The Welfare Cost of Common Ownership*

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VERY PRELIMINARY

Abstract

We study the welfare implications of the rise of common ownership and product market concentration in the United States from 1994 to 2018. We develop a general equilibrium model of oligopoly in which firms are connected through a large network that reflects ownership overlap as well as product similarity. In our model, common ownership of competing firms induces unilateral incentives to soften product market competition. We estimate our model for the universe of U.S. public corporations using a combination of firm financials, investor holdings and text-based product similarity data. We perform counterfactual calculations that allow us to evaluate how the efficiency and distributional impact of common ownership have evolved over this period. The rise of common ownership has led to a considerable deadweight loss that increases from 0.3% in 1994 to 4% of total surplus in 2018, as well as to a smaller share of total surplus accruing to consumers.

JEL Codes: D43, D61, E23, L13, L41, G34

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1 Introduction

The U.S. economy has experienced two significant trends in concentration over the last three decades. First, across a broad range of U.S. industries revenue and employment concentration have increased (Grullon et al., 2019; Pellegrino, 2019). Second, ownership of US corporate equity is increasingly concentrated in the hands of a few large institutional investors (Ben-David et al., 2020). This latter trend has been referred to as the rise of common ownership (Azar, 2012; Gilje, Gormley and Levit, 2018; Backus, Conlon and Sinkinson, 2021).

Common ownership refers to overlapping ownership of firms that compete in the same product markets. The tremendous increase in common ownership is of concern to antitrust policymakers (Phillips, 2018) because it introduces an economic motive for firms to compete less aggressively. If firms make strategic decisions with the intent of maximizing the profits accruing to their respective investors, common ownership leads firms to (partially) internalize the effect of an increase in supply on their competitors' profits. This in turn induces them to produce lower quantities and charge higher markups, ultimately leading to larger deadweight losses. This concern is supported by a theoretical literature, starting with Rotemberg (1984), and empirical contributions, most notably Azar, Schmalz and Tecu (2018), that analyze oligopolistic behavior in the presence of common ownership. In response, antitrust authorities around the world including the Department of Justice, the Federal Trade Commission, the European Commission, and the OECD, have acknowledged concerns about the anticompetitive effects of common ownership.[1]

In this paper, we study the welfare cost of common ownership from a theoretical and empirical perspective. We develop a general equilibrium model of oligopolistic competition under common ownership–a generalization of the model of Pellegrino (2019) that allows for the presence of common ownership. We estimate the model using data on firm financials, text-based product similarity (Hoberg and Phillips, 2016), and mutual fund holdings (Backus et al., 2021) covering the universe of U.S. publicly-listed corporations from 1994 to 2018.

Our model has two distinctive features. First, following the literature on hedonic demand (Lancaster, 1966; Rosen, 1974) the representative consumer has utility over product characteristics. Hence, the cross-price elasticity of demand between any two products depends on whether they possess similar attributes. Following Pellegrino (2019), this feature allows us

[1] Solomon (2016) reported on an investigation based on Senate testimony by the head of the Antitrust Division, Federal Trade Commission (2018) featured a hearing on common ownership, and Vestager (2018) disclosed that the Commission is "looking carefully" at common ownership given indications of its increase and potential for anticompetitive effects. For other recent activity, see OECD (2017) and European Competition Commission (2017).

to estimate a time-varying cross-price elasticity of demand that is specific to each firm pair, using the dataset of Hoberg and Phillips (2016). Second, firms act to maximize a weighted sum of profits earned by their investors, with each investor receiving a weight proportional to its ownership stake (Azar, 2012; López and Vives, 2019; Backus et al., 2021; Azar and Vives, 2021a). This setup is isomorphic to each firm maximizing a weighted sum of its own profits and its competitors profits, with each company receiving a weight proportional to a well-defined measure of common ownership.

Our paper fills an important gap in the literature on common ownership. Although the increase in common ownership is already well documented and a number of empirical papers have estimated anticompetitive effects of common ownership on prices, quantities, markups, and profitability, no paper has provided an estimate of the welfare cost of common ownership. Taking as given that common ownership *does* affect competitive behavior, how large are the resulting welfare costs of the increase in common ownership and industry concentration that we have witnessed over the past two decades? Answering this question requires a model that is both tractable and flexible enough to accommodate the complex overlapping networks of product market competition and ownership that exist among public firms. The principal contribution of our paper is to propose such a model and to practically estimate it in the data.

The first step of our empirical analysis is to visualize the two networks in which firms are embedded: that of product similarity and that of common ownership. The network of product similarities displays a pronounced community structure: large groups of firms tend to cluster in certain areas of the network. In contrast, the network of common ownership has a hub-and-spoke structure with a large proportion of firms sharing significant overlap and the remainder of largely unconnected firms at the periphery. Second, across the distribution of firm pairs there is little correlation between product similarity and common ownership.

Next, we take the model to the data. Our estimation of the model reveals three broad patterns. First, the welfare costs of common ownership are significant, but not as large as the welfare costs of oligopoly. We estimate that in 2018, the most recent year of our sample, the deadweight loss of oligopoly amounts to about 11.5% of total surplus while the level of common ownership leads to an additional deadweight loss of 4% of total surplus. Second, the welfare losses of common ownership fall entirely on consumers. We estimate that in 2018 common ownership raises aggregate profits by \$378 billion from \$5.261 trillion to \$5.639 trillion, but lowers consumer surplus by \$799 billion from \$4.113 trillion to \$3.314 trillion. Third, the negative effects of common ownership on total welfare and consumer surplus have grown considerably over the last two decades. Whereas common ownership reduced total surplus by a mere 0.3% in 1994 this deadweight loss increases more than tenfold to 4% in

2018. Over the same time period, common ownership raised corporate profits by 1% in 1994 and 6.6% in 2018, but lowered consumer surplus by less than 2% in 1994 but almost 20% in 2018.

We further explore how alternative assumptions about corporate governance modify these results. Indeed, there are good reasons to believe that larger investors exert influence that exceeds the size of their stake. However, even with superproportional influence common ownership has essentially identical effects on deadweight loss, corporate profits, and consumer surplus. In contrast, when we assume that only blockholders (i.e., shareholders holding 5% or more of a company's stock) can exert influence we find that common ownership only has a relatively small impact until 2013. However, even under blockholder influence common ownership leads to a deadweight loss of 2.5% of total surplus, raises firm profits by almost 5% and lowers consumer surplus by almost 13% of total surplus in 2018.

Although our paper builds on previous work of Pellegrino (2019), both the research question and the methodological approach differ. The latter paper assumes that U.S. public corporations play a large Cournot game with no common ownership effects, and studies the welfare gains from moving to a competitive equilibrium. In contrast, this paper starts instead from the opposite assumption that firms compete à la Cournot under the influence of common ownership, and studies the welfare gains that result from moving to a Cournot game with no common ownership. In short, Pellegrino (2019) studies the aggregate welfare implications of oligopolistic behavior, whereas this paper focuses specifically on estimating the welfare consequences of common ownership.

The closest theoretical paper to our work is the macroeconomic framework Azar and Vives (2021a) in which symmetric common ownership across identical oligopolistic firms leads to additional market power with respect to both product market competition and labor hiring. In contrast to their work, our model assumes competitive labor markets, but allows for arbitrary product differentiation between firms as well as asymmetries in ownership structure and firm size. As a result, our theoretical framework allows us to empirically estimate the welfare cost and distributional impact of common ownership.

The rest of the paper is organized as follows. Section 2 develops our theoretical model. Section 3 describes the data and Section 4 reports the empirical results for the baseline model of corporate governance. Section 5 provides additional empirical results under alternative corporate governance assumptions. Section 6 concludes.

2 Theoretical Model

Our theoretical model builds on the theoretical framework presented in Pellegrino (2019). We therefore only briefly explain the model setup and refer the reader to the original model discussion in Pellegrino (2019) for further details.

2.1 Generalized Hedonic-Linear (GHL) Demand System

There is a representative agent who is a consumer, worker, and owner. This representative agent consumes all the goods produced in the economy, supplies labor as a production input, and receives income from owning shares of all the firms in the economy.

There are n firms, indexed by $i \in \{1, 2, ..., n\}$ that produce differentiated products. Consumers have hedonic demand (Lancaster, 1966; Rosen, 1974) and value each product as a bundle of characteristics. The number of characteristics is $m + n$.

There are two types of characteristics: m common characteristics indexed by $j \in \{1, 2, ..., m\}$ and n idiosyncratic characteristics. Because these characteristics are product-specific and not present in other products they have the same index i as the corresponding product. The scalar a_{ji} is the number of units of common characteristic j provided by product i. Each product is described by an m-dimensional column vector $\mathbf{a}_i$, which we assume, without loss of generality, to be of unit length:

$$\mathbf{a}_i = \begin{bmatrix} a_{1i} & a_{2i} & \dots & a_{mi} \end{bmatrix}'$$

$$\text{such that} \qquad \sum_{j=1}^{m} a_{ji}^2 = 1 \quad \forall\, i \in \{1, 2, ..., n\}$$

The vector $\mathbf{a}_i$ provides firm i's coordinates in the space of common characteristics. We stack all the coordinate vectors $\mathbf{a}_i$ inside the $m \times n$ matrix $\mathbf{A}$:

$$\mathbf{A} = \begin{bmatrix} \mathbf{a}_1 & \mathbf{a}_2 & \cdots & \mathbf{a}_n \end{bmatrix} = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{m1} & a_{m2} & \cdots & a_{mn} \end{bmatrix}$$

Let q_i be the number of units produced by firm i and consumed by the representative agent. The n-dimensional vector $\mathbf{q}$ contains the quantities of all the n firms in the economy and is given by

$$\mathbf{q} \;=\; \left[\begin{array}{cccc} q_1 & q_2 & \cdots & q_n \end{array}\right]'$$

An *allocation* is a vector $\mathbf{q}$ that specifies, for every firm, the number of units produced.

The representative agent linearly combines the characteristics of different products and the consumer's preferences are defined in terms of these characteristics. Denote the total units of common characteristic j by x_j

$$x_j \;=\; \sum_i a_{ji} q_i$$

The matrix $\mathbf{A}$ projects the vector of units purchased $\mathbf{q}$ on the space of common characteristics:

$$\mathbf{x} \;=\; \mathbf{A}\mathbf{q} \tag{1}$$

Each unit of good i provides one unit of its corresponding idiosyncratic characteristic which allows us to write q_i in place of the units of idiosyncratic characteristic i. The representative agent has a utility function which is quadratic in common $\mathbf{x}$ and idiosyncratic $\mathbf{q}$ characteristics and which also incorporates a linear disutility for the total number of hours of worked H. It is given by

$$U(\mathbf{x}, \mathbf{q}, H) \quad \stackrel{\text{def}}{=} \quad \alpha \cdot \sum_{j=1}^{m} \left(b_j^x x_j \,-\, \frac{1}{2}\, x_j^2 \right) + (1-\alpha) \sum_{i=1}^{n} \left(b_i^q q_i \,-\, \frac{1}{2}\, q_i^2 \right) - H \tag{2}$$

where b_j^x and b_i^q are characteristic-specific preference shifters. $\alpha \in [0,1]$ is the utility weight of common characteristics which governs the degree of *horizontal differentiation* among products (Epple, 1987).

