Portfolio Diversification, Market Power, and the Theory of the Firm*

José Azar†

IESE Business School, Universidad de Navarra

December 23, 2016

PRELIMINARY. COMMENTS WELCOME.

Abstract

This paper develops a model of firm behavior in the context of oligopoly and portfolio diversification by shareholders. Competition for shareholder votes among potential managers seeking corporate office leads to internalization and aggregation of shareholder objectives, including shares in other firms, and the fact that shareholders are consumers and workers of the firms. When all shareholders hold market portfolios, firms that are formally separate behave as a single firm. I introduce new indices that capture the internalization effects from consumer/worker control, and discuss implications for antitrust, stakeholder theory, and the boundaries of the firm.

*This paper is partly based on several chapters of my Ph.D. thesis. I thank my advisor, Chris Sims, for invaluable feedback. I am also grateful to Dilip Abreu, Avidit Acharya, Roland Benabou, Stan Besen, Martino DeStefano, Harrison Hong, Oleg Itskhoki, Ben Lipsius, Stephen Morris, Manuel Mueller-Frank, Volker Nocke, Morten Olsen, Juan Ortner, Kristopher Ramsay, Steve Salop, Jose Scheinkman, Martin Schmalz, Hyun Shin, David Sraer, Xavier Vives, Glen Weyl, Wei Xiong, and seminar participants at the University of California, Berkeley (Haas), IESE Business School, CERGE-EI, Bank of Finland, Cornerstone Research, University of North Carolina, Chapel Hill (Kenan-Flagler), Universität Mannheim, Deusto Business School, Universitat Pompeu Fabra, Charles River Associates, Princeton University, and Humboldt Universität zu Berlin for helpful comments. This work was partially supported by the Center for Science of Information (CSoI), an NSF Science and Technology Center, under grant agreement CCF-0939370.

†Address: Avinguda Pearson, 21, 08034 Barcelona, Spain . Email: jazar@iese.edu.

1 Introduction

Ownership of publicly traded firms by financial institutions has increased dramatically in recent decades. The fraction of U.S. stock market capitalization held by institutional investors increased from 7% in 1950 to about 70% today.[1] A natural consequence of this development is the ubiquity of common ownership of publicly traded firms by large financial institutions. The probability that two randomly selected firms in the same industry from the S&P 1500 have a common shareholder with at least 5% stakes in both firms increased from less than 20% in 1999Q4 to around 90% in 2014Q4 (Figure 1).[2] Thus, while there has been some degree of overlap for many decades, the current ubiquity of common ownership of large blocks of stock is a relatively recent phenomenon. This large increase in interlocking shareholdings coincided with the period of fastest growth in corporate profits and the fastest decline in the labor share since the end of World War II, with corporate profits approximately doubling as a share of GDP over a 10-year period (Figure 2).[3]

Changes of this magnitude in the ownership structure of corporations raise important questions about firm objectives and boundaries. To the extent that a group of formally separate firms have similar owners, should we continue to think of them as independent firms, or as part of a larger corporate structure? Does common ownership lead firms in the direction of joint profit maximization? To what extent do firms internalize shareholder objectives, such as shareholders being affected as consumers or as workers? How should antitrust regulation approach the issue of common ownership by financial investors? What role, if any, has the increase in common ownership played in the increasing share of corporate profits in GDP and declining labor share? Motivated by these questions, this paper develops a model of firm be-

[1] See Gompers and Metrick (2001); Gillan and Starks (2007); Davis (2008); McCahery, Sautner, and Starks (2015).

[2] Figure 1 shows dramatic increases are also observed when using 3%, 4% 6%, or 7% thresholds for the ownership stakes instead of a 5% threshold.

[3] The inverse of the labor share is commonly used to proxy for aggregate markups in the macroeconomics literature (Rotemberg and Woodford, 1999; Nekarda and Ramey, 2010). Using a more sophisticated methodology, Barkai (2016) estimates markups for the U.S. economy and also finds that they have increased in recent decades.

havior in the context of oligopoly and portfolio diversification by shareholders.

In the model, based on a standard and tractable version of probabilistic voting, several potential managers are seeking to obtain the rents associated with corporate office, but they need to compete for shareholder votes in order to obtain these rents. This process of managerial competition and selection leads to internalization and aggregation of shareholder objectives, including the fact that they can hold shares in other firms, and the fact that shareholders are, to some extent, consumers and workers of the firms.

We start by applying the framework to prove a version of a "folk theorem:" the idea that, when there is no uncertainty and shareholders are not consumers or workers of the firms, if all shareholders hold market portfolios then all firms act as if they were a single firm to maximize joint profits (Rotemberg, 1984; Gordon, 1990; Hansen and Lott, 1996). In the case of certainty, there is no disagreement between shareholders. We then extend this result to the case of uncertainty–and therefore disagreement between shareholders–and show that under some conditions all firms still act as a single firm.

We then consider cases with general portfolios and when shaerholders can be consumers or workers. In the case of oligopolistic firms with shareholder-consumers competing à la Cournot, we obtain an expression linking the average industry markup of prices above marginal costs (weighted by market shares) to the difference between an O'Brien and Salop (2000) modified Herfindahl-Hirschman Index (MHHI) using the product market shares of the firms, and an index that captures the internalization effect from the fact that shareholders can also be consumers (which we name the "consumer power index" or "CPI"). In the case when ownership is proportional to consumption, then the internalization of the effect of market power on shareholders as consumers is complete, and the firm sets price equal to marginal cost (Nielsen, 1979; Farrell, 1985). While this case seems unrealistic for publicly traded firms, it could be a good approximation (as well as a rationale for) for consumer cooperatives or publicly owned firms. We then derive an expression for the consumer power index in terms of the variances of consumption and ownership shares of the firm, as well as the relative alignment of each these with control of the firm (relative alignment is measured by the ratio of the cosine of the angle between the consumption and control share vectors and the cosine of the ownership and control share vectors). If the variance of consumption is finite, but the variance of ownership is infinite, then the CPI is zero.[4]

In the case of labor market oligopsony, again with firms competing à la Cournot, the model results in an expression linking the average industry markdown of wages below the value of the marginal product of labor (weighted by market shares) to the difference between an MHHI based on the employment shares of the firms, and an index that captures the internalization effect from the fact that shareholders can also be workers (which we name the "worker power index" or "WPI"). The wage gets closer to the marginal product of labor as labor supply and ownership become more closely aligned. The worker power index would tend be higher for worker cooperatives and at large firms in countries where some level of worker control is mandated by law. We also show that there is a level of legally mandated worker control that would restore efficiency, although in general the optimal level depends not just on firm size but on the whole ownership structure.

The main takeaway, perhaps, from the analysis of labor market oligopsony with shareholder voting, is that who owns what matters. This is for two reasons. First, it matters because the level of common ownership partly determines the level of market power in a labor market. And second, it matters because the degree to which the workers are owners of the firms determines the extent to which market power is used to reduce wages below the value of the marginal product of labor and the extraction of monopsony rents from the workers.

The model can thus shed some light on the debates on shareholder value maximization, stakeholder representation, and corporate social responsibility at large firms. Friedman (1970) argued that firms should focus solely on individual profit maximization, and Jensen (2001), somewhat more generally, argued that a firm should maximize its market value, and dismissed stakeholder representation as infeasible. Magill, Quinzii, and Rochet (2013), on the other hand,

[4] Excluding the case of zero alignment between ownership and control.

argue that stakeholder representation is feasible as long as stakeholder groups and their objectives are well defined. The theory developed in the present paper provides a clear efficiency rationale for some degree of consumer and employee representation at large firms as one possible response to market power in product and labor markets, and perhaps a complement to antitrust policy, since it seems unlikely that antitrust can deal effectively with all the instances of market power in the labor market. The reason is that consumer and employee representation can reduce the markdown of wages relative to the marginal product of labor and therefore bring the economy closer to a competitive outcome.

This line of reasoning provides an efficiency rationale for wealth inequality reduction–to the extent that reducing inequality makes control, ownership, consumption, and labor supply more aligned–because less inequality of ownership and control can automatically lead to increased representation of the interests of consumers and employees, as well as other social interests, in the objective function of the firm. In the limit, when agents are homogeneous and all firms are commonly owned, this automatic stakeholder representation leads to a Pareto efficient outcome even in the presence of market power, and even though there is no competition in the economy. Similarly–to the extent that there is "home bias" in consumption and labor supply–it provides an efficiency rationale for local ownership, since in this case local ownership would tend to align control of the firms with consumption and labor supply.

The fact that firms are connected through common ownership created by portfolio diversification also has important implications for the theory of the boundaries of the firm. Classic contributions to this theory include Coase (1937); Williamson (1975); Grossman and Hart (1986); Hart and Moore (1990). According to the Grossman-Hart-Moore theory, "a firm is exactly a set of assets under common ownership" (Holmström and Roberts, 1998). If every agent holds a market portfolio, then the ownership of all firms becomes identical, and therefore according to this definition they are really a single firm. This literature tends to focus on mergers and acquisitions as the source of changes in firm boundaries, and on the deep economic and strategic considerations that motivate mergers. In this paper, in contrast, we place the focus on portfolio diversification as a powerful force that determines ultimate ownership of firms by financial investors in stock market economies, with the effect of blurring firm boundaries at a massive scale, and in a way that is not driven by economic or strategic considerations beyond the management of portfolio risk. Another difference with this literature is that the focus in this paper is on market power, as opposed to the focus of the literature on hold-up problems and other contractual externalities.

The theory of the firm developed in this paper could also provide a solid foundation for models of general equilibrium oligopoly. A major isssue that this literature faced was that the solution to the models depended on the choice of the numeraire (Gabszewicz and Vial, 1972; Roberts and Sonnenschein, 1977; Mas-Colell, 1982; Hart, 1982b,a; Neary, 2002, 2009). However, the reason for this problem was that the literature generally assumed that firms maximized profits, which are necessarily dependent on the unit of account. In contrast, when the objective of the firm is microfounded as the outcome of a voting process, it is independent of the numeraire. Azar and Vives (2016) build on this idea to develop a simple macroeconomic model to explore theoretically the effect of market concentration on aggregate outcomes.

2 Literature Review

Modern Portfolio Theory, as developed by Markowitz (1952); Arrow (1964); Debreu (1959); Sharpe (1964); Lintner (1965) among others, prescribes that investors should hold market portfolios and thus provided intellectual support to the rise of mutual funds and index funds. This work focused on the decision problem of an investor and its normative insights are from an individual investor's point of view. From the narrow point of view of portfolio diversification by investors, the rise of mutual funds and especially low-cost index funds has been a welcome development. However, the analysis of the implications for society as a whole was limited, for example, by the fact that the theory ignored the possibility of any effect on competition because this set of models assumed that firms were price-takers. An important but under-appreciated result in economic theory is that, when all shareholders hold market portfolios, are not consumers or workers of the firms, and there is no uncertainty, then they unanimously agree on joint profit maximization by all firms in the economy, leading to an economy-wide monopoly outcome (Rotemberg, 1984; Gordon, 1990; Hansen and Lott, 1996). Modern portfolio theory recommended that investors hold market portfolios, but had nothing to say about the competitive implications of everyone following its advice because any competitive implications were excluded by the price-taking assumption.

