How Do Evolving Common Ownership Motives Shape Capital Investment?

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Abstract

The common ownership hypothesis suggests that firms compete less vigorously with each other to maximize portfolio profits. What does this hypothesis mean for aggregate investment as portfolio motives grow over time? As the common ownership motive grows, firms decrease their investment because they know a larger capital stock will cut into portfolio profits. While the existing literature on common ownership focuses on static competition, this paper demonstrates that portfolio maximization also shrinks aggregate investment, output, and consumption. Common ownership motives may partly explain the decline in business dynamism through a declining capital stock, higher markups, and lower labor share. I also find that markups respond nonlinearly to increases in common ownership, which differs from existing empirical studies.

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1 Introduction

Recent research in firm behavior revealed that firms may consider the profitability of their competitors when they make competitive decisions (Azar et al., 2018). The literature suggests that this phenomenon, referred to as common ownership, can increase markups and suppress wages as the degree of pooled shareholding increases. The literature so far has primarily focused on studying the firm- and industry-level impacts of common ownership. Less clear is the role of decreased competitive pressure on aggregate outcomes. Understanding the role of common ownership in aggregate outcomes is becoming increasingly important as pooled shareholding grows over time. Among 70% of the largest firms in the US in 2020, the largest single shareholder is one of BlackRock, Vanguard, or State Street (Amel-Zadeh et al., 2022).

To understand how common ownership influences aggregate dynamics, I write a general equilibrium model featuring a common ownership friction where firms own and invest in capital. I find that the capital stock decreases and more economic output is attributed to profit share as the common ownership motive increases. Relative to a world without common ownership, firms invest less in capital because they know that a larger capital stock will make their competitors less profitable. Mechanically, the higher markups created by a common ownership competition regime cause the marginal product of capital to decline more quickly than it would in a competitive setting.

I calibrate a model to exactly match the observed increase in markups documented in De Loecker et al. (2020) given changes to the common ownership motive calculated in Amel-Zadeh et al. (2022). This increase in markups causes profit share to increase by 17 percentage points and labor share of output to decline by 14 percentage points. Additionally, firm equity price relative to GDP increases by approximately 90% despite the capital-GDP ratio decreasing by 25%. Since 1970, household wealth relative to GDP has increased by roughly 20%, while the capital stock relative to GDP has only increased by 5%. While this model overshoots the size of impact in both of these channels, it correctly generates the growing wedge between firm value and capital stock.

My contribution is along two channels. First, I find a closed form markup under price competition in a setting with differentiated goods across a continuum of sectors where individual firms are motivated by a common ownership pressure. The markup I calculate nests a standard markup in a multi-sector economy (as in Atkeson and Burstein (2008)) when the common ownership parameter is set to zero. Second, I estimate the role of common ownership on firm value, capital investment, and output in a recursive economic setting. As common ownership increases, firm profits and equity price relative to capital both increase while the capital stock, output, and consumption all decrease. This is consistent with recent discussions of declining business dynamism (Akcigit and Ates, 2021).

The model generates a few testable hypotheses. First, we would expect firm value relative to its capital stock to increase significantly. Second, we expect to see a decline in labor share as a percentage of output. Finally, we should expect to see lower capital investment in industries with a higher degree of common ownership. The first two results are consistent with the data, while the last point has not yet been studied in detail.

Related Literature The literature around common ownership generally falls into three groups – theory, micro-evidence, and macro implications. Among these, the macro implications are typically the least well understood.

The theory around common ownership has its roots in Rotemberg (1984). This was among the earliest papers that suggested that firms may place some positive coefficient on the profitability of their competitors. If shareholders own multiple firms, a firm may deliver more value to its owners by maximizing some pooled profits rather than individual profits. More recently, O'Brien and Salop (2000) derived a Modified Herfindahl Hirschmann Index (MHHI) to measure how the typical measure of market concentration changes when accounting for positive cross-firm profit weights. The authors also introduce a MHHID (or $MHHI\Delta$) metric that measures the difference between the MHHI and standard HHI measures. However, the MHHI calculation is based on the assumption that firms maximize portfolios based on a proportional weighting scheme. While the MHHI metric appeals policymakers already familiar with the HHI measure, it doesn't have as clear of an interpretation as the standard HHI metric.

An additional motive for common ownership is proposed by Denicolò and Panunzi (2023). They suggest that the portfolio maximization approach is consistent with a world with costly monitoring. Individual shareholders can engage in costly monitoring of a company's management and can improve the return on investment by doing so. Large financial intermediaries do not pursue this monitoring, so management slacks, which in turn increases profitability. In this paper, I do not take a stand on whether the common ownership motive is driven by portfolio maximization (as in O'Brien and Salop (2000)) or from a failure of corporate monitoring (as in Denicolò and Panunzi (2023)). My model nests either of these micro-founded motives for common ownership growth.

