

# A Tale of Two Networks: Common Ownership and Product Market Rivalry<sup>\*</sup>

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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 1994 to 2018. We develop a general equilibrium model in which granular firms compete in a network game of oligopoly. Firms are connected through two large networks: the first reflects ownership overlap, the second product similarity. In our model, common ownership of competing firms induces unilateral incentives to soften product market competition. A key insight of our model is that the product market effects of common ownership depend crucially on the extent to which these two networks overlap. We estimate our model for the universe of public corporations in the U.S. 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 the distributional impact of common ownership have evolved over this period. Based on our model, the welfare cost of common ownership, measured as deadweight loss-to-total surplus ratio, has increased nearly tenfold (from 0.3% to over 4%) between 1994 and 2018. The rise of common ownership has also resulted in a significant reallocation of surplus from consumers to producers.

**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 et al. (2018), that analyze oligopolistic behavior in the presence of common ownership.<sup>1</sup> 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.<sup>2</sup>

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. This feature allows us 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

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<sup>1</sup>Earlier empirical contributions include Matvos and Ostrovsky (2008) who document the effect of common ownership on shareholders' voting behavior in mergers & acquisitions and show that common owners are less likely to reject mergers.

<sup>2</sup>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).

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. A key model feature is that the anticompetitive effects of common ownership depend on the overlap between the two networks of product similarity and 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 product market welfare costs of the increase in common ownership and industry concentration that we have witnessed in the U.S. economy over the past two decades?<sup>3</sup> 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 increased more than tenfold to 4% in 2018. Over the same time period, common ownership raised corporate profits by

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<sup>3</sup>Our model and empirical analysis abstracts away any labor market effects of common ownership which may result from enhanced employer power as in the theoretical analysis of Azar and Vives (2021a). Furthermore, we do not consider coordinated effects of common ownership which may result from explicit or tacit collusion between firms or owners as documented by Shekita (2021). Because our analysis focuses exclusively on *unilateral product market* effects it therefore provides a conservative lower bound on the welfare costs of common ownership.

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. We therefore build an alternative version of the model with “superproportional” influence. Under these alternative assumptions, 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 or that large diversified owners have limited attention we find that common ownership only has a relatively small welfare 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.

Our analysis allows us to evaluate the impact of policy proposals aimed to address the challenges of common ownership. We show that the policy proposal of [Posner et al. \(2016\)](#) would reduce the deadweight loss of common ownership by roughly \$70 billion and increase consumer surplus by almost \$100 billion per year.

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 to focus exclusively on the product market effects of common ownership, but allows for arbitrary size differences between firms. Furthermore, we develop a model with a flexible demand system that can be taken to the data to identify structural parameters. This allows us not only to make qualitative predictions, but to produce time-varying dollar estimates of the (product market) welfare consequences 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 and cost structure assumptions while Section 6 explores policy counterfactuals. Section 7 concludes.

## 2 Theoretical Model

We present a general equilibrium model in which firms produce differentiated products under Cournot competition and common ownership. For expositional purposes, we present the basic model that only considers proportional proportional ownership influence. After characterizing the equilibrium of this model economy and outlining a series of counterfactuals of interest, we extend the model to consider alternative governance assumptions.

## 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  $i \in \{1, 2, \dots, n\}$  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  $m + n$ .

Each product has two types of characteristics:  $m$  common characteristics indexed by  $j \in \{1, 2, \dots, m\}$  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:

$$\mathbf{a}_i = \begin{bmatrix} a_{1i} & a_{2i} & \dots & a_{mi} \end{bmatrix}' \quad (2.1)$$

$$\text{such that } \sum_{j=1}^m a_{ji}^2 = 1 \quad \forall i \in \{1, 2, \dots, n\} \quad (2.2)$$

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  $\mathbf{A}$ :

$$\mathbf{A} = \begin{bmatrix} \mathbf{a}_1 & \mathbf{a}_2 & \dots & \mathbf{a}_n \end{bmatrix} = \begin{bmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{m1} & a_{m2} & \dots & a_{mn} \end{bmatrix} \quad (2.3)$$

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

$$\mathbf{q} = \begin{bmatrix} q_1 & q_2 & \dots & q_n \end{bmatrix}' \quad (2.4)$$

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  $x_j$

$$x_j = \sum_i a_{ji} q_i \quad (2.5)$$

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

$$\mathbf{x} = \mathbf{A}\mathbf{q} \quad (2.6)$$

Each unit of good  $i$  provides one unit of its corresponding idiosyncratic characteristic. This 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

$$U(\mathbf{x}, \mathbf{q}, H) \stackrel{\text{def}}{=} \alpha \cdot \sum_{j=1}^m \left( b_j^x x_j - \frac{1}{2} x_j^2 \right) + (1 - \alpha) \sum_{i=1}^n \left( b_i^q q_i - \frac{1}{2} q_i^2 \right) - H \quad (2.7)$$

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

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

$$H = \sum_i h_i. \quad (2.8)$$

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

$$q_i = k_i^\theta \cdot \ell(h_i) \quad (2.9)$$

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

$$h_i = c_i q_i + \frac{\delta_i}{2} q_i^2 \quad (2.10)$$

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

$$MC_i = c_i + \delta_i q_i; \quad AVC_i = c_i + \frac{\delta_i}{2} q_i. \quad (2.11)$$

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

$$H + \Pi = \sum_{i=1}^n p_i q_i. \quad (2.12)$$

## 2.2 Consumption Choices, Labor Supply, and Product Demand

Define

$$\mathbf{b} \stackrel{\text{def}}{=} \alpha \mathbf{A}' \mathbf{b}^x + (1 - \alpha) \mathbf{b}^q \quad (2.13)$$

We obtain the Lagrangian for the representative agent by plugging equation (2.6) and (2.13) into equation (2.7):

$$\mathcal{L}(\mathbf{q}, H) = \mathbf{q}' \mathbf{b} - \frac{1}{2} \mathbf{q}' [\mathbf{I} + \alpha (\mathbf{A}' \mathbf{A} - \mathbf{I})] \mathbf{q} - H - \lambda (\mathbf{q}' \mathbf{p} - H - \Pi) \quad (2.14)$$

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:

$$CS(\mathbf{q}) = \mathbf{q}' (\mathbf{b} - \mathbf{p}) - \frac{1}{2} \mathbf{q}' [\mathbf{I} + \alpha (\mathbf{A}' \mathbf{A} - \mathbf{I})] \mathbf{q} \quad (2.15)$$

$\mathbf{a}_i' \mathbf{a}_j$  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 the 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  $j'$ .

