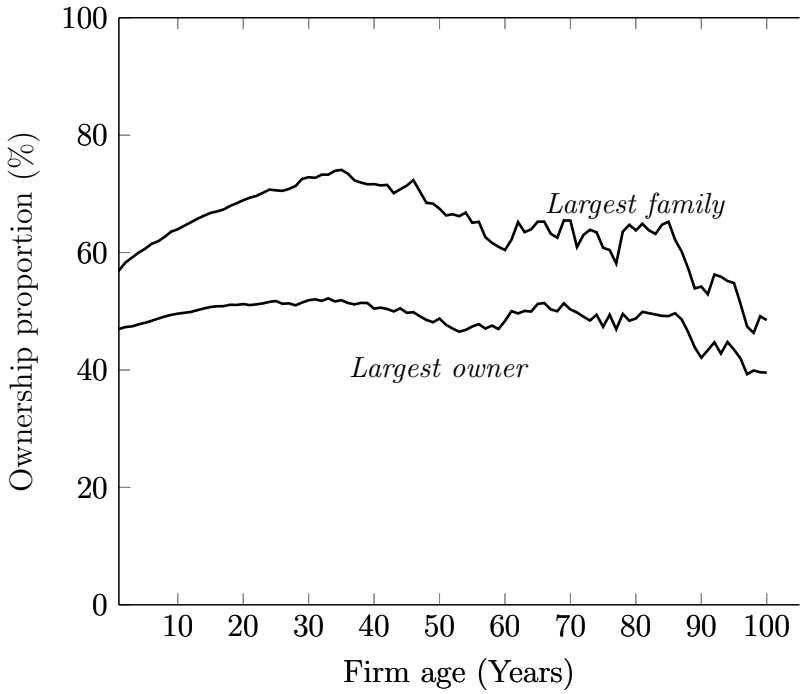

Figure 2. This figure shows the average ownership proportion of the largest individual shareholder and the largest family by firm age in private firms. *Largest owner* is the ownership proportion of the largest separate shareholder in the firm, while *Largest family* is the largest aggregate ownership proportion of shareholders related by blood or marriage. The ownership proportions are ultimate, which is the direct holding plus indirect holdings through intermediaries. The sample includes all Norwegian firms with limited liability in 2000-2014 that have consistent accounting figures, multiple owners, positive sales and employment, that are not financials, utilities, subsidiaries, or multi-sector firms, and that are not among the 15% smallest firms by assets and sales. The variables are winsorized by 1% in both tails.

Table 1 Population, filters, and sample

Filter	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Population	136.1	138.7	141.1	142.0	144.4	157.7	180.7	192.0	198.0	200.2	203.3	208.3	221.9	235.8	224.1
Financial firm	2.5	2.6	2.8	2.9	3.1	8.2	20.0	21.5	23.0	23.4	23.9	24.2	24.6	24.4	23.7
Utility firm	1.0	1.1	1.1	1.2	1.3	1.4	1.6	1.7	1.8	1.9	2.0	2.0	2.1	2.2	2.1
No main industry	3.1	2.7	2.6	5.1	6.0	9.9	10.7	1.9	1.8	2.5	3.1	3.3	3.9	4.6	5.1
No industry code	2.5	4.0	3.8	1.1	1.4	1.0	1.3	1.0	0.8	0.8	0.7	0.8	1.1	3.1	2.7
Largest equity fraction zero or missing	9.8	8.1	11.6	8.8	9.8	7.5	13.6	9.5	10.8	11.8	10.0	9.6	8.9	7.5	9.5
Inaccurate accounting	1.9	2.0	1.5	1.4	1.3	1.1	1.1	1.1	1.2	1.2	1.4	1.5	2.0	2.6	2.7
Negative equity	17.5	18.5	18.5	18.8	17.5	17.9	16.9	20.1	23.6	23.1	24.0	24.1	26.0	29.1	27.2
Subsidiary	17.6	19.0	18.5	19.6	20.1	25.9	32.5	39.5	40.7	41.5	42.8	44.6	48.0	50.3	46.9
Single-owner firm	28.5	28.3	28.1	29.3	30.0	33.7	33.8	41.5	41.7	42.1	43.7	45.9	50.7	55.6	52.6
No employees or salary expense	10.3	9.9	8.9	8.8	8.3	7.4	7.0	6.5	6.0	5.8	0.0	0.2	0.3	5.3	0.7
No operating expense	0.2	0.3	0.2	0.2	0.3	0.6	0.4	0.6	0.4	0.3	0.4	0.5	0.8	0.8	0.5
Non-positive operating revenue	1.4	1.8	1.9	2.0	2.1	2.7	3.2	4.6	4.8	4.9	6.6	6.8	7.1	6.0	6.1
15% smallest firms by assets and sales	5.4	5.3	5.3	5.6	5.8	5.8	5.8	6.3	6.7	6.1	7.8	8.3	9.6	9.5	8.7
Sample	34.6	35.3	36.4	37.2	37.5	34.5	33.0	36.4	34.7	34.8	37.1	36.6	36.8	34.7	35.7
Sample of public firms	0.11	0.12	0.10	0.10	0.10	0.11	0.10	0.12	0.13	0.08	0.08	0.07	0.07	0.05	0.04
Sample of private firms	34.5	35.2	36.3	37.1	37.4	34.4	32.9	36.2	34.6	34.7	37.0	36.6	36.7	34.6	35.6