Micro-evidence of common ownership makes up the largest subset of the common ownership literature. Azar et al. (2018) finds evidence that common ownership (measured by $MHHI\Delta$) increases prices on routes flown by airlines with common shareholders.[1] The phenomenon has also been studied in the ready-to-eat cereal industry by Backus and Conlon (2018). There, the authors find that own-profit maximization better explains pricing behavior than a common ownership regime. However, the authors are clear that they are not fully rejecting the premise of common ownership. Rather, they state that the market they study is best understood through own-profit maximization. It is worth mentioning as well that the ready-to-eat (RTE) cereal industry is already highly concentrated, with the top four firms driving 85% of sales. Azar et al. (2016) also finds evidence of common ownership frictions in the banking sector.

The micro-evidence also examines the role of finance and management in understand-

[1] There have been multiple follow-up studies that either support or refute the paper. Cite these papers.

ing corporate outcomes. Anton et al. (2016) describes how common ownership might be implemented via management incentives. Yegen (2019) finds that a relationship between common ownership and market concentration is primarily driven by standard portfolio rebalancing.

The macro effects of common ownership are generally less well-studied. Azar and Vives (2021) suggest that monopsony power in the labor market dampen or even reverse the depressing effects of common ownership. That result is sensitive to market structure and elasticity.

The closest paper to this one is Azar and Vives (2019), which studies the influence of common ownership on capital investment. That paper studies a two-period model featuring market power in the product, labor, and capital markets with three types of households. They find that common ownership decreases capital investment, output, and the interest rate. In contrast, firms in my model only have product market power. Additionally, my model features infinitely-lived households and firms. This change eliminates the interest rate decline and also generates meaningful changes to equity prices relative to the capital stock.

The remainder of this paper is organized as follows. Section 2 describes both the static and dynamic model settings. Section 3 describes the calibration of the model and results as the common ownership level increases. Section 5 concludes.

2 Model Environment

The model is written in discrete time with an infinite horizon and features two types of dynamic agents. Households save via shareholding, and intermediate production goods firms who own and operate capital. In addition to these dynamic agents, there is a static final goods aggregator that solves a cost-minimization problem each period.

Before describing the dynamic problem of these agents, I describe the static setting with the embedded exogenous common ownership motive.

2.1 Common Ownership, Pricing, and Output

Production firms operate in a continuum of sectors $\mathscr{J}$. Each sector $j \in \mathscr{J}$ contains a discrete number of firms N_f. Given start of period capital, each firm ij chooses output y_{ij}, price p_{ij}, labor n_{ij}, and future capital stock. Dividends are paid out to shareholders as the remainder of period profits less investment.

Intermediate goods firms offer differentiated goods and compete on price. The quantity demanded of each good is pinned down by the vector of prices in the economy. A perfectly competitive sector of final goods aggregators buys intermediate goods from the production firms, subject to a CES aggregation technology. Final goods are used for consumption and investment. The final goods aggregator solves a profit maximization problem:

$$\max_{y_{ij}} PY - \int_j \sum_i^N p_{ij} y_{ij} dj \tag{1}$$

$$\text{s.t. } Y = \left[\int_{\mathscr{J}} \left\{ \left(\sum_i^N y_{ij}^{\frac{\eta-1}{\eta}} \right)^{\frac{\eta}{\eta-1}} \right\}^{\frac{\theta-1}{\theta}} dj \right]^{\frac{\theta}{\theta-1}} \tag{2}$$

where N_f are the fixed number of firms in each of the atomistic sectors, η is the elasticity of substitution between goods within each sector, and θ is the elasticity of substitution across sectors. $\eta > \theta$, reflecting that cross-sector differentiation is larger than within-sector product differentiation. There is more substitution between Apple and Samsung smartphones than there is between smartphones and airline tickets.

Cost minimization by the final goods sector yields expressions for price and output:

$$p_{ij} = PY^{\frac{1}{\theta}} * y_j^{\frac{-1}{\theta}+\frac{1}{\eta}} * y_{ij}^{\frac{-1}{\eta}} \quad (3)$$

$$y_{ij} = YP^{\theta} * p_j^{\eta-\theta} * p_{ij}^{-\eta} \quad (4)$$

where y_j is sector output, defined as $y_j \equiv \left(\sum_i^N y_{ij}^{\frac{\eta-1}{\eta}}\right)^{\frac{\eta}{\eta-1}}$. The sector price p_j solves $p_j * y_j = \sum_i^N (p_{ij} * y_{ij})$. Therefore, $p_j = \left(\sum_i^N p_{ij}^{1-\eta}\right)^{\frac{1}{1-\eta}}$. Equation 4 determines equilibrium quantity demanded for each variety given the vector of prices. Without loss of generality, I use the bundle of production goods as the numeraire ($P = 1$).

Rather than maximizing profits, the production firm's managers operate the firm by maximizing their shareholders' portfolio profits. The weights of their competitors' profits $\{\kappa_{xj}\}_{x \neq i}$ are taken as given by these managers.[2] I further assume that $\kappa = 0$ for all firms outside each firm's own sector. For example, an airline would not change its price and output decisions to change the profits of a ready-to-eat cereal company, even if they have a common owner. Given a continuum of sectors, each firm could only have an atomistic effect on the profitability of other firms, so this assumption is not particularly onerous.[3] Similarly, abstracting away from supply chain relationships also excludes the possibility of tunneling. [4]

[2]This model nests a standard competitive framework if $\kappa = 0$.