Define the firm similarity matrix

$$\boldsymbol{\Sigma} \stackrel{\text{def}}{=} \alpha (\mathbf{A}' \mathbf{A} - \mathbf{I}). \quad (2.16)$$

Thus, the demand and inverse demand functions are given by

$$\text{Aggregate demand : } \mathbf{q} = (\mathbf{I} + \boldsymbol{\Sigma})^{-1} (\mathbf{b} - \mathbf{p}) \quad (2.17)$$

$$\text{Inverse demand : } \mathbf{p} = \mathbf{b} - (\mathbf{I} + \boldsymbol{\Sigma}) \mathbf{q} \quad (2.18)$$

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  $\pi_i$  of firm  $i$  are therefore given by

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

## 2.3 Advantages of GHL

### 2.3.1 Complementarities

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

$$\frac{\partial^2 \text{CS}}{\partial q_i \partial q_j} = -\sigma_{ij} \leq 0 \quad \forall i \neq j \quad (2.19)$$

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:

$$\text{Complements if } \frac{\partial q_i}{\partial p_j} < 0 \quad \text{Substitutes if } \frac{\partial q_i}{\partial p_j} > 0 \quad (2.20)$$

The important insight is that the cross-price elasticity of demand depends on the inverted matrix  $(\mathbf{I} + \Sigma)^{-1}$ , not on  $\Sigma$  itself. If, as in our case,  $\Sigma$  is not symmetric, the off-diagonal elements of  $-(\mathbf{I} + \Sigma)^{-1}$  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 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.

### 2.3.2 Price-Cost Passthrough

GHL differs from the perhaps 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. Thus, an important issue to evaluate is how well GHL matches empirical demand curves estimates when compared to CES.

In Figure 1 we plot three different demand curves based on CES demand, GHL demand, and non-

FIGURE 1: DEMAND SYSTEM COMPARISON

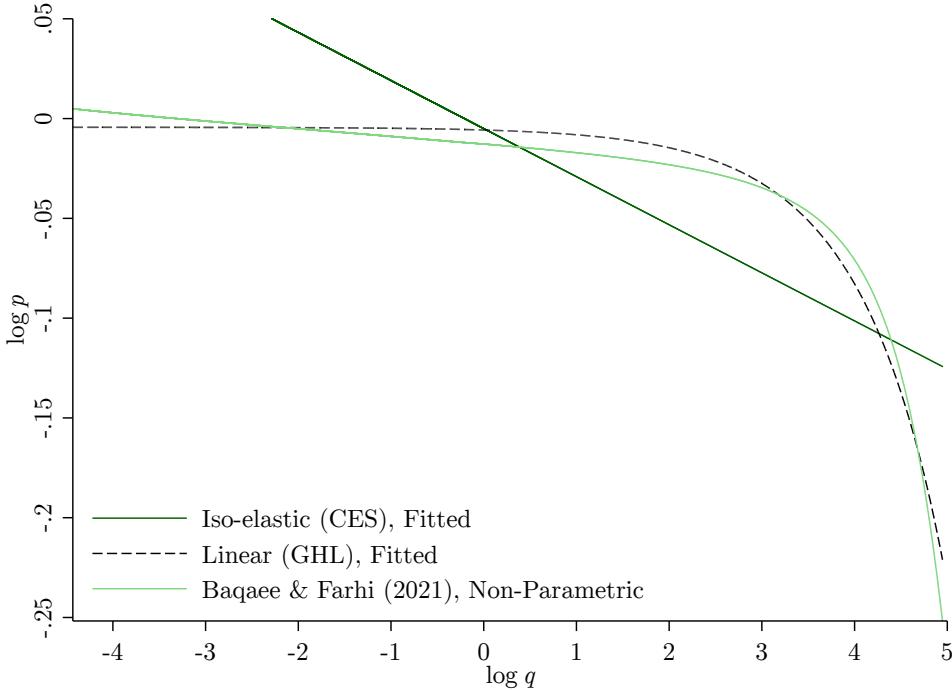


FIGURE NOTES: The figure shows a log-log plot of the demand curve estimated non-parametrically by [Baqae and Farhi \(2020\)](#) (solid light green line), against a linear (GHL) fit (dotted black line) and against an isoelastic (CES) fit (solid dark green line). Note that an isoelastic curve becomes a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

parametric demand estimates by [Baqae and Farhi \(2020\)](#) respectively.<sup>4</sup> Whereas the GHL demand curve closely matches the non-parametric estimates of [Baqae and Farhi \(2020\)](#), the isoelastic CES demand provides an entirely different fit that does not seem to match the data very well.

## 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  $i$ :

$$V_z \stackrel{\text{def}}{=} \sum_{i=1}^n s_{iz} \pi_j \quad \sum_{z=1}^Z s_{iz} = 1 \quad (2.21)$$

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  $\phi_i$ , an average of firm  $i$ 's investors' value

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<sup>4</sup>[Baqae and Farhi \(2020\)](#) fit a residual demand curve non-parametrically using price-cost passthrough estimates by [Amiti et al. \(2019\)](#) based on Belgian manufacturing enterprise micro data.

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

$$\phi_i \stackrel{\text{def}}{=} \sum_{z=1}^Z s_{iz} V_z = \sum_{z=1}^Z s_{iz} \sum_{j=1}^n s_{jz} \pi_j = \sum_{j=1}^n \pi_j \sum_{z=1}^Z s_{iz} s_{jz} \quad (2.22)$$

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

$$\mathbf{s}_i \stackrel{\text{def}}{=} \begin{bmatrix} s_{i1} & s_{i2} & \dots & s_{iZ} \end{bmatrix}' \quad (2.23)$$

The common ownership weights  $\kappa_{ij}$  are defined as

$$\kappa_{ij} \stackrel{\text{def}}{=} \frac{\mathbf{s}'_i \mathbf{s}_j}{\mathbf{s}'_i \mathbf{s}_i} \quad (2.24)$$

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

$$\phi_i \propto \pi_i + \sum_{j \neq i} \kappa_{ij} \pi_j. \quad (2.25)$$

Our notation directly follows [Backus et al. \(2021\)](#) and [Antón et al. \(2020\)](#).<sup>5</sup> We interpret  $\kappa_{ij}$  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  $\phi_i$ . 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 (2.25) 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

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<sup>5</sup>[López and Vives \(2019\)](#) and [Azar and Vives \(2021a\)](#) use the same formulation but denote  $\kappa_{ij}$  by  $\lambda_{ij}$ .

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.

By taking the profit vector as a payoff function and the vector of quantities  $\mathbf{q}$  as a strategy profile, we have implicitly defined a *linear-quadratic network game* (Ballester et al., 2006). The reason is that the combination of the matrices  $\Sigma$  (the network of product market rivalry relationships that exists among the firms which is based on the substitutability of their products) and  $\mathbf{K}$  (the network of ownership relationships based on the firms' investor shares) can be conceptualized as the adjacency matrix of a weighted network. Linear-quadratic network games belong to a larger class of games known as "potential games" (Monderer and Shapley, 1996) whose key feature is that they can be described by a scalar function which is called the game's potential.

