The Welfare Cost of Common Ownership*

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Abstract

We study the welfare implications of the rise of common ownership and product market concentration in the United States from 1999 to 2017. 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 0.7% in 1999 to 3.5% of total surplus in 2017, as well as to an increasingly 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 1999 to 2017.

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, 2021). 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 2017, the most recent year of our sample, the deadweight loss of oligopoly amounts to about 11.4% of total surplus while the level of common ownership leads to an additional deadweight loss of 3.5% of total surplus. Second, the welfare losses of common ownership fall entirely on consumers. We estimate that in 2017 common ownership raises aggregate profits by \$312 billion from \$4.922 trillion to \$5.234 trillion, but lowers consumer surplus by \$659 billion from \$3.828 trillion to \$3.169 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 0.7% in 1999 this deadweight loss more than quadrupled to 3.5% in 2017.

Over the same time period, common ownership raised corporate profits by 2% in 1999 and 6% in 2017, but lowered consumer surplus by less than 4% in 1999 but over 17% in 2017.

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 (2021) in which common ownership between oligopolistic firms leads to additional market power with respect to both product market competition and labor hiring. In contrast to their work, our model assume competitive labor markets, but allows for arbitrary product differentiation between firms. Furthermore, 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. Section 5 concludes.

2 Theoretical Model

2.1 Generalized Hedonic-Linear (GHL) Demand System

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

There are two types of characteristics. The first m characteristics are common across all goods and are indexed by $j \in \{1, 2, ..., m\}$, while the remaining n characteristics are idiosyncratic. That is, these characteristics are product-specific and not present in other products. Therefore, 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 $\mathbf{a}_i$ therefore provides firm i's coordinates in the space of common characteristics. We can stack all the coordinate vectors $\mathbf{a}_i$ inside a $m \times n$ matrix that we call $\mathbf{A}$:

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

Let q_i be the number of units produced by firm i and consumed by the representative agent, which we write inside the n-dimensional vector $\mathbf{q}$:

$$\mathbf{q} = \begin{bmatrix} q_1 & q_2 & \cdots & q_n \end{bmatrix}'$$

Definition 1. A vector $\mathbf{q}$ that specifies, for every firm, the number of units produced is called an *allocation.*

We assume that there exists a representative agent. Consistent with the hedonic demand literature, the consumer linearly combines the characteristics of different products and their preferences are defined in terms of these characteristics. Letting x_j denote the total units of common characteristic j, we have:

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

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

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

With regard to the n idiosyncratic characteristics, we assume that each unit of good i provides exactly one unit of its corresponding idiosyncratic characteristic. Hence, we can just write q_i in place of the units of idiosyncratic characteristic i. The representative agent's preferences are described by a utility function that is quadratic in both common characteristics $\mathbf{x}$ and idiosyncratic characteristics $\mathbf{q}$. The agent's preferences also incorporate a linear disutility for the total number of hours of work supplied H and are given by

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

where b_j^x and b_i^q are characteristic-specific preference shifters. In linear algebra notation we have

$$U(\mathbf{x}, \mathbf{q}, H) \quad \stackrel{\text{def}}{=} \quad \alpha \left(\mathbf{x}'\mathbf{b}^x - \frac{1}{2} \cdot \mathbf{x}'\mathbf{x} \right) + (1-\alpha) \left(\mathbf{q}'\mathbf{b}^q - \frac{1}{2} \cdot \mathbf{q}'\mathbf{q} \right) - H \tag{2}$$

$\alpha \in [0,1]$ is the utility weight that is assigned to common characteristics. Hence, it governs the degree of *horizontal differentiation* among products. This utility specification is a generalization of the preferences used by Epple (1987). In addition to introducing idiosyncratic characteristics, we make leisure the outside good which 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 given by

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

We assume (without loss of generality) that labor is the numéraire of this economy such that the price of one unit of labor is 1. Therefore, h_i is also the total variable cost incurred by firm 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 capital input (fixed) and the function $\ell(\cdot)$ is such that firm i's technology can be described by the following 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. MC and AVC denote, respectively, the marginal cost and the average variable cost:

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

For some of the empirical analysis, we will later also consider fixed costs f_i. Firm i's total cost function will then become

$$\mathrm{TC}_i \;=\; f_i + c_i q_i + \frac{\delta_i}{2} q_i^2$$

The representative consumer buys the goods bundle $\mathbf{q}$ taking $\mathbf{p}$ (the vector of prices) as given. Moreover, we assume that the representative consumer is endowed with the shares of all the companies in the economy. As a consequence, the aggregate profits are paid back to them. Their consumption basket, defined in terms of the unit purchased $\mathbf{q}$, has to respect the following budget constraint:

$$H + \Pi = \sum_{i=1}^{n} p_i q_i$$

Notice that for now we have defined aggregate economic profits Π to include all non-labor compensation (which equates to assuming that f_i is sunk). We will later consider a narrower metric of profits from which fixed costs $\left(F \overset{\text{def}}{=} \sum_i f_i\right)$ are netted out.

2.2 Equilibrium

To streamline notation, let us define

$$b_i \overset{\text{def}}{=} \alpha \sum_j a_{ji}^x x_j + (1-\alpha)\, b_i^q$$

or, in linear algebra notation:

$$\mathbf{b} \overset{\text{def}}{=} \alpha\, \mathbf{A}'\mathbf{b}^x + (1-\alpha)\, \mathbf{b}^q \tag{4}$$

Then, plugging equation (1) and (4) inside equation (2), we obtain the following Lagrangian for the representative consumer:

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

The choice of labor hours as the numéraire immediately pins down the Lagrange multiplier $\lambda = 1$. As a result, the consumer chooses a demand function $\mathbf{q}(\mathbf{p})$ to maximize the following consumer surplus function:

$$\mathrm{CS}(\mathbf{q}) = \mathbf{q}'(\mathbf{b} - \mathbf{p}) - \frac{1}{2}\mathbf{q}'\left[\mathbf{I} + \alpha\left(\mathbf{A}'\mathbf{A} - \mathbf{I}\right)\right]\mathbf{q} \tag{5}$$

Let us now define the concept of *cosine similarity.*

Definition 2. We call the dot product $\mathbf{a}_i'\mathbf{a}_j$ the *cosine similarity* between i and j.