[3]Vertical supply chain dependencies would violate this assumption. However, evidence of common ownership playing a role in supply chain relationships is much less common than within-industry portfolio optimization. Rather than introduce a model of cross-industry profit maximization, I stick to the empirical literature and assume that firms only maximize portfolio profits within their industry.

[4]Tunneling refers to the process where a large firm enriches one of its minority shareholders by engaging in an unprofitable business relationship with a firm largely owned by the same shareholder. This process is generally illegal.

Using Equation 4 as a constraint on pricing and output, the each production firm solves:

$$\pi^*(\mathbb{K}) = \max_{p_{ij},y_{ij},n} p_{ij} * y_{ij} - w * n + \sum_{x \neq i} \kappa_{ix} * \pi_{xj}(p_{ij}) \tag{5}$$
$$\text{s.t. } y_{ij} \leq k_{ij}^{\alpha} n_{ij}^{\gamma}$$
$$y_{ij} \leq= Y * p_{ij}^{-\eta} * (p_{ij}^{1-\eta} + \sum_{x \neq i} p_{xj}^{1-\eta})^{\frac{\eta-\theta}{1-\eta}} * P^{\theta}$$

where κ_{xj} are the profit weights on competitors' profits, w is the maarket wage, n_{ij} is the firm's hired labor, p are intermediate goods prices, and y are intermediate goods outputs. The aggregate state $\mathbb{K}$ contains the distribution of firms over capital and the common ownership factor. In equilibrium, all firms face the same problem and the distribution of capital will be degenerate.

Taking first order conditions and imposing symmetry (which is the case in equilibrium) leads to an equilibrium markup of:

$$\frac{p_{ij}}{\hat{\mu}} = \frac{(N-1)\eta + \theta}{(N-1)(\eta - \kappa(\eta - \theta)) - N + \theta} \tag{6}$$

Derivation of the expression above is included in Appendix A.1.

At this point, there are a few sanity checks that are worth looking at. The first would be the case where there is no common ownership ($\kappa = 0$). This leads to a markup of $\frac{(N-1)\eta+\theta}{(N-1)\eta-N+\theta}$. This is the markup in a differentiated goods setting with a fixed number of firms per sector and a continuum of sectors under Bertrand competition.[5] In the case of perfect common ownership ($\kappa = 1$), markup is $\frac{(N-1)\eta+\theta}{N(\theta-1)}$. This would represent a monopolist in each sector that maximizes profits across a portfolio of their brands within that sector.[6]

Equilibrium price and wage can be calculated in a closed form from the markup and

[5] For example, see equation 19 in Atkeson and Burstein (2008).

[6] Note that I still assume that cross-sector profit weights are zero. If cross-sector profit weights were nonzero and $\kappa \to 1$, that would look like a world where every product is simply a brand under the ownership of a hyper-monopolist. Such a setting is beyond the scope of this paper.

aggregate price conditions:

$$p_{ij} = N^{\frac{1}{\eta-1}} \tag{7}$$

$$w = \gamma k^{\alpha} n^{\gamma-1} N^{\frac{1}{\eta-1}} \frac{(N-1)*(\eta-\kappa(\eta-\theta)) - N + \theta}{(N-1)\eta + \theta} \tag{8}$$

2.2 Households

A representative household provides labor inelastically, saves in equities, and enjoys period utility from consumption. In a departure from Azar and Vives (2021), I do not model the labor market. Empirical evidence so far primarily suggests that common ownership is exercised through product market power rather than labor market power.

Households solve:

$$V(s;K) = \max_{s'} u(c) + \beta V(s';K') \tag{9}$$

$$\text{s.t.} \quad c + Ps' \leq w + (P+D)s$$

$$K' = \Gamma(K)$$

where c is consumption, w is the equilibrium wage, s is aggregate shareholding, P is equilibrium equity price, D are dividend payments from the production sector, and K is the aggregate capital stock. Households take the common ownership parameter κ as given.[7] Period utility from consumption takes the form $u(c) = \frac{c^{1-\sigma}-1}{1-\sigma}$.

[7]Common ownership can be endogenized by introducing a financial intermediation sector alongside heterogeneous households that choose to save either in individual firms or aggregate equity. However, that sort of setting would be much less tractable and would lose analytic expressions for capital accumulation. Additionally, it would require finding a consistent discounting regime that satisfies all shareholders. It is beyond the scope of this work to develop a micro-founded theory for the rise in common ownership.

2.3 Production Firms

Production firms make investment choices to maximize return to their shareholders. Period profits are determined by the static profit maximization problem described in Section 2.1. Each firm's dynamic problem is given as:

$$F(k;K) = \max_{k'} \pi^*(k;K) + (1-\delta)k - k' + \chi F(k';K') \tag{10}$$
$$\text{s.t.} \quad K' = \Gamma(K)$$

where $\Gamma(K)$ describes the law of motion for aggregate capital. In equilibrium, $k' = K'$, but I keep these explicitly separate to better track what each firm controls.

In equilibrium, firms will discount at the same rate as their owners $(\chi = \beta)$. When choosing future capital, firms do not consider the effect of additional capital accumulation on their competitors. Firms already maximize portfolio value in the static maximization problem denoted by π^*. Via the Envelope Theorem, a change in the capital stock is valued at the marginal revenue product of capital.