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

$$\mathbf{0} = (\mathbf{b} - \mathbf{c}) - (2\mathbf{I} + \Delta + \Sigma + \mathbf{K} \circ \Sigma) \mathbf{q} \quad (2.26)$$

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

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

$$\mathbf{q}^\Xi \stackrel{\text{def}}{=} \arg \max_{\mathbf{q}} \Xi(\mathbf{q}) = (2\mathbf{I} + \Delta + \Sigma + \mathbf{K} \circ \Sigma)^{-1} (\mathbf{b} - \mathbf{c}). \quad (2.27)$$

## 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  $\phi_i$  which results in the Cournot Common Ownership allocation in equation (2.27). We now consider counterfactuals in which the same firms make production decisions with alternative objective functions. For example, rather than maximizing portfolio profits  $\phi_i$  firms maximize just their own profits  $\pi_i$  as under standard Cournot competition. Each of these counterfactuals, summarized in the set of equations in (2.28) and inversely ranked by their degree of competitiveness, is the maximizer of a specific scalar quadratic function, which we call *potential* following the nomenclature of Monderer and

Shapley (1996).<sup>6</sup> For example, the potential function  $\Xi(\mathbf{q})$  can be thought of, intuitively, as the objective function of the *pseudo-planner* problem that is solved by the Nash equilibrium allocation under common ownership whereas the potential function  $\Psi(\mathbf{q})$  is the objective function of the pseudo-planner problem for the Nash equilibrium allocation without common ownership.

$$\begin{aligned}
\text{Monopoly Potential : } \Pi(\mathbf{q}) &= \mathbf{q}' (\mathbf{b} - \mathbf{c}) - \mathbf{q}' \left( \mathbf{I} + \frac{1}{2} \mathbf{\Delta} + \mathbf{\Sigma} \right) \mathbf{q} \\
\text{CCO Potential : } \Xi(\mathbf{q}) &= \mathbf{q}' (\mathbf{b} - \mathbf{c}) - \mathbf{q}' \left( \mathbf{I} + \frac{1}{2} \mathbf{\Delta} + \frac{1}{2} \mathbf{\Sigma} + \frac{1}{2} \mathbf{K} \circ \mathbf{\Sigma} \right) \mathbf{q} \\
\text{Cournot Potential : } \Psi(\mathbf{q}) &= \mathbf{q}' (\mathbf{b} - \mathbf{c}) - \mathbf{q}' \left( \mathbf{I} + \frac{1}{2} \mathbf{\Delta} + \frac{1}{2} \mathbf{\Sigma} \right) \mathbf{q} \\
\text{Total Surplus : } W(\mathbf{q}) &= \mathbf{q}' (\mathbf{b} - \mathbf{c}) - \frac{1}{2} \cdot \mathbf{q}' (\mathbf{I} + \mathbf{\Delta} + \mathbf{\Sigma}) \mathbf{q}
\end{aligned} \tag{2.28}$$

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  $\kappa_{ij}$  in  $\mathbf{K}$  are equal to 0 for  $i \neq j$  and equal to 1 for  $i = j$ :

$$\mathbf{q}^\Psi \stackrel{\text{def}}{=} \arg \max_{\mathbf{q}} \Psi(\mathbf{q}) = (2\mathbf{I} + \mathbf{\Delta} + \mathbf{\Sigma})^{-1} (\mathbf{b} - \mathbf{c}) \tag{2.29}$$

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  $W(\mathbf{q})$ :

$$\mathbf{q}^W \stackrel{\text{def}}{=} \arg \max_{\mathbf{q}} W(\mathbf{q}) = (\mathbf{I} + \mathbf{\Delta} + \mathbf{\Sigma})^{-1} (\mathbf{b} - \mathbf{c}) \tag{2.30}$$

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  $\Pi(\mathbf{q})$ :

$$\mathbf{q}^\Pi \stackrel{\text{def}}{=} \arg \max_{\mathbf{q}} \Pi(\mathbf{q}) = (2\mathbf{I} + \mathbf{\Delta} + 2\mathbf{\Sigma})^{-1} (\mathbf{b} - \mathbf{c}) \tag{2.31}$$

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<sup>6</sup>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.

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.,  $\kappa_{ij} \rightarrow 1$ ).

### 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  $\mathbf{o}_i$ .

$$\mathbf{o}_i = \begin{bmatrix} o_{i,1} \\ o_{i,2} \\ \vdots \\ o_{i,61146} \end{bmatrix} \quad (3.1)$$

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

$$\mathbf{a}_i = \frac{\mathbf{o}_i}{\|\mathbf{o}_i\|}. \quad (3.2)$$

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

$$\mathbf{A}'\mathbf{A} = \begin{bmatrix} \mathbf{a}_1'\mathbf{a}_1 & \mathbf{a}_1'\mathbf{a}_2 & \cdots & \mathbf{a}_1'\mathbf{a}_n \\ \mathbf{a}_2'\mathbf{a}_1 & \mathbf{a}_2'\mathbf{a}_2 & \cdots & \mathbf{a}_2'\mathbf{a}_n \\ \vdots & \vdots & \ddots & \vdots \\ \mathbf{a}_n'\mathbf{a}_1 & \mathbf{a}_n'\mathbf{a}_2 & \cdots & \mathbf{a}_n'\mathbf{a}_n \end{bmatrix} \quad (3.3)$$

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.<sup>7</sup>

### 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 two datasets 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.

Our data covers the period 1994-2018. For the years 1999-2017 we use a dataset constructed by [Backus, Conlon and Sinkinson \(2021\)](#), who parsed the data contained in 13(f) forms. For the remaining years, we use 13(f) data from Thomson Reuters, obtained through the WRDS platform. We merge this data, using CUSIP codes, to the total amount of shares outstanding provided, for each firm, in Compustat.

By dividing the shareholdings of individual investors by the total number of shares outstanding, we obtain the normalized shares vector  $\mathbf{s}_i$ . We then apply equation (2.24) to compute the matrix  $\mathbf{K}$  of ownership shares.

### 3.3 Calibration and Identification

In order to take our model to the data and then perform counterfactual analysis, we need to perform the following operations. First, we need to calibrate the parameters  $\alpha$  and  $\delta$ . Second, we need to identify the quantity vector  $\mathbf{q}$ , the price vector  $\mathbf{p}$ , the cost intercepts  $\mathbf{c}$  and finally the demand intercepts  $\mathbf{b}$ .

We take the calibrated parameters for  $\alpha$  and  $\delta$  directly from [Pellegrino \(2019\)](#) – 0.05 and 6 respectively – and we check that our model produces an equally good fit of markups and cross-price elasticity data: a table with non-targeted moments is produced in Appendix C.

To identify  $\mathbf{q}$  we use the fact that we can write the vector of profits in terms of profits, and the matrices  $(\Delta, \Sigma, \mathbf{K})$ , which are already measured or calibrated:

$$\pi = \text{diag}(\mathbf{q}) \left( \mathbf{I} + \frac{1}{2} \Delta + \mathbf{K} \circ \Sigma \right) \mathbf{q} \quad (3.4)$$

While the equation above does not yield a closed-form solution for  $\mathbf{q}$ , we can solve for  $\mathbf{q}$  numerically. Prices ( $p_i$ ) are then obtained by dividing revenues ( $p_i q_i$ ) by output ( $q_i$ ). Finally, the demand and

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<sup>7</sup>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.

marginal cost intercepts are identified as follows:

$$c_i = \frac{h_i}{q_i} - \frac{\delta}{2} q_i; \quad \mathbf{b} = (2\mathbf{I} + \boldsymbol{\Delta} + \boldsymbol{\Sigma} + \mathbf{K} \circ \boldsymbol{\Sigma}) \mathbf{q} + \mathbf{c} \quad (3.5)$$

## 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 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 and use the algorithm of [Fruchterman and Reingold \(1991\)](#), henceforth FR, which is widely used in network science to visualize weighted networks.<sup>8</sup>

Every publicly traded firm in 2004 is a dot in the each of the two panels of Figure 2. In the left panel, firm pairs that have a high cosine product 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 the left panel of Figure 2 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 the right panel of Figure 2. 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 2 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 a remainder of largely unconnected firms at the periphery.

