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COMMON-OWNERSHIP VERSUS CROSS-OWNERSHIP: EVIDENCE FROM THE AUTOMOBILE INDUSTRY*

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Overlapping ownership has gained considerable momentum in the last decades, yet little is known about the role of its sources. We quantify the relative importance of common-ownership (by shareholders external to an industry) and cross-ownership (by firms within the industry). We focus on the global automobile industry, over the period 2007–2021, and document that common-ownership links constitute between 31% and 39% of the equity ownership of automobile manufacturers, while cross-ownership links amount to 6%–9%. We show that not accounting for these relatively modest cross-ownership links has important implications: it can increase the average weight assigned by managers to the profit of competitors by between 33% and 68%.

I. INTRODUCTION

The unprecedented growth and concentration of the asset management industry over recent decades (McIntyre *et al.* [2022]) has led major asset managers to hold significant stakes in almost all the major firms of a multitude of industries. These common-ownership links may lead to a failure of Hart [1979]'s competitiveness condition, according to which shareholders unanimously agree on own-profit maximization, regardless of their preferences.[1] As such, the managers of firms with common shareholders

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[1] To see why, note, for example, that if firm A imposes a negative externality on firm B, a shareholder of firm A who also holds shares in firm B typically wants the manager of firm A

may not maximize own profit, but, instead, weigh the (potential) conflicting preferences of their shareholders and (partially) internalize the externalities their strategies impose on the profits of other firms (Rotemberg [1984]; Hansen and Lott [1996]). This can decrease the incentives to compete and, naturally, lessen product market competition.[2]

In some industries, however, in addition to common-ownership links by shareholders external to the industry, there are also (for a variety of reasons) cross-ownership links by shareholders that are internal to the industry, that is, firms within an industry are themselves shareholders of other firms in the industry. Examples may be found in various industries, such as automobiles (Neto *et al.* [2020]), banking (Termushoev and Stakhovych [2019]), media (Ferguson [1983]), electric power (Amundsen and Bergman [2002]) and insurance (La Porta *et al.* [1999]). Cross-ownership in itself can also decrease the incentives to compete and, naturally, lessen product market competition.[3] Moreover, it also has the potential to *reinforce* common-ownership. The reason is that cross-ownership links change the distribution of ultimate holdings among external shareholders (see, e.g., Ellerman [1991]; and Brito *et al.* [2018a]).

To see why, let us consider an industry with three firms: firms A, B, and C. To begin with, assume a shareholder structure with solely common-ownership links. In particular, assume that firm A has two shareholders: shareholders 1 and 2, with shareholder 1 being an external noncommon shareholder (with holdings solely in firm A) and shareholder 2 being an external common shareholder (with holdings in firms A and B). This shareholder structure implies, as discussed above, that the manager of firm A may (partially) internalize the externalities her strategies impose on the profit of firm B (as shareholder 2 has a direct interest in the profit of firm B), although not on the profit of firm C (as no shareholder has a direct interest in the profit of firm C).

Assume now a shareholder structure with (additionally) cross-ownership links among the firms in the industry. In particular, assume that firm A

to pursue a less aggressive strategy than the strategy desired by a shareholder with no holdings in firm B. Although noncommon shareholders may favor a different firm-specific strategy, that does not mean they are harmed by common shareholding because these links may, for example, reduce the competitiveness of rival firms, and noncommon shareholders benefit from a reduction of competition between the firm and its rivals (see Schmalz [2018] for a formal model).

[2] For example, Brito *et al.* [2019] show that the internalization induced by common shareholders among firms with horizontal relationships (and which thereby are likely to impose a negative externality on each other) can directly lead to higher product prices and lower output levels.

[3] For example, Reynolds and Snapp [1986] and Shelegia and Spiegel [2012] show that cross-ownership links can increase prices while Bresnahan and Salop [1986] and Dietzenbacher *et al.* [2000] show that they can increase price-cost margins. Farrell and Shapiro [1990] show, on the other hand, that even if at the cost of higher prices, cross-ownership links can increase welfare, due to improved industry performance, while Gilo *et al.* [2006] show that they may not necessarily facilitate tacit collusion.

has holdings in firm B and that firm B has holdings in firm C. These cross-ownership links have several qualitative implications. First, the ultimate interest of shareholder 2 in firm B is greater than her direct holdings in the firm, because she now also has an indirect interest in the profit of firm B (via the profit of firm A). Second, although shareholder 1 has holdings solely in firm A, the cross-ownership link between firms A and B turns her ultimately into a common shareholder of firm B, because she now has an indirect interest in the profit of this firm (via the profit of firm A). Third, although none of the shareholders of firm A have direct holdings in firm C, the cross-ownership links between the three firms turn these shareholders ultimately into common shareholders of firm C, because they now have an indirect interest in the profit of this firm (via the profit of firms A and B). In other words, cross-ownership links have the potential to reinforce common-ownership in two dimensions: (a) increase the degree of internalization of the externalities that management strategies impose on the profit of the rivals in which external shareholders have direct holdings on; and (b) increase the number of firms considered in this internalization.

The prevalence and rise of common-ownership in the economy over the recent years has already been examined empirically in the literature. Recent examples include Backus *et al.* [2021b], Amel-Zadeh *et al.* [2022], and Boot *et al.* [2022]. They all measure the degree of internalization induced by common-ownership using the profit weight formulation suggested by Rotemberg [1984], Bresnahan and Salop [1986], and O'Brien and Salop [2000], and first applied to the modern phenomenon of overlapping ownership by Azar *et al.* [2018]. Backus *et al.* [2021b] and Amel-Zadeh *et al.* [2022] examine the set of S&P 500 firms. The former consider the holdings of S&P 500 firms by large institutional shareholders. They show that the average profit weight assigned by managers to other firms has increased from 0.2 in 1980 to almost 0.7 in 2017. The latter consider the holdings not only of institutional shareholders, but also of corporate insiders and blockholders. They show that once we account for these holdings, the profit weight assigned to other firms is, in fact, lower (with most profit weights decreasing by between 5% and 25%). Boot *et al.* [2022], in turn, examine the set of S&P Europe 350 firms. They show that the average profit weight assigned to other firms has increased from 0.08 in 2004 to 0.21 in 2015. This implies that while the average profit weight is lower than for the set of S&P 500 firms, the increase has been steeper in Europe than in the United States.