Making leisure the outside good allows us to close us the general equilibrium model. We denote by h_i the labor input acquired by every firm i. The labor market clearing condition is

$$H \;=\; \sum_i h_i.$$

Labor is the numéraire of this economy such that the price of one unit of labor is 1. Therefore, the total variable cost incurred by firm i is equal to the labor input h_i. Firm i produces output q_i using a quasi-Cobb Douglas production function

$$q_i \;=\; k_i^{\theta} \cdot \ell(h_i)$$

where k_i is the (fixed) capital input. The function $\ell(\cdot)$ is such that firm i's production technology is given by a quadratic total variable cost function

$$h_i \;=\; c_i q_i \;+\; \frac{\delta_i}{2}\, q_i^2 \tag{3}$$

where c_i and δ_i depend on k_i. The marginal cost (MC) and the average variable cost (AVC) are given by

$$\mathrm{MC}_i \;=\; c_i + \delta_i q_i; \qquad \mathrm{AVC}_i \;=\; c_i + \frac{\delta_i}{2} q_i.$$

The representative agent buys the goods bundle $\mathbf{q}$ taking prices $\mathbf{p}$ as given and receives the aggregate profits from holding shares of all the companies in the economy. We specify the exact ownership arrangements in Section 2.4. The agent's budget constraint is thus given by

$$H + \Pi \;=\; \sum_{i=1}^{n} p_i q_i. \tag{4}$$

2.2 Consumption Choices, Labor Supply, and Product Demand

Define

$$\mathbf{b} \;\stackrel{\text{def}}{=}\; \alpha\, \mathbf{A}'\mathbf{b}^x + (1-\alpha)\, \mathbf{b}^q \tag{5}$$

We obtain the Lagrangian for the representative agent by plugging equation (1) and (5) into equation (2):

$$\mathscr{L}(\mathbf{q}, H) \quad = \quad \mathbf{q}'\mathbf{b} - \frac{1}{2}\mathbf{q}'\left[\mathbf{I} + \alpha\left(\mathbf{A}'\mathbf{A} - \mathbf{I}\right)\right]\mathbf{q} - H - \lambda\left(\mathbf{q}'\mathbf{p} - H - \Pi\right)$$

Labor is the numéraire and hence the Lagrange multiplier is $\lambda = 1$. As a result, the consumer chooses a demand function $\mathbf{q}(\mathbf{p})$ to maximize the consumer surplus function:

$$\mathrm{CS}(\mathbf{q}) \quad = \quad \mathbf{q}'(\mathbf{b} - \mathbf{p}) - \frac{1}{2}\mathbf{q}'\left[\mathbf{I} + \alpha\left(\mathbf{A}'\mathbf{A} - \mathbf{I}\right)\right]\mathbf{q} \tag{6}$$

$\mathbf{a}_i'\mathbf{a}_j$ is the *cosine similarity* between i and j. It measures the cosine of the angle between vectors $\mathbf{a}_i$ and $\mathbf{a}_j$ in the space of common characteristics $\mathbb{R}^m$ and ranges from 0 to 1. By definition the matrix $\mathbf{A}'\mathbf{A}$ contains the *cosine similarities* between all firm pairs. When two products overlap more in characteristics space they have a higher cosine similarity and this is reflected in the product substitution patterns. If $\mathbf{a}_i'\mathbf{a}_j > \mathbf{a}_i'\mathbf{a}_{j'}$, an increase in the supply of product i leads to a larger decline in the marginal utility of product j than it does on the marginal utility of product j'.

Figure 1 provides a visual illustration of this setup for the simple case of two firms competing in the space of two common characteristics. Both firms are vectors on the unit circle. The cosine similarity $\mathbf{a}_i'\mathbf{a}_j$ captures the width of the angle θ. An increase in the cosine of the angle θ implies a lower angular distance and therefore a more overlapping set of common characteristics. The assumption that $\mathbf{a}_i$ has unit length is a normalization assumption on volumetric units (e.g., kilograms, pounds, gallons).

Figure 1: Example Product Space: Two Firms, Two Characteristics

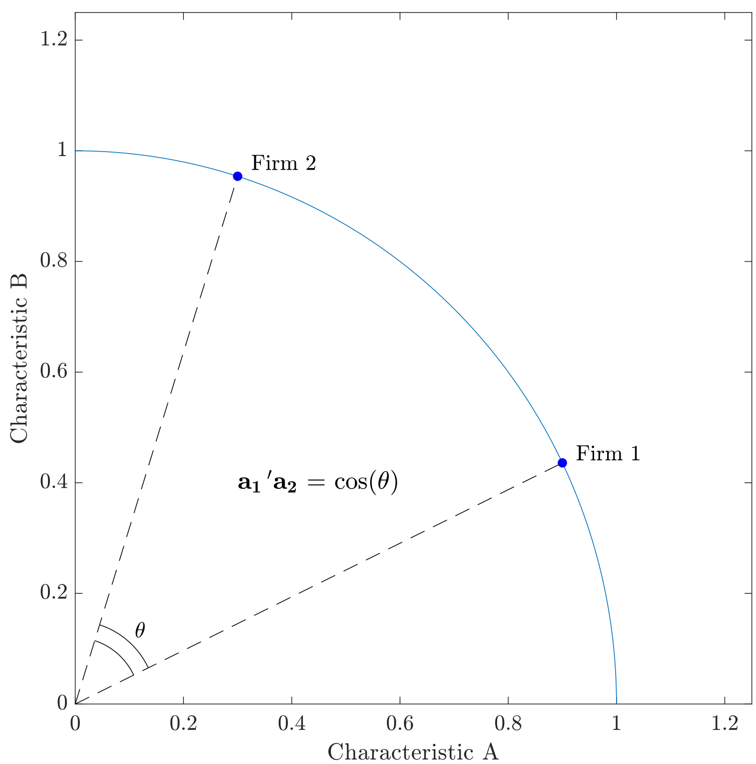

Figure Notes: The following diagram illustrates the hedonic demand model, for the simple case where there are only two product characteristics (A and B) and only two competitors (1 and 2). Each firm is a vector on the unit hypersphere of product characteristics. The dot product $\mathbf{a}_i'\mathbf{a}_j$ equals the cosine of the angle θ. The tighter the angle, the higher the cosine similarity, and the larger (in absolute value) the inverse cross-price elasticity of demand.

Define the firm similarity matrix

$$\mathbf{\Sigma} \stackrel{\text{def}}{=} \alpha \left(\mathbf{A}'\mathbf{A} - \mathbf{I} \right).$$

Thus, the demand and inverse demand functions are given by

$$\begin{aligned}\text{Aggregate demand}: \quad \mathbf{q} &= (\mathbf{I}+\boldsymbol{\Sigma})^{-1}(\mathbf{b}-\mathbf{p}) \qquad (7)\\ \text{Inverse demand}: \quad \mathbf{p} &= \mathbf{b}-(\mathbf{I}+\boldsymbol{\Sigma})\,\mathbf{q} \qquad (8)\end{aligned}$$

The quantity sold by each firm affects the price of the output sold by every other firm in the economy unless the matrix $\boldsymbol{\Sigma}$ is null. The derivative $\partial p_i/\partial q_j$ is proportional to $\mathbf{a}_i'\mathbf{a}_j$, the product similarity between i and j. The closer these two firms are in the product characteristics space, the larger is this derivative in absolute value. Because $\mathbf{A}'\mathbf{A}$ is symmetric, we have $\partial q_i/\partial p_j = \partial q_j/\partial p_i$ by construction.

The economic profits π_i of firm i are therefore given by

$$\begin{aligned}\pi_i(\mathbf{q}) &\stackrel{\text{def}}{=} p_i(\mathbf{q})\cdot q_i - h_i\\ &= q_i(b_i-c_i) - \left(1+\frac{\delta_i}{2}\right)q_i^2 - \sum_{j\neq i}\sigma_{ij}q_iq_j.\end{aligned}$$

2.3 Advantages of GHL

2.3.1 Complementarities

Our network Cournot model allows for complementarities despite the fact that $\boldsymbol{\Sigma}$ is non-negative by construction and hence the marginal utility from one unit of product j is always non-increasing in q_i:

$$\frac{\partial^2 \mathrm{CS}}{\partial q_i \partial q_j} = -\sigma_{ij} \leq 0 \quad \forall\, i \neq j \qquad (9)$$

However, this does not mean that all products are by construction substitutes and that no pair of products are complements. Recall the definition of complements and substitutes based on cross-price effects:

$$\text{Complements} \quad \text{if} \quad \frac{\partial q_i}{\partial p_j} < 0 \qquad \text{Substitutes} \quad \text{if} \quad \frac{\partial q_i}{\partial p_j} > 0 \qquad (10)$$

The important insight is that the cross-price elasticity of demand depends on the inverted matrix $(\mathbf{I}+\boldsymbol{\Sigma})^{-1}$, not on $\boldsymbol{\Sigma}$ itself. If, as in our case, $\boldsymbol{\Sigma}$ is not symmetric, the off-diagonal elements of $-(\mathbf{I}+\boldsymbol{\Sigma})^{-1}$ will generally include positive as well as negative elements. This implies that some product ik pairs are complements in the sense defined above and thus the quantity choices q_i and q_k can be strategic complements. Intuitively, this perhaps surprising complementarity arises from a dynamic that is similar to “the enemy of my enemy is my friend." An increase in quantity q_i leads to a reduction in residual demand for firm j and thus a decrease in quantity q_j, but this in turn implies an increase in residual demand firm k and thus an increase in quantity q_k.

This complementarity is important for two reasons. First, it matches realistic features of economy-wide substitution patterns. For example, our computed vector of cross-price derivatives for General Motors in 2018 includes several negative elements (i.e., complements), including energy and consumer finance companies: higher oil prices, loan rates, or insurance premia adversely affect the residual demand for cars. Second, this complementarity provides a welfare-enhancing effect of common ownership for exactly the same quantity-increasing reason as a merger between two firm producing complementary products (Economides and Salop, 1992).

2.3.2 Price-Cost Passthrough

GHL differs from the more standard CES demand in that it produces linear (as opposed to isoelastic) residual demands. Hence, demand elasticity decreases with firm size and bigger firms charge larger markups. An important issue, then, is then to evaluate how GHL fares empirically when compared to a more standard demand system such as CES.

In a recent paper, Baqaee and Farhi (2020) fit a residual demand curve non-parametrically using price-cost passthrough estimates by Amiti et al. (2019) which are in turn obtained from Belgian manufacturing enterprise micro data. In Figure 2 we use Baqaee and Farhi (2020)'s model demand curve to show that linear demand (GHL) note only compares favorably to isoelastic demand (CES) in terms of empirical fit, but also closely matches the non-parametric estimates.