This table shows the population, filters, and sample of Norwegian firms with limited liability used in the empirical analysis. The figures are stated in thousands. For each consecutive filter, the figures show the number of firms that are eliminated from the sample by the filter in question. *Inaccurate accounting* reflects inconsistent figures or combinations of figures, such as a negative asset value and when the sum of asset values does not equal debt plus equity. The data are from the Centre for Corporate Governance Research (www.bi.edu/ccgr).

Table 2 Ownership concentration by alternative measures

	Ownership concentration measure				
	All	Largest	CEO	Family	Insiders
Panel A: Private firms					
Mean	42.5***	49.3***	37.7***	63.8***	76.6***
Std	17.9	18.6	25.1	29.2	31.0
p1	4.1	11.1	0.0	5.2	0.0
p5	13.5	20.0	0.0	16.7	1.4
p25	30.5	34.0	18.0	43.3	60.0
p50	47.4	50.0	42.0	60.0	97.7
p75	50.0	60.0	50.0	100.0	100.0
p95	75.8	86.0	80.0	100.0	100.0
p99	96.0	98.0	96.0	100.0	100.0
N	498,200	498,200	450,459	481,117	492,773
Panel B: Public firms					
Mean	11.8	26.0	1.6	14.4	6.6
Std	13.8	17.9	5.3	13.9	12.2
p1	0.2	3.1	0.0	0.1	0.0
p5	0.6	6.1	0.0	0.8	0.0
p25	2.6	12.0	0.0	4.8	0.0
p50	7.1	21.0	0.0	9.8	0.0
p75	15.2	35.5	0.0	19.1	8.8
p95	40.5	62.5	12.3	40.7	32.9
p99	66.8	81.7	28.6	66.0	59.4
N	1,239	1,239	1,225	882	1,229

This table shows descriptive statistics for ownership concentration across five categories of shareholders. *All* is the Herfindahl index, which is the sum of all squared ownership proportions in the firm, *Largest* is the percentage equity holding of the largest separate shareholder, *CEO* is the percentage equity holding of the chief executive officer, *Family* is the largest aggregate stake of shareholders in the firm related by blood or marriage, while *Insiders* is the aggregate equity holding of the firm's officers and directors. The equity holdings are ultimate, which is the direct holding plus indirect holdings through intermediaries. The variables are winsorized by 1% in both tails. The sample is all Norwegian firms with limited liability during the period 2000-2014. The sample consists of firms that have consistent accounting figures, multiple owners, positive sales and employment, that are not financials, utilities, subsidiaries, or multi-sector firms, and that are not among the 15% smallest firms by assets and sales. A *** reflects a statistically significant t-value at the 1% level of a positive difference between average ownership concentration in private firms and public firms.