While the limiting result of economy-wide monopoly is useful to understand the potential consequences of the trend of increasing portfolio diversification, in practice many shareholders are still far from holding completely diversified portfolios. Shareholders also differ in other dimensions, such as the extent to which they are consumers and workers of the firms that they own in their portfolios, and in their levels of risk-aversion. Given this, can a reasonable objective function of the firm be derived from aggregation of the individual objectives of heterogeneous shareholders? The answer is no, or at least not in a completely general way, as Kenneth Arrow discovered when, as a graduate student, he attempted to generalize the theory of the firm to the case of multiple shareholders (Arrow, 1983, p. 2):

> "When in 1946 I began a grandiose and abortive dissertation aimed at improving on John Hicks's *Value and Capital*, one of the obvious needs for generalization was the theory of the firm. What if it had many owners, instead of the single owner postulated by Hicks? To be sure, it could be assumed that all were seeking to maximize profits; but suppose they had different expectations of the future? They would then have differing preferences over investment projects. I first supposed that they would decide, as the legal framework would imply, by majority voting. In economic analysis we usually have many (in fact, infinitely many) alternative possible plans, so that transitivity quickly became a significant question. It was immediately clear that majority voting did not necessarily lead to an ordering. In view of my aims, I reacted to this result as a nuisance, not a clue for further study. Besides, I was

> convinced that what we presently call the Condorcet paradox was not new. I am at a loss to identify the source of my belief, now that I know the previous literature, since I could not possibly have seen any of this obscure material prior to 1946."

Given this difficulty in dealing with the shareholder preference aggregation problem, economists chose to focus on cases in which shareholders unanimously agreed on market value maximization, which is the case when firms are price-takers and markets are complete (Ekern and Wilson, 1974; Radner, 1974; Leland, 1974). Hart (1979) proves a similar result when firms are competitive but markets are incomplete: shareholders agree on value maximization but disagree on how to achieve this goal, since not all prices are quoted in the market. Hart (1979) explicitly notes that in general shareholders may not want value-maximizing behavior because they could hold shares in other firms, and because they can be consumers:

> "Without such a competitiveness assumption, a change in a firm's production plan will have two effects on an initial shareholder's utility. First there will be a change in the shareholder's initial wealth due to changes in the (net) market value of the firm and possibly also in the (net) market values of other firms; we call this the wealth effect. Secondly, there will be changes in the prices of the bundles of contingent commodities purchased by the shareholder in the stock market; we call this the consumption effect."

While other papers in this literature assume that firms are price-takers, Hart (1979) instead considers a sequence of replica economies and derives the value maximization result by imposing enough assumptions on agents' portfolios to prevent, among others, cases such as all shareholders holding market portfolios. In contrast to this literature, this paper focuses on the oligopoly case, and develops a model of the firm in which shareholder preferences can be aggregated. This requires imposing more structure on shareholder preferences and the voting framework than Arrow did. In particular, I use the standard theory of probabilistic voting which was developed by Lindbeck and Weibull (1987); Coughlin (1992) as a model of political competition.[5]

3 The basic framework: oligopoly with shareholder voting

An oligopolistic industry consists of N firms. Firm n's profits per share can be random and depend both on its own policies $\mathbf{p}_n$ and on the policies of the other firms, $\mathbf{p}_{-n}$, as well as the state of nature $\omega \in \Omega$:

$$\pi_n = \pi_n(\mathbf{p}_n, \mathbf{p}_{-n}; \omega).$$

Suppose that $\mathbf{p}_n \in S_n \subseteq \mathbb{R}^K$, so that policies can be multidimensional. The policies of the firm can be prices, quantities, investment decisions, innovation, or in general any decision variable that the firm needs to choose. In principle, the policies could be contingent on the state of nature, but this is not necessary.

There is a set I of shareholders, whose portfolios can include shares in more than one firm in the industry. Shareholder i holds β_{in} shares in firm n. The total number of shares of each firm is normalized to 1. For simplicity, we assume one vote per share, although this can easily be relaxed. Each firm holds its own elections to choose its management, which controls the firms' policies. At each company n, there are two potential managers, A_n and B_n, in Downsian competition for the shareholder's votes. Let ξ_{i,J_n} denote the probability that shareholder i votes for managerial candidate J_n in company n's elections, where $J_n \in A_n, B_n$. The expected vote share of candidate J_n in firm n's elections is

$$\xi_{J_n} = \sum_{i \in I} \beta_{in} \xi_{i,J_n}.$$

Shareholders get utility from income, which is the sum of profits from all their shares. I will also assume that utility has a random component that depends on what candidate is in

[5]Some papers in the incomplete markets literature also used voting models to aggregate shareholder preferences. For example, median voter theory is used by Benninga and Muller (1979); DeMarzo (1993).

power in each of the firms.[6] One way to think about the random component of utility is that managerial candidates cannot predict perfectly the way in which a particular shareholder will vote in the election. That is, there is some uncertainty about shareholder voting behavior from the point of view of the managerial candidates. More activist shareholders will communicate with potential managers to reduce this uncertainty. As we will see, the higher the level of information the managerial candidates have about a given shareholder's preferences, the higher that shareholder's weight is in the firm's equilibrium objective function.

The utility of shareholder i when the policy of firm n is $\mathbf{p}_n$, the policies of the other firms are $\mathbf{p}_{-n}$, and the vector of elected parties is $\{J_n\}_{n=1}^N$ is

$$\tilde{U}_i\left(\mathbf{p}_n, \mathbf{p}_{-n}, \{J_s\}_{s=1}^N\right) = U_i(\mathbf{p}_n, \mathbf{p}_{-n}) + \sum_{s=1}^N \tilde{\sigma}_{is}(J_s),$$

where $U_i(\mathbf{p}_n, \mathbf{p}_{-n}) = \mathbb{E}\left[u_i\left(\sum_{s=1}^N \beta_{is}\pi_s(\mathbf{p}_s, \mathbf{p}_{-s}; \omega)\right)\right]$. The utility function u_i of each group is increasing in income, with non-increasing marginal utility. The $\tilde{\sigma}_{in}(J_n)$ terms represent the random utility that shareholder g obtains if candidate J_i controls the board of company n. The random utility terms are independent across firms and shareholders, and independent of the state of nature ω. As a normalization, let $\tilde{\sigma}_{in}(A_n) = 0$. To ensure existence of equilibrium in this relatively general case, we make the following assumptions:

Assumption 1. (Compact and convex strategy spaces) *The strategy spaces S_n are nonempty compact convex subsets of Euclidean space.*

Assumption 2. (Continuous shareholder utilities) *The deterministic component of utility, $U_i(\mathbf{p}_n, \mathbf{p}_{-n})$, is continuous and twice-differentiable in $(\mathbf{p}_n, \mathbf{p}_{-n})$ and has continuous second-derivatives.*

Assumption 3. (Concave shareholder utilities) *The deterministic component of utility, $U_i(\mathbf{p}_n, \mathbf{p}_{-n})$,*

[6]Alternatively, one could consider a deterministic voting model, which would lead to firms in equilibrium maximizing a weighted-median of shareholder utilities. The intuition about internalization of overlapping ownership stakes and of the effects of firm prices and wages on shareholders as consumers and workers would be the same. A probabilistic voting is more tractable than a deterministic model, and arguably more realistic, given that in practice managers are unlikely to be completely certain about which way a particular shareholder will vote in an election.

is strictly concave in $\mathbf{p}_n$.

Assumption 4. (Uniform distribution of bias) *The bias of voter* i *for candidate* J_n, $\tilde{\sigma}_{in}(J_n)$ *is distributed uniformly on* $\left[-\frac{1}{2\psi_{in}}, \frac{1}{2\psi_{in}}\right]$.

While these assumptions are fairly restrictive, especially concavity of shareholder utilities, they are standard in the probabilistic voting literature and used to ensure existence of an equilibrium. They are sufficient but not necessary, and can be relaxed in particular applications of the theory. For example, in later sections in which we apply the framework in a Cournot context we relax concavity of individual shareholder objective functions and assume a weaker condition.

Let $\mathbf{p}_{A_n}$ denote the platform of candidate A_n and $\mathbf{p}_{B_n}$ that of candidate B_n.

Assumption 5. (Conditional sincerity) *Voters are conditionally sincere. That is, in each firm's election they vote for the candidate whose policies maximize their utilities, given the equilibrium policies in all the other firms. In case of indifference between the two parties, a voter randomizes.*

Conditional sincerity (Alesina and Rosenthal, 1995, 1996; Chari, Jones, and Marimon, 1997; Ahn and Oliveros, 2012) is a natural assumption as a starting point in models of multiple elections. Alesina and Rosenthal (1996) obtain it as a result of coalition proof Nash equilibrium in a model of simultaneous presidential and congressional split-ticket elections.[7]

Using Assumption 5, the probability that shareholder i votes for candidate A_n is

$$\xi_{i,A_n} = P\left[\tilde{\sigma}_{in}(B_n) < U_i(\mathbf{p}_{A_n}, \mathbf{p}_{-n}) - U_i(\mathbf{p}_{B_n}, \mathbf{p}_{-n})\right].$$

As notation, we call H_{in} the cumulative distribution function of $\tilde{\sigma}_{in}(B_n)$ (since it is uniform,

[7] In this paper, I treat conditional sincerity as a plausible behavioral assumption, which, while natural as a starting point, does not necessarily hold in general. A complete characterization of the conditions under which conditional sincerity arises as the outcome of strategic voting in models of multiple elections is an open problem.

$H_{in}(x) = \frac{1}{2} + \psi_{in}x$). The vote share of candidate A_n is

$$\xi_{A_n} = \sum_{i \in I} \beta_{in} H_{in} \left[U_i(\mathbf{p}_{A_n}, \mathbf{p}_{-n}) - U_i(\mathbf{p}_{B_n}, \mathbf{p}_{-n}) \right]. \tag{1}$$

We can solve the model under alternative assumptions on managerial candidate objectives. One possibility is to assume that candidates choose their platforms to maximize their expected vote shares.