2.4 Ownership

There are Z investment funds which are owned by the representative agent and indexed by z. V_z, the value of fund z, is the sum of the profits that they are entitled to based on their ownership share in each company i:

$$V_z \stackrel{\text{def}}{=} \sum_{i=1}^{n} s_{iz}\, \pi_j \qquad \sum_{z=1}^{Z} s_{iz} = 1 \tag{11}$$

where s_{jz} is the percentage of shares of company j owned by investor z. Following Rotemberg (1984), we assume that the manager of firm i maximizes ϕ_i, an average of firm i's investors'

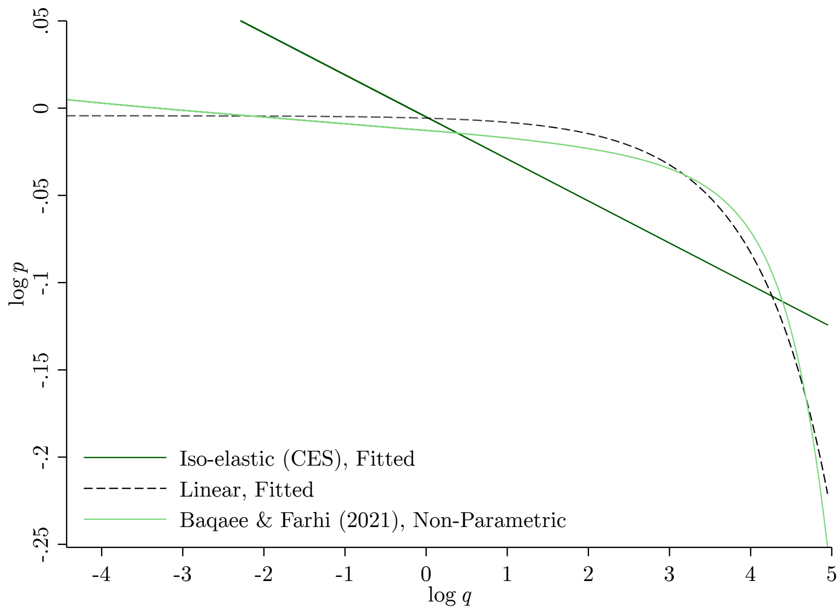

FIGURE NOTES: The figure shows a log-log plot of the demand curve estimated non-parametrically by Baqaee and Farhi (2020) (solid light green line), against a linear fit (dotted black line) and against an isoelastic (CES) fit (solid dark green line). Note that an isoelastic curve becomes a straight line in a log-log plot. Baqaee and Farhi (2020)'s model demand curve is obtained from price-cost passthrough estimates by Amiti et al. (2019).

value functions, weighted by the investors' ownership shares in all firms in the economy:

$$\phi_i \quad \stackrel{\text{def}}{=} \quad \sum_{z=1}^{Z} s_{iz} V_z \quad = \quad \sum_{z=1}^{Z} s_{iz} \sum_{j=1}^{I} s_{jz} \pi_j \quad = \quad \sum_{j=1}^{I} \pi_j \sum_{z=1}^{Z} s_{iz} s_{jz} \tag{12}$$

We assume that firms engage in Cournot competition and that the profit functions are concave. Hence, to maximize V_i, firm i's management sets the following derivative with respect to q_i equal to zero:

$$\begin{aligned}
\frac{\partial \phi_i}{\partial q_i} &= \sum_{j=1}^{N} \mathbf{s}_i' \mathbf{s}_j \cdot \frac{\partial \pi_j}{\partial q_i} \\
&= \mathbf{s}_i' \mathbf{s}_i \left[b_i - c_i - (2 + \delta_i)\, q_i - \alpha \sum_{j \neq i} \mathbf{a}_i' \mathbf{a}_j q_i \right] - \alpha \sum_{j \neq i} \mathbf{s}_i' \mathbf{s}_j \cdot \mathbf{a}_i' \mathbf{a}_j \cdot q_i
\end{aligned}$$

where

$$\mathbf{s}_i \quad \stackrel{\text{def}}{=} \quad \begin{bmatrix} s_{i1} & s_{i2} & \dots & s_{iZ} \end{bmatrix}'$$

The common ownership weights κ_{ij} are defined as

$$\kappa_{ij} \stackrel{\text{def}}{=} \frac{\mathbf{s}_i'\mathbf{s}_j}{\mathbf{s}_i'\mathbf{s}_i}$$

which allows us to rewrite firm i's objective function in the following way

$$\phi_i \propto \pi_i + \sum_{j \neq i} \kappa_{ij}\pi_j. \tag{13}$$

Our notation directly follows Backus et al. (2021) and Antón et al. (2020).[2] We interpret κ_{ij} as the weight—due to common ownership—that each firm (or each manager) i's objective function assigns to the profits of other firms relative to its own profits and corresponds to what Edgeworth (1881) termed the "coefficient of effective sympathy among firms."

At this point it is worth discussing our assumption that the manager of firm i maximizes ϕ_i. There is a long tradition in economics of weighting shareholder interests in the objective function of the firm, including Drèze (1974), Grossman and Hart (1979), and Rotemberg (1984). More recently, almost all of the common ownership literature has used the same objective function for firms as in equation (13) with Azar (2020) and Antón et al. (2020) providing microeconomic foundations for the manager's maximization choice. However, this assumption that firms (or managers) maximize the weighted portfolio profits of their investors differs from Azar and Vives (2021a). They instead assume that firms maximize the weighted investor *utilities*. Firms are assumed to take into account that their quantities affect the consumption choices of investors through the firm quantities' influence on the aggregate price index. For example, under this assumption airlines internalize that some of its investors are also air travelers and setting higher quantities lowers the relative price of air travel in the consumption bundle of these owner-consumers. This can give rise to strategic complementarities between firms across industries and a pro-competitive effect of common ownership.

In contrast, in our benchmark case firms ignore the impact of their quantity choices on the consumption bundles of their investors. However, despite ignoring this channel strategic complementarities between firms (and thus pro-competitive effects of common ownership) can still arise in our setting. Rather than resulting from changes in the aggregate price index and firms maximizing the indirect utility of the ultimate owners they arise from the network structure as discussed in Section 2.3.1.

[2] López and Vives (2019) and Azar and Vives (2021a) use the same formulation but denote κ_{ij} by λ_{ij}.

We can now write the vector of the firms' first order conditions as

$$\mathbf{0} \;=\; (\mathbf{b}-\mathbf{c}) - (2\mathbf{I} + \boldsymbol{\Delta} + \boldsymbol{\Sigma} + \mathbf{K} \circ \boldsymbol{\Sigma})\,\mathbf{q}$$

where $\circ$ is the Hadamard (element-by-element) product and $\mathbf{K}$ is the $n \times n$ common ownership matrix of κ_{ij} for all n firms in the economy. This yields the following equilibrium quantity vector $\mathbf{q}^{\Phi}$ under *Cournot Common Ownership* (CCO).

Definition 1. The *Cournot Common Ownership* allocation $\mathbf{q}^{\Phi}$ is defined as:

$$\mathbf{q}^{\Phi} \quad \stackrel{\text{def}}{=} \quad \arg\max_{\mathbf{q}} \Phi(\mathbf{q}) \quad = (2\mathbf{I} + \boldsymbol{\Delta} + \boldsymbol{\Sigma} + \mathbf{K} \circ \boldsymbol{\Sigma})^{-1}(\mathbf{b}-\mathbf{c})\,. \tag{14}$$

2.5 Market Structure and Ownership Counterfactuals

We use our theoretical model to study how welfare statistics such as total surplus respond to changes in market structure. Our baseline assumption is that firms compete as in an economy-wide Cournot oligopoly in which the manager of each firm i maximizes the objective function ϕ_i which results in the Cournot Common Ownership allocation in equation (14). We now consider counterfactuals in which the same firms make production decisions with alternative objective functions. For example, rather than maximizing portfolio profits ϕ_i firms maximize just their own profits π_i as under standard Cournot competition. Each of these counterfactuals, summarized in the set of equations in (15) and inversely ranked by their degree of competitiveness, is the maximizer of a specific scalar quadratic function, which we call *potential*.[3]

[3] The closed-form expressions for the output vector $\mathbf{q}$ which we provide below assume an interior solution. For our empirical analysis, we also compute a numerical solution that is subject to a non-negativity constraint on $\mathbf{q}$ and we verify that it is approximately equal to the unconstrained solution (error $< 0.1\%$ for the total surplus function in perfect competition). The non-negativity constraint binds for very few firms.

Potential Functions

$$\begin{aligned}
\text{Monopoly Potential}: \quad \Pi(\mathbf{q}) &= \mathbf{q}'(\mathbf{b}-\mathbf{c}) - \mathbf{q}'\left(\mathbf{I}+\frac{1}{2}\boldsymbol{\Delta}+\boldsymbol{\Sigma}\right)\mathbf{q} \\
\text{CCO Potential}: \quad \Phi(\mathbf{q}) &= \mathbf{q}'(\mathbf{b}-\mathbf{c}) - \mathbf{q}'\left(\mathbf{I}+\frac{1}{2}\boldsymbol{\Delta}+\frac{1}{2}\boldsymbol{\Sigma}+\frac{1}{2}\mathbf{K}\circ\boldsymbol{\Sigma}\right)\mathbf{q} \\
\text{Cournot Potential}: \quad \Psi(\mathbf{q}) &= \mathbf{q}'(\mathbf{b}-\mathbf{c}) - \mathbf{q}'\left(\mathbf{I}+\frac{1}{2}\boldsymbol{\Delta}+\frac{1}{2}\boldsymbol{\Sigma}\right)\mathbf{q} \\
\text{Total Surplus}: \quad W(\mathbf{q}) &= \mathbf{q}'(\mathbf{b}-\mathbf{c}) - \frac{1}{2}\cdot\mathbf{q}'(\mathbf{I}+\boldsymbol{\Delta}+\boldsymbol{\Sigma})\mathbf{q}
\end{aligned} \tag{15}$$

We first consider *Cournot* competition which assumes away any common ownership effects by assuming that investors do not hold diversified portfolios.

Definition 2. The *Cournot* allocation $\mathbf{q}^{\Psi}$ is defined as that in which all profit weights κ_{ij} in $\mathbf{K}$ are equal to 0 for $i \neq j$ and equal to 1 for $i = j$:

$$\mathbf{q}^{\Psi} \stackrel{\text{def}}{=} \arg\max_{\mathbf{q}} \Psi(\mathbf{q}) = (2\mathbf{I}+\boldsymbol{\Delta}+\boldsymbol{\Sigma})^{-1}(\mathbf{b}-\mathbf{c}) \tag{16}$$

Next we consider *Perfect Competition* in which firms act as atomistic producers and price all units at marginal cost.

Definition 3. The *Perfect Competition* allocation $\mathbf{q}^{W}$ is defined as the maximizer of the aggregate total surplus function $W(\mathbf{q})$:

$$\mathbf{q}^{W} \stackrel{\text{def}}{=} \arg\max_{\mathbf{q}} W(\mathbf{q}) = (\mathbf{I}+\boldsymbol{\Delta}+\boldsymbol{\Sigma})^{-1}(\mathbf{b}-\mathbf{c}) \tag{17}$$

The least competitive allocation is *Monopoly.* It represents a situation in which one agent who does not internalize consumer surplus, has control over all the firms in the economy and maximizes the aggregate profits of all firms.

Definition 4. The *Monopoly* allocation $\mathbf{q}^{\Pi}$ is defined as the maximizer of the aggregate profit function $\Pi(\mathbf{q})$:

$$\mathbf{q}^{\Pi} \stackrel{\text{def}}{=} \arg\max_{\mathbf{q}} \Pi(\mathbf{q}) = (2\mathbf{I}+\boldsymbol{\Delta}+2\boldsymbol{\Sigma})^{-1}(\mathbf{b}-\mathbf{c}) \tag{18}$$

This allocation can be alternatively conceptualized as an economy without any antitrust policy restricting ownership allocations, in which firms have unlimited ability to coordinate their supply choices. This allocation is the limit of a Cournot equilibrium with common ownership when all of the profit weights tend to one (i.e., $\kappa_{ij} \to 1$).