Table 3. Dynamics of ownership concentration

Panel A: Largest shareholder

	Frequency			Magnitude					
Lower change		% of change cases		All		Positive change		Negative change	
threshold is ±	No change	Positive	Negative	Mean	Median	Mean	Median	Mean	Median
Private firms									
0.0	81.9***	51.4	48.6	9.2***	4.3	9.5	4.5	-8.9	-4.0
2.5	89.7***	51.6	48.4	15.7***	12.0	16.2	12.5	-15.3	-11.0
5.0	91.7***	52.2	47.8	18.6***	15.2	19.0	16.0	-18.2	-15.0
10.0	94.4***	53.4	46.6	23.7***	20.0	23.9	20.0	-23.5	-20.0
33.0	99.0***	55.0	45.0	44.8	40.3	44.7	40.5	-44.9	-40.1
50.0	99.8	53.8	46.2	63.7	60.9	64.0	60.9	-63.5	-61.0
Public firms									
0.0	14.4	49.4	50.6	7.8	4.2	8.2	4.0	-7.3	-4.3
2.5	46.0	46.8	53.2	11.8	8.7	13.2	9.7	-10.6	-7.5
5.0	61.1	48.3	51.7	15.0	12.0	16.5	12.8	-13.7	-11.5
10.0	76.3	51.3	48.7	20.1	16.9	21.5	16.7	-18.7	-17.0
33.0	97.7	82.6	17.4	44.0	40.6	43.6	40.6	-46.2	-39.3
50.0	99.5	80.0	20.0	63.9	68.5	62.1	60.5	-71.2	-71.2

Continued on the next page

Table 3. Dynamics of ownership concentration *(Continued)*

Panel B: Largest family

	Frequency			Magnitude					
Lower change		% of change cases		All		Positive change		Negative change	
threshold is ±	No change	Positive	Negative	Mean	Median	Mean	Median	Mean	Median
Private firms									
0.0	79.5***	52.1	47.9	13.0***	5.6	12.7	6.0	-13.3	-5.2
2.5	87.3***	52.3	47.7	20.5***	15.0	19.9	15.6	-21.2	-15.0
5.0	89.1***	52.4	47.6	23.4***	17.0	22.6	17.0	-24.2	-17.5
10.0	91.6***	52.7	47.3	28.2***	23.5	27.1	22.7	-29.5	-24.0
33.0	97.2	50.0	50.0	47.9	46.0	45.8	42.5	-50.0	-49.6
50.0	98.8	42.3	57.7	60.2	53.3	58.8	51.0	-61.3	-55.7
Public firms									
0.0	9.7	47.0	53.0	4.8	2.0	4.9	2.0	-3.9	-1.3
2.5	58.8	46.9	53.1	9.5	6.2	9.8	6.4	-9.2	-5.8
5.0	74.2	48.8	51.2	13.1	9.5	13.2	9.6	-13.0	-9.4
10.0	87.6	49.4	50.6	19.8	18.0	19.8	16.3	-19.8	-19.0
33.0	99.1	50.0	50.0	40.3	36.2	45.3	43.6	-35.4	-35.3
50.0	99.9	100.0	0.0	56.3	56.3	56.3	56.3	0.0	0.0

This table shows the frequency and magnitude of change in the equity stake of the largest separate shareholder (*Largest shareholdeer*) in Panel A and of the largest family by ownership (*Largest family*) in Panel B, using lower thresholds for change in ownership that vary between 0 and 50 percent in absolute terms in both panels. We define a family as owning individuals related by blood or marriage. The equity holdings are ultimate, which is the direct holding plus indirect holdings through intermediaries. *Magnitude* is the size of the change in percentage units. *All* is the absolute value of all changes. The variables are winsorized by 1% in both tails. The sample is all Norwegian firms with limited liability in 2000-2014 that have consistent accounting figures, multiple owners, positive sales and employment, that are not financials, utilities, subsidiaries, or multi-sector firms, and that are not among the 15% smallest firms by assets and sales. A *** in column 2 reflects a statistically significant t-value at the 1% level of a positive difference between the frequency of no change in ownership concentration from one year to the next in private firms and public firms. A *** in column 5 reflects a statistically significant t-value at the 1% level of a positive difference between the absolute value of the change in ownership concentration from one year to the next in private firms and public firms.