However, to the best of our knowledge, the potential reinforcing role of cross-ownership links on the internalization induced by common-ownership has not been examined empirically in the literature. We propose to fill this gap by examining the relative roles of common- and cross-ownership in the global automobile industry for the period 2007–2021. This industry is ideally suited for such a study for two reasons. First, automobile manufacturers command a substantial share of the global GDP. Thus, it is not surprising that major asset

managers have holdings in the major manufacturers.[4] Second, automobile manufacturers engage in different types of partnerships (which include, among others, cross-ownership links) to share high development costs, reduce sourcing costs, gain access to new markets, establish economies of scale or gain access to complementary resources (Robertson and Karl [1998]). In fact, cross-ownership links (and other types of partnerships) have a long tradition in the automobile industry, as discussed in Online Appendix C.

In particular, we document that, during our sample period, common-ownership links in the industry constitute between 31% and 39% of the equity ownership of automobile manufacturers, while cross-ownership links amount to 6%–9%. We subsequently show that accounting for these relatively modest cross-ownership links has important implications for the profit weights assigned to other firms. We find that accounting for cross-ownership links can increase the average weight assigned by managers to the profit of competitors by between 33% and 68%.

The remainder of the article is organized as follows. Section II describes the theoretical framework used to compute the profit weights. Section III applies the profit weights to the global automobile industry. Section IV concludes and discusses policy implications.

II. THEORETICAL FRAMEWORK

There are F multiproduct firms, indexed by $f \in \mathfrak{F} \equiv \{1, \dots, F\}$, whose total stock is composed of voting stock and nonvoting (preferred) stock. Both stocks give the holder the right to a share of the firm's profits, but only the former gives the holder the right to vote in the firm's general assembly.

There are also K shareholders, indexed by $k \in \Theta \equiv \{1, \dots, F, \dots, K\}$, who may engage in overlapping ownership. The set of shareholders can include not just shareholders $\Theta \setminus \mathfrak{F}$ that are external to the industry (and can engage in common-ownership), but also shareholders from the subset of firms that are internal to the industry (and can engage in cross-ownership).

The holdings $\phi_{kf} \in [0, 1]$ of total stock of shareholder k in firm f, regardless of whether it be voting or nonvoting stock, capture her *financial rights* to the firm's profits. The holdings $v_{kf} \in [0, 1]$ of voting stock of shareholder k in firm f, capture her *voting rights* in the firm. These voting rights may not necessarily coincide with her *control rights* in the firm, $\gamma_{kf} \in [0, 1]$, which refer to her rights to influence the decisions of firm f and depend, in general, not only on her voting rights, but also on the distribution of voting rights in the firm: $\gamma_{kf} = \mathcal{F}\left(v_{kf} | v_{1f}, \dots, v_{kf}, \dots, v_{Kf}\right)$. For instance, shareholder k

[4] In 2021, for example, the Big Three asset managers (BlackRock, Vanguard and State Street) held significant stakes in literally all the major manufacturers. These includes BAIC, BMW, Changan, Dongfeng, FAW, Ford, GM, Geely, Great Wall, Honda, Hyundai, Mazda, Mitsubishi, Nissan, Renault, SAIC, Subaru, Suzuki, Stellantis, Tata, Toyota, and Volkswagen.

may have no control over the decision-making within firm f, that is, $\gamma_{kf} = 0$, even while holding 49% of the voting rights in the firm, if one other shareholder holds 51%. In contrast, shareholder k may have effective control over the decision-making within firm f, that is, $\gamma_{kf} = 1$, even while holding 10% of the voting rights in the firm, if each of the remaining shareholders is atomistic.

We assume that external shareholders hold voting rights in at least one firm of the industry. This implies that the firms in the industry are not entirely held by the firms themselves. As such, we have that $\sum_{k\in\Theta\setminus\mathfrak{F}} v_{kf} > 0$ for at least one firm f. Because the financial rights of a shareholder in a firm denotes her holdings of total stock in the firm, regardless of whether it be voting or nonvoting stock, it implies we also have that $\sum_{k\in\Theta\setminus\mathfrak{F}} \phi_{kf} > 0$ for at least one firm f.

II(i). *Ultimate Financial, Voting and Control Rights*

The automobile industry is characterized by a multitude of cross-ownership links. We follow Ellerman [1991] and Brito *et al.* [2018a] in computing the ultimate rights (induced from the existing cross-ownership links) that external shareholders hold in the different firms. We begin this analysis by focusing on the financial rights.

II(i)(a). *Financial Rights*

The ultimate financial rights that external shareholder k holds in firm f, ϕ^u_{kf}, includes not just her direct financial rights in the firm, ϕ_{kf}, but also the indirect financial rights that may result from holding ultimate financial rights in a rival $g \in \mathfrak{F}\setminus f$ that holds, in turn, financial rights in firm f. This implies that for all $k \in \Theta\setminus\mathfrak{F}$ and $f, g \in \mathfrak{F}$, we have:

$$\phi^u_{kf} = \phi_{kf} + \sum_{g\in\mathfrak{F}\setminus f} \phi^u_{kg}\phi_{gf}, \tag{1}$$

where $\mathfrak{F}\setminus f$ denotes the set $\mathfrak{F}$ not including firm f. The set of equations (1) implicitly determines the ultimate financial rights of each external shareholder as a function of the direct financial rights of all shareholders (internal and external). Please see Online Appendix A for the computation details. We now address the voting and control rights.