3 Data

3.1 Text-Based Product Similarity

The key data input required to apply our model to the data is the matrix of product similarities $\mathbf{A}'\mathbf{A}$. Our empirical counterpart to this object comes from Hoberg and Phillips (2016, henceforth HP), who compute product cosine similarities for firms in Compustat by analyzing the text of their 10-K forms. The form contains a *product description* section, which is the target of the algorithm devised by HP. HP build a vocabulary of 61,146 words that firms use to describe their products, and that identify product characteristics. For each firm i, HP use this vocabulary to construct a vector of word occurrences $\mathbf{o}_i$.

$$\mathbf{o}_i = \begin{bmatrix} o_{i,1} \\ o_{i,2} \\ \vdots \\ o_{i,61146} \end{bmatrix}$$

This vector is then normalized (i.e., divided by the Euclidean norm to obtain the counterpart of $\mathbf{a}_i$)

$$\mathbf{a}_i = \frac{\mathbf{o}_i}{\|\mathbf{o}_i\|}.$$

Finally, all $\mathbf{a}_i$ vectors are dot-multiplied to obtain $\mathbf{A}'\mathbf{A}$:

$$\mathbf{A}'\mathbf{A} = \begin{bmatrix} \mathbf{a}_1'\mathbf{a}_1 & \mathbf{a}_1'\mathbf{a}_2 & \cdots & \mathbf{a}_1'\mathbf{a}_n \\ \mathbf{a}_2'\mathbf{a}_1 & \mathbf{a}_2'\mathbf{a}_2 & \cdots & \mathbf{a}_2'\mathbf{a}_n \\ \vdots & \vdots & \ddots & \vdots \\ \mathbf{a}_n'\mathbf{a}_1 & \mathbf{a}_n'\mathbf{a}_2 & \cdots & \mathbf{a}_n'\mathbf{a}_n \end{bmatrix}$$

To the extent that the word frequencies in the vocabulary constructed by HP correctly represent product characteristics, the resulting matrix is the exact empirical counterpart to $\mathbf{A}'\mathbf{A}$—the matrix of cross-price effects in our theoretical model. The fact that all publicly traded firms in the United States are required to file a 10-K form makes the HP dataset unique. It is the only dataset that covers the near entirety (97.8%) of the CRSP-Compustat universe.[4]

3.2 Ownership Data

In order to calculate the matrix of common ownership profit weights $\mathbf{K}$, we require the matrix of ownership shares $\mathbf{S}$. We obtain $\mathbf{S}$ from a dataset of mutual fund holdings reported in form 13(f) filings. Form 13(f) is a mandatory filing of the Securities and Exchange Commission (SEC) in which institutional investors with assets in excess of \$100 million are required to report their holdings of US securities, including those of all US public corporations.

The quantitative data contained in these forms have been parsed by Backus, Conlon and Sinkinson (2021) to construct a dataset of security holdings for the period from 1994 to 2018. We use their dataset in our empirical analysis to compute the matrix $\mathbf{K}$ of ownership shares.

3.3 Identification

The first step in identifying the model is obtaining the vector of output quantities $\mathbf{q}$. To do so we need to rewrite the vector of profits based on this equilibrium condition, output can be recovered from profits:

$$\pi \;=\; \text{diag}(\mathbf{q})\left(\mathbf{I}+\frac{1}{2}\boldsymbol{\Delta}+\mathbf{K}\circ\boldsymbol{\Sigma}\right)\mathbf{q}$$

The rest of the identification and calibration of the model follows Pellegrino (2019).

4 Empirical Results

Our empirical analysis proceeds in two steps. First, we describe the salient features of the data on product similarity and common ownership. Second, we report the empirical model estimates of welfare, consumer surplus, and profit and their evolution over time.

[4] One of HP's objectives in developing this dataset is to remedy two well-known shortcomings of the traditional industry classifications: (i) the inability to capture imperfect substitutability between products, which is the most salient feature of our model; and (ii) the fact that commonly used industry classifications, such as SIC and NAICS, are based on similarity in *production processes*, rather than in product characteristics. In other words, they are appropriate for estimating production functions, but unsuitable for proxying for the elasticity of substitution between different products.

4.1 Product Similarity and Common Ownership

4.1.1 Network Structure of Product Similarity and Common Ownership

We begin our empirical analysis by visualizing the network structure of product similarity and common ownership.

Figure 3: Network Visualization of the Hoberg-Phillips Dataset

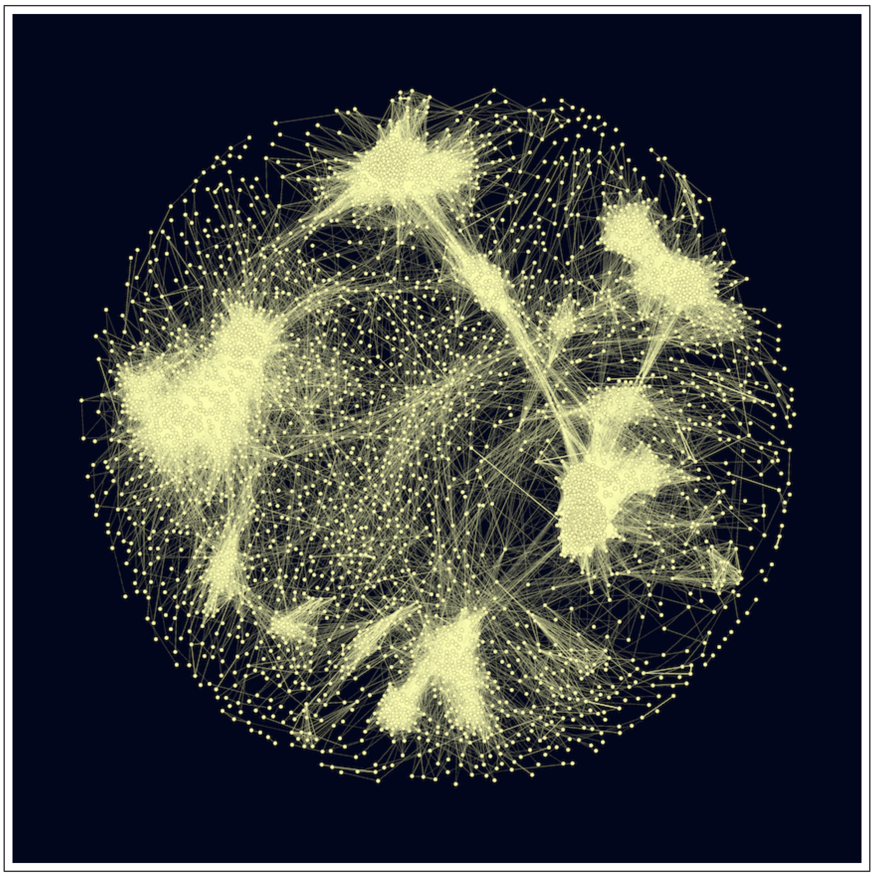

Figure Notes: The diagram is a two-dimensional representation of the network of product similarities computed by Hoberg and Phillips (2016), which is used in the estimation of the model presented in Section 2. The data covers the universe of Compustat firms in 2004. Firm pairs that have thicker links are closer in product market space. These distances are computed in a space that has approximately 61,000 dimensions. To plot this high-dimensional object over a plane, we apply the gravity algorithm of Fruchterman and Reingold (1991).

We first visualize the network structure of HP's dataset. We reduce the dimensionality of the dataset from 61,146 (the number of words in the HP's vocabulary) to two. We use the algorithm of Fruchterman and Reingold (1991, henceforth FR), which is widely used in network science to visualize weighted networks[5].

Every publicly traded firm in 2004 is a dot in Figure 3. Firm pairs that have a high cosine similarity, are closer and are joined by a thicker line. Two patterns are particularly noteworthy. First, the distribution of firms over the space of product characteristics is uneven. Some areas in Figure 3 are significantly more densely populated with firms than others. Second, the network displays a pronounced community structure because large groups of firms tend to cluster in certain areas of the network.

We repeat the same exercise for the network of ownership links between all the companies in our sample. As before, we reduce the dimensionality of the dataset from 3,126 (the number of investors) to two and use the FR algorithm to visualize the network in Figure 4 where every dot is a public firm in 2004. Firm pairs that have large ownership weights between them appear closer, and are joined by a thicker line. Conversely, firms that are less similar in their ownership are not joined, and are more distant. In contrast to the product similarity network depicted in Figure 3 the network does not exhibit a community structure, but instead has a distinct hub-and-spoke structure with a large proportion of firms sharing significant overlap and the remainder of largely unconnected firms at the periphery.

4.1.2 Relationship between Product Similarity and Common Ownership

A crucial aspect of our empirical analysis is to document the empirical relationship between product similarity $\mathbf{\Sigma}$ and common ownership $\mathbf{K}$ because this relationship governs the magnitude of the welfare cost of common ownership. As can be seen from equation (14) it is the Hadamard product of $\mathbf{K}$ and $\mathbf{\Sigma}$ that determines how much the realized quantity choices of firms under Cournot competition with common ownership differ from the standard benchmarks of standard Cournot without common ownership in equation (16) and monopoly in equation (18).

Figure 5 plots the histogram of the joint distribution of the product similarity $\mathbf{a}_i \cdot \mathbf{a}_j$ and the common ownership weight κ_{ij} for any firm pair i and j in 2018. Note that while each product similarity pair $\mathbf{a}_i \cdot \mathbf{a}_j$ is symmetric, the common ownership weight κ_{ij} is not symmetric. We therefore plot each pair of firm i and j twice.

A large proportion of firm pairs has little product similarity and little common ownership

[5] The algorithm models the network nodes as particles, letting them dynamically arrange themselves on a bidimensional surface as if they were subject to attractive and repulsive forces. One known shortcoming of this algorithm is that it is sensitive to the initial configurations of the nodes, and it can have a hard time uncovering the cluster structure of large networks. To mitigate this problem, and to make sure that the cluster structure of the network is properly displayed, we pre-arrange the nodes using the OpenOrd algorithm (which was developed for this purpose) before running FR.

Figure 4: Network Visualization of the Common Ownership Network

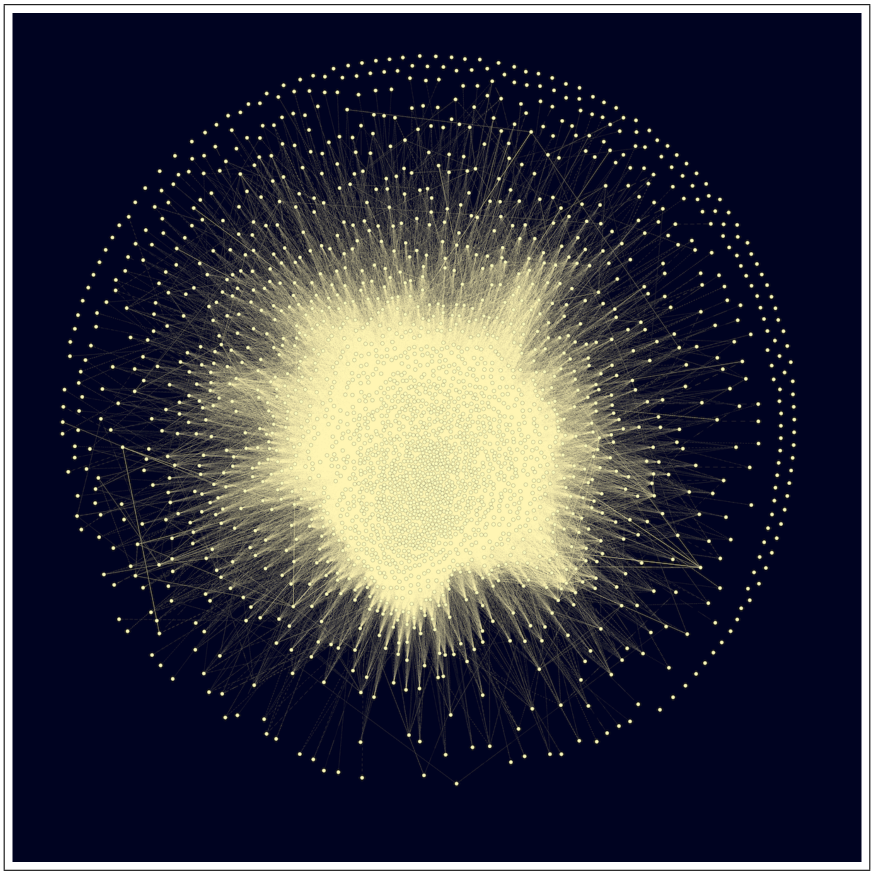

Figure Notes: The diagram is a two-dimensional representation of the network of ownership shares, which is used in the estimation of the model presented in Section 2. The data covers the universe of publicly-listed firms in 2004. Firm pairs that have thicker links have more overlap in their ownership.

between them. The complete absence of overlap is relatively more pronounced in ownership than in product similarity space as evidenced by the discontinuity at 0 for κ_{ij}. However, a sizable proportion of firm pairs overlaps considerably in both product similarity and ownership space. The same pattern can also be seen in a simple scatter plot of the same variables in Figure 6. There is no clear relationship between product similarity and common ownership. The correlation between the two variables in 2018 is 0.0034. This means that common ownership is not much more pronounced for firms that are more similar in product space.