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<sup>8</sup>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 2: NETWORK VISUALIZATION

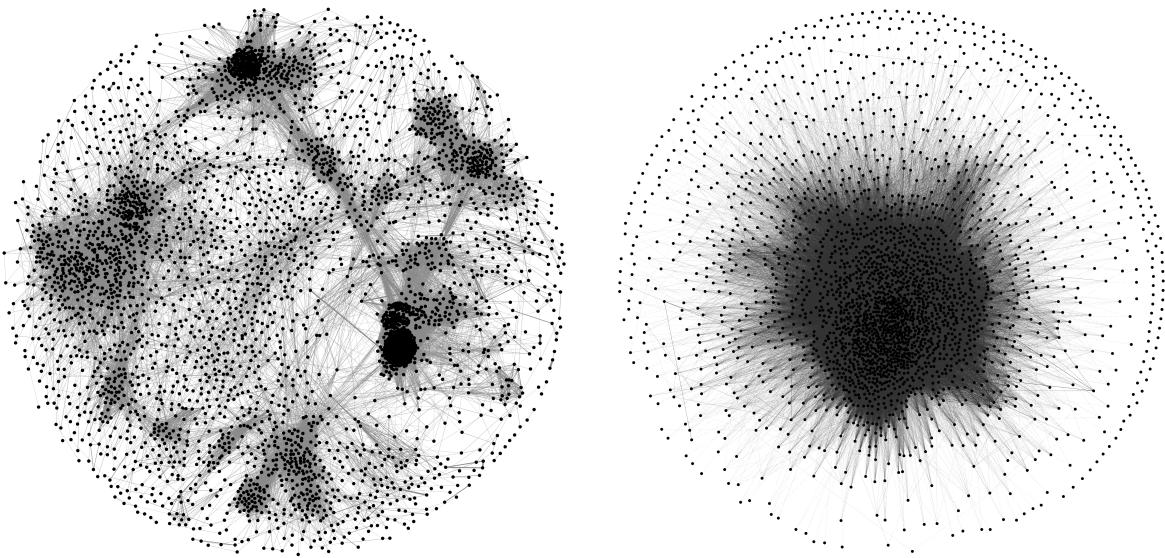


FIGURE NOTES: The diagrams are two-dimensional representations of the network of product similarities (left panel) computed by [Hoberg and Phillips \(2016\)](#) and of the network of ownership shares (right panel). Both networks are used in the estimation of the model presented in Section 2. The data cover the universe of publicly-listed firms in 2004. Firm pairs that have thicker links are closer in product market space and closer in ownership space, respectively. These distances are computed in spaces that have approximately 61,000 and 3,100 dimensions, respectively. To plot these high-dimensional objects over a plane, we apply the gravity algorithm of [Fruchterman and Reingold \(1991\)](#).

#### 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  $\Sigma$  and common ownership  $\mathbf{K}$  because this relationship governs the magnitude of the welfare cost of common ownership. As can be seen from equation (2.27) it is the Hadamard product of  $\mathbf{K}$  and  $\Sigma$  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 (2.29) and monopoly in equation (2.31).

Figure 3 plots the histogram of the joint distribution of the product similarity  $\mathbf{a}_i \cdot \mathbf{a}_j$  and the common ownership weight  $\kappa_{ij}$  for any firm pair  $i$  and  $j$  in 2018. Although each product similarity pair  $\mathbf{a}_i \cdot \mathbf{a}_j$  is symmetric, the common ownership weight  $\kappa_{ij}$  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 discontinuous jump at 0 for  $\kappa_{ij}$ . However, a sizable

FIGURE 3: PRODUCT SIMILARITY AND PROFIT WEIGHTS (2018)

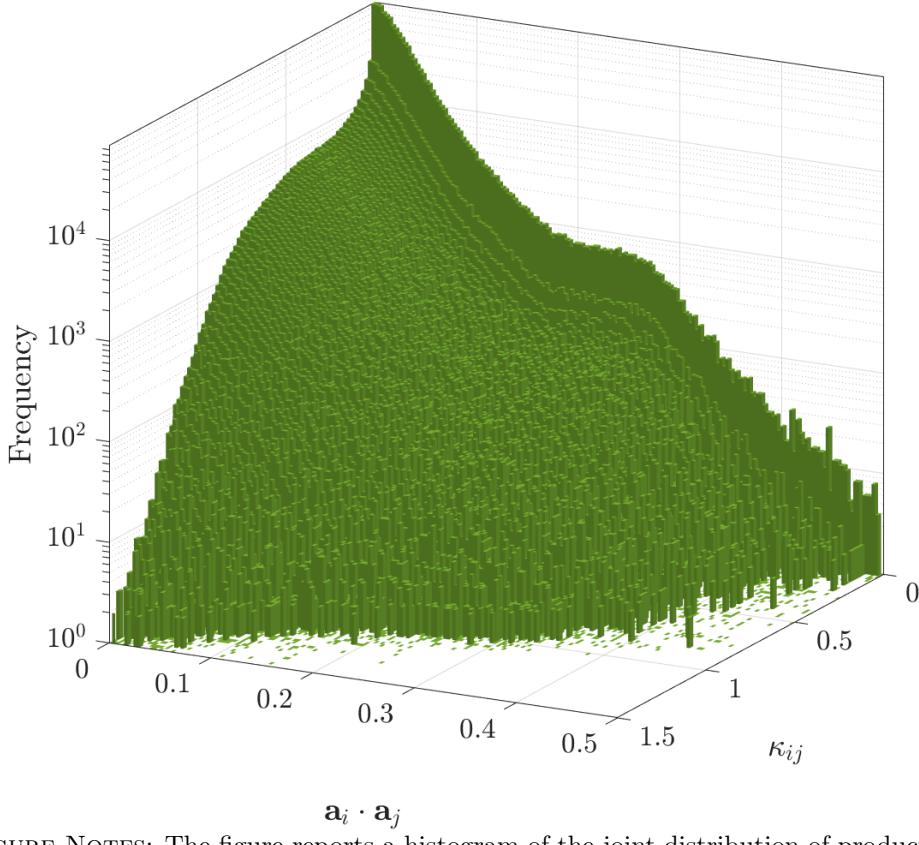


FIGURE NOTES: The figure reports a histogram of the joint distribution of product similarity  $\mathbf{a}_i \cdot \mathbf{a}_j$  and profit weights  $\kappa_{ij}$  for all firm  $ij$  pairs in 2018.

proportion of firm pairs overlaps considerably in both product similarity and ownership space. 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, the figure also shows that a small proportion of  $\kappa_{ij}$  has values greater than 1. Such values of  $\kappa$  exceeding 1 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 even if we restrict all  $\kappa_{ij}$  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 exert influence in proportion to their ownership shares and that firms set

quantities in accordance with the objective function given in equation (2.22).