II(i)(b). *Voting and Control Rights*

The ultimate voting rights that external shareholder k holds in firm f, v^u_{kf}, includes not just her direct voting rights in the firm, v_{kf}, but also the indirect voting rights that may result from holding ultimate control rights in a rival $g \in \mathfrak{F}\setminus f$ that holds, in turn, voting rights in firm f. To see why, let us consider the following example, borrowed from Levy [2011]. If an external shareholder fully controls firms A and B and each of the firms holds in turn 30% of the

voting rights in firm C, then the external shareholder ultimately holds 60% of the voting rights in firm C. This implies that for all $k \in \Theta \setminus \mathfrak{F}$ and $f, g \in \mathfrak{F}$, we have:

$$(2) \qquad \begin{aligned} v^u_{kf} &= v_{kf} + \sum_{g \in \mathfrak{F} \setminus f} \gamma^u_{kg} v_{gf} \\ &= v_{kf} + \sum_{g \in \mathfrak{F} \setminus f} \mathcal{F}\left(v^u_{kg} | v^u_{F+1g}, \dots, v^u_{kg}, \dots, v^u_{Kg}\right) v_{gf}. \end{aligned}$$

If the ultimate control rights of external shareholders in any given firm (implied by the vector of their ultimate voting rights) are non-negative and sum up to one, the set of equations (2) implicitly determines the ultimate voting rights of each external shareholder as a function of the direct voting rights of all shareholders (internal and external). Please see Online Appendix A for the computation details.

II(ii). *Profit Weights*

The managers of firms with overlapping shareholders may weigh the eventual conflicting objectives of their shareholders, rather than maximizing own profits. This implies that they may internalize (to some degree) the externalities their strategies impose on other firms (Rotemberg [1984]; Hansen and Lott [1996]). The quantification of this induced internalization is paramount to empirically quantify the prevalence of overlapping ownership. To do so, the formulation of the (internalization) weight that the manager of a firm assigns to the profit of other firms is key. This formulation is, however, nontrivial. To see why, let us consider, for example, that firm A has four shareholders, each holding 25% of the firm, and that one of those shareholders also holds 20% of firm B. If firm A imposes an externality on firm B, what weight would the manager of firm A assign to the profit of firm B?

The dominant formulation of the profit weights that result from overlapping shareholding is due to O'Brien and Salop [2000]. Incorporating features from both Rotemberg [1984] and Bresnahan and Salop [1986], they assume that (a) the preferences of shareholders are captured by their (financial) returns; and (b) the managers of firms with overlapping shareholders would maximize a control-weighted sum of the returns of the firm's shareholders.[5] In the presence of both cross- and common-ownership, this

[5] Azar [2012, 2017], Brito *et al.* [2018a] and Moskalev [2019] microfound the dominant formulation of these profit weights through a voting model in which shareholders vote to elect the manager from two potential candidates, an incumbent and a challenger, with conceivably differing strategy proposals to the firm (or alternatively vote to express whether they approve or not of a managerial change in the firm's status quo strategic plan). Candidates are assumed to care about holding office. In turn, shareholders are assumed to care about the returns that result from the different strategy proposals and to have an additive profit-irrelevant bias for (or

implies that the manager of each firm f would maximize $\sum_{k\in\Theta\setminus\mathfrak{F}}\gamma^u_{kf}R_k$, where $R_k=\sum_{g\in\mathfrak{F}}\phi^u_{kg}\pi_g$ denotes the return of shareholder k's ultimate financial rights holdings in all the firms in the industry, and π_g denotes the profit of firm g. Naturally, this is entirely equivalent to maximizing a weighted sum of the profits of (potentially) all the firms in the industry, where the (normalized) weight that the manager assigns to the profit of firm g for any $f,g\in\mathfrak{F}$ is given by:[6]

$$w_{fg}=\frac{\sum_{k\in\Theta\setminus\mathfrak{F}}\gamma^u_{kf}\phi^u_{kg}}{\sum_{k\in\Theta\setminus\mathfrak{F}}\gamma^u_{kf}\phi^u_{kf}}. \tag{3}$$

This dominant formulation in the literature is derived from the key assumption that managers maximize a control-weighted sum of the returns of the firm's shareholders. In practice, however, operational decision variable(s) are often not decided by top managers, but by middle managers, who may not know the extent of the holdings of the firm's shareholders in other firms. As such, we may view formulation (3) as a measure of the degree of internalization that *could* be induced by overlapping ownership if managers *fully* internalized the returns of shareholders, but this may differ from the *actual* degree of internalization induced by overlapping ownership. This cautionary remark may help to explain the ongoing debate on the competitive effects of overlapping ownership. Reduced-form evidence suggests that overlapping ownership may impact (a) product prices (Azar *et al.* [2018, 2022]), but without being very explicit on the underlying mechanisms; (b) stock returns (Boller and Scott Morton [2020]); and (c) entry (Newham *et al.* [2022]). Evidence from structural models has been more mixed and industry-specific. Kennedy *et al.* [2017] and Backus *et al.* [2021a] find no evidence that overlapping ownership raises product prices, while Park and Seo [2019] and Azar and Ribeiro [2022] find the opposite result.

III. EMPIRICAL APPLICATION

III(i). *Data Description*

We examine the profit weights that result from the ownership patterns in the global automobile industry for the period 2007–2021. We focus on the

against) the challenger. Voting is probabilistic in the sense that the bias, while known to voters, is unobserved by candidates, who treat it as random. This microfoundation is consistent with empirical evidence establishing that shareholders' voting impacts the objective function of managers (Aggarwal *et al.* [2019]).

[6] This formulation has been critiqued for yielding counter-intuitive profit weights when the ownership of nonoverlapping shareholders is highly dispersed. Brito *et al.* [2023] propose an alternative formulation of the objective function of managers, which solves this criticism.

following automobile manufacturers: BAIC, BMW, Changan, Chrysler, Daihatsu, Dongfeng, FAW, Fiat, Ford, Geely, GM, Great Wall, Honda, Hyundai, Mazda, Mercedes, Mitsubishi, Nissan, PSA, Renault, SAIC, Subaru, Suzuki, Tata, Toyota, and Volkswagen.[7] According to the International Organization of Motor Vehicle Manufacturers (which provides statistics, by manufacturer, on the world motor vehicle production until 2017), these manufacturers account for around 90% of the yearly world motor vehicle production between 2007 and 2017.