Assumption 6. (Vote share objective) *Candidates maximize expected vote share at their firm.*

Elections for all companies are held simultaneously, and the two parties in each company announce their platforms simultaneously as well. A pure-strategy Nash equilibrium for the industry under vote share objective is a set of platforms $\{\mathbf{p}_{A_n}, \mathbf{p}_{B_n}\}_{n=1}^{N}$ such that, given the platform of the other candidate in the firm, and the winning policies in all the other firms, a managerial candidate chooses its platform to maximize its vote share. The first-order condition for managerial candidate A_n is

$$\sum_{i \in I} \psi_{in} \beta_{in} \frac{\partial U_i(\mathbf{p}_{A_n}, \mathbf{p}_{-n})}{\partial \mathbf{p}_{A_n}} = 0, \tag{2}$$

where

$$\frac{\partial U_i(\mathbf{p}_n, \mathbf{p}_{-n})}{\partial \mathbf{p}_{A_n}} = \left(\frac{\partial U_i(\mathbf{p}_{A_n}, \mathbf{p}_{-n})}{\partial p^1_{A_n}}, \ldots, \frac{\partial U_i(\mathbf{p}_{A_n}, \mathbf{p}_{-n})}{\partial p^K_{A_n}} \right).$$

In the latter expression, $p^k_{A_n}$ is the kth component of the policy vector $\mathbf{p}_{A_n}$. The derivatives in terms of the profit functions are

$$\frac{\partial U_i(\mathbf{p}_n, \mathbf{p}_{-n})}{\partial \mathbf{p}_{A_n}} = \mathbb{E}\left[u_i' \left(\sum_{s=1}^{N} \beta_{is} \pi_s(\mathbf{p}_s, \mathbf{p}_{-s}; \omega) \right) \sum_{s=1}^{N} \beta_{is} \frac{\partial \pi_s(\mathbf{p}_s, \mathbf{p}_{-s})}{\partial \mathbf{p}_n} \right].$$

The maximization problem for managerial candidate B_n is symmetric.

Proposition 1. *Under assumptions 1, 2, 3, 4, 5, 6, a pure-strategy equilibrium of the voting game exists. In the equilibrium, the two candidates at every firm converge to the same strategy, which maximizes a* *weighted average of shareholder utilities conditional on rival strategies:*

$$\sum_{i \in I} \psi_{in} \beta_{in} U_i(\mathbf{p}_n, \mathbf{p}_{-n}) \text{ for } n = 1, \ldots, N. \tag{3}$$

Proof. The conditional sincerity assumption (5) ensures that the maximization problem of a managerial candidate can be expressed taking as given the strategies of the other firms. The assumptions of compact and convex strategy sets, concavity, uniformly distributed bias, and vote-share objective (1, 3, 4 and 6) ensure that the objective function of a managerial candidate is strictly concave conditional on rival firm strategies and therefore has a unique maximum. Because the maximization problems of both candidates at each firm are symmetric, they both choose the same strategy conditional on the strategies of the other firms. This leads to a well-defined best-response function for each firm, as a function of the strategies of rival firms. The assumptions of compact-convex strategy sets and continuity (1 and 2) ensure that the best-response functions are upper-hemicontinuous. Thus, we can apply Kakutani's fixed point theorem to ensure existence of an equilibrium. □

Note that the weights in the average of shareholder utilities are different at different firms. The maximization takes into account the effect of the policies of firm n on the profits that shareholders get from every firm, not just firm n. Thus, when the owners of a firm are also the residual claimants for other firms, they internalize some of the pecuniary externalities that the actions of the first firm generate for the other firms that they hold.

Alternatively, one could assume that managerial candidates maximize the probability of winning the election. This would be the case if there is, say, an exogenous rent from corporate office, and managerial candidates maximize the expected utility from that rent, which is the constant rent times the probability of obtaining it.

Assumption 7. (Win objective) *Candidates maximize probability of winning corporate office at their firm.*

If the candidates maximize win probability, then a similar result obtains, but with the Banzhaf voting power indices taking the place of the voting shares in the weights of the firms' objective functions. To see this, note that the first-order condition for managerial candidate A_n is

$$\sum_{i \in I} \frac{\partial P_{A_n}}{\partial \xi_{i,A_n}} \psi_{in} \frac{\partial U_i(\mathbf{p}_{A_n}, \mathbf{p}_{-n})}{\partial \mathbf{p}_{A_n}} = 0, \tag{4}$$

where $\frac{\partial P_{A_n}}{\partial \xi_{i,A_n}}$ is the derivative of the probability that managerial candidate A_n wins the election with respect to the probability that shareholder i votes for managerial candidate A_n. The probability that candidate A_n wins the election is

$$P_{A_n} = \sum_{C \in \mathcal{M}_n} \left(\prod_{i \in C} \xi_{i,A_n} \right) \left(\prod_{i \notin C} (1 - \xi_{i,A_n}) \right), \tag{5}$$

where $\mathcal{M}_n$ is the set of majority coalitions at firm n. Evaluated at $\xi_{i,A_n} = 1/2$ for all i, the derivative of this probability with respect to ξ_{i,A_n} is equal to

$$\frac{\partial P_{A_n}}{\partial \xi_{i,A_n}} = \frac{1}{2^{n-1}} \left\{ \sum_{C \subset I | i \in C} \left[\mathbb{1}(C \in \mathcal{M}_n) - \mathbb{1}(C \backslash \{g\} \in \mathcal{M}_n) \right] \right\}. \tag{6}$$

The expression on the right-hand side is the Banzhaf index of voting power ($\mathcal{B}_{in}$) for shareholder i at firm n, which is proportional to the number of coalitions where shareholder i is pivotal in firm n's election.[8] The denominator 2^{n-1} is the total number of possible ways in which the set of shareholders excluding i can vote.[9] One can show a similar characterization of equilibrium under the assumption that managerial candidates maximize the probability of winning office:

Proposition 2. *Under assumptions 1, 2, 3, 4, 5, 7, a pure-strategy equilibrium of the voting game exists. In the equilibrium, the two candidates at every firm converge to the same strategy, which maximizes the*

[8]Sometimes also referred to as the Penrose-Banzhaf index. See Penrose (1946) and Banzhaf III (1964).

[9]This index is often used as an *ad hoc* voting power measure, but as this illustrates, it can be microfounded as voter utility weights when two candidates are engaged in Downsian competition because in equilibrium voters randomize their votes equally between the two candidates.

following weighted average of shareholder utilities conditional on rival strategies:

$$\sum_{i \in I} \psi_{in} \mathcal{B}_{in} U_i(\mathbf{p}_n, \mathbf{p}_{-n}) \textit{ for } n = 1, \ldots, N. \tag{7}$$

Proof. The conditional sincerity assumption (5) ensures that the maximization problem of a managerial candidate can be expressed taking as given the strategies of the other firms. The assumptions of compact and convex strategy sets, concavity, uniformly distributed bias, and win objective (1, 3, 4 and 7) ensure that the objective function of a managerial candidate is strictly concave conditional on rival firm strategies and therefore has a unique maximum. To see this, note that the second-derivative of the objective of managerial candidate A_n is

$$\sum_{i \in I} \frac{\partial^2 P_{A_n}}{\partial \xi_{i,A_n}{}^2} \left(\psi_{in} \frac{\partial U_i(\mathbf{p}_{A_n}, \mathbf{p}_{-n})}{\partial \mathbf{p}_{A_n}} \right) \left(\psi_{in} \frac{\partial U_i(\mathbf{p}_{A_n}, \mathbf{p}_{-n})}{\partial \mathbf{p}_{A_n}} \right)' + \sum_{i \in I} \frac{\partial P_{A_n}}{\partial \xi_{i,A_n}} \psi_{in} \frac{\partial^2 U_i(\mathbf{p}_{A_n}, \mathbf{p}_{-n})}{\partial \mathbf{p}_{A_n}^2},$$

but the first term is equal to zero since

$$\frac{\partial P_{A_n}}{\partial \xi_{i,A_n}} = \sum_{C \in \mathcal{M}_n, i \in C} \left(\prod_{j \in C, j \neq i} \xi_{j,A_n} \right) \left(\prod_{j \notin C} (1 - \xi_{j,A_n}) \right) - \sum_{C \in \mathcal{M}_n, i \notin C} \left(\prod_{j \in C} \xi_{j,A_n} \right) \left(\prod_{j \notin C, j \neq i} (1 - \xi_{,A_n}) \right)$$

and thus $\frac{\partial^2 P_{A_n}}{\partial \xi_{i,A_n}{}^2} = 0$ for all i, since the derivative does not depend on ξ_{i,A_n}. Thus, the second-derivative of the managerial candidate's objective function is equal to

$$\sum_{i \in I} \frac{\partial P_{A_n}}{\partial \xi_{i,A_n}} \psi_{in} \frac{\partial^2 U_i(\mathbf{p}_{A_n}, \mathbf{p}_{-n})}{\partial \mathbf{p}_{A_n}^2},$$

which is a negative-definite matrix for all possible values of the firm strategy and rival strategies. Because the maximization problems of both candidates at each firm are symmetric, they both choose the same strategy conditional on the strategies of the other firms. Thus, in equilibrium

$$\frac{\partial P_{A_n}}{\partial \xi_{i,A_n}} = \frac{1}{2^{n-1}} \left\{ \sum_{C \subset I | i \in C} [\mathbb{1}(C \in \mathcal{M}_n) - \mathbb{1}(C \backslash \{g\} \in \mathcal{M}_n)] \right\} \equiv \mathcal{B}_{in}. \tag{8}$$

for any possible value of rival firm strategies. This leads to a well-defined best-response function for each firm, as a function of the strategies of rival firms. Moreover, the best-response function is equivalent to the one that would obtain as the solution to maximizing $\sum_{i \in I} \psi_{in} \mathcal{B}_{in} U_i(\mathbf{p}_n, \mathbf{p}_{-n})$ conditional on $\mathbf{p}_{-n}$. The assumptions of compact-convex strategy sets and continuity (1 and 2) ensure that the best-response functions are upper-hemicontinuous. Thus, we can apply Kakutani's fixed point theorem to ensure existence of an equilibrium. $\square$

One can normalize the weights of the shareholder utilities in the objective function to add up to 100%, with the normalized weight $\overline{\mathcal{B}}_{in}$ of shareholder i at firm n given by

$$\overline{\mathcal{B}}_{in} \equiv \frac{\psi_{in} \mathcal{B}_{in}}{\sum_{s \in I} \psi_{in} \mathcal{B}_n^s}. \tag{9}$$

These normalized weights depend not just on the Banzhaf indices, which are a function of the voting shares only, but also on the relative noise that which potential managers have on the objectives of the different shareholders.

The Banzhaf index tends to assign more than proportional weight to large shareholders, since they are more likely to be pivotal than smaller shareholders. As a shareholders shares approach 50%, the probability of being pivotal approaches 100%, and thus the shareholder gets close to complete control of the firm.

