Online Appendix

COMMON-OWNERSHIP *vs.* CROSS-OWNERSHIP: EVIDENCE FROM THE AUTOMOBILE INDUSTRY

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Appendix A. Ultimate Rights

Ultimate Financial Rights

In order to see why the set of equations (1) in the main text implicitly determines the ultimate financial rights of each external shareholder as a function of the direct financial rights of all shareholders (internal and external), let $\mathbf{F}$ and $\mathbf{F}^u$ denote the $(K-F)\times F$ matrices capturing the direct and ultimate financial rights, respectively, of external shareholders, with typical elements ϕ_{kf} and ϕ^u_{kf} representing the direct and ultimate financial rights, respectively, of external shareholder k in firm f. Let also $\mathbf{F}^*$ denote the $F \times F$ matrix capturing the direct financial rights of internal shareholders, with zero diagonal elements, $\phi_{ff} = 0$, and off-diagonal elements, $0 \leq \phi_{fg} \leq 1$ (if $f \neq g \in \Im$), representing the direct financial rights of firm f in firm g. We can then use matrices $\mathbf{F}$, $\mathbf{F}^u$ and $\mathbf{F}^*$ to write the set of equations (1) in vector notation, as follows:

$$\mathbf{F}^u = \mathbf{F} + \mathbf{F}^u\mathbf{F}^*. \tag{A.1}$$

In order to solve for $\mathbf{F}^u$ explicitly we can rewrite it as:

$$\mathbf{F}^u\left(\mathbf{I}_F - \mathbf{F}^*\right) = \mathbf{F}, \tag{A.2}$$

where $\mathbf{I}_F$ denotes a $F \times F$ identity matrix.

The assumption that external shareholders hold voting rights in at least one firm of the industry implies that $\sum_{k\in\Im}\phi_{kf} \leq 1$ for all firms f with strict inequality for at least one firm. This constitutes a sufficient condition for the Frobenius root of the non-negative square matrix $\mathbf{F}^*$ to be less than unit (see Theorem 12, Chapter 4, in Murata [1977]). As a consequence, the absolute value of any eigenvalue of $\mathbf{F}^*$ is less than unit and, thus, its spectral radius, which implies, in turn, that $\left(\mathbf{I}_N - \mathbf{F}^*\right)^{-1}$ exists, with typical element ϕ^*_{fg} representing the ultimate financial rights of firm f in firm g. We can, thereby, solve for $\mathbf{F}^u$ explicitly as follows:

$$\mathbf{F}^u = \mathbf{F}\left(\mathbf{I}_N - \mathbf{F}^*\right)^{-1}, \tag{A.3}$$

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which establishes, as postulated, that the ultimate financial rights of each external shareholder can, in fact, be written as a function of the direct financial rights of all shareholders. Brito *et al.* [2018] show that the ultimate financial rights of external shareholders implied by the set of equations (A.3) are non-negative and sum up to one for any given firm.

Ultimate Voting and Control Rights

In order to see why that the set of equations (2) in the main text implicitly determines the ultimate voting rights of each external shareholder as a function of the direct voting rights of all shareholders (internal and external), let $\mathbf{V}$, $\mathbf{V}^u$ and $\mathbf{C}^u$ denote the $(K-F)\times F$ matrices capturing the direct voting rights, ultimate voting rights and ultimate control, respectively, of external shareholders, with typical elements υ_{kf}, υ^u_{kf} and γ^u_{kf} representing the direct voting rights, ultimate voting rights and ultimate control rights, respectively, of external shareholder k in firm f. Let also $\mathbf{V}^*$ denote the $F\times F$ matrix capturing the direct voting rights of internal shareholders, with zero diagonal elements, $\upsilon_{ff}=0$, and off-diagonal elements, $0\leq\upsilon_{fg}\leq 1$ (if $f\neq g\in\Im$), representing the direct voting rights of firm f in firm g. We can use matrices $\mathbf{V}$, $\mathbf{V}^u$, $\mathbf{C}^u$ and $\mathbf{V}^*$ to write the set of equations (2) in vector notation, as follows:

$$\begin{aligned}\mathbf{V}^u &= \mathbf{V}+\mathbf{C}^u\mathbf{V}^* \\ &= \mathbf{V}+\mathcal{F}\left(\mathbf{V}^u\right)\mathbf{V}^*,\end{aligned} \tag{A.4}$$