The rationale for this nomenclature is that $\mathbf{a}_i'\mathbf{a}_j$ geometrically measures the cosine of the angle between vectors $\mathbf{a}_i$ and $\mathbf{a}_j$ in the space of common characteristics $\mathbb{R}^m$. Hence, the cosine similarity ranges from zero to one. Because, by definition, we have

$$\left(\mathbf{A}'\mathbf{A}\right)_{ij} = \mathbf{a}_i'\mathbf{a}_j,$$

the matrix $\mathbf{A}'\mathbf{A}$ contains the *cosine similarities* between all firm pairs. A higher cosine similarity implies that two products provide a more overlapping mix of characteristics. 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 helps visualize this setup for the simple case of two firms (Firm 1 and Firm 2) competing in the space of two common characteristics A and B. As can be seen in the figure, both firms exist as vectors on the unit circle. With more than three characteristics, it would be a hypersphere instead. 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.

FIGURE 1: EXAMPLE PRODUCT SPACE: TWO FIRMS, TWO CHARACTERISTICS

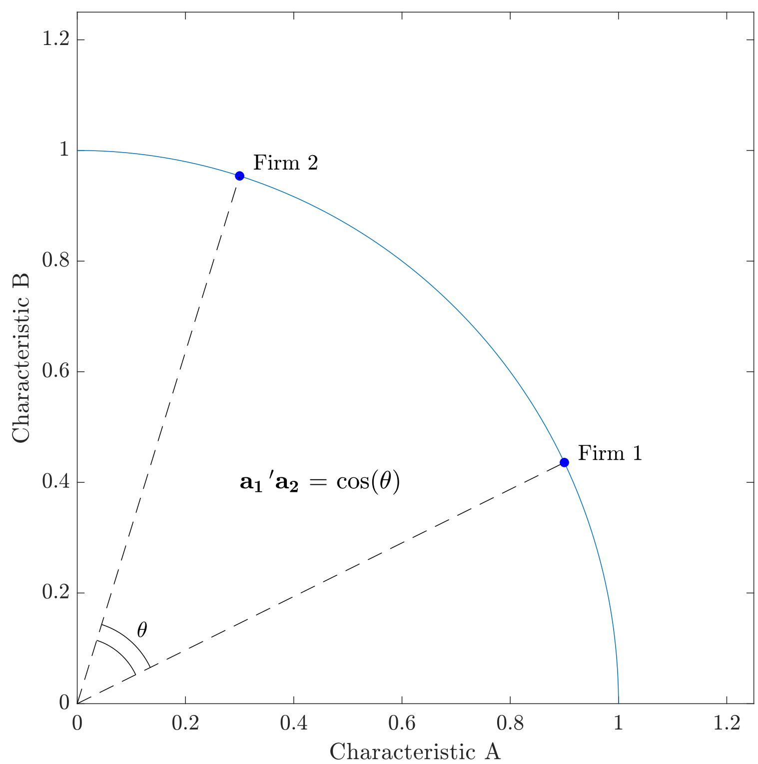

FIGURE NOTES: The following diagram exemplifies the hedonic demand model, for the simple case where there are only two product characteristics (A and B) and only two competitors (1 and 2). Each firm exists as a vector on the unit hypersphere of product characteristics (in this example, we have a circle). 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.

The assumption that $\mathbf{a}_i$ has unit length is a normalization assumption on volumetric units (e.g., kilograms, pounds, gallons). The normalization consists in picking, for each good i, the volume unit so that i is geometrically represented by a point on the m-dimensional hypersphere.

We can streamline the notation further by defining 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

$$\text{Aggregate demand}: \quad \mathbf{q} = \left(\mathbf{I}+\mathbf{\Sigma}\right)^{-1}\left(\mathbf{b}-\mathbf{p}\right) \tag{6}$$

$$\text{Inverse demand}: \quad \mathbf{p} = \mathbf{b}-\left(\mathbf{I}+\mathbf{\Sigma}\right)\mathbf{q} \tag{7}$$

The quantity sold by each firm affects the price of the output sold by every other firm in the economy unless the matrix $\mathbf{\Sigma}$ 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.

Finally, we define the economic profits π_i of firm i as follows:

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

2.3 Common Ownership

There are Z investment funds, who 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:

$$V_z \stackrel{\text{def}}{=} \sum_{i=1}^{n} s_{iz}\,\pi_j \qquad \sum_{z=1}^{Z} s_{iz}=1 \tag{8}$$

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

$$\phi_i \stackrel{\text{def}}{=} \sum_{z=1}^{Z} s_{iz} V_z = \sum_{z=1}^{Z} s_{iz} \sum_{j=1}^{I} s_{jz}\pi_j = \sum_{j=1}^{I} \pi_j \sum_{z=1}^{Z} s_{iz} s_{jz} \tag{9}$$

We assume that firms engage in Cournot competition and that profit functions are concave. Hence, to maximize V_i, 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

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

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

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

Our notation directly follows Backus et al. (2021) and Antón et al. (2020).[2] 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).

$$\mathbf{q}^{\Phi} = (2\mathbf{I} + \boldsymbol{\Delta} + \boldsymbol{\Sigma} + \mathbf{K} \circ \boldsymbol{\Sigma})^{-1} (\mathbf{b} - \mathbf{c})\,. \tag{10}$$

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

2.4 Market Structure and Ownership Counterfactuals

A key application of our theoretical model is to study how welfare statistics such as total surplus respond to changes in market structure. Having made the required assumption that firms compete by a well-defined set of rules (i.e., Cournot oligopoly under common ownership), we can now consider counterfactuals in which the same firms play by a different set of rules. In this subsection, we define four of these counterfactuals. Each of these counterfactuals, summarized in the set of equations in (11) and inversely ranked by their degree of competitiveness, is the maximizer of a specific scalar quadratic function, which we call *potential*. 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

$$
\begin{aligned}
\text{Aggregate Profit}: \quad \Pi(\mathbf{q}) &= \mathbf{q}'(\mathbf{b}-\mathbf{c}) - \mathbf{q}'\left(\mathbf{I}+\frac{1}{2}\mathbf{\Delta}+\mathbf{\Sigma}\right)\mathbf{q} \\
\text{CCO Potential}: \quad \Phi(\mathbf{q}) &= \mathbf{q}'(\mathbf{b}-\mathbf{c}) - \mathbf{q}'\left(\mathbf{I}+\frac{1}{2}\mathbf{\Delta}+\frac{1}{2}\mathbf{\Sigma}+\frac{1}{2}\mathbf{K}\circ\mathbf{\Sigma}\right)\mathbf{q} \\
\text{Cournot Potential}: \quad \Psi(\mathbf{q}) &= \mathbf{q}'(\mathbf{b}-\mathbf{c}) - \mathbf{q}'\left(\mathbf{I}+\frac{1}{2}\mathbf{\Delta}+\frac{1}{2}\mathbf{\Sigma}\right)\mathbf{q} \\
\text{Total Surplus}: \quad W(\mathbf{q}) &= \mathbf{q}'(\mathbf{b}-\mathbf{c}) - \frac{1}{2}\cdot\mathbf{q}'(\mathbf{I}+\mathbf{\Delta}+\mathbf{\Sigma})\mathbf{q}
\end{aligned} \tag{11}
$$

The first counterfactual that we consider is *Cournot* which assumes away any common ownership effects by positing that investors do not hold diversified portfolios.