Table 4. Descriptive statistics of firm characteristics

Panel A: Frequency distributions

Statistic	Size	Risk	Performance	Growth	Leverage	Liquidity
Mean	13.6	0.2	8.7	4.0	0.7	2.4
Std	34.7	0.2	14.8	33.7	0.2	4.1
p1	0.1	0.0	-36.6	-76.5	0.1	0.1
p5	0.3	0.0	-11.7	-34.1	0.2	0.4
p25	1.7	0.1	0.6	-8.8	0.5	1.1
p50	3.9	0.1	6.2	-0.5	0.7	1.4
p75	10.1	0.2	15.7	9.9	0.9	2.1
p95	54.0	0.6	36.5	53.7	1.0	6.7
p99	239.7	1.1	56.3	194.3	1.0	32.7
N	498,200	416,427	533,719	416,427	533,719	532,743

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Table 4. Descriptive statistics for firm characteristics *(Continued)*

Panel B: Bivariate correlation coefficients

Characteristic		1	2	3	4	5	6	7	8	9	10
1	All										
2	Largest	0.939									
3	CEO	0.562	0.533								
4	Family	0.522	0.490	0.486							
5	Insiders	0.347	0.219	0.570	0.495						
6	Size	-0.087	-0.052	-0.173	-0.086	-0.183					
7	Risk	-0.024	-0.014	-0.036	-0.029	-0.056	-0.025				
8	Performance	0.071	0.053	0.105	0.043	0.111	-0.015	-0.051			
9	Growth	-0.066	-0.063	-0.057	-0.096	-0.033	0.137	-0.052	0.138		
10	Leverage	0.035	0.003	0.058	-0.036	0.107	0.036	-0.082	-0.082	0.122	
11	Liquidity	-0.022	-0.016	-0.047	0.021	-0.056	-0.060	0.183	-0.045	-0.095	-0.317

This table shows frequency distributions of firms characteristics in Panel A and pairwise coefficients of correlation for ownership characteristics and firm characteristics in Panel B. *All* is the sum of every squared equity fraction in the firm (the Herfindahl index), *Largest* is the equity fraction of the largest separate shareholder, *CEO* is the equity fraction of the chief executive officer, *Family* is the largest aggregate equity fraction of shareholders related by blood or marriage, while *Insiders* is the aggregate equity fraction of the firm's officers and directors. The equity fractions are ultimate (direct fraction plus indirect fractions through intermediaries). *Size* is revenue in millions of NOK as of 2014, *Risk* is the standard deviation of sales divided by average sales during the past three years, while *Performance* is operating earnings divided by total assets in real terms. *Growth* is the geometric annual increase in real sales during the two previous years, *Leverage* is total debt divided by total assets, and *Liquidity* is current assets divided by current liabilities. The variables are winsorized by 1% in the tails. The sample is all private Norwegian firms from 2000 to 2014 with limited liability that have consistent accounting figures, multiple owners, positive sales and employment, that are not financials, utilities, subsidiaries, or multi-sector firms, and that are not among the 15% smallest firms by assets and sales.

Table 5 Estimating the baseline model

Independent variable	Hypo-thesis	All firms (1)	All firms (2)	All firms (3)	Firms with ownership change (4)
Ownership (t-1)	+	0.762***	0.810***	0.818***	0.248***
Ownership (t-2)			0.028***	0.057***	
Ownership (t-3)				0.020***	
Size	−	0.119	0.154*	0.192**	-0.257
Risk	?	0.115	0.127	0.158	-0.396
Performance	−	-0.006**	-0.006**	-0.007**	0.005
Growth	+	0.000	0.000	-0.001	0.005
Leverage	+	-0.685***	-0.861***	-0.717**	-2.460*
Liquidity	+	0.002	0.012	0.022	-0.043
Constant		6.817	0.447	-1.684	20.799***
Industry fixed effects		Yes	Yes	Yes	Yes
Year fixed effects		Yes	Yes	Yes	Yes
N		314,423	277,397	241,341	28,585
Firms		58,235	54,123	48,995	15,032
Wald $\chi^2(18)$ test		0.000	0.000	0.000	0.000
AR(2) p-value		0.000	0.000	0.003	0.751
AR(3) p-value			0.003	0.137	
AR(4) p-value				0.313	