where $\mathcal{F}(\cdot)$ denotes the function which maps the ultimate voting rights of external shareholders implied by matrix $\mathbf{V}^u$ into the corresponding ultimate control rights established in matrix $\mathbf{C}^u$. Brito *et al.* [2018] show that (a) if there exists a unique matrix $\mathbf{V}^u$ that solves $\mathbf{V}^u=\mathbf{V}+\mathcal{F}\left(\mathbf{V}^u\right)\mathbf{V}^*$, the fixed point iterates given by $\mathbf{V}^{u(i+1)}=\mathbf{V}+\mathcal{F}\left(\mathbf{V}^{u(i)}\right)\mathbf{V}^*$ converges to $\mathbf{V}^u$ as $i\to\infty$ from *any* initial condition $\mathbf{V}^{u(0)}$, as under the assumption that external shareholders hold voting rights in at least one firm of the industry $\mathbf{V}$ is not a null matrix;and (b) the ultimate voting rights of external shareholders implied by the set of equations (A.4) are non-negative and sum up to one for any given firm.

In the particular case of proportional corporate control, where the corporate control rights of the different shareholders are captured by their corresponding voting rights, we have that $\mathbf{C}^u=\mathcal{F}\left(\mathbf{V}^u\right)=\mathbf{V}^u$. This implies that $\mathbf{V}^u=\mathbf{V}+\mathbf{V}^u\mathbf{V}^*$, which - under the assumption that external shareholders hold voting rights in at least one firm of the industry - yields $\mathbf{V}^u=\mathbf{V}\left(\mathbf{I}_N-\mathbf{V}^*\right)^{-1}$.

Appendix B. Ownership Data Sources

We obtain ownership information from Refinitiv Eikon, which we combine when appropriate with ownership information from annual reports and TARP assistance reports prepared by the Congressional Research Service for Congress. The details are as follows.

For BMW, Changan, Daihatsu, FAW, Fiat, Ford, Geely, Honda, Hyundai, Mazda, Mercedes, Mitsubishi, Nissan, PSA, Renault, SAIC, Subaru, Suzuki, Tata, Toyota, and Volkswagen, as well as for the merged entities FCA and Stellantis, ownership information is obtained solely from Refinitiv Eikon. The Reuters instrument codes used and periods considered for each of these manufacturers are the following: BMW (RIC: BMWG.DE; Period: 2007-2021), Changan (RIC: 000625.SZ; Period: 2007-2021), Daihatsu (RIC: 7262.T^G16; Period: 2007-2015), FAW (RIC: 000800.SZ; Period: 2007-2021), FCA (RIC: STLA.MI; Period: 2014-2020), Fiat (RIC: STLA.MI; Period: 2007-2013), Ford (RIC: F; Period: 2007-2021), Geely (RIC: 0175.HK; Period: 2007-2021), Honda (RIC: 7267.T; Period: 2007-2021), Hyundai (RIC: 005380.KS; Period: 2007-2021), Mazda (RIC: 7261.T; Period: 2007-2021), Mercedes (RIC: MBGn.DE; Period: 2007-2021), Mitsubishi (RIC: 7211.T; Period: 2007-2021), Nissan (RIC: 7201.T; Period: 2007-2021), PSA (RIC: PEUP.PA^A21; Period: 2007-2020),[1] Renault (RIC: RENA.PA; Period: 2007-2021), SAIC (RIC: 600104.SS; Period: 2007-2021), Stellantis (RIC: STLA.MI; Period: 2021), Subaru (RIC: 7270.T; Period: 2007-2021), Suzuki (RIC: 7269.T; Period: 2007-2021), Tata (RIC: TAMO.NS; Period: 2007-2021), Toyota (RIC: 7203.T; Period: 2007-2021), and Volkswagen (RIC: VOWG.DE; Period: 2007-2021).

For BAIC, Dongfeng, and Great Wall, ownership information is obtained from Refinitiv as well as from annual reports. The reason is as follows. The equity ownership of BAIC, Dongfeng, and Great Wall is divided into A-shares and H-shares. A-shares are domestic shares which can be traded (or not) on Chinese stock exchanges while H-shares are overseas-listed foreign shares. As a consequence of this equity structure, the ownership of these three automobile manufacturers combines the two shares types. The A-shares of BAIC and Dongfeng are not traded and, as such, ownership information is obtained from their annual reports.[2] The A-shares of Great Wall are traded on the Shanghai Stock Exchange and, as such, ownership information is obtained from Refinitiv. The Reuters instrument code used is 601633.SS, for the period 2007-2021. The H-shares of the three automobile manufacturers are traded on the Hong Kong Stock Exchange and, as such, ownership information is also

[1] We amend the ownership information from Refinitiv between 2014 and 2020 regarding the stake of Dongfeng on PSA, because Refinitiv reports this holdings as a direct holding of the Government of People's Republic of China. In 2021, as part of the package of agreements signed by the shareholders upon the merger between PSA and FCA, Dongfeng was required to sell part of its stake in PSA. It did so in September 2021. Refinitiv reports the (reduced) stake in 2021 correctly, as a direct holding of Dongfeng and not of the Government of People's Republic of China.