Definition 3. The *Cournot* $\mathbf{q}^{\Psi}$ allocation is defined as that in which all profit weights κ_{ij} are equal to 0 for $i \neq j$ and equal to 1 for $i = j$:

$$
\mathbf{q}^{\Psi} \stackrel{\text{def}}{=} \arg\max_{\mathbf{q}} \Pi(\mathbf{q}) = (2\mathbf{I}+\mathbf{\Delta}+\mathbf{\Sigma})^{-1}(\mathbf{b}-\mathbf{c}) \tag{12}
$$

The second counterfactual we consider is *Perfect Competition.* Firms act as atomistic producers and price all units sold at marginal cost.

Definition 4. The *Perfect Competition* allocation $\mathbf{q}^W$ is defined as the maximizer of the aggregate total surplus function $W(\mathbf{q})$:

$$\mathbf{q}^W \quad \overset{\text{def}}{=} \quad \arg\max_{\mathbf{q}} W(\mathbf{q}) \quad = \quad (\mathbf{I} + \mathbf{\Delta} + \mathbf{\Sigma})^{-1} (\mathbf{b} - \mathbf{c}) \tag{13}$$

The third counterfactual 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 aggregate profits.

Definition 5. The *Monopoly* allocation $\mathbf{q}^\Pi$ is defined as the maximizer of the aggregate profit function $\Pi(\mathbf{q})$:

$$\mathbf{q}^\Pi \quad \overset{\text{def}}{=} \quad \arg\max_{\mathbf{q}} \Pi(\mathbf{q}) \quad = \quad (2\mathbf{I} + \mathbf{\Delta} + 2\mathbf{\Sigma})^{-1} (\mathbf{b} - \mathbf{c}) \tag{14}$$

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 of all 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 $\mathbf{A}'\mathbf{A}$. The empirical counterpart to this object is provided by Hoberg and Phillips (2016, henceforth HP),who compute product cosine similarities for firms in Compustat by analyzing the text of their 10-K forms. By law, every publicly traded firm in the United States must submit a 10-K form annually to the Securities and Exchange Commission (SEC). The form contains a *product description* section, which is the target of the algorithm devised by HP. They build a vocabulary of 61,146 words that firms use to describe their products,[3] and that identify product characteristics. Based on this vocabulary, HP produce, for each

[3]We report here verbatim the description of the methodology from the original article by Hoberg and Phillips (2016):"[...] *In our main specification, we limit attention to nouns (defined by Webster.com) and proper nouns that appear in no more than 25 percent of all product descriptions in order to avoid common words. We define proper nouns as words that appear with the first letter capitalized at least 90 percent of the time in our sample of 10-Ks. We also omit common words that are used by more than 25 percent of all firms, and we omit geographical words including country and state names, as well as the names of the top 50 cities in the United States and in the world.* [...]"

firm i, 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, that is, 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. 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.

In terms of coverage, both across firms and across time, no other available dataset comes close to HP's. It is the only data set that allows us to cover a meaningful share of the economic activity in the United States, for every year since 1997.

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 1999-2017. 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:

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

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

3.4 Beyond Full Attention

The key assumption of the model previously presented is that the company management fully internalizes the weighted profit shares of its investors. While intuitively appealing, this assumption may not be entirely realistic. Agency problems between owners and managers, as analyzed in Antón et al. (2020), may attenuate or even exacerbate the anticompetitive effects of common ownership. Similarly, Gilje, Gormley and Levit (2019, henceforth GGL) have highlighted the importance of modelling investor inattention in evaluating the extent of common ownership. Investor attention here refers to the extent to which firm owners incorporate strategic considerations related to common ownership in influencing company's decision. The rationale is that monitoring a firm's management and forcing it to incorporate strategic considerations related to common ownership requires a cost from the investor. Incurring this cost might not be optimal for every investor. This is likely to be the case for firm holdings that constitute only a small portion of a large diversified investor's overall portfolio.

Motivated by this consideration, GGL propose a corporate governance model of common ownership, which allows to generalize equation (8) by incorporating investor attention:

$$\phi_i \quad = \quad \sum_{z=1}^{Z} s_{iz} \cdot \left[g_{iz} \cdot V_z + (1 - g_{iz})\, \pi_i \right] \tag{15}$$

Figure 2: GGL Attention Function

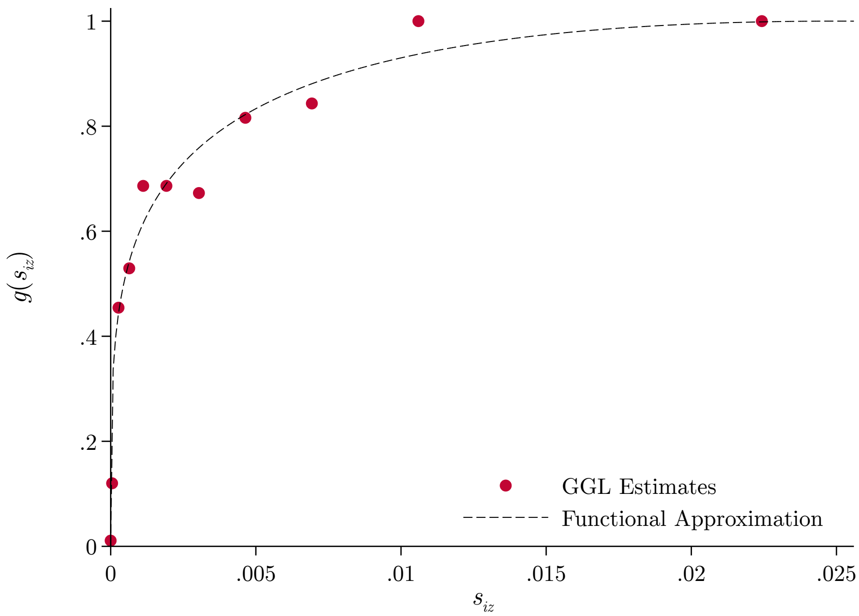

Figure Notes: The following diagram displays two versions of the investor attention function $g(s_{iz})$: the non-parametric version based on estimates by Gilje, Gormley and Levit (2019) and the functional approximation suggested in this paper (equation 17).