Finally, both figures also show that a small proportion of κ_{ij} has values greater than 1. Such values of lead to owners placing more weight on the profits of the other firm j than on the profits of their own firm i. This makes it possible for common ownership to create incentives for the "tunneling" of profits from one firm to another (Johnson et al., 2000).

Figure 5: Product Similarity and Profit Weights (2018)

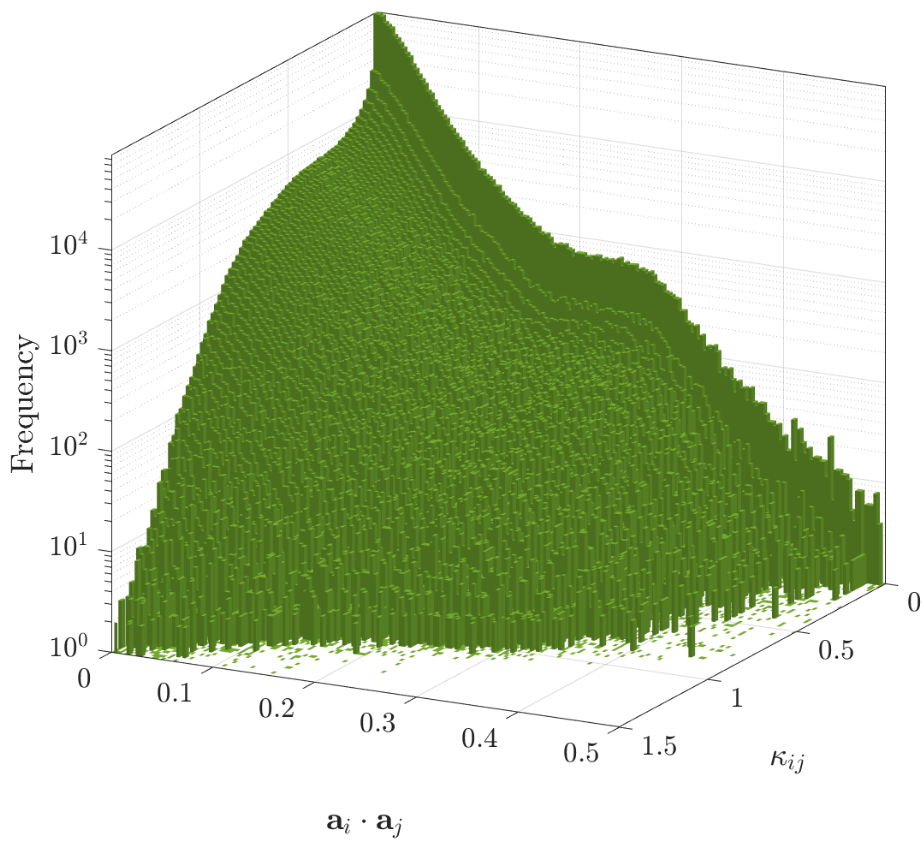

Figure Notes: The figure reports a histogram of the joint distribution of product similarity $\mathbf{a}_i \cdot \mathbf{a}_j$ and profit weights κ_{ij} for all firm ij pairs in 2018.

However, the proportion of these firms is sufficiently small such that if we restrict all κ_{ij} to be strictly smaller than 1, the estimates of our model are essentially unchanged.

4.2 Welfare, Consumer Surplus, and Profit Estimates

We now present the results of the empirical estimation of our model. These baseline estimates assume that investors do not have divided attention, but instead set the quantities of the firms they control in accordance with the objective function given in equation (12).

Our first empirical exercise computes total surplus and decomposes it into profits and consumer surplus as reported in Table 1 for 2018, the most recent year in our sample. We perform these calculations for the observed equilibrium, which our model assumes to be the Cournot-Nash equilibrium under common ownership (column 1), and the counterfactuals discussed in Section 2 (columns 2, 3, and 4). Table 2 in the appendix reports the same

Table 1: Welfare Estimates (2018)

	Scenario	*Common Ownership*	*Cournot-Nash*	*Perfect Competition*	*Monopoly*
		(1)	(2)	(3)	(4)
Welfare Statistic	**Variable**	$\mathbf{q}^{\Phi}$	$\mathbf{q}^{\Psi}$	$\mathbf{q}^{W}$	$\mathbf{q}^{\Pi}$
Total Surplus (US$ trillions)	$W(\mathbf{q})$	8.953	9.374	10.597	8.484
Aggregate Profits (US$ trillions)	$\Pi(\mathbf{q})$	5.639	5.261	2.033	5.878
Consumer Surplus (US$ trillions)	$\mathrm{CS}(\mathbf{q})$	3.314	4.113	8.565	2.606
Total Surplus / Perfect Competition	$\frac{W(\mathbf{q})}{W(\mathbf{q}^{W})}$	0.845	0.885	1.000	0.802
Aggregate Profit / Total Surplus	$\frac{\Pi(\mathbf{q})}{W(\mathbf{q})}$	0.630	0.561	0.192	0.693
Consumer Surplus / Total Surplus	$\frac{\mathrm{CS}(\mathbf{q})}{W(\mathbf{q})}$	0.370	0.439	0.808	0.307

Table Notes: The table reports the model estimates of aggregate profits, consumer surplus, and total surplus for each of the counterfactual scenarios presented in Section 2.

Figure 6: Product Similarity and Profit Weights (2018)

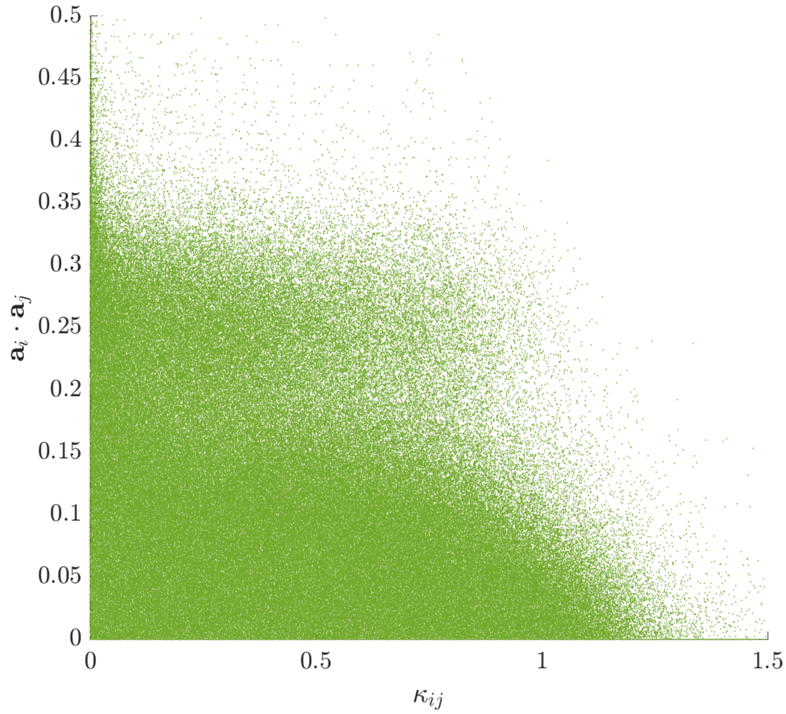

Figure Notes: The figure provides a scatter plot of the joint distribution of product similarity $\mathbf{a}_i \cdot \mathbf{a}_j$ and profit weights κ_{ij} for all firm ij pairs in 2018.

estimates for 1994, the first year of our sample. Additionally, Table 3 in the appendix reports the estimates when all κ_{ij} are restricted to be smaller than 1.

We estimate that in 2018 under *Common Ownership* publicly-listed firms earn an aggregate economic profit of \$5.639 trillion and produce an estimated total surplus of \$8.953 trillion. Consumer surplus is therefore estimated to be \$3.314 trillion. 63% of the total surplus produced is appropriated by the companies in the form of oligopoly profits under common ownership while the remaining 37% accrues to consumers. To put these estimates into context, the GDP of U.S. corporations in the same year is around \$11 trillion. The difference between GDP and total surplus is that total surplus does not include the value of labor input but it does include the value of inframarginal consumption. GDP, on the other hand, includes the value of labor input but not the inframarginal value of consumption. In this model each unit of labor is paid exactly its marginal disutility. Therefore, there is no inframarginal value of leisure.

The estimates for our two primary counterfactuals, *Cournot-Nash* and *Perfect Competition*, are reported in column 2 and 3. Comparing the estimates of these counterfactual models with those of the *Common Ownership* allocation in column 1 shows that the welfare costs of common ownership are significant, but not as large as the welfare costs of oligopoly. First, total surplus is slightly higher at \$9.374 trillion under oligopoly without common ownership (Cournot-Nash) and significantly higher at \$10.597 trillion under perfect competition. Thus, we estimate that in 2018 the deadweight loss of oligopoly amounts to about 11.5% of total surplus. On top of that, common ownership leads to an additional deadweight loss of 4% of total surplus.

While the effects of oligopoly and common ownership on efficiency are significant, their respective distributional effects are even more substantial. When firms price at marginal cost, a much larger share of the total surplus goes to the consumer: \$8.565 trillion, more than double than in the Cournot-Nash (\$4.113 trillion) and the Common Ownership (\$3.314 trillion) allocations. This means that under perfect competition 80.8% of the total surplus accrues to consumers. In contrast, merely 43.9% and 37% of total surplus accrue to consumers under oligopoly without and with common ownership. Corporate profits, on the other hand, move exactly in the opposite direction. The aggregate profits under common ownership (\$5.639 trillion) are almost 3 times as large as those under perfect competition (\$2.033 trillion).

The comparison between *Common Ownership* in column 1 and *Cournot-Nash* in column 2 further allows us to focus on the distributional effects of common ownership on top of the effect of product market power due to oligopoly. Not only does common ownership in the economy lead to a total welfare loss of \$421 billion, but the welfare losses of common ownership fall entirely on consumers. Whereas common ownership raises aggregate profits by \$378 billion from \$5.261 trillion to \$5.639 trillion, it lowers consumer surplus by \$799 billion from \$4.113 trillion to \$3.314 trillion.

The final counterfactual we analyze is the *Monopoly* allocation for which we report the welfare estimates in column 4. This allocation represents a scenario in which all firms are controlled by a single decision-maker who coordinates supply choices. In this allocation, aggregate surplus is only equal to \$8.484 trillion and thus significantly lower than even in common ownership equilibrium allocation. Despite the decrease in aggregate welfare, profits are markedly higher still at \$5.878 trillion. In contrast, consumer surplus is reduced to just \$2.606 trillion, a mere 30.7% of the total surplus under this allocation.