[2] For BAIC, annual reports are only publicly available from 2014 onwards (inclusive), when the (H-shares of the) firm became listed on the Hong Kong Stock Exchange. For the period between 2007 and 2012, we assume the holders of A-shares are the same as those reported in the 2014 annual report. This seems a reasonable assumption as the holders of A-shares have remained relatively constant from 2014 to 2021. For 2013, we include also Mercedes (then Daimler) as an holder of BAIC shares (with a 12% stake) as in November 2013 Mercedes acquired this stake in long-standing partner BAIC Motor.

obtained from Refinitiv. The Reuters instrument codes used and periods considered for each of these manufacturers are the following: BAIC (RIC: 1958.HK; Period: 2014-2021), Dongfeng (RIC: 0489.HK; Period: 2007-2021), and Great Wall (2333.HK; Period: 2007-2021). The combination of the two types of shares makes use of the corresponding total number of shares, obtained from the firms annual reports.

For Chrysler (both Chrysler LLC, for the period 2007-2008, and Chrysler Group LLC, for the period 2009-2013), ownership information is obtained from the Chrysler's TARP assistance report prepared by the Congressional Research Service for the US Congress (Webel and Canis [2012]).

Finally, for GM, ownership information for the periods 2007-2008 and 2010-2021 is obtained from Refinitiv. The Reuters instrument code used is MTLQQ.PK^D11 for the period 2007-2008 and GM for the period 2010-2021. Ownership information for 2009 is obtained from the GM's TARP assistance report prepared by the Congressional Research Service for the US Congress (Canis and Webel [2013]).

Appendix C. Cross-Ownership Links

Cross-ownership links have a long tradition in the automobile industry. Alley [1997] documents cross-ownership links between US and Japanese manufacturers as early as 1979. Examples include the holdings (some of which ended already) among Mercedes, Nissan and Renault, between Ford and Mazda, between Nissan and Renault, between Volkswagen and Suzuki, and among Toyota and a number of other Asian manufacturers (see Neto *et al.* [2020] for a thorough account). Other types of partnerships include joint ventures, where firms join their forces to establish a child company, and non-equity strategic alliances, where firms agree to pool their resources and capabilities together. Examples of horizontal joint ventures are the partnerships between Western car makers and their Chinese counterparts, in order to access the Chinese market (Hu *et al.* [2014]). Vertical joint ventures comprise firms of different industries, such as in efforts to produce batteries, develop autonomous driving technology, build charging infrastructure, and introduce car-sharing services (Automotive News Europe [2018]). A leading example of strategic alliances is the joint development of car platforms, whereby firms share design, engineering, and production efforts, leading to different models sharing the same components (Autoblog [2022]). Recent cases include the joint development of the Toyota GR86 and the Subaru GTR and Volkswagen's MQB platform, whose first version was introduced in 2012, which has been used by different products of the brands Audi, Seat, Skoda, and Volkswagen itself.

In this Appendix, we provide a more detailed description, obtained from business press articles and firms press releases, of each cross-ownership link reported in Table 1 of the main text.

Dongfeng

In March 2014, in a financial rescue operation, Dongfeng and the French Government each acquired a 14% stake in PSA. In December 2019, PSA and FCA announced a merger that would give rise to Stellantis. The deal closed on January 2021 and, as part of a package of agreements signed by shareholders upon the merger, Dongfeng was required to sell part of its stake in PSA, which it did in September 2021.

Fiat

Following the 2008 financial crisis, Chrysler (then Chrysler LLC) filed for bankruptcy in April 2009 and restructured its operations with oversight from the Obama Administration and the bankruptcy court. Many of the assets were sold to a new legal entity, Chrysler Group LLC, in which Fiat took a management role and a 20% equity stake. In 2011, Fiat increased this stake to 58.5% which it kept until 2014 when both entities merged, giving rise to FCA.