We first compute total surplus and decompose it into profits and consumer surplus as reported in Table 1 for 2018, the most recent year in our sample. These calculations are based on the assumption that the observed equilibrium is the Cournot-Nash equilibrium under common ownership (column 1) of our model in Section 2. In columns 2, 3, and 4 we report the counterfactual estimates based on the alternative model assumptions. Table 2 in the appendix reports the same estimates for 1994, the first year of our sample. Additionally, Table 3 in the appendix reports the estimates when all  $\kappa_{ij}$  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, consumers gain a surplus of \$3.314 trillion, and the estimated total surplus is equal to \$8.953 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. It is instructive to put these estimates into context by comparing them to the GDP of U.S. corporations in the same year which is around \$11 trillion. The difference between GDP and total surplus computed here is that total surplus is twofold. Total surplus does not include the value of labor input, but it does include the value of inframarginal consumption. In contrast, GDP includes the value of labor input but not the inframarginal value of consumption.<sup>9</sup>

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.

Although the effects of oligopoly and common ownership on efficiency are considerable, their respective distributional effects are even more substantial. Under perfect competition consumers capture a much larger share of the total surplus: \$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 when firms price at marginal cost 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

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<sup>9</sup>Recall that in our model each unit of labor is paid exactly its marginal disutility and thus there is no inframarginal value of leisure.

TABLE 1: WELFARE ESTIMATES (2018)

Welfare Statistic	Variable	$\mathbf{q}^{\Xi}$	$\mathbf{q}^{\Psi}$	$\mathbf{q}^W$	$\mathbf{q}^{\Pi}$
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)	$CS(\mathbf{q})$	3.314	4.113	8.565	2.606
<hr/>					
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	$\frac{CS(\mathbf{q})}{W(\mathbf{q})}$	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.

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. Recall that under this allocation all firms are controlled by a single decision-maker who coordinates supply choices and maximizes aggregate firm profits. Aggregate surplus is equal to only \$8.484 trillion and thus significantly lower than in the 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 equal to 30.7% of the total surplus.

According to our estimates the market power due to oligopoly and common ownership of U.S. public firms has considerably effects on aggregate welfare, firm profits, and consumer welfare by generating resource misallocation and raising deadweight loss as well as by altering the division of surplus 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 based on annual estimates obtained from mapping our model to Compustat data on a yearly basis. We are particularly interested in 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.<sup>10</sup>

In Figure 4, 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 for the observed *Common Ownership* equilibrium. The combined area represents total surplus  $W$ . On the right axis we also plot profits as a share of total surplus  $\Pi/W$  (dotted black line).

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. Because of these opposing shifts, the profit share of surplus increased from 51.2% of total surplus to 63%, but a significantly lower share of the surplus generated by public companies accrues to consumers, 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 5. Under standard Cournot without common

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<sup>10</sup>Because our model uses both HP's time-varying product similarity data and time-varying ownership, our estimates account for how the product offering of U.S. public firms and their ownership has changed over time.

FIGURE 4: TOTAL SURPLUS OF U.S. PUBLIC FIRMS

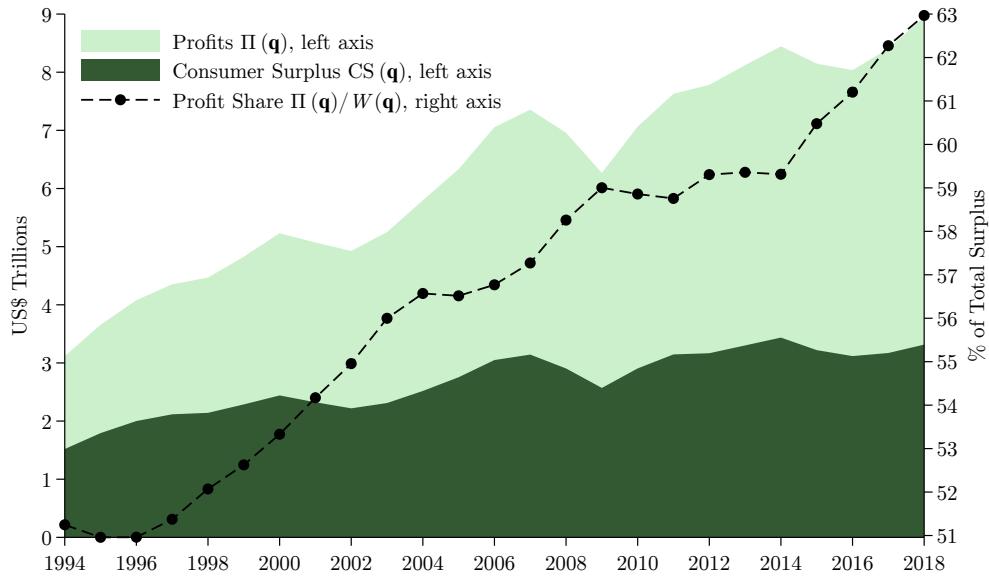


FIGURE NOTES: The figure plots the evolution of aggregate (economic) profits  $\Pi(\mathbf{q})$ , aggregate consumer surplus  $CS(\mathbf{q})$ , and total surplus  $W(\mathbf{q})$ , as defined in the model in Section 2. Profits as a percentage of total surplus ( $\Pi(\mathbf{q})/W(\mathbf{q})$ , black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

FIGURE 5: PROFIT SHARE OF TOTAL SURPLUS

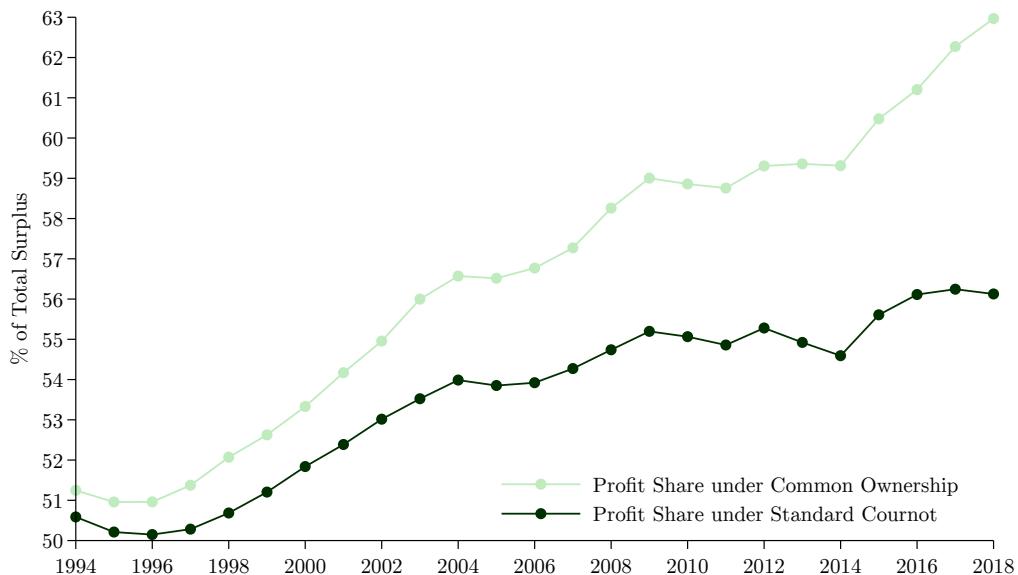


FIGURE NOTES: The figure plots the profit share under standard Cournot (dark green line) and Cournot with common ownership (light green line) between 1994 and 2018.