For each manufacturer and year, we obtain ownership information from Refinitiv Eikon, which we combine when appropriate with ownership information from annual reports and Troubled Asset Relief Program (TARP) assistance reports prepared by the Congressional Research Service for the US Congress. Please see Online Appendix B for additional details (including the Reuters instrument codes used). Refinitiv Eikon has a number of advantages compared to other data sources. First, in addition to 13F filings, which are only filed by large shareholders in the US, it includes both institutional and noninstitutional shareholders. Amel-Zadeh *et al.* [2022] show that including solely institutional shareholders when calculating profit weights"can bias the measured level and mask the true variation of overlapping ownership of firms, whether in the same industry, or across industries".

Second, the ownership information in Refinitiv Eikon is to a large extent aggregated by asset manager and therefore requires less processing than the 13-F fillings. Notwithstanding this aggregation, it still has several separate entries for the Big Three asset managers (BlackRock, Vanguard and State Street), which report some of their subsidiary holdings separately. We consolidate those entries, since Fichtner *et al.* [2017] show that the Big Three do utilize coordinated voting strategies and hence follow a centralized corporate governance strategy. We also consolidate the holdings of the following shareholders of BAIC, Changan, Dongfend, FAW, and SAIC: Beijing Automotive Group Co, China Changan Automobile Group Co, Dongfeng Motor Corporation, China FAW Co, and Shanghai Automotive Industry (Group), respectively, as they are wholly owned subsidiaries of the Government of the People's Republic of China, the Municipality of Beijing or the municipality of Shanghai. We also consolidate the holdings of Li Shufu, Geely's founder, which are reported by Refinitiv Eikon under two different headings: Li (Shu Fu) and Li (Shufu).

Third, Refinitiv Eikon has historical data on delisted companies, which is key because of the recent consolidation of the automobile industry. Figure 1 reports the number of automobile manufacturers in the sample over time, illustrating this consolidation: in October 2014, Chrysler and Fiat merge

[7] We do not include Kia as a stand-alone manufacturer because Kia and Hyundai are members of the Hyundai Motor Group, a South Korean chaebol, with Hyundai regarded as the *de facto* representative of the group.

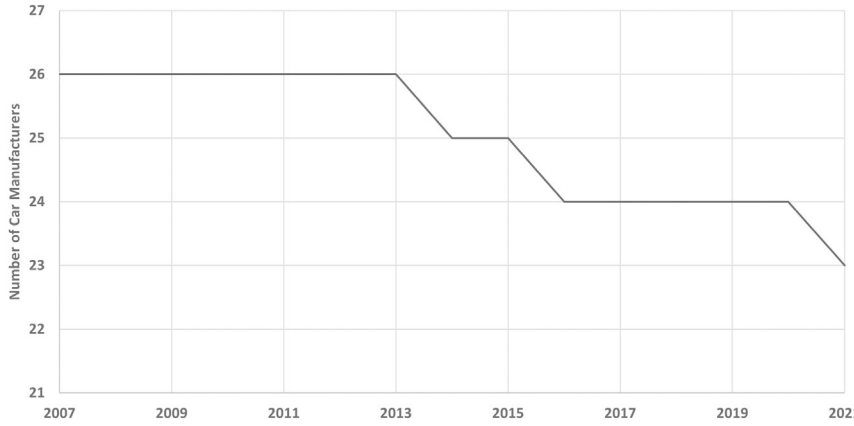

Figure 1
Number of Car Manufacturers in the Sample

(giving rise to FCA); in August 2016, Daihatsu became a wholly owned subsidiary of Toyota; and in January 2021, FCA and PSA merge (giving rise to Stellantis).

We classify a shareholder of a firm as an internal shareholder (i.e., a rival automobile manufacturer) if the name of the shareholder coincides exactly with the name of the manufacturer from Refinitiv Eikon, with two exceptions: (a) for GM, we also consider the holdings of GM Asset Management; and (b) for Nissan, we also consider the holdings of Nissan Finance Co., Ltd. Both are wholly owned subsidiaries of GM and Nissan, respectively. We do not classify as internal shareholders, affiliated firms of the manufacturer and subsidiaries of external shareholders.[8]

III(i)(a). *Common and Cross-Ownership Links*

Figure 2 plots the (arithmetic) average of the financial rights held by the shareholders reported in Refinitiv Eikon across the different automobile manufacturers in each year, discriminated by shareholder type. The plot shows that the shareholders reported in Refinitiv Eikon hold between 64% and 68% of the financial rights of the average automobile manufacturer in the sample, discriminated as follows. Between 19% and 26% are held by external

[8] In particular, we do not consider for Toyota the holdings of affiliates Toyota Asset Management Co., Ltd. (before the merger in 2013 with Sumitomo Mitsui Asset Management Co Ltd) and Toyota Tsusho Corp, as Toyota stakes on both firms are only partial. Further, we also do not consider for BAIC the holdings of BAIC Group Industrial Investment Co Ltd, a wholly owned subsidiary of BAIC's *external* shareholder Beijing Automotive Group Co. Ltd. Finally, we do not consider for Mitsubishi the holdings of other firms of the Mitsubishi Group as each firm of the group is independent.