In sum, our estimates suggest that the market power due to oligopoly and common ownership of U.S. public firms has significant consequences for aggregate welfare, and that it impacts consumer welfare through two channels. First, it increases the dispersion of markups, generating resource misallocation which raises the deadweight loss. Second, it also increases the level of markups, which in turn affects how surplus is shared between producers and consumers.

4.3 Time Trends in Welfare, Consumer Surplus, and Profits

We now consider time trends in welfare, consumer surplus, and firm profits.

FIGURE 7: TOTAL SURPLUS OF U.S. PUBLIC FIRMS (1994-2018)

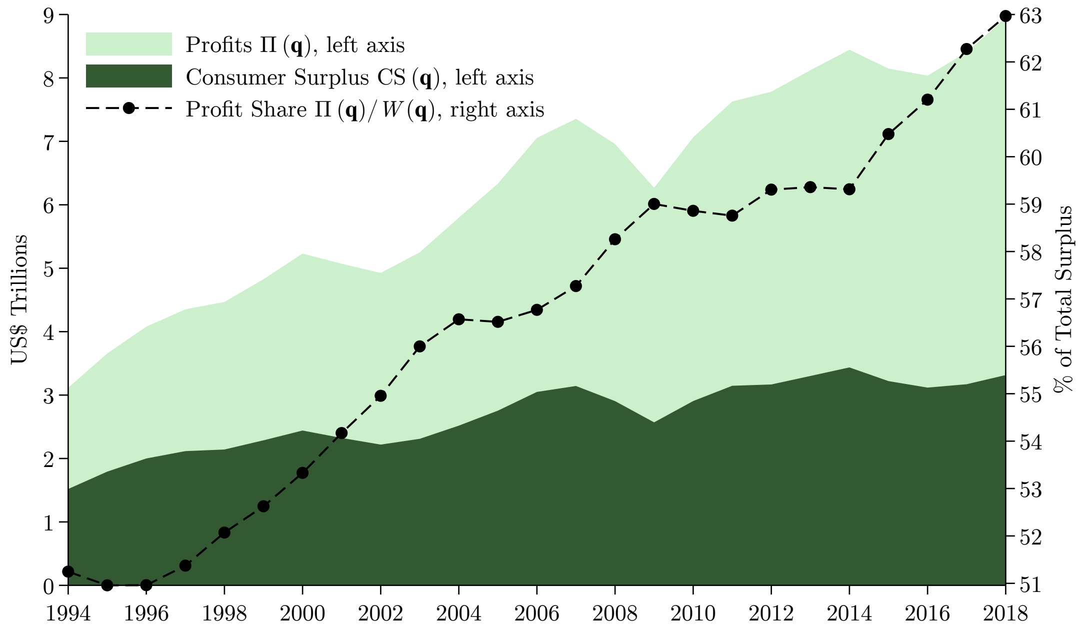

FIGURE NOTES: The figure plots the evolution of aggregate (economic) profits $\Pi(\mathbf{q})$, aggregate consumer surplus $CS(\mathbf{q})$, and total surplus $W(\mathbf{q})$, as defined in the model in Section 2. Profits as a percentage of total surplus ($\Pi(\mathbf{q})/W(\mathbf{q})$, black dotted line) are shown on the right axis. These statistics are estimated over the universe of the U.S. publicly-listed corporations. These surplus measures are gross of fixed costs.

HP's cosine similarity data and the scraped 13(f) filings are available starting in 1994. By mapping our model to Compustat data year by year, we can produce annual estimates of the welfare measures we presented above. This allows us to study the welfare implications of the joint rise of product market and ownership concentration among publicly-listed U.S. companies for the period from 1994 to 2018. Because our model leverages both HP's time-varying product similarity data and time-varying ownership, these estimates account for how the product offering of U.S. public firms and their ownership has changed over time.

In Figure 7, we plot aggregate consumer surplus $CS(\mathbf{q})$ (dark green area) and profits $\Pi(\mathbf{q})$ (light green area) for every year between 1994 and 2018. The combined area represents total surplus W. We also plot, on the right axis (dotted black line), profits as a share of total surplus Π/W. All these measures are computed for the observed *Common Ownership* equilibrium.

FIGURE 8: PROFIT SHARE OF TOTAL SURPLUS (1994-2018)

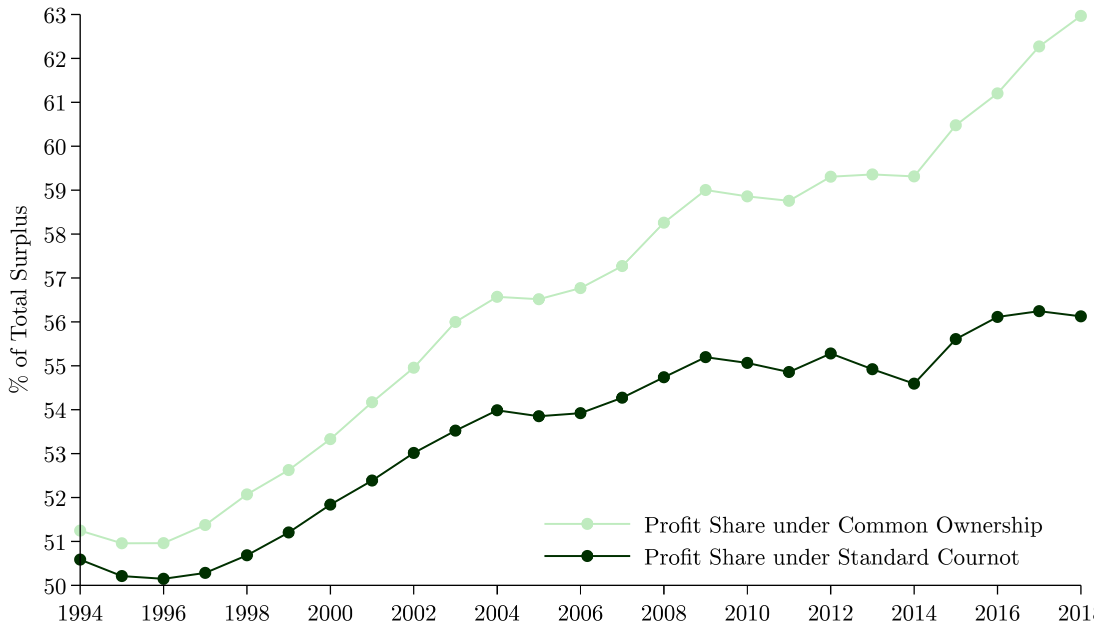

FIGURE NOTES: The figure plots the profit share under standard Cournot (dark green line) and Cournot with common ownership (light green line) between 1994 and 2018.

The graph shows that the total surplus produced by U.S. public corporations almost tripled between 1994 and 2018 from \$3.116 trillion to \$8.953 trillion. Most of the increase over this time period is due to the increase in profits while the gains in consumer surplus have been comparatively modest. Profits increased from \$1.597 trillion to \$5.639 trillion. Consumer surplus increased from \$1.519 trillion in 1994 to \$3.314 trillion in 2018. As a consequence, the profit share of surplus increased from 51.2% of total surplus to 63%. Consumers capture a significantly lower share of the surplus generated by public companies, dropping from 48.8% of total surplus in 1994 to 37% in 2018.

To investigate the evolution of the profit share in greater detail and to decompose the separate effects of oligopoly and common ownership we plot the profit share of total surplus under Cournot with and without common ownership in Figure 8. Under standard Cournot without common ownership (dark green line) the increase in the profit share is significantly less pronounced than under Cournot with common ownership (light green line). Under standard Cournot the profit share only increases by 5.5 percentage points from 50.6% to 56.1%. In contrast, the increase in the profit share under common ownership is almost twice as large. The profit share increases by almost 12 percentage points from 51.2% to 63%.

Figure 9: Deadweight Loss (1994-2018)

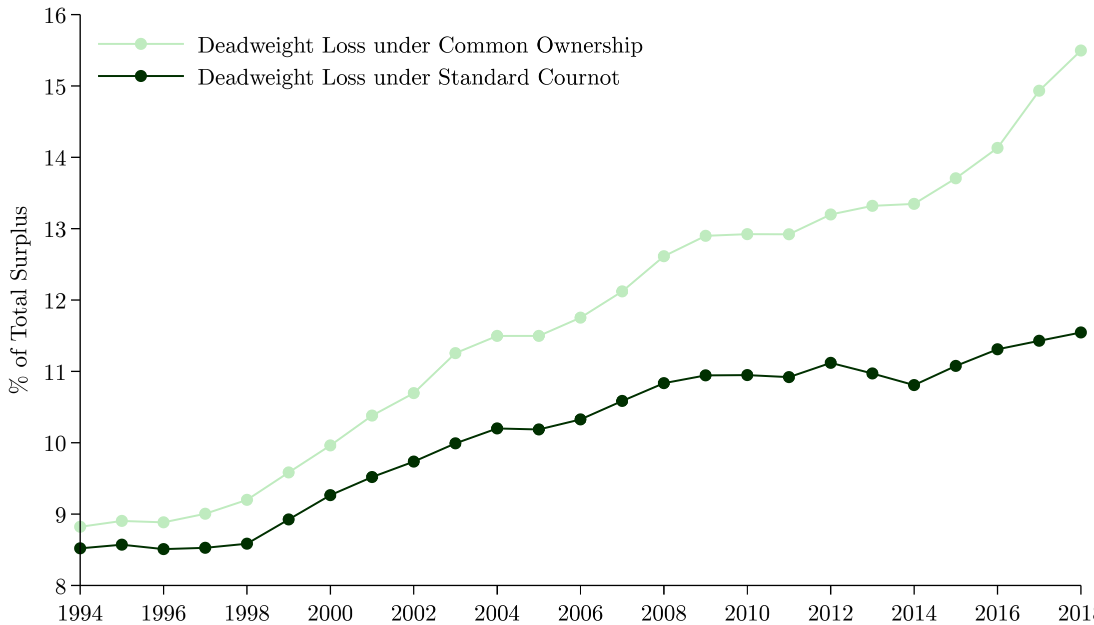

Figure Notes: The figure plots the estimated deadweight loss (DWL) of oligopoly and of oligopoly and common ownership, between 1994 and 2018. The dark green line is the DWL of oligopoly, the % difference in total surplus between the Cournot equilibrium and the Perfect Competition scenario. The light green line is the % difference between the Cournot Common Ownership equilibrium and the Perfect Competition scenario. These surplus measures are gross of fixed costs.

In Figure 9, we plot, over the same period, the respective percentage gains in total surplus from moving from the standard Cournot equilibrium $\mathbf{q}^{\Psi}$ and from the Cournot with common ownership equilibrium $\mathbf{q}^{\Phi}$ to the first-best perfect competition equilibrium $\mathbf{q}^{W}$. These are the deadweight losses of oligopolistic behavior (dark green line) and of the combination of oligopolistic behavior and common ownership (light green line). Their respective trends closely mimic those of the profit shares of total surplus under both of these regimes. The deadweight losses increase from 8.5% and 8.8% in 1994 to 11.5% and 15.5% in 2018. This suggests that both the impact of oligopoly and the impact of common ownership on surplus creation have increased considerably over the last two decades.

The primary focus of our paper is to consider the welfare impact of common ownership over and above the impact of oligopoly. Figure 10 plots the evolution of the deadweight loss that is solely due to the presence of common ownership. Specifically, the figure plots the difference between the two lines in Figure 9. This is the difference between the % difference in total surplus between standard Cournot and perfect competition and the % difference in total surplus between Cournot with common ownership and perfect competition. Whereas the deadweight loss attributable to common ownership is relatively modest in 1994 (0.3% of total surplus), it increases more than tenfold over the course of our sample reaching 4% of total surplus in 2018. As a result, the increase in deadweight loss under Cournot with common ownership (Figure 9, light green line) from 8.8% in 1994 to 15.5% in 2018 is due in slightly larger part to common ownership (59.7% of the increase) than to standard oligopoly reasons (40.3%).