This table uses system GMM to estimate the determinants of ownership concentration in the baseline model as specified by equation (1) in the main text. The predictions are stated in the second column. Every independent variable is lagged one period except for ownership concentration, which enters with either one, two, or three lags. *Ownership* is measured as the largest aggregate, ultimate equity proportion of shareholders in the firm related by blood or marriage. *Size* is the log of sales in millions of NOK as of 2014, *Risk* is the standard deviation of sales divided by average sales during the past three years, while *Performance* is operating earnings divided by total assets in real terms. *Growth* is the geometric annual increase in real sales during the two previous years, *Leverage* is total debt divided by total assets, and *Liquidity* is current assets divided by current liabilities. The variables are winsorized by 1% in the tails. The *All firms* sample consists of all private Norwegian firms with limited liability from 2000 to 2014 that have consistent accounting figures, multiple owners, positive sales and employment, that are not financials, utilities, subsidiaries, or multi-sector firms, and that are not among the 15% smallest firms by assets and sales. The sample *Firms with ownership change* includes only observations where ownership differs in two consecutive periods. The AR(t) p-value (t = 2,3,4) shows the probability value of the Arellano-Bond test for zero autocorrelation in first-differenced errors t periods apart. A statistically significant relationship at the 1%, 5%, and 10% levels is denoted ***, **, and *, respectively.

Table 6. Alternative ownership concentration measures and control thresholds

Panel A: Alternative ownership concentration measures

	Hypo-	Largest		All		Insiders		CEO	
Independent variable	thesis	All firms	Changes	All firms	Changes	All firms	Changes	All firms	Changes
Ownership (t-1)	+	0.840***	0.274***	0.837***	0.364***	0.627***	0.049**	0.797***	-0.027
Ownership (t-2)		0.068***		0.077***		0.067***		0.065***	
Ownership (t-3)		0.019***		0.024***		0.024***		0.020***	
Size	−	0.279***	0.132	0.205***	-0.085	0.088	-0.987**	0.243**	-1.270**
Risk	?	0.417**	0.299	0.354**	-0.294	0.003	-1.079	-0.029	-0.420
Performance	−	-0.007***	-0.005	-0.006***	-0.009	-0.002	-0.017	-0.006*	-0.009**
Growth	+	-0.002**	-0.007*	-0.002**	-0.002	-0.001	0.013	-0.001	0.014
Leverage	+	-0.537***	-1.376	-0.692***	-1.496**	-0.411	0.491	-0.584	-0.821
Liquidity	+	-0.003	0.027	-0.004	0.045	0.009	0.060	0.010	0.068
Constant		3.256	7.417	3.313	12.297	26.196*	58.610***	0.781	35.863***
Industry fixed effects		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N		241,341	29,305	253,101	46,680	249,341	39,625	228,877	21,341
Firms		48,995	14,907	50,634	19,612	49,961	19,484	45,942	12,751
Wald $\chi^2(18)$ test		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
AR(2) p-value		0.773	0.103	0.549	0.002	0.015	0.123	0.772	0.002
AR(3) p-value		0.000		0.004		0.001		0.137	
AR(4) p-value		0.088		0.819		0.752		0.287	

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Panel B: Alternative control thresholds

	Hypo-	$< 33.33\%$		$33.33 - 50.00\%$		$50.00 - 66.66\%$		$66.66 - 99.00\%$	
Independent variable	thesis	All firms	Changes	All firms	Changes	All firms	Changes	All firms	Changes
Ownership(t-1)	+	0.607***	0.386***	0.888***	0.500***	0.955***	0.282*	0.878***	0.149
Ownership(t-2)		0.052***		0.032**		0.022*		0.056***	
Ownership(t-3)		0.021*		0.003		0.003		-0.002	
Size	−	0.054	0.210	-0.029	-0.085	0.008	0.918	-0.075	-0.563
Risk	?	0.142	1.180*	0.262*	0.899	0.086	-0.901	-0.367	2.160
Performance	−	-0.002	0.000	-0.002	0.002	0.000	-0.019	-0.003	-0.006
Growth	+	0.000	0.000	0.001	0.001	0.000	-0.010	0.001	-0.005
Leverage	?	-0.516	-0.976	0.225	0.802	-0.004	5.145**	-0.116	0.343
Liquidity	+	-0.023	0.011	0.022**	0.060**	0.000	0.102*	-0.005	-0.057
Constant		6.899	1.712	0.352	16.117**	-1.038	38.636**	5.695	80.183**
Industry fixed effects		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N		28,702	9,386	19,422	3,099	54,862	1,981	25,557	3,289
Firms		6,719	4,235	5,667	2,021	14,282	1,447	6,982	2,236
Wald $\chi^2(18)$ test		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.092
AR(2) p-value		0.043	0.519	0.369	0.339	0.962	0.589	0.702	0.073
AR(3) p-value		0.750		0.458		0.186		0.126	
AR(4) p-value		0.809		0.444		0.025		0.329	