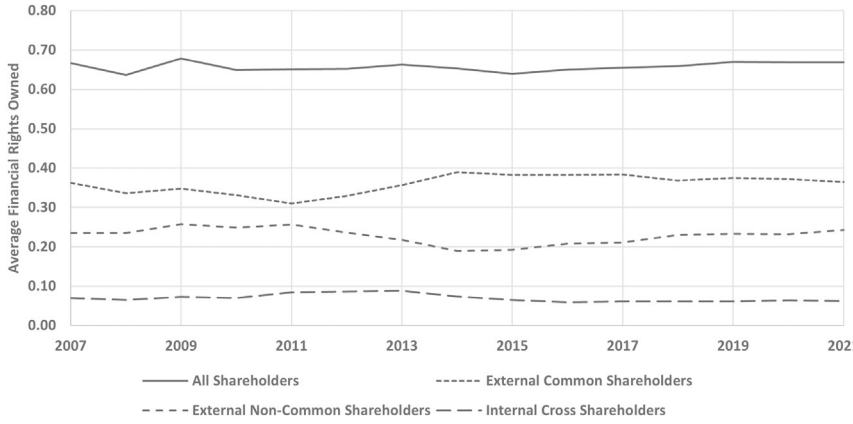

Figure 2
Average Financial Rights in the Sample

noncommon shareholders (with holdings in a single manufacturer in a given year), between 31% and 39% are held by external common shareholders (with holdings in at least two manufacturers in a given year, reflecting common ownership), and between 6% and 9% are held by internal shareholders (reflecting cross-ownership).

Table I reports the direct pairwise cross-ownership links in the sample. In each year, there are between 9 and 14 direct pairwise cross-ownership links, involving, on average, between 12% and 17% of a manufacturer's financial rights. Please see Online Appendix C for a more detailed description of each cross-ownership link. The links in the first part of the sample stem from a combination of alliances aiming to emulate the successful Renault-Nissan partnership and a response to the challenges posed by the financial crisis, for example, the quest for cost reductions and production efficiencies through technology sharing and joint development of product lines (BBC [2012]). The recovery of the global economy mid-sample led to a decrease in the number of links while challenges such as the development of electric mobility, autonomous driving, and mobility as a service led to an increase in the number of cross-ownership links in the final part of the sample (Automotive News Europe [2018]).[9]

[9] The decrease in cross-ownership links mid-sample occurs due to a variety of reasons such as (a) the Fiat-Chrysler merger (in 2014) and the Daihatsu acquisition by Toyota (in 2016); and (b) the end of the Volkswagen-Suzuki (in 2014), Ford-Mazda (in 2015), and Subaru-Suzuki (in 2016) partnerships. Although in the same period, the Mercedes-BAIC partnership was created (in 2013), with the aim of increasing the foothold of the German carmaker in the Chinese market and sharing development costs (CNN [2019]), it was not sufficient to counteract the overall trend. Finally, the number of cross-ownership links increased toward the end of the sample as the result of Toyota's partnerships with Mazda (in 2017) and Suzuki (in 2020).

TABLE I
DIRECT CROSS-OWNERSHIP LINKS IN THE SAMPLE

Shareholder	Firm	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Dongfeng	PSA/Stellantis								14.126	13.687	13.662	12.226	12.226	12.226	12.362	4.444
Fiat	Chrysler			20.000	20.000	58.500	58.500	58.500								
Ford	Mazda	33.407	13.782	13.782	3.500	3.500	2.078	2.078	2.077							
GM	Ford	0.033		0.017		0.005	0.004	0.005	0.003							
	Mercedes	0.002	0.002													
	PSA						7.000									
Mazda	Toyota												0.254	0.254	0.254	0.254
Mercedes	BAIC							12.000	10.566	10.083	10.083	10.083	9.554	9.554	9.554	9.554
	Chrysler	19.900	19.900													
	Nissan				3.100	3.100	3.100	3.100	3.100	3.100	3.272	3.320	3.320	3.320	3.320	3.320
	Renault				3.100	3.100	3.100	3.100	3.100	3.100	3.100	3.100	3.100	3.100	3.100	
	Tata	6.641	6.637	5.690												
Nissan	Mitsubishi										33.995	33.995	33.995	33.995	33.995	33.995
	Renault	15.000	15.000	15.000	15.000	15.000	15.000	15.000	15.000	15.000	15.000	15.000	15.000	15.000	15.000	15.000
Renault	Mercedes				3.087	3.086	3.081	3.099	3.099	3.099	3.099	3.099	3.099	3.099	3.099	1.541
	Nissan	44.329	44.329	44.329	43.401	43.401	43.401	43.401	43.401	43.401	43.401	43.401	43.401	43.401	43.401	43.401
Subaru	Suzuki	1.065	1.065	1.065	1.065	1.065	1.030	1.030	1.030	1.030						
Suzuki	Subaru	1.749	1.749	1.749	1.749	1.749	1.749	1.749	1.749	1.749						
	Toyota														0.190	0.190
Toyota	Daihatsu	51.190	51.190	51.190	51.190	51.190	51.190	51.190	51.190	51.190						
	Mazda											5.054	5.054	5.054	5.054	5.054
	Subaru	8.686	16.478	16.478	16.478	16.478	16.478	16.478	16.478	16.478	16.771	16.771	16.771	16.771	19.969	19.969
	Suzuki														4.887	4.887
Volkswagen	Suzuki			19.893	19.893	19.893	19.893	19.893	19.893							
Number Direct CO Links		11	10	11	12	13	14	14	14	11	9	10	11	11	13	12
Average FR Direct CO Links		16.546	17.013	17.199	15.130	16.928	16.115	16.473	13.201	14.720	15.820	14.605	13.252	13.252	11.860	11.801

Notes: CO denotes cross-ownership. Figures represent the (financial rights) holdings in percentage points of the manufacturer depicted in the shareholder's column on the manufacturer depicted in the firm's column. Chrysler denotes holdings on Chrysler LLC for the period 2007–2008, and Chrysler Group LLC for the period 2009–2013. Fiat denotes holdings of Fiat Automobiles S.p.A. for the period 2007–2013. Mercedes denotes holdings of and on Daimler AG for the period 2007–2021. PSA/Stellantis denotes holdings on Peugeot S.A. for the period 2007–2020 and Stellantis N.V. for 2021. Subaru denotes holdings of and on Fuji Heavy Industries Ltd. for the period 2007–2016 and Subaru Corp for the period 2017–2021.