where $g_{iz} \in [0,1]$ represents the degree of investor z attention in the company i stake which they own. If $g_{iz} = 0$ for all firm i investor z pairs, this objective function is identical to standard own firm profit maximization. At the other extreme, if $g_{iz} = 1$ it is identical to the common ownership objective function in equation (9). GGL provide empirical evidence that the investor attention is an increasing and concave function of β_{iz}, the share of company i as a percentage of the total portfolio held by investor z:

$$\beta_{iz} = \frac{v_{iz}}{\sum_i v_{iz}} \tag{16}$$

where v_{iz} is the market value of the stake held by investor z in company i. Hence, they write g_{iz} as a function of β_{iz}. With some abuse of notation:

$$g_{iz} = g(\beta_{iz})$$

where g is a continuous function that maps the interval $[0,1]$ on itself. Because we are in a static model, equation (16) simplifies to:

$$\beta_{iz} = \frac{s_{iz}\pi_{iz}}{\sum_{j=1}^{n} s_{jz}\pi_{jz}}$$

This setup yields a different expression for the profit weights given by

$$\kappa_{ij} \stackrel{\text{def}}{=} \frac{\mathbf{s}_i'\mathbf{G}_i'\mathbf{s}_j}{\mathbf{s}_i'\mathbf{G}_i'\mathbf{s}_i} \qquad \text{where} \quad \mathbf{G}_i \stackrel{\text{def}}{=} \begin{bmatrix} g(\beta_{i1}) & 0 & \cdots & 0 \\ 0 & g(\beta_{i2}) & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & g(\beta_{iZ}) \end{bmatrix}$$

For the attention function, we use the following functional approximation to the non-parametric estimates of GGL based on the method of Iliev and Lowry (2015).

$$g(s_{iz}) = \begin{cases} \sqrt{1-\left(2\sqrt{10\,s_{iz}}-1\right)^2} & \text{if} \quad 0 \le s_{iz} \le \frac{1}{40} \\ 1 & \text{if} \quad \frac{1}{40} < s_{iz} \le 1 \end{cases} \tag{17}$$

We plot the attention function in Figure 2.

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.

4.1 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.

We first visualize 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

Figure 3: Network Visualization of the Hoberg-Phillips Dataset

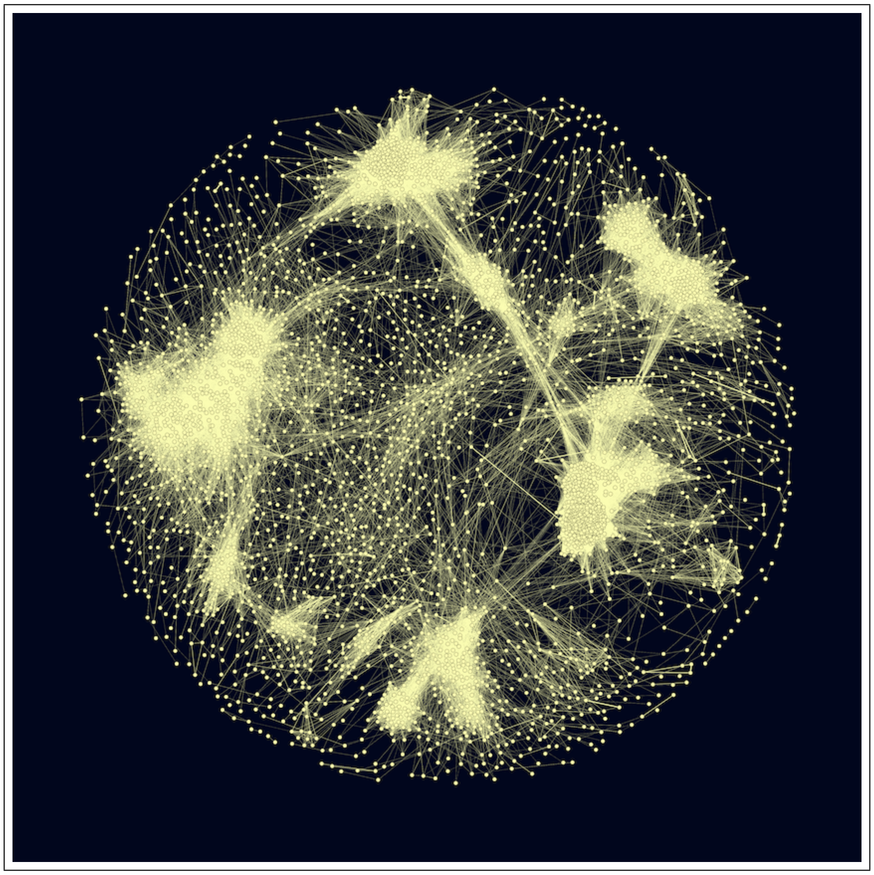

Figure Notes: The diagram is a two-dimensional representation of the network of product similarities computed by Hoberg and Phillips (2016), which is used in the estimation of the model presented in Section 2. The data covers the universe of Compustat firms in 2004. Firm pairs that have thicker links 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).

weighted networks[4].

The result of this exercise is Figure 3: every dot in the graph is a publicly traded firm as of 2004. Firm pairs that have a high cosine similarity appear closer, and are joined by a thicker

[4]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.

line. Conversely, firms that are more dissimilar are not joined, and are more distant. From the graph, we can see that the distribution of firms over the space of product characteristics is manifestly uneven: some areas are significantly more densely populated with firms than others. The network displays a pronounced community structure: large groups of firms tend to cluster in certain areas of the network.