This table uses system GMM to estimate the determinants of ownership concentration measured in four alternative ways in Panel A (*Largest*, *All*, *Insiders*, *CEO*), while Panel B explores whether the relationship between the largest family's stake and its determinants is sensitive to ownership control thresholds. The predictions are specified in the second column. Every independent variable is lagged one period except for ownership concentration, which enters with one, two, and three lags for the *All firms* sample and with one lag for the *Changes* sample. Ownership is ultimate, which is the sum of direct and indirect holdings. The independent variables are defined in Table 5. The *Changes* sample is the subsample of observations where ownership changes from one period to the next in the sample of all private Norwegian firms with limited liability from 2000 to 2014 that have consistent accounting figures, multiple owners, positive sales and employment, that are not financials, utilities, subsidiaries, multi-sector firms, and that are not among the 15% smallest firms by assets and sales. The AR(t) p-value (t = 2,3,4) shows the probability value of the Arellano-Bond test for zero autocorrelation in first-differenced errors t periods apart. The variables are winsorized by 1% in the tails. A statistically significant relationship at the 1%, 5%, and 10% levels is denoted ***, **, and *, respectively.

Table 7 Estimating the baseline model with ordinary least squares and with firm fixed effects

		OLS				FE			
	Hypo-	All firms		Changes		All firms		Changes	
Independent variable	thesis	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Ownership(t-1)	+	0.823***		0.845***		0.526***		0.083***	
Ownership(t-2)		0.085***				0.035***			
Ownership(t-3)		0.053***				-0.017***			
Size	−	-0.207***	-4.055***	-0.928***	-3.481***	-0.010	-0.585***	-0.932***	-0.900***
Risk	?	0.033	-4.645***	-1.059*	-0.982	0.212	-0.173	-1.949**	-1.899
Performance	−	0.004**	0.098***	0.051***	0.254***	0.000	0.004*	0.022**	0.023
Growth	+	-0.002***	-0.036***	-0.011***	-0.046***	-0.001	0.000	0.001	-0.001
Leverage	+	-0.183**	-1.861***	0.717	6.736***	-0.135	-0.083	0.503	0.999
Liquidity	+	-0.003	0.071**	-0.013	0.035	-0.010	-0.019	-0.021	-0.025
Constant		2.963***	74.612***	9.621***	40.188***	24.869***	60.680***	1.635***	32.599***
Industry fixed effects		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N		241,341	316,619	28,585	30,677	241,341	316,619	28,585	30,677
Firms		48,995	58,545	15,032	15,969	48,995	58,545	15,032	15,969
R^2		0.913	0.065	0.700	0.118	0.891	0.000	0.033	0.006
R^2, Endogeneity test		0.000	0.000	0.000	0.000	0.678	0.068	0.691	0.197
Autocorrelation test		-0.008***	0.949***	-0.236***	0.854***	0.767***	0.956***	0.876***	0.901***
R^2, Autocorrelation test		0.000	0.899	0.057	0.717	0.574	0.913	0.746	0.792

In this table, we estimate the determinants of ownership concentration using alternatively ordinary least squares (*OLS*) on pooled data and the fixed effects *(FE)* method on panel data. The estimates for the baseline model are shown in specifications (1) and (3) for *OLS* and in (5) and (7) for *FE*. The estimates when we ignore lagged ownership in the baseline model are shown in specifications (2) and (4) for *OLS* and in (6) and (8) for *FE*. The predictions are specified in the second column. We measure ownership as the equity fraction of the firm's largest family by ultimate ownership. Every independent variable is lagged one period except for ownership concentration. The independent variables are defined in Table 5. The variables are winsorized by 1% in the tails. *All firms* reflects that every firm is included in the sample, which consists of all private Norwegian firms with limited liability from 2000 to 2014 that have consistent accounting figures, multiple owners, positive sales and employment, that are not financials, utilities, subsidiaries, or multi-sector firms, and that are not among the 15% smallest firms by assets and sales. The sample *Changes* contains the firms that experience a change in ownership concentration from one year to the next. We cluster standard errors at the firm level and account for time and industry. A statistically significant relationship at the 1%, 5%, and 10% levels is denoted ***, **, and *, respectively.