It is possible to add a previous stage in the model in which shareholders can invest in increasing their control shares of the firm, either by paying a cost of information to reduce the uncertainty in their voting behavior (Matějka and Tabellini, 2016), or by buying votes directly, if this were institutionally possible (Dekel and Wolinsky, 2012; Posner and Weyl, 2013).[10] This would further increase the power of larger shareholders relative to small shareholders. Small shareholders would have little incentive to pay the costs, since their stakes in the firm are small. However, large shareholders would have an incentive to pay the cost of activism, since the

[10] In a practice called "empty voting", hedge funds can construct financial instruments to replicate a voting share without financial interest. For more details, see, for example, Hu (2015).

benefits of increased representation of their own objectives in the objective of the firms could outweigh the cost.

Thus, while direct communication between shareholders and managers is not necessary for managers to internalize shareholder interests in their decision-making, a particular shareholder investing in information and engaging with management to communicate its objectives can gain a higher weight in the objective of the firm relative to other shareholders. If large shareholders have portfolios that are markedly different from those of smaller shareholders, the increased representation of large shareholders could be to the detriment of small shareholders.

4 A folk theorem: complete diversification of shareholder portfolios leads to monopoly

In this section, we apply the voting model in order to prove formally a version of a "folk theorem:" the idea that when all shareholders hold market portfolios, then all firms in an economy act as a single firm, because shareholders agree unanimously on joint profit maximization (Rotemberg, 1984; Gordon, 1990; Hansen and Lott, 1996). I then extend this result to the case in which all shareholders hold market portfolios but disagree on firm policies due to the presence of uncertainty.[11]

We will find it useful to define complete diversification:

Definition 1. *(Complete Diversification) A shareholder who holds a market portfolio, that is any portfolio that is proportional to the total number of shares of each firm, is* completely diversified.

Theorem 1 (Folk)**.** *Suppose all shareholders are completely diversified, are not consumers or workers of the firms, and there is no uncertainty. Then the equilibrium of the voting game yields the same outcome as the one that a monopolist who owned all the firms and maximized their joint profits would choose.*

[11] In this section, I assume that potential managers maximize expected vote share, but the results generalize to the case of maximization of win probability.

Proof. To see why this is the case, note that when all shareholders are completely diversified, β_{in} is the same across firms for a given shareholder. That is, $\beta_{in} = \beta_i$ for all n and all i. Thus, the outcome of the voting equilibrium is characterized by the solution to

$$\max_{\mathbf{p}_n} \sum_{i \in I} \psi_{in} \beta_i u_i \left(\beta_i \sum_{s=1}^{N} \pi_s(\mathbf{p}_s, \mathbf{p}_{-s}) \right) \text{ for } n = 1, \ldots, N.$$

We can rewrite this as

$$\max_{\mathbf{p}_n} f_n \left(\sum_{s=1}^{N} \pi_s(\mathbf{p}_s, \mathbf{p}_{-s}) \right) \text{ for } n = 1, \ldots, N,$$

where

$$f_n(z) = \sum_{i \in I} \psi_{in} \beta_i u_i \left(\beta_i z \right).$$

Since $f_n(z)$ is monotonically increasing, the solution to is equivalent to

$$\max_{\mathbf{p}_n} \sum_{s=1}^{N} \pi_s(\mathbf{p}_s, \mathbf{p}_{-s}) \text{ for } n = 1, \ldots, N.$$

Because the objective function is the same for all firms, we can rewrite this as

$$\max_{\{\mathbf{p}_n\}_{n=1}^{N}} \sum_{s=1}^{N} \pi_s(\mathbf{p}_s, \mathbf{p}_{-s}).$$

□

The intuition is simple: when all shareholders are completely diversified and there is no uncertainty, then there is no conflict of interest among them, and the aggregation problem becomes trivial. Thus, in the special case of complete diversification and certainty (or risk-neutrality), shareholders would be unanimous in their support for joint profit maximization as the objective of the firm. In fact, any preference aggregation method satisfying Arrow's unanimity axiom would yield the same outcome.

For the more general case with uncertainty (and allowing for risk-averse shareholders), we can show a similar result. We need an additional assumption, which is that the distribution of the bias be the same across firms for a given shaerholder, even when the distribution can be different for different shareholders. In terms of the uniform distribution, this requires that the parameter ψ_{in} depend only on i and not on n:

Assumption 8. (Same distribution of bias across firms for a given shareholder) *The of the distribution of the bias terms depends on i but not on n. That is,* $\psi_{in} = \psi_i$ *for all n and all i.*

Theorem 2. *Suppose all shareholders are completely diversified, and assumption 8 holds. Then the equilibrium of the voting game yields the same outcome as the one that a monopolist who owned all the firms and maximized a weighted average of the utilities of the shareholders would choose.*

Proof. Because of complete diversification, a shareholder i holds the same number of shares β_i in each firm. The equilibrium thus corresponds to the solution of

$$\max_{\mathbf{p}_n} \sum_{i \in I} \psi_{in} \beta_i U_i(\mathbf{p}_n, \mathbf{p}_{-n}) \text{ for } n = 1, \ldots, N.$$

Assumption 8 requires ψ_{in} to be the same for every firm, and thus the objective function is the same for all n. The problem can thus be rewritten as

$$\max_{\{\mathbf{p}_n\}_{n=1}^{N}} \sum_{i \in I} \psi_i \beta_i U_i(\mathbf{p}_n, \mathbf{p}_{-n}).$$

This is the problem that a monopolist would solve, if her utility function was a weighted average of the utilities of the shareholders. The weight of shareholder i is equal to $\psi_i \beta_i$. □

Note that, although all the shareholders hold proportional portfolios, there is still a conflict of interest between them. This is due to the fact that there is uncertainty and shareholders, unless they are risk neutral, care about the distribution of joint profits, not just the expected value. For example, they may have different degrees of risk aversion, both because some may be wealthier than others (i.e. hold a bigger share of the market portfolio), or because their utility functions differ. Although all shareholders are fully internalizing the pecuniary externalities that the actions of each firm generates on the profits of the other firms, some may want the firms to take on more risks, and some may want less risky actions. Thus, in this case there is still a non-trivial preference aggregation problem. The assumption that the distribution of bias is the same across firms for a given shareholder (even when it can differ across shareholders), ensures that the voting equilibrium at each firm is equivalent to maximizing the same objective function. In other words, in a sense all firms are aggregating shareholder preferences in the same way, and this leads to the result that they act as a single firm.

Note also that an almost identical result would also apply to cases in which the shareholders' utility functions take into account price effects on shareholders as consumers, workers, and suppliers of factors of production more generally. In those cases a monopolist that maximized a weighted average of the utilities of its shareholders would also internalize, to some extent, their interests as consumers and factor suppliers.

In the next sections, we consider in more detail cases in which portfolios are incompletely diversified, and quantify explicitly the internalization of consumption and labor supply effects.

5 Oligopoly and shareholder-consumers

In this section, we relax the assumption that the shareholders are not consumers of the firms. Consider the case in which a continuum I of shareholder-consumers of measure 1, and N oligopolistic firms producing a good x with price p and competing in quantities. Shareholder i owns a fraction β_{ij} of the shares firm j, with $\int_{i \in I} \beta_{ij} = 1$ for all j. Shareholders have quasilinear utility over the oligopolistic good x and net wealth y (which serves as the numeraire):

$$U_i(x_i, y_i) = u_i(x_i) + y_i,$$

with $u_i' > 0$ and $u_i'' < 0$. Net wealth is equal to initial monetary wealth $m_{i,0}$ plus the value of their shares minus their expenditure on good x, leading to the budget constraint

$$px_i + y_i = m_i \equiv m_{i,0} + \sum_{j=1}^{N} \beta_{ij}\pi_j,$$

where π_j are the total profits of firm j, which the shareholders take as given because they are atomistic.

The first-order conditions lead to the usual expression for the demand for good x_i (assuming that the oligopolistic industry is small enough relative to the economy to have an interior solution):

$$u_i'(x_i) = p.$$

Shareholder i has indirect utility function $v_i(p, m_i)$.

Aggregate demand for x_i is

$$D(p) = \int_{i \in I} x_i di = \int_{i \in I} (u_i')^{-1}(p) di.$$

We will find it useful to express this relationship in terms of an inverse demand function $p(Q)$, where Q is the aggregate quantity produced in the industry.

Firm j's profits are given by $\pi_j = p(\sum_{k=1}^{N} q_k)q_j - c(q_j)$ with $c_j(q_j)$ being its total cost function. We assume that managerial candidates maximize expected vote share. The managerial candidates of firm j then maximizes a weighted average of the utilities of the shareholders, with weights proportional to the number of shares times the density of their bias, plus a constant term:

$$\max_{q_j} \int_{i \in I} \gamma_{ij} v_i \left(p(q_j + q_{-j}), w, m_i(q_j; q_{-j}) \right) di + k, \tag{10}$$

where γ_{ij} is equal to $\frac{\beta_{ij}\psi_{ij}}{\int_{s \in I} \beta_{sj}\psi_{sj} ds}$.

The first-order condition for a managerial candidate at firm j is:

$$\int_{i\in I}\gamma_{ij}\left\{\frac{\partial v_i}{\partial p}p'(Q)+\frac{\partial v_i}{\partial m_i}\left(\sum_k\beta_{ik}p'(Q)q_k+\beta_{ij}(p-C'_j)\right)\right\}di=0.$$

A necessary and sufficient condition to ensure concavity of the individual shareholders' objective functions with respect to the quantity of firm j is:

$$-p''x_i+(p')^2\frac{\partial x_i}{\partial p}+p''\sum_k\beta_{ik}q_k+p'\beta_{ij}+p'-c''<0.$$

However, we can use a weaker condition, which is that the condition holds for the *average* shareholder (with the average calculated using weights γ):

$$\int_{i\in I}\gamma_{ij}\left(-p''x_i+(p')^2\frac{\partial x_i}{\partial p}+p''\sum_k\beta_{ik}q_k+\beta_{ij}p'+\beta_{ij}(p'-c'')\right)<0.$$

This condition ensures the existence of equilibrium in the Cournot model with shareholder-consumers. It is clear that, for example, the case of linear demands and linear or convex costs satisfies both conditions, since in that case $p''=0$ and the terms that do not contain p'' as a factor are negative. If for the weighted-average shareholder of firm j the expression $\int_{i\in I}\gamma_{ij}\left(\sum_k\beta_{ik}q_k-x_i\right)$ is positive, indicating that the weighted average shareholder has a higher interest in the industry as an owner than as a consumer, then the condition requires that the demand function be "not too convex."