Ford

In 1974, Ford and Mazda began a partnership that eventually led to Ford acquiring a stake in Mazda in 1979, which Ford expanded over time to a (controlling) 33.4% stake by 1996. From 2008 (amid the world financial crisis) to 2015, Ford gradually divested its stake in Mazda. And by September 2015, Ford had fully divested its interest in Mazda.

GM

GM Asset Management, GM's pension plan investment firm and wholly owned subsidiary of GM, held a stake in Ford (in 2007, 2008, and 2011 to 2014) and in Mercedes (then Daimler, in 2007 and 2008).

On February 2012, GM and PSA announced the creation of a major alliance, as part of which GM acquired a 7% in PSA. This alliance was, however, short-lived, as in December 2013, after PSA's financial woes worsened, GM sold its stake in PSA.

Mazda

In May 2015, Mazda and Toyota signed an agreement to form a long-term partnership. In August 2017, Mazda and Toyota agreed to enter a business and capital alliance, with the aim of further strengthening their partnership. As part of this capital alliance, Mazda committed to acquire a 0.254% stake in Toyota.

Mercedes

The partnership between Mercedes (then Daimler-Benz) and Tata (then TELCO) began in the 1950s to manufacture trucks. In March 2010, Mercedes (then Daimler) sold its 5.69% stake in Tata arguing to be in an "excellent position" to capitalise on the growth potential of the Indian passenger and commercial vehicle markets without the help of Tata.

In 1998, Mercedes (then Daimler-Benz) merged with Chrysler (giving rise to Daimler-Chrysler). In 2007, DaimlerChrysler agrees to sell 80.1% of Chrysler to private equity firm Cerberus Capital Management LP, giving rise to two separate entities, Daimler AG and Chrysler LLC, with Daimler keeping a 19.9% stake in Chrysler. The economic collapse during the financial crisis of 2007–2008 led Chrysler LLC to file for bankruptcy in April 2009 and, with oversight from the Obama Administration as well as the bankruptcy court, restructure its operations. Many of the assets were sold to a new legal entity, Chrysler Group LLC.

In April 2010, Mercedes (then Daimler) and the Renault-Nissan alliance announced a broad strategic cooperation. As part of this strategic cooperation, Mercedes acquired a 3.1% stake in Nissan and Renault. In November 2021, Mercedes (then Daimler) decided to dissolve the ties to then Renault-Nissan-Mitsubishi alliance in favor of more individual relationships. As a consequence, the firm sold its stake in Renault.

In November 2013, Mercedes (then Daimler) acquired a 12% stake in long-standing partner BAIC Motor, significantly deepen their already strong strategic partnership.

Nissan

In March 1999, a heavily indebted Nissan agreed to a major strategic alliance with Renault. As part of this strategic alliance, Nissan acquired, in March 2002, a 13.5% stake in Renault, which it then expanded to 15% in May 2002.

In October 2016, Nissan acquired a 34% stake in Mitsubishi, becoming its largest shareholder, with the aim of collaborating on joint purchasing, deeper localization, joint plant utilization, common vehicle platforms, technology-sharing and an expansion of the firms' combined presence in both developed and emerging markets. As a result of the acquisition, Mitsubishi become part of the global Alliance with Nissan and Renault.

Renault

In March 1999, Renault agreed to a major strategic alliance with heavily indebted Nissan to rescue it. As part of this alliance, Renault would assume part of Nissan's debt in return for a 36.6% equity stake in the company. In March 2002, Renault increased its stake in Nissan to 44.4%, which was later trimmed to around 43%.

In April 2010, the Renault-Nissan alliance and Mercedes (then Daimler) announced a broad strategic cooperation. As part of this strategic cooperation, Renault acquired a 3.1% stake in Mercedes. In March 2021, Renault announced to have sold part of its stake in Mercedes to reduce debt and leverage profits.

Subaru

In December 1999, Subaru enters a business tie-up with Suzuki, as part of which the two firms agreed to hold shares in each other. In August 2016, the firms announced the end of this business tie-up and Subaru sold its 1.03% stake in Suzuki.

Suzuki

In December 1999, Suzuki enters a business tie-up with Subaru, as part of which the two firms agreed to hold shares in each other. In August 2016, the firms announced the end of this business tie-up and Suzuki sold its 1.749% stake in Subaru.

In October 2016, Suzuki and Toyota began considering a business partnership. In October 2019, the two firms announced an agreement regarding a capital alliance to establish and promote a long-term partnership (in order to develop newer technologies and meet sweeping changes upending the global auto industry). As part of this capital alliance, Suzuki committed to acquire a 0.19% stake in Toyota after approval from the foreign competition authorities.