Each firm's choice of capital satisfies:

$$\frac{1}{\beta} = 1 - \delta + \mu\alpha k^{\alpha-1} n^{\gamma} \tag{11}$$

Using the relationship between price and marginal product described in Equation 6 with the equilibrium price yields:

$$k = \left[\left(\frac{1}{\beta} + 1 - \delta \right)^{-1} N^{\frac{1}{\eta-1}} \alpha n^{\gamma} \frac{(N-1)(\eta - \kappa * (\eta - \theta)) - N + \theta}{(N-1)\eta + \theta} \right]^{\frac{1}{1-\alpha}} \tag{12}$$

As the common ownership parameter κ increases, capital investment falls. Firms internalize the fact that increased investment decreases the profits of their competitors.

2.4 Equilibrium

A recursive competitive equilibrium with aggregate state $S \equiv (\bar{k}, \mu)$ is defined as:

1. Value functions $F(k; \mathbb{K})$ and $V(s; \mathbb{K})$ that solve the firm's and household's problems respectively;
2. Prices for shares and labor: $P(\mathbb{K})$, $w(\mathbb{K})$;
3. Firm decision rule for capital and dividends: $k' = g(k; S)$, $D = D(k; S)$;
4. Household shareholding decision rules: s'
5. The aggregate law of motion for capital $\bar{k}' = \Gamma(S)$; and

that satisfy the following market clearing conditions:

1. Labor: $\int_{\mathscr{J}} \sum_{i=1}^{N_z} n_{ij} dj = n$
2. Shares: $s' = 1$
3. Goods: $Y = C + I$

The market for shares will clear with the correct share prices and the market for labor will clear with the correct wage. The goods market clears via Walras' Law.

3 Calibration and Results

Household utility parameters are chosen to target a 7% rate of return on equities. This is done through the choice of β. The curvature σ of the utility function does not play a role in finding steady state behavior because there is no risk in this economy.

The production function $k^\alpha n^\gamma$ is assumed to be decreasing returns, $\alpha + \gamma < 1$. There isn't a meaningful difference between results in a constant returns versus a decreasing

Meaning	Parameter	Value
Household Parameters		
Curvature of utility function	σ	3
Discounting	β	$\frac{1}{1.07}$
Production Parameters		
Depreciation	δ	0.07
Capital share of production	α	0.30
Labor's share of production	γ	0.69
Aggregate employment	n	0.33
Competition Parameters		
Number of firms per sector	N_F	10
Within-sector elasticity	η	11.426
Cross-sector elasticity	θ	6.441

Table 1: Household Parameters are chosen to target a 7% rate of return on equities. Production Parameters are chosen to target the average rate of depreciation in the United States. Labor's share of output is chosen to match payments to labor in 1980 consistent with estimated markups. Capital's share of output is set to create decreasing returns to scale. Parameter values related to markup (η & θ) chosen to target the observed change in markups from 1980 to 2016 consistent with the observed change in common ownership. The number of firms are set to 10, which is consistent with highly competitive sectors.

returns technology. Under imperfect competition, firms naturally face a decreasing revenue product even under a constant returns production function. α is chosen so that the payments to labor in 1980 match the data. Depreciation δ is set to match the average rate of depreciation in the US economy. Aggregate employment matches the average hours worked by employed households.

The competition parameters are calibrated to target observed markups in 1980 and 2017 given the changes in common ownership. I assume there are 10 firms per sector, which leads to an HHI of 1,000. This level sets all sectors to be "competitive" according to the Department of Justice guidelines.[8] Given a fixed number of firms, I calibrate η and θ to jointly match the observed markups in 1980 and 2017 (as documented in De Loecker et al. (2020)) given the changes to the common ownership sympathy parameter κ (as documented in Backus et al. (2021)). The calibrated parameters are consistent with estimates from Broda and Weinstein (2006). Critically, we have that $\eta > \theta$, which means that substitution within sectors is larger than substitution across sectors. If Ford cars increase in

[8] https://www.justice.gov/atr/herfindahl-hirschman-index

price, it will have a larger impact on demand for Chevrolet cars than it will on demand for Dyson vacuums.

3.1 Results

To test the role of common ownership on aggregate outcomes, I evaluate the model across all rational sympathy coefficients $\kappa \in [0,1]$. When $\kappa = 0$, the model nests the standard competitive framework where firms maximize their own period profits. At the other extreme $\kappa = 1$, each firm in a sector equally weighs the profits of their competitors. This would look like an environment where one monopolist controls production of N_f brands in a sector. Two other points worth mentioning are the estimated average common ownership sympathy levels documented in Backus et al. (2021).[9] In 1980, the average common ownership sympathy coefficient was 0.20, which increased to 0.70 in 2017.

Table 2 shows some key economic measures as the level of common ownership increases. Output, consumption, labor share, and the capital to output ratio all monotonically decrease as the common ownership sympathy coefficient increases. This is entirely driven by markups. As common ownership rises, firms reduce their output and raise prices. This results in a steeper marginal revenue curve, so firms choose to invest in less capital.