Figure 4: Network Visualization of the Common Ownership Network

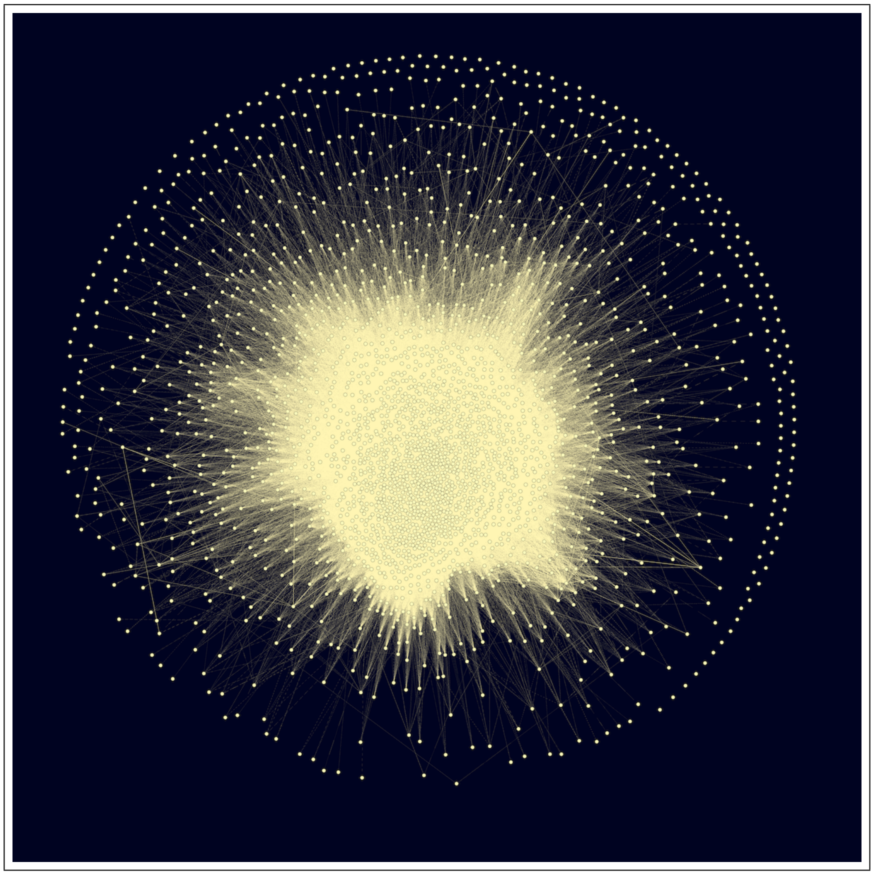

Figure Notes: The diagram is a two-dimensional representation of the network of ownership shares, which is used in the estimation of the model presented in Section 2. The data covers the universe of publicly-listed firms in 2004. Firm pairs that have thicker links have more overlap in their ownership.

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 FR algorithm to visualize the network in Figure 4. Every dot in the graph 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 (10) 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 (12) and monopoly in equation (14).

Figure 5: Product Similarity and Profit Weights (2017)

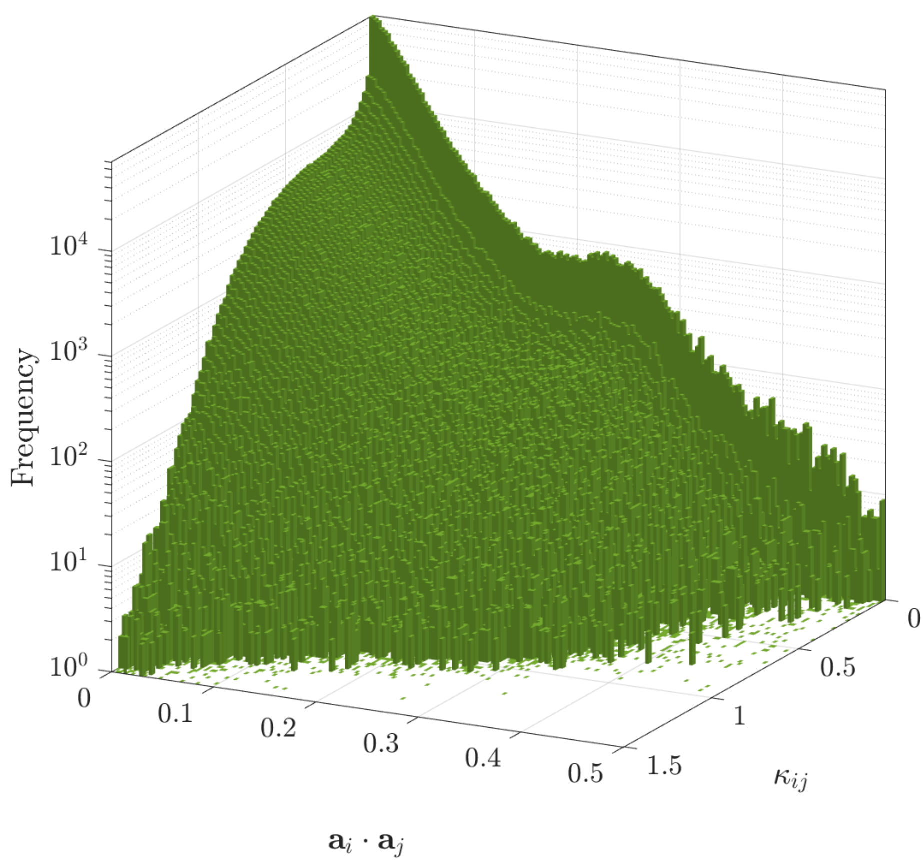

Figure Notes: The figure reports a histogram of the joint distribution of product similarity $\mathbf{a}_i \cdot \mathbf{a}_j$ and profit weights κ_{ij} for all firm ij pairs.

Figure 6: Product Similarity and Profit Weights (2017)

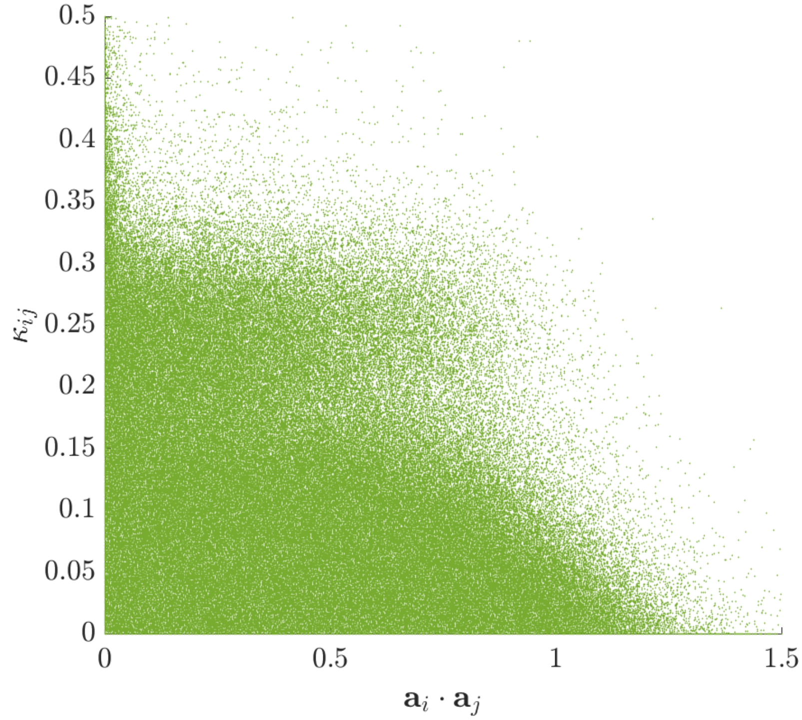

Figure Notes: The figure provides a scatter plot of the joint distribution of product similarity $\mathbf{a}_i \cdot \mathbf{a}_j$ and profit weights κ_{ij} for all firm ij pairs.