Toyota

In 1967, Toyota and Daihatsu agreed to form a cooperative alliance, to enhance the international competitiveness of Japan's automotive industry. As a result of this agreement, Toyota acquired a stake in Daihatsu, which it then expanded over time to a controlling stake by 1998. In 2016, the two firms reached an agreement whereby Daihatsu became a wholly-owned subsidiary of Toyota.

In October 2005, Toyota and Subaru agreed on business collaboration related to development and production. As part of this business collaboration, Toyota acquired a 8.7% stake in Subaru. In 2008, the two firms expanded their cooperative ties and Toyota increased its

stake in Subaru to 16.5%. In 2021, the two firms expanded their cooperative ties even further and Toyota increased its stake in Subaru to 20%.

In May 2015, Toyota and Mazda signed an agreement to form a long-term partnership. Later on, in August 2017, the two manufacturers decided to strength their partnership by entering a business and capital alliance, with the aim of further strengthening their partnership. As part of this capital alliance, Toyota committed to acquire a 5.05% stake in Mazda by October 2017.

In October 2016, Suzuki and Toyota began considering a business partnership. In October 2019, the two firms announced an agreement regarding a capital alliance to establish and promote a long-term partnership (in order to develop newer technologies and meet sweeping changes upending the global auto industry). As part of this capital alliance, Toyota committed to acquire a 4.9% stake in Suzuki after approval from the foreign competition authorities.

Volkswagen

In December 2009, Suzuki and Volkswagen announced that they reached a common understanding to establish a close long-term strategic partnership with the aim of achieving synergies in the areas of rapidly growing emerging markets as well as in the development and manufacturing of innovative and environmentally friendly compact cars. As part of this business collaboration, Volkswagen acquired a 19.9% stake in Suzuki. Soon after this acquisition, the relationship began to fray, with Suzuki accusing Volkswagen of withholding information it had promised to share, while Volkswagen objecting to a Suzuki deal to buy diesel engines from Fiat. In November 2011, Suzuki gives notice to Volkswagen of the termination of the partnership, but Volkswagen does not reply. As a result, Suzuki files for arbitration at the International Court of Arbitration of the International Chamber of Commerce (ICC). In August 2015, the ICC holds the termination of the partnership between Suzuki and Volkswagen valid.

Appendix D. Julia Code

In this Appendix, we provide the Julia code used to compute the two formulations of the profit weights associated to each manufacturer pair in each year, allowing also for our two alternative measures of corporate control.

We begin by describing the code to compute the normalized Banzhaf power indices that result from voting rights. We then describe the code to compute ultimate financial and control rights. Finally, we describe the code to compute our two formulations of the profit weights.

Banzhaf Power Indices

The code below computes the normalized Banzhaf power indices that result from the direct or ultimate voting rights (measured between 0–1) depicted in matrix **a**.

```
function banzhaf(a);
   a = 1000*a;
   a = floor.(a);
   a = 10*a;
   C = zeros(size(a,1),size(a,2));
   for i = 1:size(a,2);
      q = BigInt(5000-(10000-sum(a[:,i]))/2);
      if sum(a[:,i].>q)==1;
         tmp0 = a[:,i].>q;
         tmp1 = findall(x->x>0, tmp0);
         C[tmp1[1],i] = 1;
      else;
         tmp0a = [1:1:size(a,1);];
         tmp0b = [tmp0a a[:,i]];
         tmp = tmp0b[a[:,i].!=0,:];
         tmp2 = size(tmp,1);
         if isempty(tmp)==0;
            den = big(2)^(tmp2-1);
            tmp3 = tmp[:,2];
            tmp4a = tmp[sortperm(tmp[:, 2]),:];
            tmp4 = tmp4a[:,2];
            dlast = zeros(1+BigInt(sum(tmp4)),1);
            dlast[1] = 1;
            d = zeros(1+BigInt(sum(tmp4)),size(tmp3,1));
            for r = 1:size(tmp3,1);
               tmp5 = sum(tmp4[1:r]);
               d[1,r] = dlast[1];
               for j = 1:BigInt(sum(tmp4));
                  if j<tmp4[r];
                     d[j+1,r] = big(dlast[j+1]);
                  else;
                     d[j+1,r] = big(dlast[j+1]) + big(dlast[j+1-BigInt(tmp4[r])]);
                  end;
```

```
            end;
            dlast = d[:,r];
         end;
         cw = zeros(1+BigInt(sum(tmp4)),size(tmp3,1));
         for r = 1:size(tmp3,1);
            for j = 0:(BigInt(sum(tmp4))-BigInt(tmp4[r]));
               if j<tmp4[r];
                  cw[j+1,r] = big(d[j+1,size(tmp3,1)]);
               else;
                  cw[j+1,r] = big(d[j+1,size(tmp3,1)])-big(cw[j+1-BigInt(tmp4[r]),r]);
                  if cw[j+1,r]<0;
                     cw[j+1,r] = 0;
                  end;
               end;
            end;
         end;
         for r = 1:size(tmp3,1);
            num = 0;
            for j = (q-BigInt(tmp4[r])):(q-1);
               num = num + big(cw[j+1,r]);
            end;
            C[BigInt(tmp4a[r,1]),i] = num/den;
         end;
      else;
         C[:,i] = zeros(size(a,1),1);
      end;
   end;
end;
tmp = sum(C, dims=1);
CN = zeros(size(C,1),size(C,2));
for i = 1:size(a,2);
   if tmp[i]==0;
      CN[:,i] = C[:,i];
   else;
      CN[:,i] = C[:,i]./(ones(size(C,1),1)*tmp[i]);
   end;
end;
return CN;
end;
```