Having ensured the existence of an equilibrium, we can now use the first-order conditions to characterize it as follows:

Proposition 3. *In a model of Cournot oligopoly with shareholder-consumers, the share-weighted average markup in equilibrium is:*

$$\sum_j s_j\frac{p-c'_j}{p}=\frac{1}{\eta}\left(MHHI-CPI\right),$$

where η is the elasticity of demand, the MHHI is the modified Herfindahl-Hirschman Index, defined as

$$MHHI \equiv \sum_j \sum_k \frac{\int_{i\in I} \gamma_{ij}\beta_{ik} di}{\int_{i\in I} \gamma_{ij}\beta_{ij} di} s_j s_k,$$

where η is the elasticity of demand for x and s_j is the market share of firm j in the market for x; and the CPI is the consumer power index, defined as:

$$CPI \equiv \sum_j \frac{\int_{i\in I} \gamma_{ij}\mu_i di}{\int_{i\in I} \gamma_{ij}\beta_{ij} di} s_j,$$

where μ_i is the fraction of the product consumed by shareholder i.

Proof. Using Roy's identity, we can rewrite the first-order conditions as

$$\int_{i\in I} \gamma_{ij} \left\{ -\frac{\partial v_i}{\partial m_i} p'(Q) x_i + \frac{\partial v_i}{\partial m_i} \left(\sum_k \beta_{ik} p'(Q) q_k + \beta_{ij}(p - c_j') \right) \right\} di = 0.$$

Since the marginal utility of wealth is equal to 1 for all shareholders due to the quasilinearity assumption, we can rewrite this as

$$\int_{i\in I} \gamma_{ij} \left\{ p'(Q) \left(\sum_k \beta_{ik} q_k - x_i \right) + \beta_{ij}(p - c_j') \right\} di = 0.$$

Rearranging terms, we obtain:

$$p - c_j' = -p' \left\{ \sum_k \frac{\int_{i\in I} \gamma_{ij}\beta_{ik} di}{\int_{i\in I} \gamma_{ij}\beta_{ij} di} q_k - \frac{\int_{i\in I} \gamma_{ij} x_i di}{\int_{i\in I} \gamma_{ij}\beta_{ij} di} \right\}.$$

Dividing both sides by p and multiplying and dividing the right-hand side by Q yields an expression for the markup of firm j in terms of shares and the elasticity of demand:

$$\frac{p - c_j'}{p} = -\frac{p'Q}{p} \left\{ \sum_k \frac{\int_{i\in I} \gamma_{ij}\beta_{ik} di}{\int_{i\in I} \gamma_{ij}\beta_{ij} di} \frac{q_k}{Q} - \frac{\int_{i\in I} \gamma_{ij} \frac{x_i}{Q} di}{\int_{i\in I} \gamma_{ij}\beta_{ij} di} \right\}.$$

Using the fact that $s_k = \frac{q_k}{Q}$, $\mu_i = \frac{x_i}{Q}$, and $\frac{1}{\eta} = -\frac{p'Q}{p}$, we can write this expression as

$$\frac{p - c_j'}{p} = \frac{1}{\eta} \left\{ \sum_k \frac{\int_{i \in I} \gamma_{ij} \beta_{ik} di}{\int_{i \in I} \gamma_{ij} \beta_{ij} di} s_k - \frac{\int_{i \in I} \gamma_{ij} \mu_i di}{\int_{i \in I} \gamma_{ij} \beta_{ij} di} \right\}.$$

Taking a market-share weighted average on both sides we obtain:

$$\sum_j s_j \frac{p - c_j'}{p} = \frac{1}{\eta} \left(\sum_j \sum_k \frac{\int_{i \in I} \gamma_{ij} \beta_{ik} di}{\int_{i \in I} \gamma_{ij} \beta_{ij} di} s_j s_k - \sum_j \frac{\int_{i \in I} \gamma_{ij} \mu_i di}{\int_{i \in I} \gamma_{ij} \beta_{ij} di} s_j \right),$$

which completes the proof. □

The consumer power index quantifies the alignment between shareholders' consumption and control vectors. By rewriting the inner products in terms of the corresponding cosine similarities[12] and the norms, we obtain the following result:

Proposition 4. *The CPI can be expressed in terms of the variance of consumption shares, the variances of the ownership shares of the various firms, and the ratios of cosine similarities between consumption and control shares and between ownership and control shares:*

$$CPI = \sum_j \frac{\cos(\alpha_{\gamma_j, \boldsymbol{\mu}}) \sqrt{\sigma^2_{\boldsymbol{\mu}} + 1}}{\cos(\alpha_{\gamma_j, \boldsymbol{\beta}_j}) \sqrt{\sigma^2_{\boldsymbol{\beta}_j} + 1}} s_j,$$

where $\alpha_{\gamma_j, \boldsymbol{\mu}}$ is the angle between the consumption share vector $\boldsymbol{\mu}$ and the control share vector of firm j, γ_j, $\alpha_{\gamma_j, \boldsymbol{\beta}_j}$ is the angle between the ownership share vector and the control share vector of firm j, and $\sigma^2_{\boldsymbol{\mu}}$ and $\sigma^2_{\boldsymbol{\beta}_j}$ are the variances of the consumption share and ownership share vectors, respectively.

Proof. Take the formula for the CPI and use the inner product formula

$$\int a_i b_i di = \cos\left(\alpha_{\boldsymbol{a}, \boldsymbol{b}}\right) \sqrt{\int a_i^2 di} \sqrt{\int b_i^2 di},$$

[12] The cosine similarity between two vectors is defined as the cosine of the angle between the two vectors, and can be interpreted as an uncentered measure of correlation between the two vectors. Since it is a cosine, its value is between -1 and 1.

to rewrite it as

$$CPI = \sum_j \frac{\cos(\alpha_{\gamma_j,\mu})\sqrt{\int \gamma_{ij}^2 di}\sqrt{\int \mu_i^2 di}}{\cos(\alpha_{\gamma_j,\mu})\sqrt{\int \gamma_{ij}^2 di}\sqrt{\int \beta_{ij}^2 di}} s_j.$$

The $\sqrt{\int \gamma_{ij}^2 di}$ factors cancel out. Adding and subtracting one inside the square roots in the other factors yields:

$$CPI = \sum_j \frac{\cos(\alpha_{\gamma_j,\mu})\sqrt{\int \mu_i^2 di - 1 + 1}}{\cos(\alpha_{\gamma_j,\mu})\sqrt{\int \beta_{ij}^2 di - 1 + 1}} s_j.$$

Noting that $\sigma_\mu^2 = \int \mu_i^2 di - 1$ and $\sigma_{\beta_j}^2 = \int \beta_{ij}^2 di - 1$ completes the proof. □

Using this formula, one can argue that consumption internalization is unlikely to be large in most applications, because estimates of the variance of the wealth distribution suggest that the variance of the wealth distribution is infinite.[13] For example, Vermeulen (2014) estimates the parameters of wealth inequality for the U.S. and several European countries under a Pareto parameterization, and finds that the shape parameter estimates are centered between 1 and 2 for all the countries considered (the Pareto distribution has an infinite variance when the shape parameter is between 1 and 2). Wealth in the form of stock-ownership is even more highly concentrated than wealth in general (Wolff, 2010), although obviously this may not apply to all firms, for example small locally-owned family firms. The distribution of consumption, on the other hand, is close to log-normal (Battistin, Blundell, and Lewbel, 2009), and thus has finite variance.

This analysis brings to attention the interesting fact that the variance of wealth is much higher than the variance of consumption, which seems puzzling, since the wealthy would be better off consuming their wealth that saving it indefinitely. Precautionary savings in an intertemporal model with uncertainty provides a possible answer to this puzzle. However, Carroll (1998) argues that precautionary saving is empirically not enough to explain the savings rates of the wealthy, and that instead some version of Max Weber's "capitalist spirit"–that is,

[13] Or, to be more precise, the wealth distribution in the actual population is estimated to be drawn from a distribution with infinite variance, since the draws cannot have infinite variance themselves.

the idea that wealth accumulation above a certain level becomes an end in itself–is necessary to explain them (Weber, 1930).

The analysis in this section also provides an efficiency rationale for policies to reduce wealth inequality, since this would naturally lead to greater representation of stakeholder and social interests in the objective function of the firm. The latter leads to internalization of externalities that firms generate on stakeholders as in Magill, Quinzii, and Rochet (2013). Similar arguments would apply to pollution externalities. This analysis also points to a possible benefit of local ownership: to the extent that there is "home bias" in consumption or in other externalities, local ownership can make ownership more aligned with stakeholder interests.

6 Labor-market oligopsony and shareholder-workers

Consider a small industry that sells its output in the world market, taking the price as given. There are N firms that have market power in the local labor market. Firm j has a production function that uses only labor $F_j(L_j)$ (capital or land can be thought of as fixed factors). There is a continuum of shareholders of the firms of measure 1, who also supply labor. Each shareholder has a time endowment T. Their utility functions for leisure l, which has price w and net wealth y, which is the numeriare, are quasilinear:

$$U_i(l_i, y_i) = u_i(l_i) + y_i,$$

with $u_i' > 0$ and $u_i'' < 0$. Net wealth is equal to initial monetary wealth $m_{i,0}$, plus labor income from selling their time endowment net of the amount they spend on leisure, plus the value of their ownership in the oligopsonistic firms. The budget constraint of shareholder i is

$$wl_i + y_i = m_i \equiv m_{i,0} + wT + \sum_{j=1}^{N} \beta_{ij}\pi_j.$$

The first-order conditions lead to the usual expression for the demand for leisure l_i:

$$u_i'(l_i) = w.$$

Shareholder i has indirect utility function $v_i(w, m_i)$.

Aggregate labor supply is

$$L(w) = T - \int_{i \in I} l_i di = T - \int_{i \in I} (u_i')^{-1}(w) di.$$

As before, we will find it useful to express it in terms of an inverse labor supply function $w(L)$.