Table I suggests four important patterns about this network of links. First, cross-ownership links may sometimes (but not typically) lead to full mergers (as in the cases of Toyota and Daihatsu, and Fiat and Chrysler). Second, cross-ownership links tend to be relatively persistent over time, although only three pairwise links remain active over the entire sample period: Nissan on Renault; Renault on Nissan; and Toyota on Subaru (or four pairwise links, if we include the link between Toyota and Daihatsu, which led to a full merger). Third, cross-ownership links tend to form both among firms of the same geography (as Mercedes and Renault or Toyota and Subaru) and of different geographies (as Mercedes and BAIC or Nissan and Renault). Fourth, although cross-ownership is relatively modest on average, there are several large cross-ownership links. This implies that from a policy perspective, cross-ownership may be a potential concern even if one ignores common-ownership.[10]

Do cross- and common-ownership links tend to be substitutes? If so, the (theoretical) potential reinforcing role of cross-ownership links on the internalization induced by common-ownership could be less (empirically) relevant. To investigate this issue, we now examine whether the two link types are correlated. To do so, we pool the links for each manufacturer pair in each year and run a series of regressions, depicted in Table II. We begin by examining whether common- and cross-ownership links (of any given manufacturer in a competitor) are correlated *per se* (independently of their magnitude). We run a probit regression relating the indicator of a cross-ownership link (of any magnitude) to the indicator of the corresponding common-ownership link (of any magnitude). See Models (1) and (2) in Table II. We find that the correlation between the two link types is not statistically significant. We then examine whether cross-ownership links (of any given manufacturer in a competitor) are correlated with the *magnitude* of the corresponding common-ownership links. We run a probit regression relating the indicator of a cross-ownership link (of any magnitude) to the magnitude of the corresponding common-ownership link (measured as the total financial rights held by external common shareholders of the manufacturer in the competitor). See Models (3) and (4) in Table II. We find that this correlation is statistically significant and positive. Finally, we examine whether the magnitudes of common- and cross-ownership links (of any given manufacturer in a competitor) are correlated. We run a Tobit regression

[10] According to US merger regulations, cross-ownership links, involving corporate control or not, are subject to both ex-ante and ex-post review. This follows the same legal standard as any other acquisition, with the exception of noncontrolling cross-ownership links, which are subject to a more lenient standard under merger control rules. According to EU merger regulations, cross-ownership links are subject to (ex-ante) review solely if they entail a "lasting change of control". Noncontrolling cross-ownership links may in theory still be captured by antitrust rules, although in practice since antitrust enforcement became decentralized, these rules have not been applied in a case. See Tzanaki [2023] for a more detailed discussion.

TABLE II
CORRELATIONS BETWEEN CROSS- AND COMMON-OWNERSHIP LINKS

	(1)	(2)	(3)	(4)	(5)	(6)
CO Link	0.517	0.484				
	(0.344)	(0.357)				
Magnitude CO Link			1.174**	1.145**	0.174**	0.169**
			(0.284)	(0.289)	(0.052)	(0.053)
Year Fixed-Effects	No	Yes	No	Yes	No	Yes
Log L	-865.738	-864.438	-864.080	-862.801	-709.179	-708.096

Notes: CO denotes common-ownership. All regressions are based on 9016 manufacturer-pair *fg* observations. Robust standard errors in parentheses. Models (1) and (2) represent ML estimates of a probit regression relating an indicator that takes the value one if manufacturer *f* holds a stake in competitor *g* (of any magnitude) to an indicator that takes the value one if the external shareholders of manufacturer *f* hold stakes in competitor *g* (of any magnitude). Models (3) and (4) represent ML estimates of a probit regression relating an indicator that takes the value one if manufacturer *f* holds a stake in competitor *g* (of any magnitude) to the total holdings of the external shareholders of manufacturer *f* in competitor *g*. Models (5) and (6) represent ML estimates of a Tobit regression relating the holdings of manufacturer *f* in competitor *g* to the total holdings of the external shareholders of manufacturer *f* in competitor *g*.
**Indicates significance at the 1% level.

(because of the large number of null cross-ownership links in the industry) relating the magnitude of cross-ownership links to the magnitude of the corresponding common-ownership links. See Models (5) and (6) in Table II. We find that this correlation is statistically significant and positive. Naturally, correlation does not imply causation, but overall these findings suggest that, if anything, cross-ownership links are, to some extent, positively related to the magnitude of common-ownership links.

III(ii). *Profit Weights*

At first sight, the above findings suggest that cross-ownership links are relatively unimportant compared with common-ownership links. To evaluate this, we use the ownership data to compute the profit weights associated to each manufacturer pair in each year. We consider two formulations of the profit weight. First, we consider the formulation established in equation (3), which accounts for the cross-ownership links in the industry, by distinguishing between internal and external shareholders and using the *ultimate* rights of external shareholders. Second, for comparison, we consider a formulation of the profit weight which does not account for the cross-ownership links in the industry. In this case, we do not distinguish between internal and external shareholders and consider solely the *direct* rights of shareholders, as if all shareholders (internal and external) were external to the industry. This mimics the formulation in Backus *et al.* [2021b], Amel-Zadeh *et al.* [2022], and Boot *et al.* [2022], and, as such, we denote it as our *baseline* profit weight.

Moreover, we consider two measures of corporate control. We consider that the control rights of shareholders are measured by their voting rights (as in,

e.g., Azar *et al.* [2018]; Backus *et al.* [2021b]; Amel-Zadeh *et al.* [2022]; Azar *et al.* [2022]; Azar and Ribeiro [2022]; and Boot *et al.* [2022]). However, this measure of control rights may have two unappealing properties: it does not converge to 100% as the voting rights of a shareholder approach 50% and it does not depend on the voting rights of the firm's all other shareholders.[11] To address these two unappealing properties, we therefore also measure the control rights of shareholders by the normalized Banzhaf power indices that result from their voting rights (as in, e.g., Azar *et al.* [2018]; Brito *et al.* [2018a], Brito *et al.* [2018b]; and Azar and Vives [2022]). We do so, following Dubey and Shapley [1979], using the set of observed shareholders. Finally, we follow the literature in assuming a one-share-one-vote rule and that the (unobserved) retail share of each firm is made up of an infinity of atomist shareholders. Online Appendix D provides the Julia code used to perform these computations.