Because nothing has changed among household preferences, the rate of return on equity is constant in each of these settings. This is a key difference from Azar and Vives (2019), which finds that interest rates fall under common ownership in a two-period en-

[9]The historic estimates of average common ownership partly depend on which industries are measured and which data are included. For example, Amel-Zadeh et al. (2022) find that common ownership is 0.10-0.05 higher when looking at sympathy weights within the same industry rather than across industries. They also find that common ownership sympathy estimates that do not include insiders and other managers overstate the sympathy coefficient by $\sim$0.05. Those estimates are likely more complete than the ones provided in Backus et al. (2021), but the timeframe is limited to 2004-2020. Since the factors in Amel-Zadeh et al. (2022) roughly cancel each other out, I am comfortable using the estimates from Backus et al. (2021) that go back to 1980.

[10]Following the Industrial Organization literature in general and the common ownership literature in particular, I scale HHI so that it falls in the range of [0, 10,000].

Economic Output Under Alternate Common Ownership Levels

Category	Common Ownership Levels No CO	1980	2014	Monopoly
κ	0.00	0.20	0.70	1.00
Y	0.648	0.622	0.551	0.501
C	0.563	0.548	0.501	0.465
Share Price/Y	3.46	4.44	6.88	8.35
K/Y	2.02	1.84	1.38	1.11
Markup	0.10	**0.21**	**0.61**	1.01
Labor Share	62.7%	**57.0%**	42.9%	34.4%
Profit Share	24.2%	31.0%	48.2%	58.4%
HHI	1,000	1,000	1,000	1,000
MHHI[10]	1,000	2,800	7,300	10,000

Table 2: Changes to economic variables under alternate common ownership regimes. Bold variables were used to calibrate the model and match either the data or documented markups in De Loecker et al. (2020). Output, consumption, the capital to output ratio, and labor share monotonically decrease as the exogenous level of common ownership increases. The markup and share price to GDP ratio monotonically increase in the common ownership parameter. The Modified HHI term is calculated with the formula proposed by O'Brien and Salop (2000).

vironment. In the infinite horizon setting, households hold shares in equity and firms invest on their behalf. As markups rise, dividend payments as a share of output increase. This causes the share price to increase until returns to equity return to the equilibrium 7% rate.

The break between firm value and capital stock is much larger than observed in the data. Financial wealth relative to GDP has increased by roughly 20% from 1980 to 2014 while the capital stock relative to GDP has only increased by 5%. The data show a widening gap between these metrics, but it is not nearly as large as suggested by these results. Prices in the model increased by 55% while the capital/output ratio fell by 25%.

One surprising implication of this model is that consumption as a share of output is rising. Mechanically, this is driven by the falling capital-output ratio, which requires a lower investment burden to maintain.

Changes in common ownership also over-explain the observed decline in the labor share and the rise in the profit share. In the data, the labor share has fallen roughly 7 percentage points and the profit share has increased by about 8 percentage points (Ak-