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. 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 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 is -0.0036. This means that common ownership is not 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).

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 (9).

Our first empirical exercise computes total surplus and decomposes it into profits and consumer surplus as reported in Table 1 for 2017, 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 estimates for 1999, 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 2017 under *Common Ownership* publicly-listed firms earn an aggregate economic profit of \$5.234 trillion and produce an estimated total surplus of \$8.402 trillion. Consumer surplus is therefore estimated to be \$3.169 trillion. 59.8% of the total surplus produced is appropriated by the companies in the form of oligopoly profits under common ownership while the remaining 36.2% accrues to consumers. To put these estimates into context, the GDP of U.S. corporations in the same year (2017) 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 \$8.750 trillion under oligopoly without common ownership (Cournot-Nash) and significantly higher at \$9.879 trillion under perfect competition. Thus, we estimate that in 2017 the deadweight loss of oligopoly amounts to about 11.4% of total surplus. On top of that, common ownership leads to an additional deadweight loss of 3.5% of total surplus.

While the effects of oligopoly and common ownership on efficiency are significant, their

Table 1: Welfare Estimates (2017)

	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)	$W(\mathbf{q})$	8.402	8.750	9.879	7.920
Aggregate Profits (US$ trillions)	$\Pi(\mathbf{q})$	5.234	4.922	1.935	5.492
Consumer Surplus (US$ trillions)	$\mathrm{CS}(\mathbf{q})$	3.169	3.828	7.944	2.428
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	0.563	0.196	0.693
Consumer Surplus / Total Surplus	$\frac{\mathrm{CS}(\mathbf{q})}{W(\mathbf{q})}$	0.377	0.437	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.

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: \$7.944 trillion, more than double than in the Cournot-Nash (\$3.828 trillion) and the Common Ownership (\$3.169 trillion) allocations. This means that under perfect competition 80.4% of the total surplus accrues to consumers. In contrast, merely 43.7% and 37.7% 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 (\$5.234 trillion) are almost 3 times as large as those under perfect competition (\$1.935 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 \$348 billion, but the welfare losses of common ownership fall entirely on consumers. Whereas common ownership raises aggregate profits by \$312 billion from \$4.922 trillion to \$5.234 trillion, it lowers consumer surplus by \$659 billion from \$3.828 trillion to \$3.169 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 \$7.92 trillion and thus significantly lower than even in common ownership equilibrium allocation. Despite the decrease in aggregate welfare, profits are markedly higher still at \$5.492 trillion. In contrast, consumer surplus is reduced to just \$2.428 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

HP's cosine similarity data is available starting in 1997 and the scraped 13(f) filings are available starting in 1999. 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 1999 to 2017. 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 1999 and 2017. 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 7: TOTAL SURPLUS OF U.S. PUBLIC FIRMS (1999-2017)

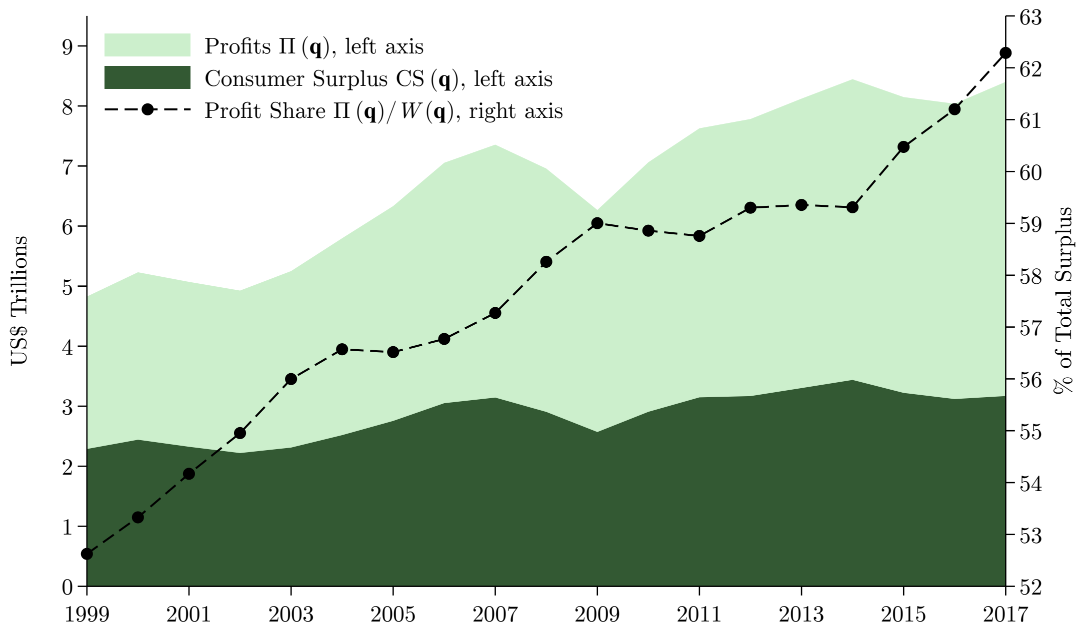

FIGURE NOTES: The figure plots the evolution of aggregate (economic) profits $\Pi(\mathbf{q})$, aggregate consumer surplus $CS(\mathbf{q})$, and total surplus $W(\mathbf{q})$, as defined in the model in Section 2. Profits as a percentage of total surplus ($\Pi(\mathbf{q})/W(\mathbf{q})$, black dotted 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.

The graph shows that the total surplus produced by U.S. public corporations almost doubled between 1999 and 2017 from \$4.8 trillion to \$8.4 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 \$2.54 trillion to \$4.827 trillion. Consumer surplus increased instead from \$2.287 trillion in 1999 to \$3.169 trillion in 2017. As a consequence, the profit share of surplus increased from 52.6% of total surplus to 62.3%.

Consumers capture a significantly lower share of the surplus generated by public companies, dropping from 47.4% of total surplus in 1999 to 37.7% in 2017.