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 6: DEADWEIGHT LOSS

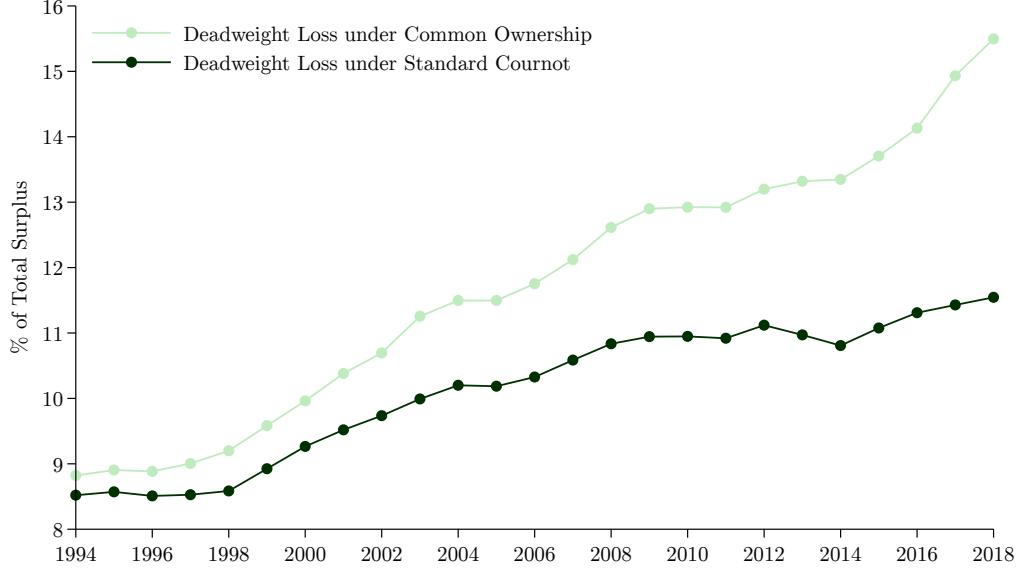


FIGURE NOTES: The figure plots the estimated deadweight loss (DWL) of oligopoly and of oligopoly and common ownership, between 1994 and 2018. The dark green line is the DWL of oligopoly, the % difference in total surplus between the Cournot equilibrium and the Perfect Competition scenario. The light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

Figure 6 plots 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  $\mathbf{q}^{\Xi}$  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. The left panel of Figure 7 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 6. 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 6, 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 7: COMMON OWNERSHIP: DEADWEIGHT LOSS AND DISTRIBUTIONAL EFFECTS

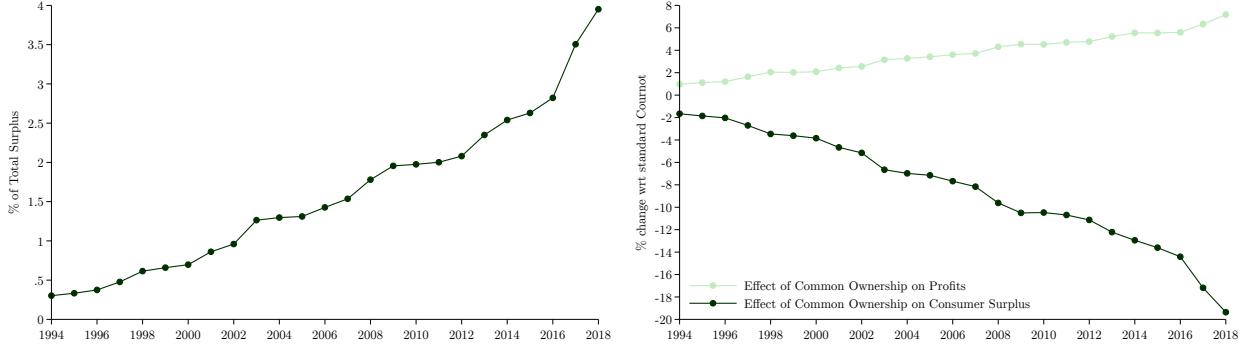


FIGURE NOTES: The figure plots the difference in deadweight loss (left panel), corporate profits, and consumer surplus (right panel) computed as % of the total surplus between Cournot with common ownership and standard Cournot from 1994 to 2018.

From an antitrust perspective we are particularly interested in the effect of common ownership on consumer surplus and its evolution over time. In the right panel of Figure 7 we plot 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.

Taken together, our results suggest that compared to 1994 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. According to our estimates this increase in aggregate market power negatively impacted both allocative efficiency and consumer welfare.

## 5 Robustness

### 5.1 Alternative Corporate Governance Assumptions

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

### 5.1.1 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 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. However, the results of Gilje et al. (2019) suggest that this influence function is concave. We therefore use the square root as an approximation.

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

$$\tilde{\kappa}_{ij} \stackrel{\text{def}}{=} \frac{\mathbf{s}'_i \mathbf{G}'_i \mathbf{s}_j}{\mathbf{s}'_i \mathbf{G}'_i \mathbf{s}_i} \quad (5.1)$$

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

### 5.1.2 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

$$\hat{\kappa}_{ij} \stackrel{\text{def}}{=} \frac{\mathbf{s}'_i \mathbf{B}'_i \mathbf{s}_j}{\mathbf{s}'_i \mathbf{s}_i} \quad (5.2)$$

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%.

### 5.1.3 Limited Investor Attention

One of the assumptions of the governance model previously presented is that each firm  $i$  fully internalizes the weighted profit shares of its investors when choosing  $q_i$ . 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 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 generalizes equation (2.21) by incorporating investor attention

$$\phi_i = \sum_{z=1}^Z s_{iz} \cdot [g_{iz} \cdot V_z + (1 - g_{iz}) \pi_i] \quad (5.3)$$

where  $g_{iz} \in [0, 1]$  represents the attention of investor  $z$  to company  $i$  which the investor partially owns. 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 (2.22). GGL provide empirical evidence that the investor attention is an increasing and concave function of  $\beta_{iz}$ , the share of company  $i$  as a percentage of the total portfolio held by investor  $z$

$$\beta_{iz} = \frac{v_{iz}}{\sum_i v_{iz}} \quad (5.4)$$

where  $v_{iz}$  is the market value of the stake held by investor  $z$  in company  $i$ . Hence, they rewrite the attention weight  $g_{iz}$  as a function of  $\beta_{iz}$  such that  $g_{iz} = g(\beta_{iz})$  where  $g$  is a continuous function that maps the interval  $[0, 1]$  on itself. Because we are in a static model the market value of investor  $i$ 's stake  $v_{iz}$  is equal to the share of the profits  $s_{iz}\pi_i$ , equation (5.4) simplifies to

$$\beta_{iz} = \frac{s_{iz}\pi_i}{\sum_{i=1}^n s_{iz}\pi_i}. \quad (5.5)$$

Although firm profits are endogenously determined and depend on the attention that investors pay to firms in their portfolio, when allocating their attention to all the different firms in their portfolio we assume that investors take the market values of these firms as given. This yields the attention-weighted profit weights  $\tilde{\kappa}_{ij}$  given by

$$\tilde{\kappa}_{ij} \stackrel{\text{def}}{=} \frac{\mathbf{s}'_i \mathbf{G}'_i \mathbf{s}_j}{\mathbf{s}'_i \mathbf{G}'_i \mathbf{s}_i} \quad \text{where} \quad \mathbf{G}_i \stackrel{\text{def}}{=} \begin{bmatrix} g(\beta_{i1}) & 0 & \cdots & 0 \\ 0 & g(\beta_{i2}) & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & g(\beta_{iZ}) \end{bmatrix} \quad (5.6)$$

We estimate  $\tilde{\mathbf{K}}$  by directly applying the attention weights estimated by GGL to our own  $\mathbf{K}$  matrix.