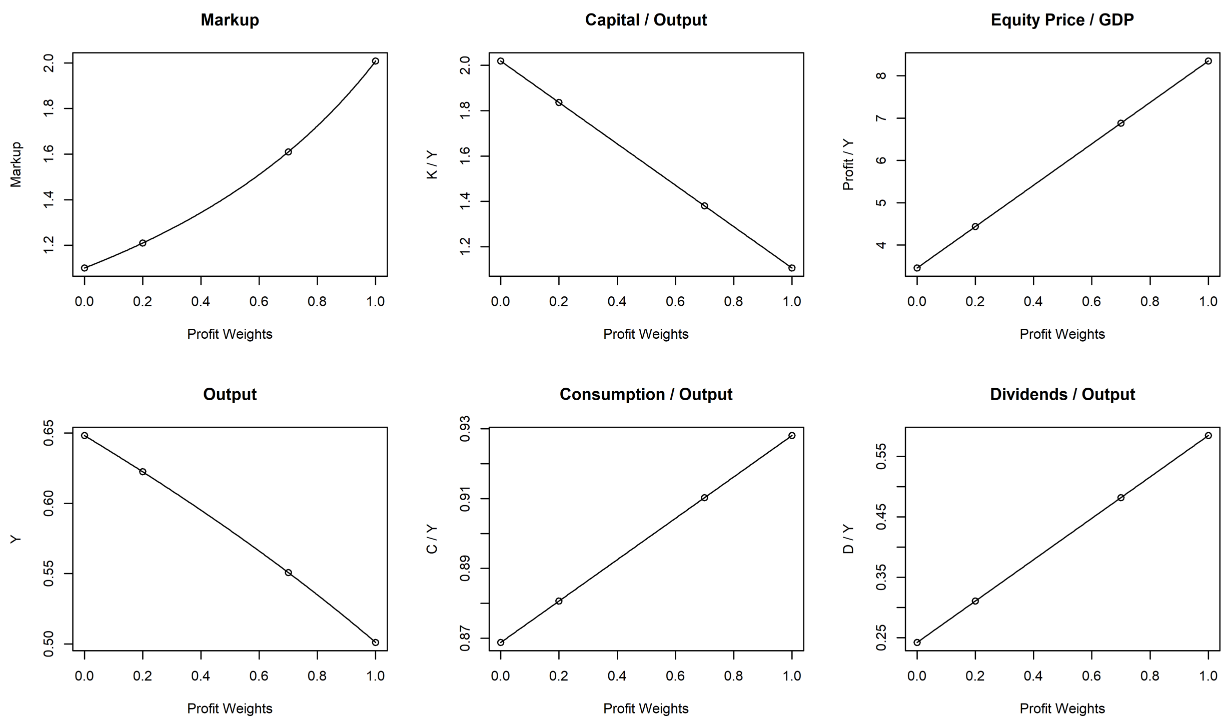

Figure 1: Markups, capital to output ratio, equity price to GDP ratio, output, consumption to output ratio, and dividend to output ratio as the exogenous profit weights increase. The circles on each graph represent a world without common ownership ($\kappa = 0$), the 1980 level of common ownershhip ($\kappa = 0.2$), the 2016 level of common ownership ($\kappa = 0.7$), and full common ownership ($\kappa = 1$). These points are the same as described in Table 2.

cigit and Ates, 2021). Common ownership generates much larger changes. Labor share falls by 14 points and the profit share increases by 17 points. The gap is likely driven by the assumption that labor is supplied inelastically by households. However, it is not immediately clear how endogenous labor supply would influence the labor share of output. Households are both investors and workers in this model, which means that they reap the gains of higher dividend payments even while their wages are falling.

Figure 1 shows how various economic outcomes respond to changes in the exogenous markup. Among these, markups and output are both nonlinear functions of the common ownership variable. The other variables shown are all linear functions of the profit weight. These graphs should not be interpreted as a canonical link between any of these outcomes and the common ownership variable. The model assumes that all firms are identical and all value each others profits equally. In the data, there is rich heterogeneity

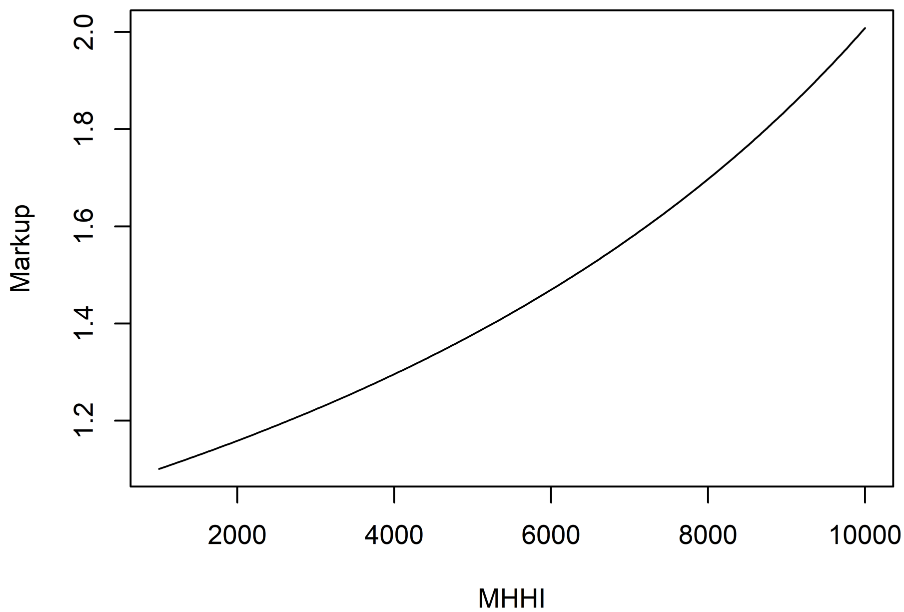

Figure 2: Markups increase nonlinearly in the Modified Herfindahl Hirschmann Index.

among firms and in their cross-firm profit weights.

3.1.1 Markup and MHHI

Equilibrium markup is a nonlinear function of profit weights κ, which also implies that markups are a nonlinear function of the Modified Herfindahl Hirschmann Index (MHHI). MHHI is calculated using the formula found in O'Brien and Salop (2000). With symmetric firms, it can be written as:

$$MHHI = N\left(\left(\frac{1}{N} * 100\right)^2 + \kappa(N-1)\left(\frac{1}{N} * 100\right)^2\right)$$

Figure 2 shows the relationship between equilibrium markup and the MHHI. Note that because HHI is constant, this graph can also be read as showing the relationship between markups and MHHIΔ. The common ownership sympathy parameter κ enters the MHHI linearly but determines equilibrium markups nonlinearly. Log markups (not pictured) are respond nonlinearly to both MHHI and κ. This result runs against some of the headline empirical results in the empirical literature. For example, Table III of Azar et al. (2018) shows that log ticket prices increase linearly with the MHHIΔ. However, the theoretical results presented here should not be taken as a rejection of the empirical evidence. The fact that all firms are identical in this setting oversimplifies equilibrium markup choices. In the real world, firms have different productivity and different κ weights on each others' profits.

4 Household Capital Ownership

As a robustness check, I study a related model where households own capital and rent it to firms. Households also own firms, so in equilibrium, the return on both equity and capital must be equal.

The first order condition for capital ownership is standard, yielding:

$$1 = \beta(r + 1 - \delta) \tag{13}$$

where r is the rental rate paid by firms for capital. This implies a rental rate $r = \frac{1}{\beta} - 1 + \delta$.