We begin by computing first, as an illustration, the profit weights associated to each of the five (of the typically) top automobile manufacturers: Ford, GM, Hyundai, Toyota, and Volkswagen. According to the International Organization of Motor Vehicle Manufacturers, these manufacturers account for around 45% of the yearly world motor vehicle production between 2007 and 2017.

Figure 3 reports the (arithmetic) average weight that *each* of the five manufacturers potentially assigns to the profit of the remaining manufacturers in the sample, in each year. Panels A1–A5 consider the case in which control rights are measured by voting rights while Panels B1–B5 consider the case in which control rights are measured by the normalized Banzhaf power indices that result from voting rights.

The plots of both panels of Figure 3 suggest that the extent of *existing* common-ownership varies substantially across manufacturers. For Hyundai and Volkswagen, the average *baseline* profit weight (i.e., not accounting for cross-ownership links) is low (below 0.03) and roughly constant across the sample while for Ford, GM and Toyota, it is (for the most cases) comparatively higher and tends to increase over time.[12] Further, the plots also suggest that accounting for the cross-ownership links in the industry is important (even when firms do not have any *direct* cross-ownership links in competitors, as it is the case, for example, with Ford and GM between 2015 and 2021), although

[11] This is because we may expect a shareholder with, for example, 10% of the firm's voting rights to have effective control if each of the remaining shareholders hold a tiny amount of the firm's voting rights.

[12] There are two broad exceptions to this characterization: (a) the average baseline profit weight of Ford exhibits a sharp decrease in 2008 due to the financial crisis; and (b) the average profit weight of GM also exhibits a sharp decrease (to the point of becoming almost zero) in the period between the 2008 financial crisis (which led GM to fill for a government-backed Chapter 11 reorganization in June 2009) and the Treasury stock sales announced in April 2013.

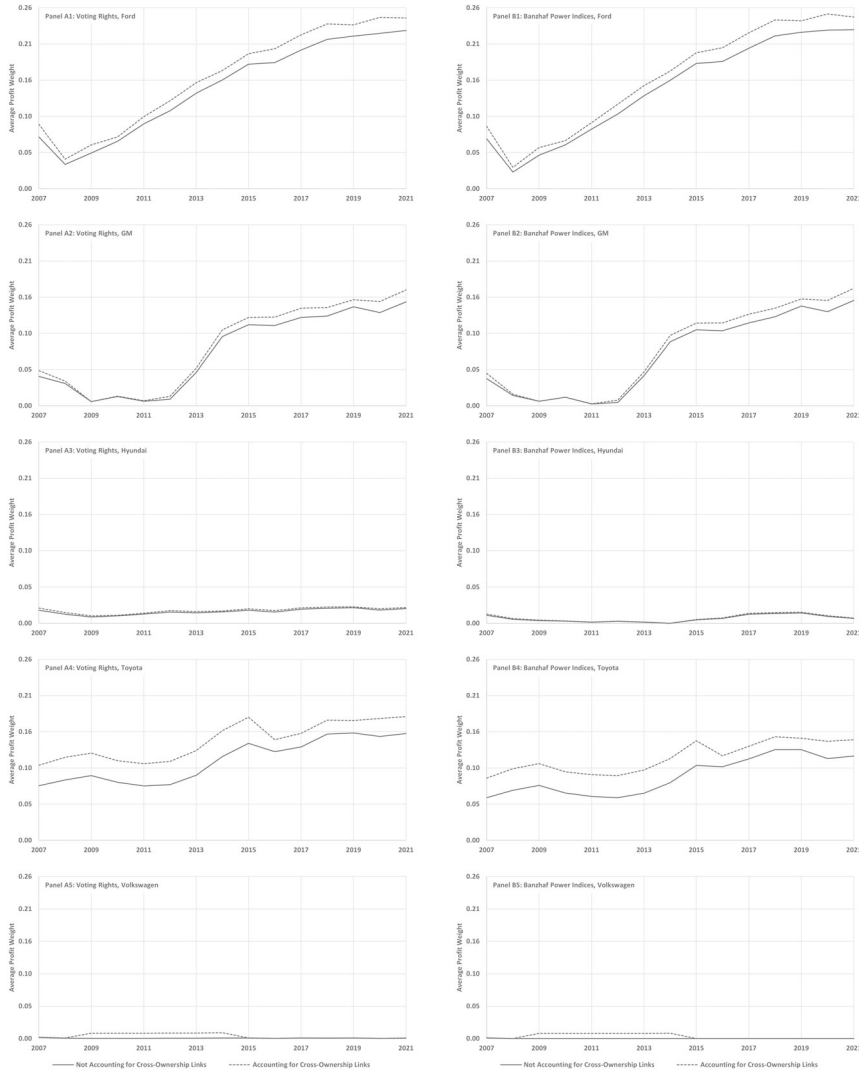

Figure 3
Average Profit Weights of a Selection of Automobile Manufacturers

the magnitude of the *reinforcing role* of cross-ownership varies substantially across manufacturers.