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 5.1 percentage points from 51.2% to 56.3%. In contrast, the increase in the profit share under common ownership is almost twice as large. The profit share increases by almost 10 percentage points from 52.6% to 62.3%.

Figure 8: Profit Share of Total Surplus (1999-2017)

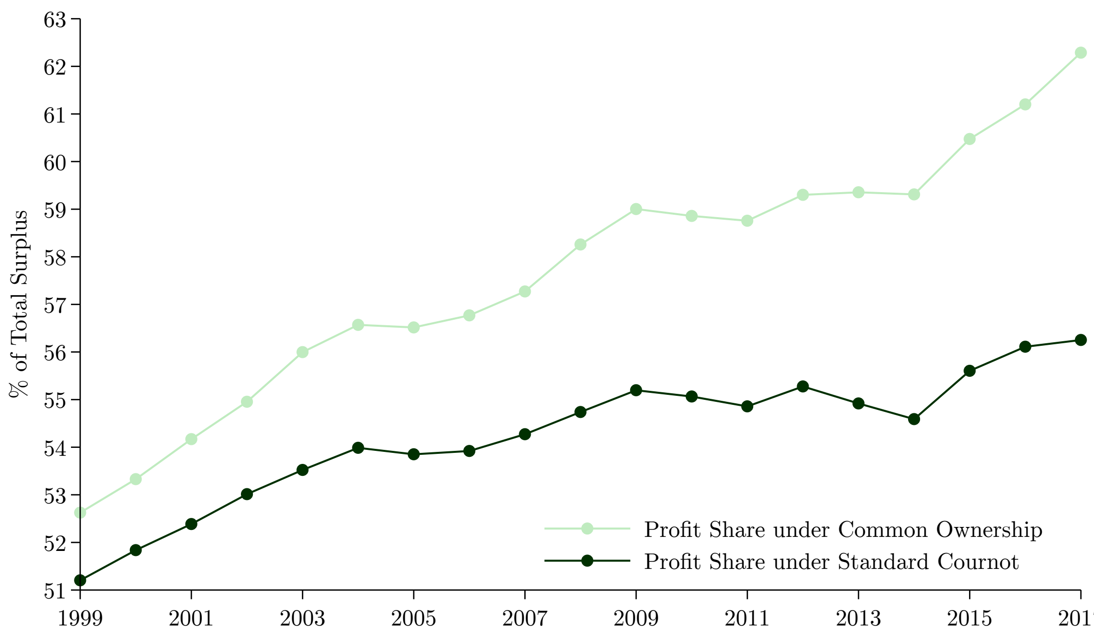

Figure Notes: The figure plots the profit share under standard Cournot (dark green line) and Cournot with common ownership (light green line) between 1999 and 2017.

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 8.9% and 9.6% in 1999 to 11.4% and 14.9% in 2017. 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.

Figure 9: Deadweight Loss (1999-2017)

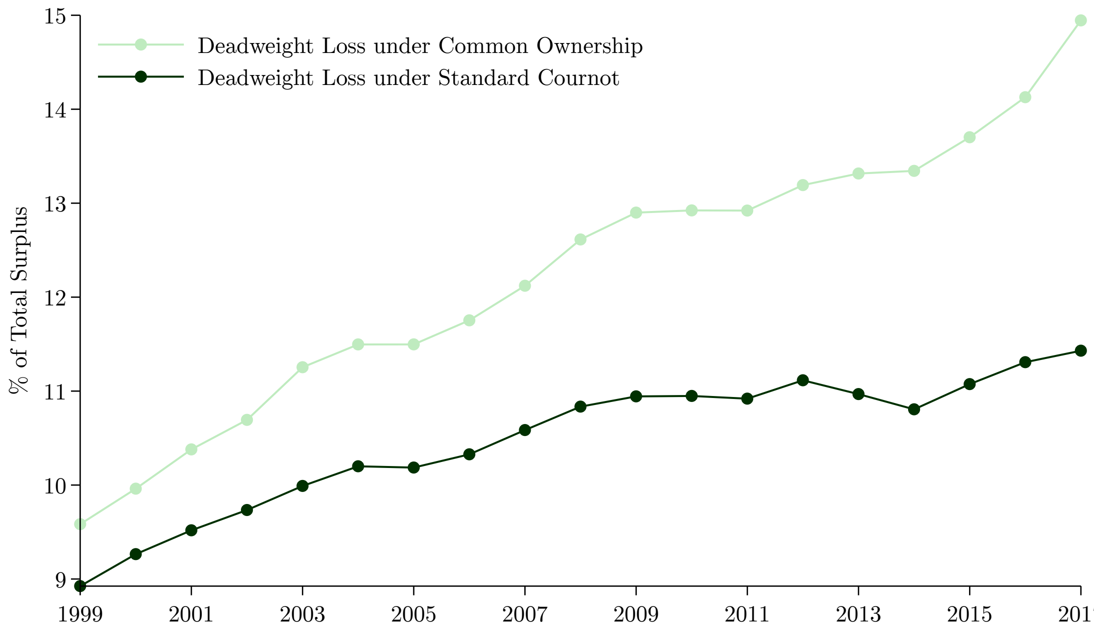

Figure Notes: The figure plots the estimated deadweight losses (DWL) of oligopoly and of oligopoly and common ownership, between 1999 and 2017. The dark green line is the DWL of oligopoly, the % difference in total surplus between the Cournot equilibrium and the Perfect Competition scenario. The light green line is the % difference between the Cournot Common Ownership equilibrium and the Perfect Competition scenario. These surplus measures are gross of fixed costs.

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 1999 (0.7% of total surplus), it more than quadruples over the 2 decades in our sample reaching 3.5% of total surplus in 2017. As a result, the increase in deadweight loss under the combined Cournot with common ownership (Figure 9, light green line) from 9.6% in 1999 to 14.9% in 2017 is due in slightly larger part to common ownership (52% of the increase) than to standard oligopoly reasons (48%).