FIGURE 10: DEADWEIGHT LOSS FROM COMMON OWNERSHIP (1994-2018)

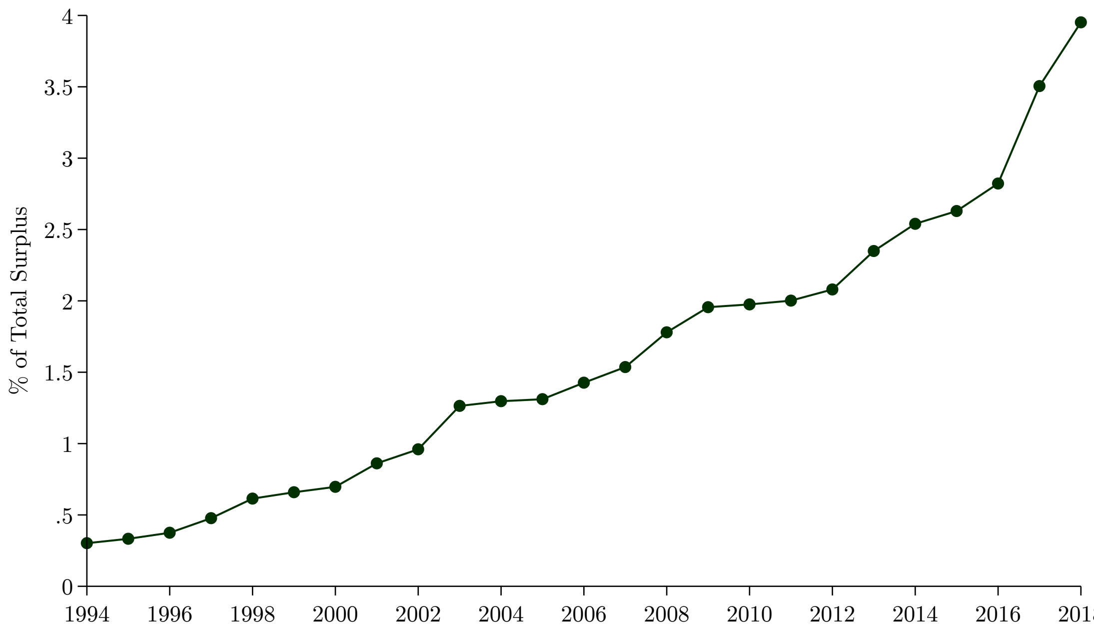

FIGURE NOTES: The figure plots the difference in deadweight loss computed as % of the total surplus between Cournot with common ownership and standard Cournot from 1994 to 2018.

From an antitrust perspective we are particularly interested in the effect of common ownership on consumer surplus and its evolution over time. Figure 11 plots the effect of common ownership on corporate profits and consumer surplus from 1994 to 2018. Common ownership raised corporate profits by 1% in 1994 and by 6.6% in 2018. At the same time, it lowered consumer surplus by less than 1.7% in 1994 but by almost 20% in 2018.

Overall, our results are consistent with the interpretation that U.S. public firms have more market power in 2018 due to both standard oligopolistic reasons as well as due to an increase in ownership concentration and overlap than they had in 1994. According to our estimates this increase in aggregate market power had a large negative impact on both

FIGURE 11: DISTRIBUTIONAL EFFECTS OF COMMON OWNERSHIP (1994-2018)

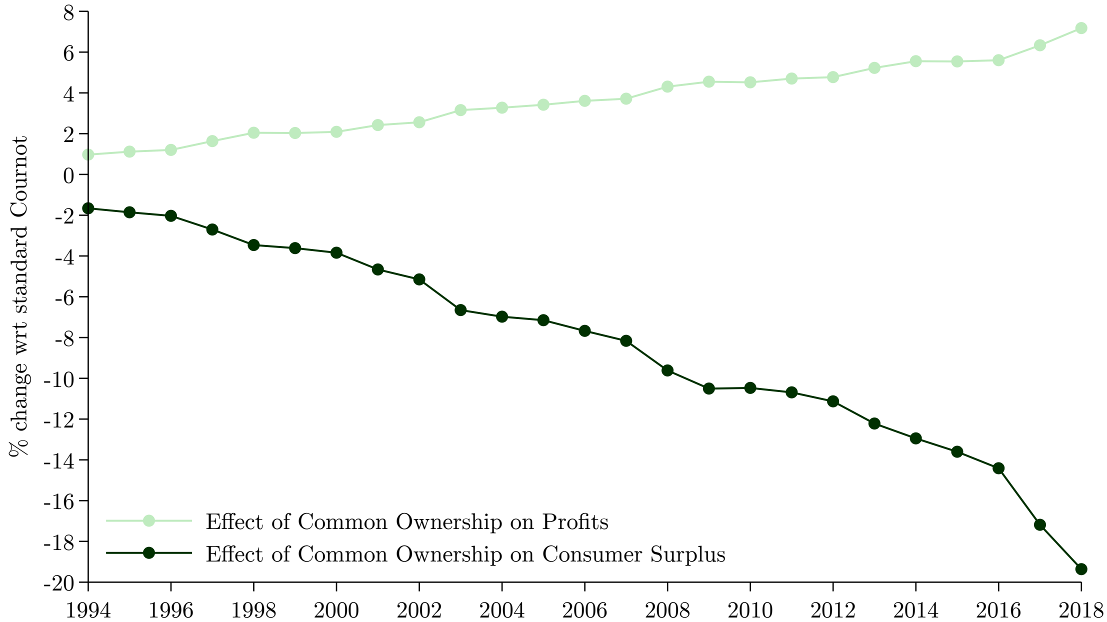

FIGURE NOTES: The figure plots the profit and consumer surplus difference between Cournot with common ownership and standard Cournot computed as % of the total surplus from 1994 to 2018.

allocative efficiency and consumer welfare.

5 Alternative Corporate Governance Assumptions

We now consider alternative assumptions of corporate governance that lead to different objective functions for the firm.

5.1 Superproportional Influence of Large Investors

One of the assumptions of the governance model previously presented is that each firm i fully internalizes the proportional profit shares of its investors when choosing q_i. However, there are good reasons to believe that larger investors exert influence that exceeds the size of their stake. This could be either because larger investors have a stronger incentive to pay attention (Gilje et al., 2019) or because the corporate voting model is more akin to majoritarian than proportional representation Azar and Vives (2021b). Our model cannot speak to whether it is attention or voting rules that leads to superproportional influence of large investors, but based on the results of Gilje et al. (2019) we know this influence function is likely to be concave. We therefore use the square root as an approximation.

The resulting influence-adjusted common ownership weights $\tilde{\kappa}_{ij}$ are given by

$$\tilde{\kappa}_{ij} \stackrel{\text{def}}{=} \frac{\mathbf{s}_i'\mathbf{G}_i'\mathbf{s}_j}{\mathbf{s}_i'\mathbf{G}_i'\mathbf{s}_i}$$

where $\mathbf{G}_i \stackrel{\text{def}}{=} \text{diag}(\mathbf{s}_i^{0.5})$ is the concave influence function.

5.2 Blockholder Thresholds

Another common cutoff rule for investor influence is that of blockholders. The literature typically defines a blockholder as a shareholder holding 5% or more of a company's stock since this level triggers additional disclosure requirements (Edmans and Holderness, 2017). Such blockholders are essential in ensuring there is at least one owner who has the correct incentives to make residual decisions in a way that creates value. Their influence can come through direct intervention in a firm's operations (otherwise known as "voice") and through selling of shares if the firm underperforms (otherwise known as "exit").

We therefore construct blockholder-adjusted common ownership weights that recognize that investors can only exert influence if their ownership stake exceeds the 5% blockholder threshold in the company. These blockholder-adjusted common ownership weights are given by

$$\hat{\kappa}_{ij} \stackrel{\text{def}}{=} \frac{\mathbf{s}_i'\mathbf{B}_i'\mathbf{s}_j}{\mathbf{s}_i'\mathbf{s}_i}$$

where $\mathbf{B}_i \stackrel{\text{def}}{=} \mathbb{1}_{s_{iz} \geq 0.05}(\mathbf{I}_n)$ is an indicator function that sets an investor z's influence to zero unless their stake in company i exceeds the blockholder threshold of 5%.

5.3 Empirical Results

We now compare the results of these alternative governance assumptions to our benchmark case which assumes Rotemberg (i.e., proportional) common ownership weights.

In Figure 12 we plot the evolution of the deadweight loss that is due to the presence of common ownership under different governance assumptions. Whereas superproportional influence of large investors leads to a deadweight loss that is quite similar though slightly larger than under proportional common ownership throughout our sample, the effect of common ownership with blockholder thresholds is much smaller in the early years of our sample. Until 2013 the deadweight loss of blockholder common ownership is well below 0.5% of total surplus. However, after that it rises rapidly to as high as 2.5% of total surplus at

Figure 12: Common Ownership DWL: Alternative Governance (1994-2018)

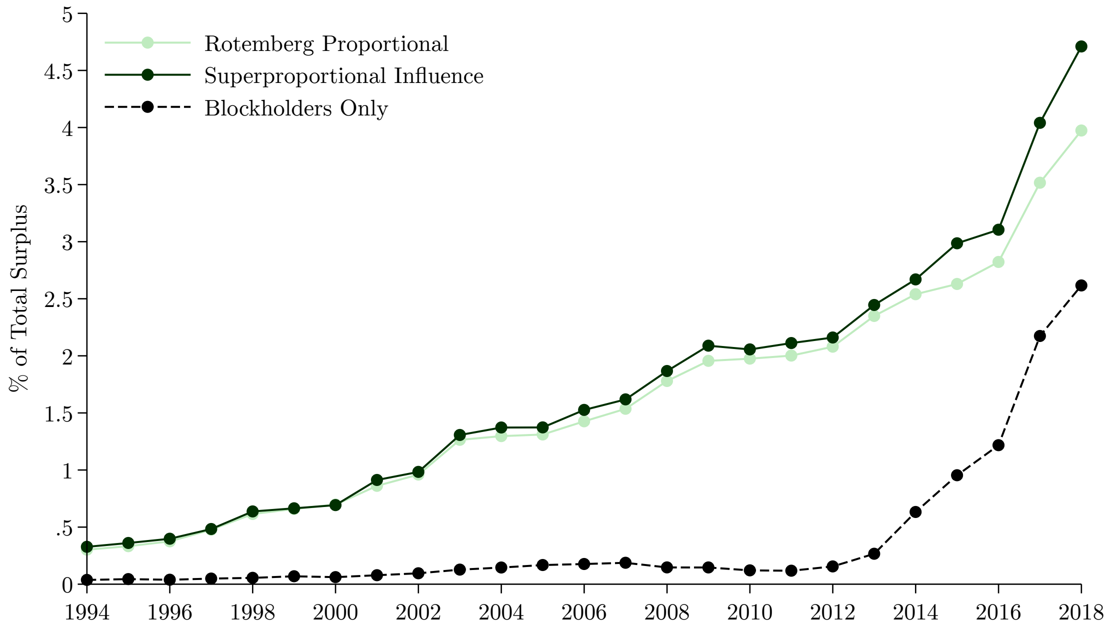

Figure Notes: The figure plots the difference in deadweight loss computed as % of the total surplus between Cournot with common ownership under proportional Rotemberg, superproportional and blockholder influence and standard Cournot from 1994 to 2018.

the end of our sample period. This in large part due to the increasingly large ownership stakes of the biggest asset management companies in all publicly listed firms. Until the mid-2010s their ownership stakes rarely exceeded the 5% blockholder threshold, but by the end of the sample they constitute the top shareholders for almost all publicly listed firms. For example, today both BlackRock and Vanguard are among the top five shareholders of almost 70 percent of the largest 2,000 publicly traded firms in the US whereas twenty years ago that number was zero percent for both firms.