### 5.1.4 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.

FIGURE 8: COMMON OWNERSHIP DWL UNDER ALTERNATIVE GOVERNANCE

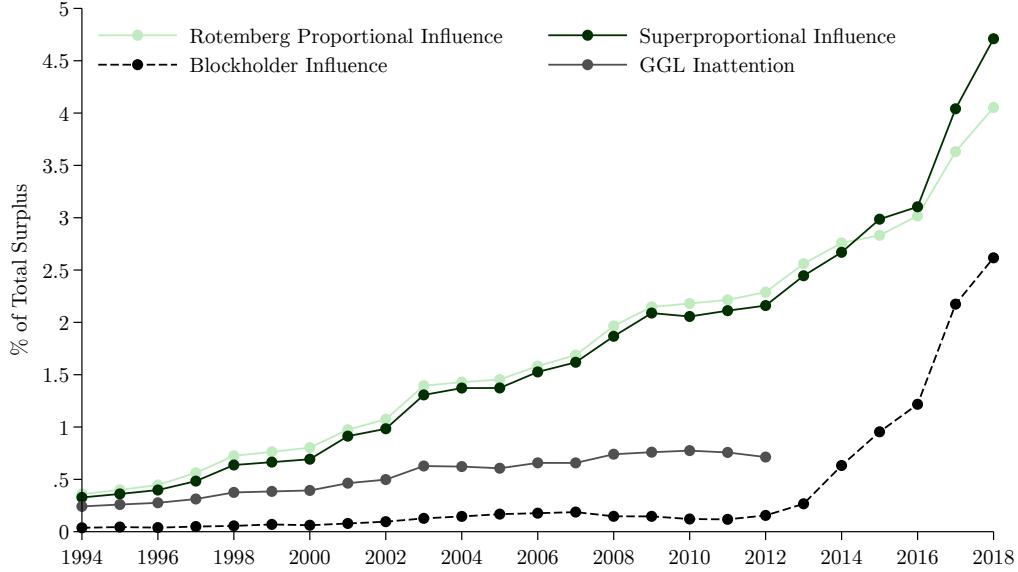


FIGURE NOTES: The figure plots the deadweight loss of common ownership computed as % of the total surplus under proportional, superproportional and blockholder influence from 1994 to 2018.

In Figure 8 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 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. Finally, the deadweight loss estimates of common ownership under the GGL governance hover between blockholder and proportional influence for the two decades during which the data required for the computation of these estimates are available. Even under GGL governance assumptions common ownership leads to a deadweight loss of 0.7%

of total surplus. Unfortunately, the GGL measures are not available after 2012 and thus miss the large increase in common ownership and potentially large deadweight loss in the later periods of our sample.

FIGURE 9: DISTRIBUTIONAL EFFECTS UNDER ALTERNATIVE GOVERNANCE (1994-2018)

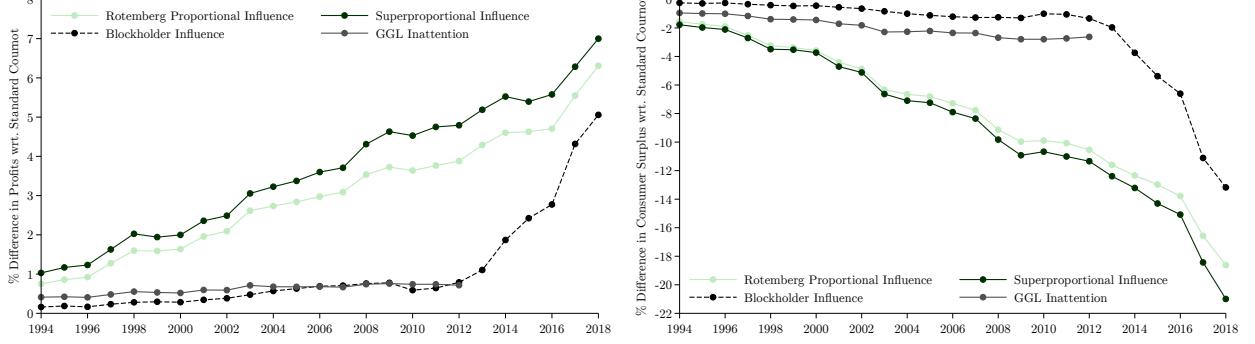


FIGURE NOTES: The figure plots the profit (left panel) and consumer surplus (right panel) difference between standard Cournot and Cournot with common ownership under proportional, superproportional and blockholder influence computed as % of the total surplus from 1994 to 2018.

In Figure 9 similar patterns emerge for the distributional consequences of common ownership on firm profits (left panel) and consumer surplus (right panel). 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 and under GGL governance have little impact on either measure until about 2012. 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 consequences that transfer rents from consumers to producers.

## 5.2 Fixed Costs

# 6 Policy Counterfactual

The vibrant literature on common ownership has led to a number of policy proposals on how to best address the challenges of its anticompetitive effect and distributional consequences. One such proposal is by Posner et al. (2016, henceforth PSW). It proposes restricting investors from holding ownership stakes exceeding 1% in competing firms according to an industry definition to be developed by antitrust authorities. This restriction would apply only to concentrated industries (i.e., HHI exceeding 2,500).

To remain consistent with our product market definition, we implement this policy using the

FIGURE 10: COMMON OWNERSHIP DWL: POLICY COUNTERFACTUAL (1994-2018)

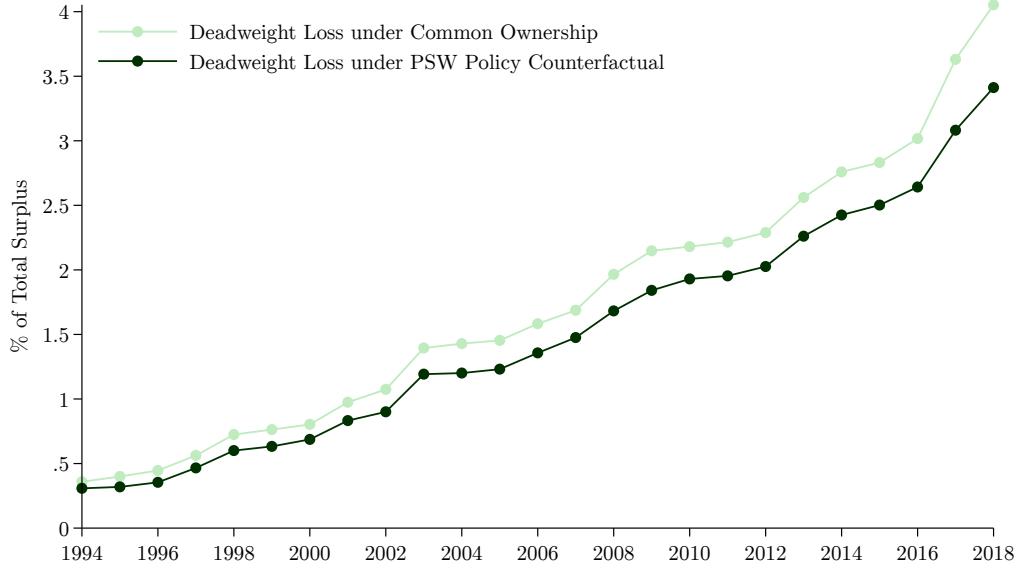


FIGURE NOTES: The figure plots the deadweight loss of common ownership computed as % of the total surplus with and without the PSW policy restrictions from 1994 to 2018.