Figure 10: Deadweight Loss from Common Ownership (1999-2017)

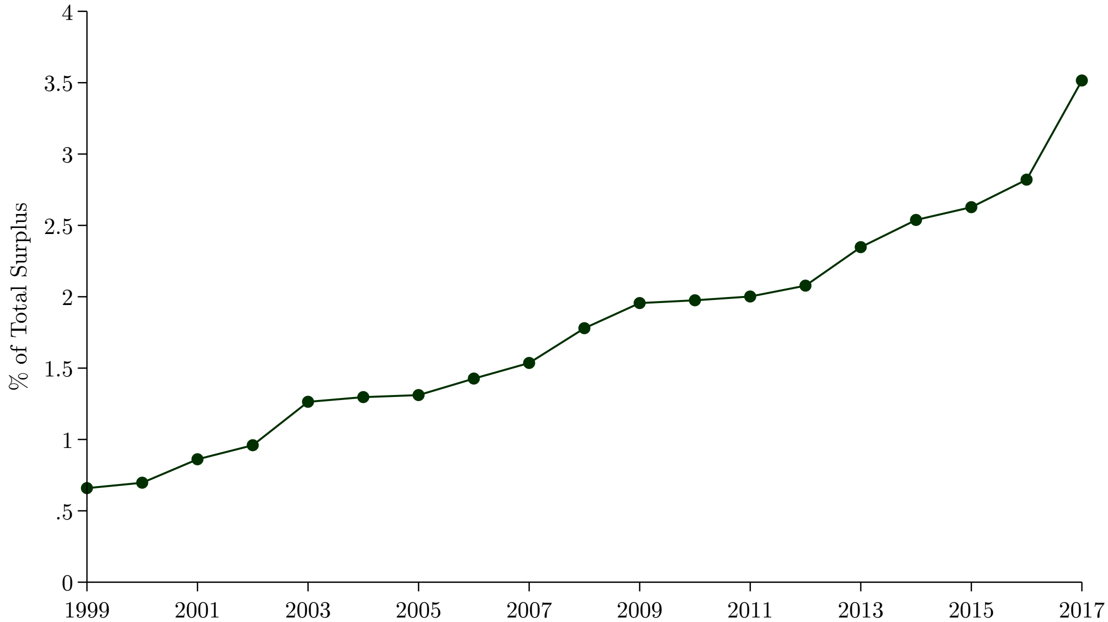

Figure Notes: The figure plots the difference in deadweight loss computed as % of the total surplus between Cournot with common ownership and standard Cournot from 1999 to 2017.

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 1999 to 2017. Common ownership raised corporate profits by 2% in 1999 and by 6% in 2017. At the same time, it lowered consumer surplus by less than 4% in 1999 but by over 17% in 2017.

Overall, our results are consistent with the interpretation that U.S. public firms have more market power in 2017 due to both standard oligopolistic reasons as well as due to an increase in ownership concentration and overlap than they had in 1999. According to our estimates this increase in aggregate market power had a large negative impact on both allocative efficiency and consumer welfare.

Figure 11: Distributional Effects of Common Ownership (1999-2017)

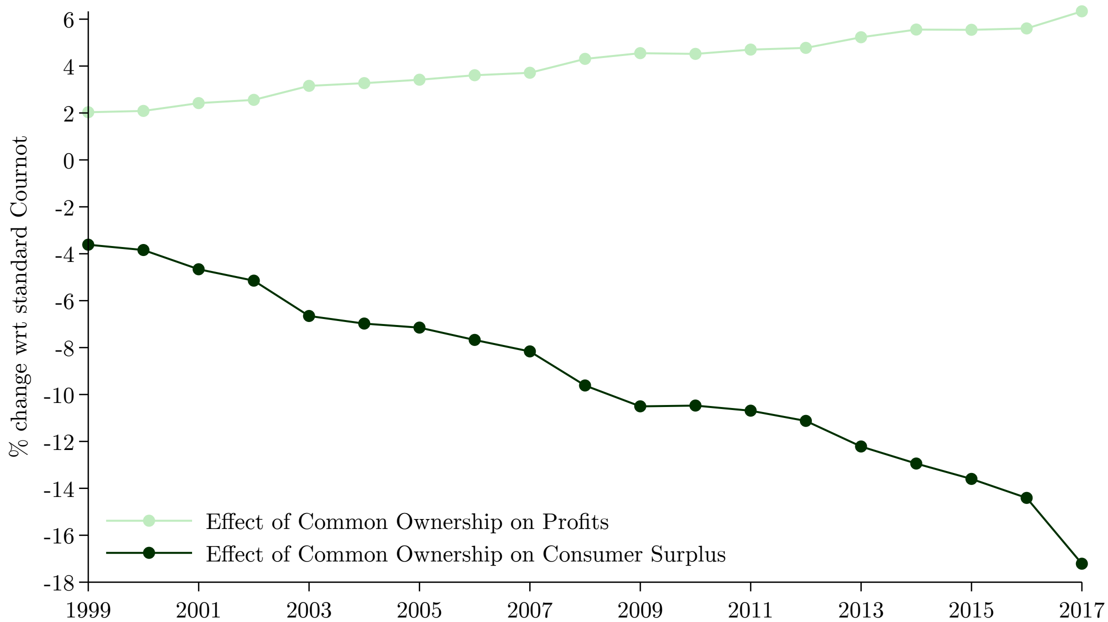

Figure Notes: The figure plots the profit and consumer surplus difference between Cournot with common ownership and standard Cournot computed as % of the total surplus from 1999 to 2017.

5 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 1999 to 2017 has led to considerable and increasing deadweight losses, amounting to 0.7% of the total surplus produced by American public corporations in 1999. This figure increased more than fourfold to 3.5%, by 2017. In addition, the increase in common ownership resulted in a significantly lower share of total surplus accruing to consumers.

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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.

Diagonal κ's are one by construction, 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

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

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 $\left(\text{IHHI}_i^{\mathcal{O}} = \text{IHHI}_i^{\mathcal{U}}\right)$, and using the fact that

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

the true Herfindahl index can be rewritten as:

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

B Additional Tables and Figures

In this appendix we provide additional tables and figures.

TABLE 2: WELFARE ESTIMATES (1999)

	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)	$W(\mathbf{q})$	4.827	4.862	5.338	4.299
Aggregate Profits (US$ trillions)	$\Pi(\mathbf{q})$	2.540	2.489	1.114	2.992
Consumer Surplus (US$ trillions)	$CS(\mathbf{q})$	2.287	2.372	4.224	1.307
Total Surplus / Perfect Competition	$\frac{W(\mathbf{q})}{W(\mathbf{q}^W)}$	0.904	0.911	1.000	0.805
Aggregate Profit / Total Surplus	$\frac{\Pi(\mathbf{q})}{W(\mathbf{q})}$	0.526	0.512	0.209	0.696
Consumer Surplus / Total Surplus	$\frac{CS(\mathbf{q})}{W(\mathbf{q})}$	0.474	0.488	0.791	0.304

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 $\kappa_{ij} \leq 1$.