Similar patterns emerge for the distributional consequences of common ownership on firm profits and consumer surplus as shown in Figure 13. Common ownership with superproportional influence leads to essentially identical increases in profits and decreases in consumer surplus as our benchmark case with Rotemberg proportional weights. Common ownership with blockholder influence thresholds has little impact on either measure until about 2013. However, even with blockholder thresholds common ownership raises firm profits by almost 5% of total surplus and lowers consumer surplus by almost 13% in 2018.

Thus, even under alternative governance assumptions common ownership leads to a sizeable deadweight loss that is increasing over time as well as considerable distributional con-

Figure 13: Distributional Effects of Common Ownership (1994-2018)

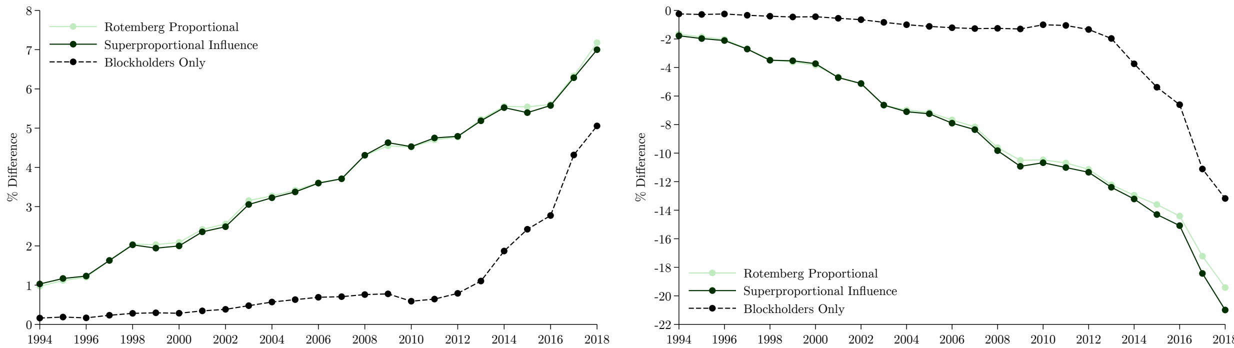

Figure Notes: The figure plots the profit and consumer surplus difference between Cournot with common ownership under proportional Rotemberg, superproportional and blockholder influence and standard Cournot computed as % of the total surplus from 1994 to 2018.

sequences that transfer rents from consumers to producers.

6 Conclusions

In this paper we provide the first estimate of the welfare cost and distributional consequences of common ownership at the economy level. We develop a general equilibrium model of oligopoly in which firms are connected through a large network that reflects ownership overlap as well as product similarity. In our model, common ownership of competing firms induces unilateral incentives to soften product market competition. We estimate our model for the universe of U.S. public corporations using a combination of firm financials, investor holdings and text-based product similarity data.

Our empirical estimates indicate that the rise of common ownership from 1994 to 2018 has led to considerable and increasing deadweight losses, amounting to 0.3% of the total surplus produced by American public corporations in 1994. This figure increased more than tenfold to 4% by 2018. In addition, the increase in common ownership resulted in a significantly lower share of total surplus accruing to consumers. We also show that these conclusions are robust to alternative corporate governance assumptions such as superproportional influence or blockownership thresholds.

Our results provide the first quantification of the welfare and distributional effects of common ownership at the macroeconomic rather than just the industry level. The economically large impact of common ownership as well as its continuing increase suggest that antitrust policy and financial regulation may have to address this new challenge.

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A Bias Correction

In this Appendix, we detail our methodology to estimate the matrix of profit weights $\mathbf{K}$, in a way that is robust to the presence of unobserved investors (which would otherwise lead to a thick right tail of implausibly large κ_{ij}). We start by rewriting κ_{ij} in the following way:

$$\kappa_{ij} \ = \ \frac{\mathbf{s}_i'\mathbf{s}_j}{\text{IHHI}_i}$$

The key problem is to estimate the numerator and the denominator based on the fact that in 13F data we observe a limited set of investors. Let us denote with O the set of Observed Investors, and $\mathcal{U}$ the set of Unobserved Investors.

Importantly, the denominator of the of vector $\mathbf{s}_i$, which is the total number of shares, includes both observed and unobserved investors, because it is taken from Compustat. Hence, typically, the observed s_{iz} will sum to a value less than one.

All the diagonal κ_{ii} are equal to one by construction and hence we can focus on the $i \neq j$ case. Under the (conservative) assumption that there is zero overlap in ownership between i and j among unobserved investors:

$$\sum_{z\in\mathcal{U}} s_{iz}s_{jz} = 0$$

we can compute the numerator of the equation above by simply ignoring the unobserved investors.

Estimating the denominator is slightly more complex. If we compute the IHHI using observed investors only we obtain:

$$\widehat{\text{IHHI}}_i \ = \ \sum_{k\in\mathcal{O}} s_{iz}^2$$

a downward biased estimate of the IHHI. For some firms, where few small investors are observed, this bias can be enormous, leading κ to exceed 10,000. Let us write the "true" IHHI as

$$\text{IHHI}_i^* \ = \ \sum_{z\in\mathcal{O}} s_{iz}^2 + \sum_{z\in\mathcal{U}} s_{iz}^2$$

Let $S_{i(\mathcal{O})}$ and $S_{i(\mathcal{U})}$ be the sum of shares for the observed and unobserved investors, respectivel:

$$S_{i(\mathcal{O})} \ = \ \sum_{z\in\mathcal{O}} s_{iz} \qquad S_{i(\mathcal{U})} \ = \ \sum_{z\in\mathcal{U}} s_{iz}$$

and let $s_{i(\mathcal{O})k}$ and $s_{i(\mathcal{U})k}$ the shares owned by investor k as a share of the observed and unobserved ones, respectively:

$$s_{i(\mathcal{O})z} \;=\; \frac{1}{S_{i(\mathcal{O})}} \cdot \sum_{z \in \mathcal{O}} s_{iz} \qquad s_{i(\mathcal{U})z} \;=\; \frac{1}{S_{i(\mathcal{U})}} \cdot \sum_{z \in \mathcal{U}} s_{iz}$$

As a result we have

$$\begin{aligned}
\mathrm{IHHI}_i^* = & \sum_{z \in \mathcal{O}} \left(S_{i(\mathcal{O})} \cdot s_{i(\mathcal{O})k}\right)^2 + \sum_{z \in \mathcal{U}} \left(S_{i(\mathcal{U})} \cdot s_{i(\mathcal{U})k}\right)^2 \\
= & \; S_{i(\mathcal{O})}^2 \cdot \sum_{z \in \mathcal{O}} s_{i(\mathcal{O})k}^2 + S_{i(\mathcal{U})}^2 \cdot \sum_{z \in \mathcal{U}} s_{i(\mathcal{U})z}^2 \\
= & \; S_{i(\mathcal{O})}^2 \cdot \mathrm{IHHI}_i^{\mathcal{O}} + S_{i(\mathcal{U})}^2 \cdot \mathrm{IHHI}_i^{\mathcal{U}}
\end{aligned}$$

where we have rewritten the terms in summation as the Herfindahl index among *observed* and *unobserved* investors only, respectively. By making the assumption that ownership concentration is identical among unobserved and observed investors $\left(\mathrm{IHHI}_i^{\mathcal{O}} = \mathrm{IHHI}_i^{\mathcal{U}}\right)$, and using the fact that

$$S_{i(\mathcal{U})} = 1 - S_{i(\mathcal{O})}$$

the true Herfindahl index can be rewritten as:

$$\begin{aligned}
\mathrm{IHHI}_i^* = & \left[S_{i(\mathcal{O})}^2 + \left(1 - S_{i(\mathcal{O})}\right)^2\right] \cdot \mathrm{IHHI}_i^{\mathcal{O}} \\
= & \left[S_{i(\mathcal{O})}^2 + \left(1 - S_{i(\mathcal{O})}\right)^2\right] \cdot \sum_{i \in \mathcal{O}} \left(\frac{1}{S_{i(\mathcal{O})}} s_i\right)^2 \\
= & \left[1 + \left(\frac{1 - S_{i(\mathcal{O})}}{S_{i(\mathcal{O})}}\right)^2\right] \cdot \widehat{\mathrm{IHHI}}_i
\end{aligned}$$

B Additional Tables and Figures

In this appendix we provide additional tables and figures.

Table 2: Welfare Estimates (1994)

	Scenario	*Common Ownership*	*Cournot-Nash*	*Perfect Competition*	*Monopoly*
		(1)	(2)	(3)	(4)
Welfare Statistic	**Variable**	$\mathbf{q}^{\Phi}$	$\mathbf{q}^{\Psi}$	$\mathbf{q}^{W}$	$\mathbf{q}^{\Pi}$
Total Surplus (US$ trillions)	$W(\mathbf{q})$	3.116	3.126	3.417	2.755
Aggregate Profits (US$ trillions)	$\Pi(\mathbf{q})$	1.597	1.581	0.723	1.919
Consumer Surplus (US$ trillions)	$CS(\mathbf{q})$	1.519	1.545	2.694	0.836
Total Surplus / Perfect Competition	$\frac{W(\mathbf{q})}{W(\mathbf{q}^W)}$	0.912	0.915	1.000	0.806
Aggregate Profit / Total Surplus	$\frac{\Pi(\mathbf{q})}{W(\mathbf{q})}$	0.512	0.506	0.212	0.697
Consumer Surplus / Total Surplus	$\frac{CS(\mathbf{q})}{W(\mathbf{q})}$	0.488	0.494	0.788	0.303

Table Notes: The table reports the model estimates of aggregate profits, consumer surplus, and total surplus for each of the counterfactual scenarios presented in Section 2.

TABLE 3: WELFARE ESTIMATES (2017) FOR $\kappa_{ij} \leq 1$

	Scenario	*Common Ownership*	*Cournot-Nash*	*Perfect Competition*	*Monopoly*
		(1)	(2)	(3)	(4)
Welfare Statistic	**Variable**	$\mathbf{q}^{\Phi}$	$\mathbf{q}^{\Psi}$	$\mathbf{q}^{W}$	$\mathbf{q}^{\Pi}$
Total Surplus (US$ trillions)	$W(\mathbf{q})$	8.406	8.752	9.881	7.922
Aggregate Profits (US$ trillions)	$\Pi(\mathbf{q})$	5.234	4.923	1.935	5.493
Consumer Surplus (US$ trillions)	$S(\mathbf{q})$	3.172	3.830	7.946	2.429
Total Surplus / Perfect Competition	$\frac{W(\mathbf{q})}{W(\mathbf{q}^{W})}$	0.851	0.886	1.000	0.802
Aggregate Profit / Total Surplus	$\frac{\Pi(\mathbf{q})}{W(\mathbf{q})}$	0.623	0.562	0.196	0.693
Consumer Surplus / Total Surplus	$\frac{CS(\mathbf{q})}{W(\mathbf{q})}$	0.377	0.438	0.804	0.307

TABLE NOTES: The table reports the model estimates of aggregate profits, consumer surplus, and total surplus for each of the counterfactual scenarios presented in Section 2 restricting $\kappa_{ij} \leq 1$.