Firm j's profits are given by $\pi_j = pF_j(L_j^d) - w(L_j, L_{-j}^d)L_j^d$. Each managerial candidate at each firm maximizes a weighted average of shareholder-worker utilities (plus a constant term), with weights given by the control shares in the firm γ_{ij}:

$$\max_{L_j} \int_{i \in I} \gamma_{ij} v_i \left(w(L_j^d; L_{-j}^d), m_i(L_j^d; L_{-j}^d) \right) di + k, \tag{11}$$

where $v_i(w, m_i)$ is the indirect utility function of shareholder i, and wealth is $m_i(L_j, L_{-j}) \equiv m_{i,0} + w(L_j^d; L_{-j}^d)T + \sum_k \beta_{ik} \pi_k(L_j^d; L_{-j}^d)$. Taking first-order conditions with respect to the labor demand of firm j yields:

$$\int_{i \in I} \gamma_{ij} \left\{ \frac{\partial v_i}{\partial w} w'(L) + \frac{\partial v_i}{\partial m_i} \left(w'(L)T - \sum_k \beta_{ik} w'(L) L_k^d + \beta_{ij}(pF_j' - w) \right) \right\} di = 0.$$

A necessary and sufficient condition for the objective function of each shareholder to be strictly concave is

$$w'' L_i - (w')^2 \frac{\partial L_i}{\partial w} + w'' \sum_k \beta_{ik} L_k - w' \beta_{ij} w' + \beta_{ij}(pF_j'' - w') < 0$$

As before, this condition would hold if labor supply is linear. Moreover,we can weaken this condition by requiring only that it holds for the weighted-average shareholder. This is enough to ensure existence of an equilibrium. We can show a result analogous to that for the oligopoly case:

Proposition 5. *In a model of Cournot labor-market oligopsony with shareholder-workers, the share-weighted average markup in equilibrium is:*

$$\sum_j s_j \frac{F_j' - \frac{w}{p}}{\frac{w}{p}} = \frac{1}{\eta^L}\left(MHHI - WPI\right),$$

where η is the elasticity of labor supply, the MHHI is the modified Herfindahl-Hirschman Index based on employment shares, defined as

$$MHHI \equiv \sum_j \sum_k \frac{\int_{i \in I} \gamma_{ij}\beta_{ik} di}{\int_{i \in I} \gamma_{ij}\beta_{ij} di} s_j^L s_k^L,$$

where s_j^L is the market share of firm j in the labor market; and the WPI is the worker power index, defined as:

$$WPI \equiv \sum_j \frac{\int_{i \in I} \gamma_{ij}\lambda_i di}{\int_{i \in I} \gamma_{ij}\beta_{ij} di} s_j,$$

where λ_i is the fraction of employment supplied by shareholder i.

Proof. Using Roy's identity for labor supply, we can rewrite this as

$$\int_{i \in I} \gamma_{ij} \left\{ \frac{\partial v_i}{\partial m_i} \frac{dw}{dL_j^d} L_i^s + \frac{\partial v_i}{\partial m_i} \left(-\sum_k \beta_{ik} \frac{dw}{dL_j^d} L_k^d + \beta_{ij}(pF_j' - w) \right) \right\} di = 0.$$

Analogously to the oligopoly case, we can rewrite this as an equilibrium relation between the share-weighted average markdown of wages relative to the marginal product of labor, the MHHI:

$$\sum_j s_j^L \eta_j^{L^s} \frac{F_j' - \frac{w}{p}}{\frac{w}{p}} = \sum_j \sum_k \frac{\int_{i \in I} \gamma_{ij}\beta_{ik} di}{\int_{i \in I} \gamma_{ij}\beta_{ij} di} s_j^L s_k^L - \sum_j \frac{\int_{i \in I} \gamma_{ij}\lambda_i di}{\int_{i \in I} \gamma_{ij}\beta_{ij} di} s_j^L.$$

□

We can also rewrite the WPI in terms of the cosine similarities and variances:

Proposition 6. *The WPI can be expressed in terms of the variance of labor supply shares, the variances of the ownership shares of the various firms, and the ratios of cosine similarities between labor supply and control shares and between ownership and control shares:*

$$WPI = \sum_j \frac{\cos(\alpha_{\gamma_j,\lambda})\sqrt{\sigma^2_{\lambda}+1}}{\cos(\alpha_{\gamma_j,\beta_j})\sqrt{\sigma^2_{\beta_j}+1}} s_j,$$

where $\alpha_{\gamma_j,\lambda}$ is the angle between the labor supply share vector $\boldsymbol{\lambda}$ and the control share vector of firm j, γ_j, $\alpha_{\gamma_j,\beta_j}$ is the angle between the ownership share vector and the control share vector of firm j, and $\sigma^2_{\boldsymbol{\mu}}$ and $\sigma^2_{\boldsymbol{\beta}_j}$ are the variances of the labor supply share and ownership share vectors, respectively.

Proof. The proof is based on the formula for the inner product in terms of the cosine similarity and the norms, and is similar to the proof of the analogous formula for the CPI. □

As in the previous model, internalization of labor supply effects are likely to be small under pure shareholder capitalism with an infinite variance of wealth.[14] However, in mixed economies that combine elements of shareholder capitalism with some worker representation, many institutional arrangements have emerged to provide workers direct control in firms beyond the control that their shareholdings would provide. Internalization of labor supply is likely to have significant effects when such institutional arrangements are present, with the effect of increasing wages and bringing them closer to the marginal product of labor. Examples of institutional arrangements to increase the correlation between labor supply and control of firms include co-determination (some level of board representation for employees in private companies is mandated by law in Austria, Croatia, Denmark, Finland, France, Germany, Hungary, Luxembourg, the Netherlands, Norway, Slovakia, Slovenia and Sweden; see Fulton, 2011), Employee Stock Ownership Programs (ESOP) in the United States, and worker cooperatives. Note that these institutional arrangements, unlike antitrust policy, do not attempt to

[14]Including human capital in the model could change this conclusion if the distribution of human capital also has an infinite variance, although this seems unlikely given that income is approximately log-normally distributed.

reduce market power in the labor market, but simply to mitigate its effect on wages by giving some control to those affected by the market power. Institutions such as unions or policies such as the minimum wage may have similar effects in practice, but the mechanisms through which they affect wages–collective bargaining and direct regulation, respectively–are different from worker representation in the objective function of the firm. The following example illustrates how co-determination, under some assumptions, can restore efficiency by having the firm's objective function internalize the effects of its market power over its own employees.

6.1 Application: optimal level of worker representation in corporate decisions

In many countries, the level of legally mandated representation of employees in corporate boards is a function of firm size, with larger firms having as much as half of the seats assigned to labor. We show here that this idea follows naturally from the model of oligopsony with shareholder workers, with one modification: we consider the case in which the employees have an exogenously determined share $\gamma^{L,j}$ of control at firm j.

For simplicity, we consider the case in which firms are separately owned, and the employees and shareholders are different groups, each of measure one. Assume that all the members within each group are identical. In the absence of co-determination, the shareholders have full control of the firms. Each representative shareholder has one share in the firm. Assume that, apart from the ownership or not of the firms, agents are otherwise identical. The equilibrium markdown of wages below the marginal product of labor at firm j without co-determination is

$$\frac{F_j' - \frac{w}{p}}{\frac{w}{p}} = \frac{s_j^L}{\eta^L}.$$

Note that larger firms have larger markdowns, even though in this model real wages are the same across all firms. The reason is that more productive firms endogenously have higher market shares in the model. Consider now the case in which the employees have a control share of $\gamma_{L,j}$. The objective of firm j's managerial candidates is now

$$\max_{L_j} (1-\gamma_{L,j}) v\left(w, m_{i,0}+\pi_j\right)+\gamma_{L,j} v\left(w, m_{i,0}+wT\right)+k,$$

The first-order condition of the firm is now

$$(1-\gamma_{L,j})\left(pF_j' - w - w' L_j\right)+\gamma_{L,j}\left(w' L_i\right).$$

To make the markup equal to zero requires

$$(1-\gamma_{L,j})\frac{L_j}{L}=\gamma_{L,j}\frac{L_i}{L}.$$

Since the workers have measure one and are all identical $\frac{L_i}{L}=1$, this is the same as

$$s_j^L=\frac{\gamma_{L,j}}{1-\gamma_{L,j}}.$$

Solving for $\gamma_{L,j}$ in terms of the employment share of firm j:

$$\gamma_{L,j}=\frac{s_j^L}{1+s_j^L}.$$

For example, if the firm is a monopsonist, then employees should get half of the board seats to restore efficiency. In the case of duopsonist with a 50% market share, employees should get a third of the board seats to restore efficiency.

Consider now a more general case, in which labor supply is still homogeneous, but shareholders hold arbitrary portfolios and are now also workers of the firms. Every agent supplies the same amount of labor to the firms. The objective function of the firm is now

$$\max_{L_j} (1-\gamma_{L,j}) \gamma_{ij} v_i+\gamma_{L,j} v_i.$$

In this case, we can show that at each firm there is a level of co-determination that would return to an efficient outcome, that is, wage equal to the value of the marginal product of labor:

Proposition 7. *Suppose that labor supply is homogeneous and the distribution of control among the shareholders is proportional to shares. There exists a level of worker representation at each firm $\gamma^*_{L,j} \in [0,1]$ such that the firm sets wage equal to the value of the marginal product of labor.*

Proof. The problem is equivalent to taking the formula for the markup derived in proposition 5, but with control shares $\gamma_{L,j} + (1-\gamma_{L,j})\gamma_{i,j}$. From the first-order condition of firm j, the wage is equal to the value of the marginal product if and only if

$$(1-\gamma_{L,j})\left(s_j \int_{i\in I} \beta_{ij}^2 di + \sum_{k\neq j} s_k \int_{i\in I} \beta_{ij}\beta_{ik} di - 1\right) - \gamma_{L,j} = 0$$

Since $\int_{i\in I} \beta_{ij}^2 di \geq 1$, this expression is non-negative if $\gamma_{L,j} = 0$. The expression is negative if $\gamma_{L,j} = 1$. Since this is a continuous function of $\gamma_{L,j}$, the intermediate-value theorem implies that there is a $\gamma_{L,j}$ such that it is equal to zero, and therefore for this $\gamma_{L,j}$ the wage equals the marginal product at firm j. □

This shows that some level of board representation for workers can help address the market power by firms in the labor market. In the presence of common ownership the exact level that would achieve this depends on the ownership structure of the firm in a non-trivial way, and not just on the firm's size. Solving for the optimal level of co-determination would be more difficult in the case of heterogenous workers. That said, it seems that even in these more general cases the idea that *some* level of employee representation can help mitigate the effects of market power in labor markets, especially at large firms, would still hold.

7 Conclusion

This paper developed a model of firm behavior in the context of portfolio diversification and market power by the firms. Various potential managers compete for shareholder votes. When firms have overlapping owners, they take into account the impact of their strategic plans not only on their own profits, but also on the profits of rivals that are on their shareholders' portfolios. The model shows a straightforward mechanism that implies that direct communication between shareholders and managers is not necessary for overlapping ownership to have an effect on firm behavior, as long as shareholders have the power of the vote and their portfolios are public information. We used the voting model to derive expressions for shareholder control over the oligopolistic firms under various assumptions. Larger shareholders can have control disproportionate to their shares if the managerial candidates maximize their probability of winning the election. Also, more informed shareholders would have greater weight in the objective functions of the firms.