Table 8 Using control variables with one and two lags

		Ownership concentration measure				
Independent variable	Hypothesis	Family	Largest	CEO	Insiders	All
Ownership (t-1)	+	0.824***	0.839***	0.799***	0.619***	0.835***
Ownership (t-2)		0.061***	0.072***	0.067***	0.070***	0.080***
Ownership (t-3)		0.022***	0.018***	0.021***	0.024***	0.024***
Size(t-1)	−	0.182*	0.288***	0.224*	-0.086	0.236***
Size(t-2)		0.368***	0.039	0.119	0.069	0.090
Risk(t-1)	?	0.282	0.467**	0.061	0.126	0.466
Risk(t-2)		0.390	0.177	-0.037	-0.049	0.246**
Performance(t-1)	−	-0.006*	-0.009***	-0.006	-0.002	-0.010***
Performance(t-2)		-0.005*	-0.003	-0.002	-0.002	-0.006***
Growth(t-1)	+	-0.001	-0.003**	0.000	0.002	-0.002**
Growth(t-2)		-0.001	0.000	0.000	0.000	0.000
Leverage(t-1)	+	-0.621**	-0.587***	-0.693*	-0.166	-0.745***
Leverage(t-2)		-0.217	0.302	-0.585*	-0.971**	0.293
Liquidity(t-1)	+	0.031**	0.002	0.008	0.011	0.000
Liquidity(t-2)		0.018	-0.004	-0.013	0.003	-0.001
Constant		-5.251	3.749	0.646	15.983	2.969
Industry fixed effects		Yes	Yes	Yes	Yes	Yes
Year fixed effects		Yes	Yes	Yes	Yes	Yes
N		219,149	229,717	208,321	226,251	229,717
Firms		44,136	45,593	41,489	45,029	45,593
Wald $\chi^2(18)$ test		0.000	0.000	0.000	0.000	0.000
AR(2) p-value		0.002	0.260	0.634	0.150	0.958
AR(3) p-value		0.456	0.000	0.118	0.001	0.001
AR(4) p-value		0.596	0.105	0.443	0.984	0.985

This table uses system GMM to estimate the determinants of ownership concentration when we add one more lag to the control variables in the baseline model as specified by equation (1) in the main text. We use four ownership concentration measures in addition to the holding of the largest family by ownership. The predictions are stated in the second column. Every control variable is lagged one and two periods, while ownership concentration enters with one, two, and three lags. *Family* is the largest aggregate stake of shareholders in the firm related by blood or marriage, *Largest* is the percentage equity holding of the largest separate shareholder, *CEO* is the percentage equity holding of the chief executive officer, *Insiders* is the aggregate equity holding of the firm's officers and directors, while *All* is the Herfindahl index, which is the sum of all squared ownership proportions in the firm. The equity holdings are ultimate, which is the direct holding plus indirect holdings through intermediaries. *Size* is the log of sales in millions of NOK as of 2014, *Risk* is the standard deviation of sales divided by average sales during the past three years, while *Performance* is operating earnings divided by total assets in real terms. *Growth* is the geometric annual increase in real sales during the two previous years, *Leverage* is total debt divided by total assets, and *Liquidity* is current assets divided by current liabilities. The variables are winsorized by 1% in the tails. The AR(t) p-value (t = 2,3,4) shows the probability value of the Arellano-Bond test for zero autocorrelation in first-differenced errors t periods apart. The sample consists of all private Norwegian firms with limited liability from 2000 to 2014 that have consistent accounting figures, multiple owners, positive sales and employment, that are not financials, utilities, subsidiaries, or multi-sector firms, and that are not among the 15% smallest firms by assets and sales. A statistically significant relationship at the 1%, 5%, and 10% levels is denoted ***, **, and *, respectively.

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