The firm's choice of how much capital to hire each period is calculated just as its demand for labor given in Equation 8:

$$r = \alpha k^{\alpha-1} n^{\gamma} N^{\frac{1}{\eta-1}} \frac{(N-1) * (\eta - \kappa(\eta - \theta)) - N + \theta}{(N-1)\eta + \theta} \tag{14}$$

Critically, this results in the same demand for capital as was calculated in Equation 12. Therefore, it does not matter if households or firms own capital in this setting. This is critically driven by the arbitrage potential by households. Households will invest in capital and equity in a balanced manner. In a setting where firm owners and savers are distinct populations, this relationship may break down.

5 Conclusion

I study a model of competition among differentiated goods in a continuum of sectors where firms operate under a variety of common ownership regimes. I find that capital investment falls as common ownership increases. This increases markups, drives down labor share of output, and increases firm value relative to GDP. I find that markup is a nonlinear function of markup. These findings reinforce the existing literature on common ownership and add a more explicit dynamic dimension by studying capital accumulation.

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A Appendix

A.1 Work in Progress: Common Ownership Equilibrium Markup in Multi-Sector Environment

The first order conditions for the firm are given by:

$$
\begin{aligned}
[n]: \quad & w = \mu \underbrace{\gamma k^{\alpha} n^{\gamma-1}}_{\text{MPL}} \\
[y_{ij}]: \quad & p_{ij} = \hat{\mu} + \lambda \\
[p_{ij}]: \quad & y_{ij} = \lambda [p_{ij}^{-\eta} (p_{ij}^{1-\eta} + \sum_{x \neq i} p_{xj}^{1-\eta})^{\frac{\eta-\theta}{1-\eta}} * P^{\theta} Y)] * \\
& \left[\eta p_{ij}^{-1} - (\eta - \theta) p_{ij}^{-\eta} [p_{ij}^{1-\eta} + \sum_{x \neq i} p_{xj}^{1-\eta}]^{-1} \right] - \\
& \left(\kappa_{ix} (N-1) p_{xj} * (\eta - \theta) p_{ij}^{-\eta} (p_{ij}^{1-\eta} + \sum_{x \neq i} p_{xj}^{1-\eta})^{-1} \right) \\
[\hat{\mu}]: \quad & y_i = k^{\alpha} n^{\gamma} \\
[\lambda]: \quad & y_{ij} = Y * p_{ij}^{-\eta} * (p_{ij}^{1-\eta} + \sum_{x \neq i} p_{xj}^{1-\eta})^{\frac{\eta-\theta}{1-\eta}} * P^{\theta}
\end{aligned}
$$

In a multi-sector environment with common ownership, equilibrium markup will depend on elasticity, the number of firms in each sector, and the degree of common ownership. I use a multi-sector environment because the markups suggested by a single sector world are infeasibly large. As a reminder, that markup was:

$$
\mu_{\text{Single sector}} = \frac{\epsilon N}{(\epsilon - 1)(N - 1)(1 - \kappa)}
$$

If there were a single owner of all firms, then κ would approach one. That would lead to infinite markup, which is not economically sensible. Even at lower levels of common ownership, however, the markup terms increases much more quickly than would be believable looking at historical trends.

In a multi-sector economy, the final goods aggregator solves a cost minimization problem to determine how many intermediate goods it must purchase to satisfy aggregate demand, conditional on intermediate goods prices. Its problem is to solve:

$$\max_{y_{ij}} PY - \int_j \sum_i^N p_{ij} y_{ij} dj$$
$$\text{s.t. } Y = \left[\int_{\mathscr{J}} \left\{ \left(\sum_i^N y_{ij}^{\frac{\eta-1}{\eta}} \right)^{\frac{\eta}{\eta-1}} \right\}^{\frac{\theta-1}{\theta}} dj \right]^{\frac{\theta}{\theta-1}}$$

The first order conditions from this problem are given by:

$$p_i = PY^{\frac{1}{\theta}} * y_j^{\frac{-1}{\theta}+\frac{1}{\eta}} * y_i^{\frac{-1}{\eta}}$$
$$y_{ij} = Y * p_{ij}^{-\eta} * p_j^{\eta-\theta} * P^{\theta}$$

The intermediate goods firm takes this inverse demand function as a constraint when solving its profit maximization problem. It chooses price, output, and labor in order to maximize its profits and the weighted profits of its within-sector competitors. Because each firm is part of a sector that is an atomistic component of the aggregate economy, it believes it cannot affect the profitability of firms outside of its own sector. The firm knows that it can increase its competitors profits by raising its own price and cutting capacity. The intermediate goods firm solves:

$$\max_{p_{ij},y_{ij},n} p_{ij} * y_{ij} - w * n + \sum_{x \neq i} \kappa_{ix} * \pi_{xj}(p_{ij}) \tag{15}$$

$$\text{s.t. } y_i \leq k^{\alpha} n^{\gamma}$$

$$y_{ij} = Y * p_{ij}^{-\eta} * (p_{ij}^{1-\eta} + \sum_{x \neq i} p_{xj}^{1-\eta})^{\frac{\eta-\theta}{1-\eta}} * P^{\theta}$$