TNIC industry classifications developed by HP and the associated industry HHIs. In order to avoid taking a stance on how investors would reallocate their portfolios if forced to sell some holdings—and also to make our implementation of this counterfactual transparent—we simply set  $\kappa_{ij} = 0$  for all firm pairs  $(i, j)$  that belong to the same TNIC3 industry and whose average HHI is 2,500 or higher.<sup>11</sup>

In Figure 10 we plot the evolution of the deadweight loss of common ownership with and without the ownership restrictions of the PSW proposal. At the comparatively low levels of common ownership at the beginning of our sample, the policy counterfactual does not have much of an effect. The deadweight loss is effectively the same with and without the PSW policy. However, by 2018 the PSW policy would lead to a reduction in deadweight loss from 4% to 3.5% of total surplus that is equivalent to roughly \$70 billion. Moreover, the PSW policy would primarily benefit consumers by raising consumer surplus by \$96 billion while having a much smaller adverse effect of -\$28 billion on corporate profits.

## 7 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

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<sup>11</sup>In TNIC, two competitors will generally have different HHIs due to the fact that each firm has its own set of competitors. For each firm pair we use the average of the two HHIs.

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 in several industries across the entire economy as well as its continuing increase suggest that antitrust policy and financial regulation may have to address this new challenge. Our counterfactual analysis shows that recent policy proposals aimed at curtailing the anticompetitive effects of common ownership would significantly increase consumer welfare and reduce deadweight loss.

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# Appendices

## COMMON OWNERSHIP AND PRODUCT MARKET COMPETITION: A TALE OF TWO NETWORKS

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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  $\kappa_{ij}$ ). We start by rewriting  $\kappa_{ij}$  in the following way:

$$\kappa_{ij} = \frac{\mathbf{s}'_i \mathbf{s}_j}{\text{IHII}_i} \quad (\text{A.1})$$

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  $U$  the set of Unobserved Investors.

Importantly, the denominator of the 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  $\kappa_{ii}$  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:

$$\sum_{z \in U} s_{iz} s_{jz} = 0 \quad (\text{A.2})$$

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 IHII using observed investors only we obtain:

$$\widehat{\text{IHII}}_i = \sum_{k \in O} s_{iz}^2 \quad (\text{A.3})$$

a downward biased estimate of the IHII. For some firms, where few small investors are observed, this bias can be enormous, leading  $\kappa$  to exceed 10,000. Let us write the “true” IHII as

$$\text{IHII}_i^* = \sum_{z \in O} s_{iz}^2 + \sum_{z \in U} s_{iz}^2 \quad (\text{A.4})$$

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

$$S_{i(\mathcal{O})} = \sum_{z \in \mathcal{O}} s_{iz} \quad S_{i(\mathcal{U})} = \sum_{z \in \mathcal{U}} s_{iz} \quad (\text{A.5})$$

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:

$$s_{i(\mathcal{O})z} = \frac{1}{S_{i(\mathcal{O})}} \cdot \sum_{z \in \mathcal{O}} s_{iz} \quad s_{i(\mathcal{U})z} = \frac{1}{S_{i(\mathcal{U})}} \cdot \sum_{z \in \mathcal{U}} s_{iz} \quad (\text{A.6})$$

As a result we have

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

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

$$S_{i(\mathcal{U})} = 1 - S_{i(\mathcal{O})} \quad (\text{A.7})$$

the true Herfindahl index can be rewritten as:

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

## B Additional Tables and Figures

In this appendix we provide additional tables and figures.

TABLE 2: WELFARE ESTIMATES (1994)

Welfare Statistic	Variable	$\mathbf{q}^{\Xi}$	$\mathbf{q}^{\Psi}$	$\mathbf{q}^W$	$\mathbf{q}^{\Pi}$
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  $\kappa_{ij} \leq 1$ 

Welfare Statistic	Variable	Common Ownership			
		$\mathbf{q}^{\Xi}$	$\mathbf{q}^{\Psi}$	$\mathbf{q}^W$	$\mathbf{q}^{\Pi}$
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
<hr/>					
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  $\kappa_{ij} \leq 1$ .

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

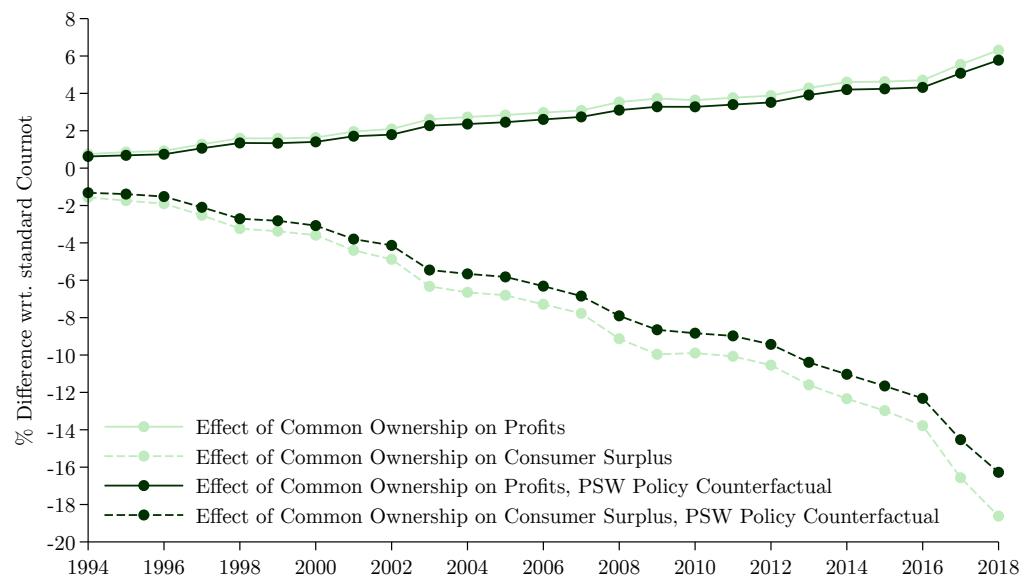


FIGURE NOTES: The figure plots the profit and consumer surplus difference between standard Cournot and Cournot with common ownership under proportional, superproportional and blockholder influence computed as % of the total surplus from 1994 to 2018.