Applying the framework to the setting of oligopoly with shareholder-consumers, we derived an expression for the average industry markup in terms of the difference between a modified Herfindahl-Hirschman Index and an index that quantifies the alignment of consumption and control of the firms. In the context of labor-market oligopsony, we obtain a similar expression for the average markdown of wages below the value of the marginal product of labor. We argued that, given that the variance of stock market wealth is much higher than the variance of consumption or labor supply, these effects are likely to be small under pure shareholder capitalism, but other institutional arrangements and corporate governance institutions could give additional worker control. Leading examples include worker and consumer cooperatives, employee representation in corporate boards, and employee stock ownership programs. These institutions can in principle help mitigate the negative effects of market power, even though they do not reduce that power. Antitrust policy, on the other hand, by reducing common ownership can reduce the markdown of wages relative to the marginal product of labor through an increase in competition for consumers and workers by firms.[15] To the extent that antitrust policy cannot completely eliminate market power–especially in labor markets–these kinds of

[15]See Azar (2011, 2012); Azar, Schmalz, and Tecu (2015); Posner and Weyl (2015); Elhauge (2016); Baker (2016); Azar, Raina, and Schmalz (2016); Posner, Scott Morton, and Weyl (2016) for further analysis and policy proposals on antitrust policy in relation to portfolio diversification and common ownership by financial institutions.

institutional arrangements could be a complementary way to address the problem of market power.

The theory of the firm developed in this paper differs from previous theories in that firm boundaries can become blurred through common ownership links (as well as its focus on market power). Previous theories, on the other hand, were essentially theories of mergers (Coase, 1937; Williamson, 1975; Grossman and Hart, 1986). Portfolio diversification can lead to the integration of firm ownership without economic or strategic objectives other than portfolio risk reduction. When all agents hold market portfolios, the shareholders want the firms to act in unison to maximize their objectives, and firms essentially become branches of a larger corporate structure, even if they are formally separate entities. Thus, theorists of firm boundaries may need to consider not just why different ownership structures may arise, but also why organization within a common ownership "superorganism" would require separate firms with highly correlated ownership rather than just one large superfirm that is formally a unit. Possible answers include efficiencies from the elimination of redundancies, and that attempting to formally merge all publicly traded firms would push against the antitrust laws in an obvious way, while portfolio diversification does so in a way that could more easily "go under the radar," or even when it is considered, may be harder to tackle by the antitrust authorities.

From a macroeconomic point of view, the increase in overlapping ownership in the last two decades could potentially contribute to secular stagnation, by giving firms power to permanently reduce employment and production in order to drive up markups and markdowns, and therefore increasing profits (Elhauge, 2016; Summers, 2016). The theory of firm behavior developed in this paper is particularly well suited for macroeconomic modeling and general equilibrium analysis more broadly, because unlike in the case of profit maximizing firms, behavior is independent of the choice of numeraire. In that direction, Azar and Vives (2016) develop a macroeconomic model with oligopolistic firms and shareholder voting, and show that an increase in market concentration would in many ways look similar to a permanent reduction in aggregate demand, leading to lower wages, real interest rates, employment, and investment, and higher income inequality. Further exploration of these complex issues may be a promising area for research in the future.

References

AHN, D. S., AND S. OLIVEROS (2012): "Combinatorial Voting," *Econometrica*, 80(1), 89–141.

ALESINA, A., AND H. ROSENTHAL (1995): *Partisan politics, divided government, and the economy*. Cambridge Univ Pr.

——— (1996): "A theory of divided government," *Econometrica: Journal of the Econometric Society*, 64(6), 1311–1341.

ARROW, K. (1983): *Collected papers of Kenneth J. Arrow: Social choice and justice*. Belknap Pr.

ARROW, K. J. (1964): "The role of securities in the optimal allocation of risk-bearing," *The Review of Economic Studies*, 31(2), 91–96.

AZAR, J. (2011): "A new look at oligopoly: Implicit collusion through portfolio diversification," *Available at SSRN 1993364*.

——— (2012): "A new look at oligopoly: Implicit collusion through portfolio diversification," *Ph.D. Thesis, Princeton University*.

AZAR, J., S. RAINA, AND M. C. SCHMALZ (2016): "Ultimate Ownership and Bank Competition," *Available at SSRN 2710252*.

AZAR, J., M. C. SCHMALZ, AND I. TECU (2015): "Anti-competitive effects of common ownership," *Ross School of Business Paper*, (1235).

AZAR, J., AND X. VIVES (2016): "Market Concentration and Aggregate Demand," *Working Paper*.

BAKER, J. (2016): "Overlapping Financial Investor Ownership, Market Power, and Antitrust Enforcement: My Qualified Agreement with Professor Elhauge," *Harvard Law Review*.

BANZHAF III, J. F. (1964): "Weighted voting doesn't work: A mathematical analysis," *Rutgers L. Rev.*, 19, 317.

BARKAI, S. (2016): "Declining Labor and Capital Shares," .

BATTISTIN, E., R. BLUNDELL, AND A. LEWBEL (2009): "Why Is Consumption More Log Normal than Income? Gibrat?s Law Revisited," *Journal of Political Economy*, 117(6), 1140–1154.

BENNINGA, S., AND E. MULLER (1979): "Majority choice and the objective function of the firm under uncertainty," *The Bell Journal of Economics*, pp. 670–682.

CARROLL, C. D. (1998): "Why do the rich save so much?," Discussion paper, National Bureau of Economic Research.

CHARI, V., L. JONES, AND R. MARIMON (1997): "The economics of split-ticket voting in representative democracies," *The American Economic Review*, 87(5), 957–976.

COASE, R. H. (1937): "The nature of the firm," *economica*, 4(16), 386–405.

COUGHLIN, P. (1992): *Probabilistic voting theory*. Cambridge Univ Pr.

DAVIS, G. F. (2008): "A new finance capitalism? Mutual funds and ownership re-concentration in the United States," *European Management Review*, 5(1), 11–21.

DEBREU, G. (1959): *Theory of value: An axiomatic analysis of economic equilibrium*, no. 17. Yale University Press.

DEKEL, E., AND A. WOLINSKY (2012): "Buying Shares and/or Votes for Corporate Control," *The Review of Economic Studies*, 79(1), 196–226.

DEMARZO, P. (1993): "Majority voting and corporate control: the rule of the dominant shareholder," *The Review of Economic Studies*, 60(3), 713–734.

EKERN, S., AND R. WILSON (1974): "On the Theory of the Firm in an Economy with Incomplete Markets," *Bell Journal of Economics*, 5(1), 171–180.

ELHAUGE, E. R. (2016): "Horizontal Shareholding," *Harvard Law Review*, 109(5).

FARRELL, J. (1985): "Owner-consumers and efficiency," *Economics Letters*, 19(4), 303–306.

FRIEDMAN, M. (1970): "The social responsibility of business is to increase its profits," *New York Times Magazine*, pp. 122–126.

FULTON, L. (2011): "Worker representation in Europe," *Labour Research Department and ETUI (online publication)*.

GABSZEWICZ, J. J., AND J.-P. VIAL (1972): "Oligopoly ?a la Cournot? in a general equilibrium analysis," *Journal of economic theory*, 4(3), 381–400.

GILLAN, S., AND L. STARKS (2007): "The Evolution of Shareholder Activism in the United States*," *Journal of Applied Corporate Finance*, 19(1), 55–73.

GOMPERS, P., AND A. METRICK (2001): "Institutional investors and equity prices*," *Quarterly Journal of Economics*, 116(1), 229–259.

GORDON, R. (1990): "Do Publicly Traded Corporations Act in the Public Interest?," Discussion paper, National Bureau of Economic Research.

GROSSMAN, S. J., AND O. D. HART (1986): "The costs and benefits of ownership: A theory of vertical and lateral integration," *The Journal of Political Economy*, pp. 691–719.

HANSEN, R., AND J. LOTT (1996): "Externalities and corporate objectives in a world with diversified shareholder/consumers," *Journal of Financial and Quantitative Analysis*, 31(1).

HART, O. (1979): "On Shareholder Unanimity in Large Stock Market Economies," *Econometrica*, 47, 1057–1083.

——— (1982a): "A model of imperfect competition with Keynesian features," *The quarterly journal of economics*, pp. 109–138.

HART, O., AND J. MOORE (1990): "Property Rights and the Nature of the Firm," *Journal of political economy*, pp. 1119–1158.

HART, O. D. (1982b): *Imperfect competition in general equilibrium: an overview of recent work*.

HOLMSTRÖM, B., AND J. ROBERTS (1998): "The boundaries of the firm revisited," *The Journal of Economic Perspectives*, 12(4), 73–94.

HU, H. T. (2015): "Financial innovation and governance mechanisms: The evolution of decoupling and transparency," *Business Lawyer, Forthcoming*.

JENSEN, M. C. (2001): "Value maximization, stakeholder theory, and the corporate objective function," *Journal of applied corporate finance*, 14(3), 8–21.

LELAND, H. E. (1974): "Production theory and the stock market," *The Bell Journal of Economics and Management Science*, pp. 125–144.

LINDBECK, A., AND J. WEIBULL (1987): "Balanced-budget redistribution as the outcome of political competition," *Public Choice*, 52(3), 273–297.

LINTNER, J. (1965): "The valuation of risk assets and the selection of risky investments in stock portfolios and capital budgets," *The review of economics and statistics*, pp. 13–37.

MAGILL, M. J., M. QUINZII, AND J.-C. ROCHET (2013): "A critique of shareholder value maximization," *Swiss Finance Institute Research Paper*, (13-16).

MARKOWITZ, H. (1952): "Portfolio Selection," *The Journal of Finance*, 7(1), pp. 77–91.

MAS-COLELL, A. (1982): "The Cournotian foundations of Walrasian equilibrium theory: an exposition of recent theory," *Advances in economic theory*, pp. 183–224.

MATĚJKA, F., AND G. TABELLINI (2016): "Electoral Competition with Rationally Inattentive Voters," .

MCCAHERY, J. A., Z. SAUTNER, AND L. T. STARKS (2015): "Behind the scenes: The corporate governance preferences of institutional investors," *Journal of Finance, forthcoming*.

NEARY, J. (2002): "The road less travelled: Oligopoly and competition policy in general equilibrium," .

——— (2009): "International trade in general oligopolistic equilibrium," *University College Dublin, mimeo*.

NEKARDA, C., AND V. RAMEY (2010): "The Cyclical Behavior of the Price-Cost Markup," *University of California, San Diego (July)*.

NIELSEN, N. C. (1979): "Monopoly Pricing and Diversified Consumers," *The Scandinavian Journal of Economics*, pp. 367–377.

O'BRIEN, D. P., AND S. C. SALOP (2000): "Competitive effects of partial ownership: Financial interest and corporate control," *Antitrust Law Journal*, 67(3), 559–614.

PENROSE, L. S. (1946): "The elementary statistics of majority voting," *Journal of the Royal Statistical Society*, 109(1), 53–57.

POSNER, E., AND G. WEYL (2015): "Mutual Funds' Dark Side," *Slate*, http://www.slate.com/articles/news_and_politics/view_from_chicago/2015/04/mutual_funds_mak

POSNER, E. A., F. M. SCOTT MORTON, AND E. G. WEYL (2016): "A Proposal to Limit the Anti-Competitive Power of Institutional Investors," .