which yields these first order conditions, assuming all LaGrange multipliers are nonzero:

$$[n]: \qquad w = \mu \underbrace{\gamma k^{\alpha} n^{\gamma-1}}_{\text{MPL}}$$

$$[y_{ij}]: \qquad p_{ij} = \hat{\mu} + \lambda$$

$$[p_{ij}]: \qquad y_{ij} = \lambda[p_{ij}^{-\eta}(p_{ij}^{1-\eta} + \sum_{x \neq i} p_{xj}^{1-\eta})^{\frac{\eta-\theta}{1-\eta}} * P^{\theta} Y)] * \left[\eta p_{ij}^{-1} - (\eta - \theta) p_{ij}^{-\eta} [p_{ij}^{1-\eta} + \sum_{x \neq i} p_{xj}^{1-\eta}]^{-1}\right] - \left(\kappa_{ix}(N-1) p_{xj} * (\eta - \theta) p_{ij}^{-\eta} (p_{ij}^{1-\eta} + \sum_{x \neq i} p_{xj}^{1-\eta})^{-1}\right)$$

$$[\hat{\mu}]: \qquad y_i = k^{\alpha} n^{\gamma}$$

$$[\lambda]: \qquad y_{ij} = Y * p_{ij}^{-\eta} * (p_{ij}^{1-\eta} + \sum_{x \neq i} p_{xj}^{1-\eta})^{\frac{\eta-\theta}{1-\eta}} * P^{\theta}$$

From here, I can impose symmetry because all firms have the same technology and maximization problems. I also normalize $P = 1$ without loss of generality. Symmetry will give $p_{ij} = p_{xj}$ and $y_{ij} = y_{xj}$, which gives aggregate output as $Y = N^{\frac{\eta}{\eta-1}} y_{ij}$. The first order conditions can be rearranged to solve for equilibrium markup ($\frac{p}{\mu}$):

$$\frac{p_{ij}}{\hat{\mu}} = \frac{(N-1)\eta + \theta}{(N-1)(\eta - \kappa * (\eta - \theta)) - N + \theta}$$

Common Ownership Level	Single-sector markup	Multi-sector markup
0	1.10	1.10
0.2	1.37	1.22
0.4	1.83	1.38
0.6	2.74	1.59
0.8	5.48	1.88
1	∞	2.28

Table **??**: Comparison of markups between single- and multi-sector models. Parameters described in the surrounding text.

Table **??** shows a comparison of markups with different levels of common ownership. The single-sector model has cross-sector elasticity of 12 and 250 sectors. The elasticity here is chosen at the high end of estimates at the SIC-5 level. The number of sectors is simply a number that is "large enough" that it doesn't have a significant upward influence on markup.

The multi-sector model has the same parameters which are used in the body of this chapter. Cross-sector substitution is 6 and within-sector substitution is 12, with ten firms per sector. These substitution levels are in line with SIC-3 versus SIC-5 elasticities. The number of firms per sector is 10. While this number sounds relatively small for some sectors (like bars and restaurants), it is appropriate for a number of larger-ticket industries like automobiles and aviation. This firm number approximation is also more conservative than some markup models. For example, Mongey (2018) simplifies the economy into only two firms per sector and argues that it is sufficient for understanding changes in markup over time.

The multi-sector model has nearly identical levels of markup when common ownership is at zero. As common ownership increases, multi-sector markup increases at a much more reasonable pace than there is in the single-sector baseline case. For reference, estimates of common ownership since the 1970's show it shifting from roughly 20% to 60% in the mid-2010's. In the single-sector environment, this would have moved markups from 37% up to 174%. In the multi-sector model, markups rise from 22% to 59%. In both cases, markups are higher than would be expected based on economic data. However, the multi-sector approximation is much closer to a reasonable estimate. A better-calibrated model may be able to replicate the change in markups as an untargeted moment, though that research is a potential issue for future work.

FOCs for capital:

$$\frac{p_{ij}}{\mu} = \frac{N^{\frac{1}{\eta-1}}}{\left(\frac{\frac{1}{\beta}-1+\delta}{\alpha k^{\alpha-1} n^{\gamma}}\right)} = \frac{(N-1)\eta+\theta}{(N-1)(\eta-\kappa(\eta-\theta))-N+\theta}$$

$$\alpha k^{\alpha-1} n^{\gamma} = (\frac{1}{\beta}-1+\delta)N^{\frac{1}{1-\eta}}\frac{(N-1)\eta+\theta}{(N-1)(\eta-\kappa(\eta-\theta))-N+\theta}$$

$$k^{\alpha-1} = \frac{\frac{1}{\beta}-1+\delta}{\alpha n^{\gamma}}N^{\frac{1}{1-\eta}}\frac{(N-1)\eta+\theta}{(N-1)(\eta-\kappa(\eta-\theta))-N+\theta}$$

$$k = \left(\frac{\alpha n^{\gamma}}{\frac{1}{\beta}-1+\delta}N^{\frac{1}{\eta-1}}\frac{(N-1)(\eta-\kappa(\eta-\theta))-N+\theta}{(N-1)\eta+\theta}\right)^{1-\alpha}$$