We now take a more aggregate approach in the lines of Backus *et al.* [2021b], Amel-Zadeh *et al.* [2022] and Boot *et al.* [2022]. Figure 4 reports the (arithmetic) average profit weights *over all* cross-pairs of car manufacturers in the sample in each year. As before, Panel A considers the case in which control

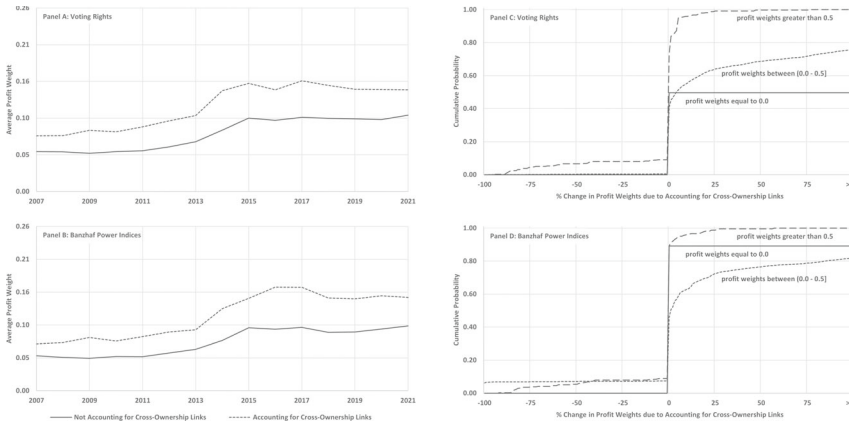

Figure 4
Average Profit Weights of the Global Automobile Industry

rights are measured by voting rights while Panel B considers the case in which control rights are measured by the normalized Banzhaf power indices that result from voting rights.

The plots of both panels suggest that the average baseline profit weight has increased steadily over time from just over 0.05 in 2007 to between 0.10 and 0.11 in 2017 (depending on how control rights are measured) and has decreased slightly since then. Hence, profit weights in the global automobile industry are lower when compared to the set of S&P 500 firms (as reviewed in the introduction). This is consistent with the evidence in Boot *et al.* [2022], as US asset managers typically hold smaller stakes in non-US firms. Further, the plots also suggest that accounting for the cross-ownership links in the industry is important. Not doing so, that is, computing profit weights as if all shareholders (internal and external) were external to the industry, underestimates the average profit weight. In particular, the average profit weight accounting for cross-ownership links is between 33% and 68% *higher* (depending on the years and on how control rights are measured).

To examine this bias in more detail, Figure 4, Panels C and D report the distribution of the percentage change in profit weights due to accounting for cross-ownership links, for all individual firm-pairs across all years.[13] They do so for three levels of the baseline profit weights: zero profit weights, positive profit weights less than or equal to 0.5, and positive profit weights greater than 0.5.

[13] The percentage change associated to individual firm-pairs for which profit weights are zero regardless of whether we account or not for cross-ownership links, is depicted as zero in Figure 4, Panels C and D.

Figure 4, Panel C considers the case in which control rights are measured by voting rights. The results confirm that cross-ownership links do alter the extent of *existing* common-ownership. In particular, we find that when we account for cross-ownership links, the share of *positive* baseline profit weights that do change is sizeable: 60% for baseline profit weights between zero and 0.5 (which account for 87% of the profit weights), and 36% for baseline profit weights greater than 0.5 (which account for 4% of the profit weights). Further, the changes are mostly positive,[14] which implies that cross-ownership links typically *reinforce* the degree of internalization induced by existing common-ownership. In particular, we find that the changes in baseline profit weights between zero and 0.5 are concentrated between 1% and 25% (23% out of 60%) and above 100% (24% out of 60%), while the changes in baseline profit weights greater 0.5 are concentrated between 1% and 25% (26% out of 36%). Finally, the results also confirm that cross-ownership links can induce otherwise *nonexistent* common-ownership. In particular, we find that when we account for cross-ownership links, 50% of the *zero* baseline profit weights (which account for 8% of the profit weights) do change and become positive. These results are (qualitatively) robust to measuring control rights by the normalized Banzhaf power indices that result from voting rights, as depicted in Figure 4, Panel D.

Naturally, automobile manufacturers in the sample may not be active in all markets. For that reason, we may not, as such, directly infer competition concerns from the average profit weights for the whole industry. To examine this issue, we make use of country-level motor vehicle (volume) sales data, obtained from the market research firm JATO, to consider in more detail five (sizeable) regional markets: Australia, Brazil, China, Europe, and the US. The analysis documents that although the number of automobile manufacturers active in each market is typically (and sometimes substantially) lower than the total number of automobile manufacturers in our overall sample, we obtain the same *qualitative* patterns for the regional markets (naturally with quantitative differences across regions) as those found for the global automobile industry as a whole. Please see Online Appendix E for the full regional analysis and Online Appendix F for the list of automobile manufacturers considered in each regional market and year.

IV. CONCLUSIONS

We examine the evolution of overlapping ownership in the global automobile industry over the period 2007–2021. As the industry is characterized by both

[14] Accounting for cross-ownership links changes the distribution of (financial and voting) rights among external shareholders. If the change in distribution is such that, for example, the *concentration* of common external shareholders decreases once we account for cross-ownership links, profit weights can *decrease*.

common- and cross-ownership links, it is important to quantify the relative importance of these two sources of overlapping ownership.

We document that common-ownership links constitute between 31% and 39% of the equity ownership of automobile manufacturers, while cross-ownership links amount to 6%–9%. Moreover, we show that accounting for these relatively modest cross-ownership links has important implications. It increases the average weight potentially assigned by managers to the profit of competitors by between 33% and 68%, depending on the years and on the measure of corporate control used.

Our findings have important implications for future research. They suggest that in industries in which cross-ownership is a potentially important phenomenon, those links may provide additional useful variation in profit weights. In future research, this variation can be used to help identifying the impact of overlapping ownership on competition, and the mechanisms behind it.

Our findings also have important policy implications for merger analysis in industries characterized by common-ownership links. In general, one may distinguish between two effects (see also, e.g., Azar and Tzanaki [2022]). On the one hand, existing common-ownership between merging firms reduces the incremental anti-competitive effect of a merger. On the other hand, common-ownership with nonmerging competitors may raise these firms' responses. Hence, the overall effect is ambiguous. As such, concerns may arise depending on the specific merger, and would be different if one also incorporates the role of cross-ownership as an amplifier of common-ownership.

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