POSNER, E. A., AND E. G. WEYL (2013): "Quadratic voting as efficient corporate governance," *University of Chicago Law Review, Forthcoming*.

RADNER, R. (1974): "A note on unanimity of stockholders' preferences among alternative production plans: a reformulation of the Ekern-Wilson model," *The Bell Journal of Economics and Management Science*, pp. 181–184.

ROBERTS, J., AND H. SONNENSCHEIN (1977): "On the foundations of the theory of monopolistic competition," *Econometrica: journal of the Econometric Society*, pp. 101–113.

ROTEMBERG, J. (1984): "Financial transaction costs and industrial performance," .

ROTEMBERG, J. J., AND M. WOODFORD (1999): "The cyclical behavior of prices and costs," *Handbook of macroeconomics*, 1, 1051–1135.

SHARPE, W. F. (1964): "Capital asset prices: A theory of market equilibrium under conditions of risk," *The journal of finance*, 19(3), 425–442.

SUMMERS, L. (2016): "Corporate Profits are Near Record Highs. Here's Why That's a Problem.," *Washington Post*, https://www.washingtonpost.com/news/wonk/wp/2016/03/30/larry-summers-corporate-profits-are-near-record-highs-heres-why-thats-a-problem/.

VERMEULEN, P. (2014): "How fat is the top tail of the wealth distribution?," ECB Working Paper.

WEBER, M. (1930): "The Protestant ethic and the spirit of capitalism.," .

WILLIAMSON, O. E. (1975): "Markets and hierarchies," *New York*, pp. 26–30.

WOLFF, E. N. (2010): "Recent trends in household wealth in the United States: Rising debt and the middle-class squeeze-an update to 2007," .

Figures

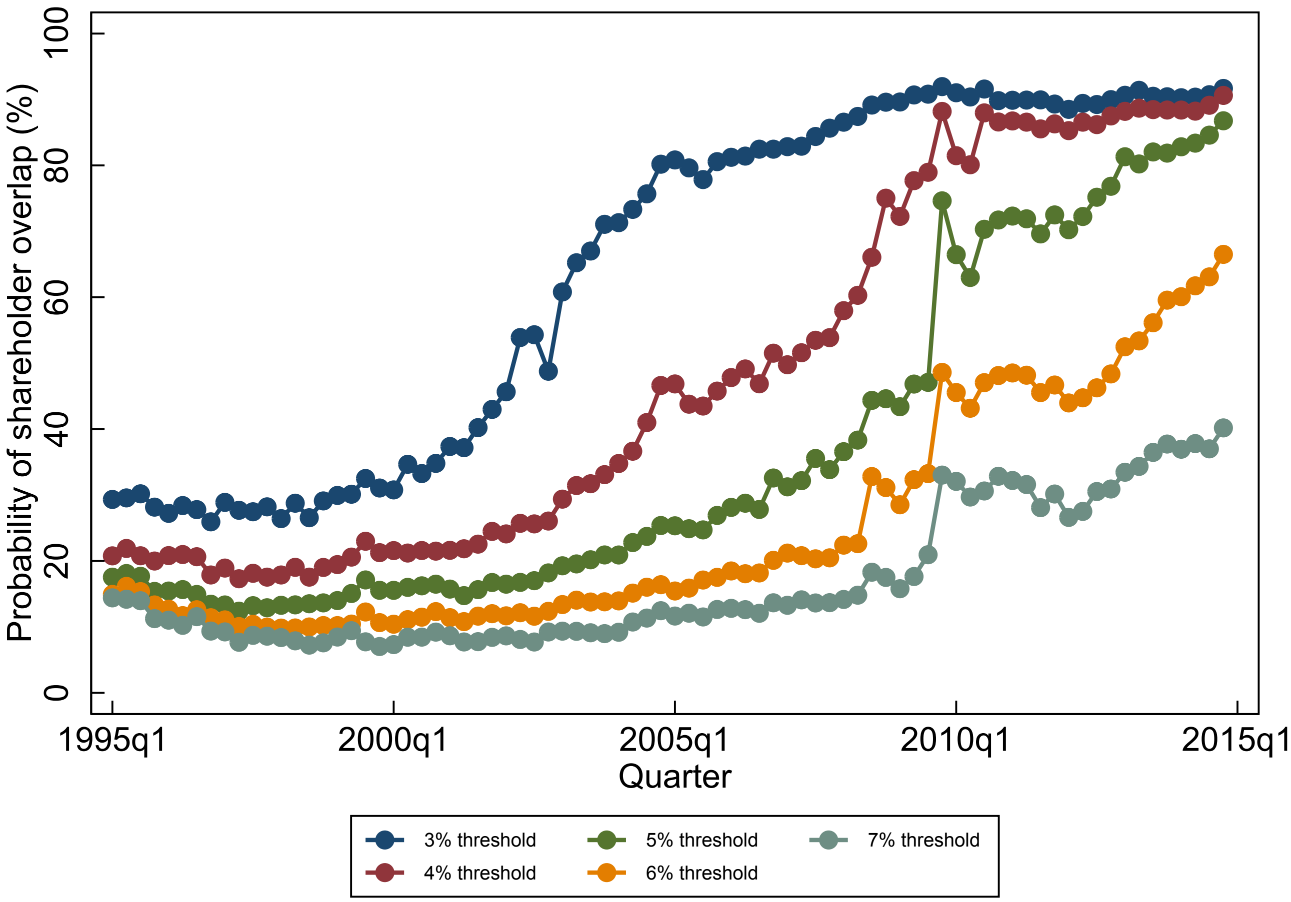

Figure 1. Probability of shareholder overlap for S&P 1500 firms in the same industry at various ownership thresholds. This figure shows the probability that two firms in the same 3-digit SIC industry, selected at random from the S&P 1500 index component firms (and that are also in the Thomson dataset), have a shareholder in common (with at least x% ownership in both firms, where x = 3, 4, 5, 6, or 7 percent) over the period 1995Q1 to 2014Q4. The probability is sometimes also called the density of the interlocking shareholder network: $Density = \frac{\sum_{i=1}^{n}\sum_{j<i} y_{ij}}{n(n-1)/2}$, where n is the number of nodes in the network and y_{ij} is equal to 1 if firm i and firm j are connected, and zero otherwise (by convention, a firm is not considered to be connected to itself, and thus the adjacency matrix has zeros in its diagonal). The probability in a given period and for a given threshold is calculated by first calculating the network density for each industry, and then taking a weighted average of the densities with the number of firms in each industry as weights. Source: author's calculations using data from Thomson 13F Institutional Ownership and SEC filings for Barclays and BlackRock in periods where some of their filings are missing from the Thomson data.

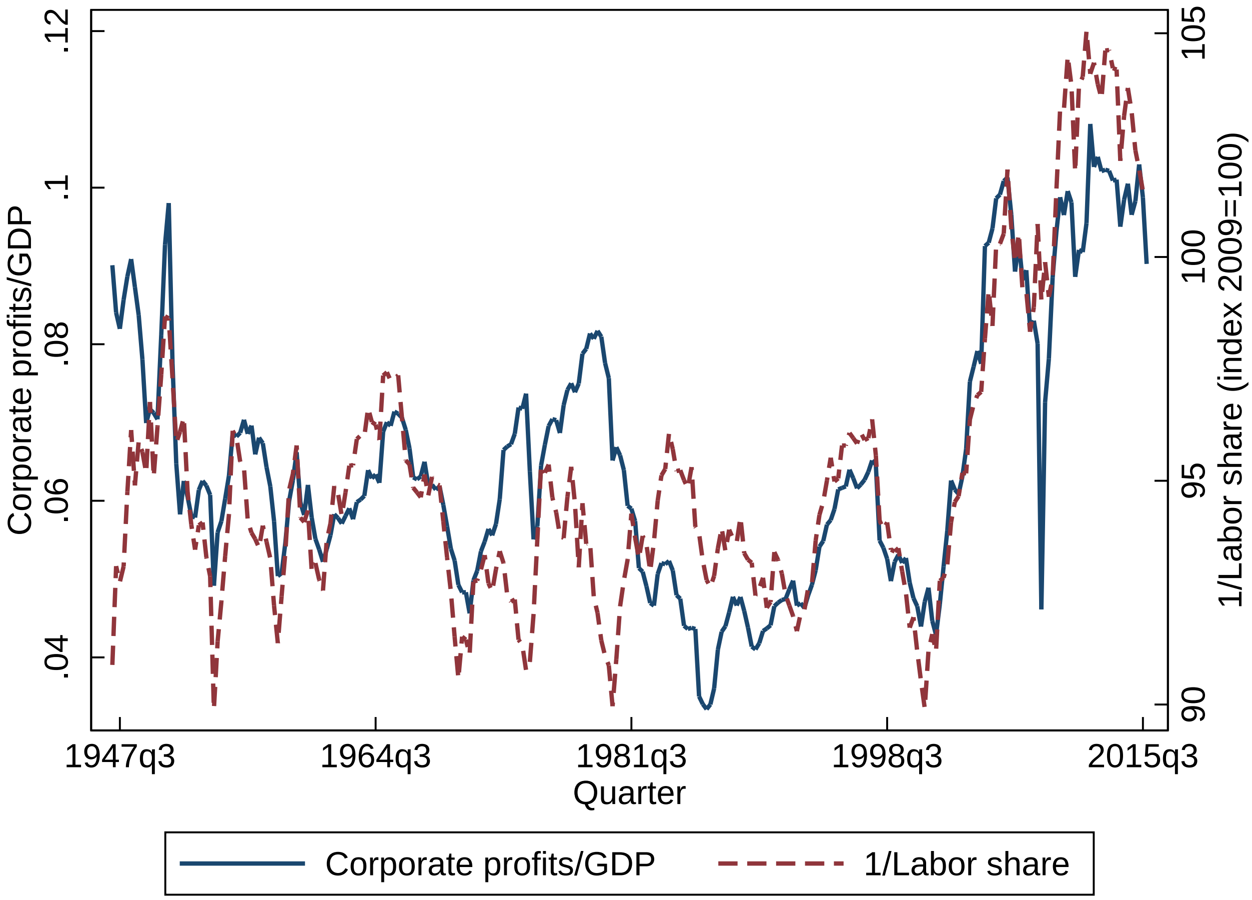

Figure 2. Corporate profits as a share of GDP and inverse of the labor share: 1947Q1–2015Q3. This figure shows corporate profits after tax as a share of GDP and the inverse of the labor share for the nonfinancial corporate sector over the period 1947Q1–2015Q3. The inverse of the labor share is often used as a proxy for the aggregate level of markups (Rotemberg and Woodford, 1999; Nekarda and Ramey, 2010). Source: author's calculations using data from FRED.