Ultimate Financial and Control Rights

The code below computes the ultimate financial rights from the *direct* financial rights depicted in matrices $\mathbf{F}$ and $\mathbf{F}^*$.

```
Fu = F*inv(I-Fstar);
```

The code below computes the ultimate control rights (measured by voting rights) from the direct voting rights depicted in matrices $\mathbf{V}$ and $\mathbf{V}^*$.

```
Cu = V*inv(I-Vstar);
```

The code below computes the ultimate control rights (measured by the normalized Banzhaf power indices that result) from the direct voting rights depicted in matrices $\mathbf{V}$ and $\mathbf{V}^*$.

```
Cu0 = V*inv(I-Vstar);
Vu0 = V + Cu0*Vstar;
mdiff = 1;
while mdiff > 1e-15;
   tmpb0 = [Cu0; Vu0];
   Cu1 = banzhaf(Vu0);
   Vu1 = V + Cu1*Vstar;
   mdiff = maximum(abs.(Vu1-Vu0));
   Cu0 = Cu1;
   Vu0 = Vu1;
end;
```

Profit Weights

The code below computes the matrix of profit weights, according to the dominant formulation suggested by Rotemberg [1984], Bresnahan and Salop [1986] and O'Brien and Salop [2000], from the matrices of ultimate financial and control rights, $\mathbf{F}^u$ and $\mathbf{C}^u$, so to account for the cross-ownership links in the industry.

```
L = Cu'*Fu;
W = diagm(0 => 1 ./diag(L))*L;
```

The code below computes the matrix of profit weights, according to the dominant formulation suggested by Rotemberg [1984], Bresnahan and Salop [1986] and O'Brien and Salop [2000], from the matrix of *direct* financial rights, $\mathbf{F}^{all}$, which stacks the direct financial rights of both internal and external shareholders (as if all shareholders were external to the industry) and from the matrix of direct control rights, $\mathbf{C}^{all}$, computed from the matrix of direct voting rights, $\mathbf{V}^{all}$, which also stacks the direct voting rights of both internal and external shareholders (as if all shareholders were external to the industry).

```
L = Call'*Fall;
W = diagm(0 => 1 ./diag(L))*L;
```

Appendix E. Regional Automobile Market Analysis

As automobile manufacturers are not necessarily active in all markets, we may not directly infer competition concerns from the average profit weights for the whole industry. Thus, we now consider in more detail five (sizeable) regional markets: Australia, Brazil, China, Europe, and the US. We make use of country-level motor vehicle (volume) sales data, obtained from the market research firm JATO. The dataset includes the (volume) sales of every new passenger car model sold during 2007-2021 for a collection of different countries.[3] Using this data, we redo the profit weight analysis above. More specifically, we first select all car models with sales in the 99th percentile in the regional market and year (hence only removing models with very low sales). We then identify the manufacturers of the selected car models, and match that with our original set of car manufacturers. As such, we account for those manufacturers that are, at least to some extent, competitively active in the regional market in a particular year.

Figure E.1 reports the number of automobile manufacturers considered in each market over time. It documents that 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. Please see Appendix for the list of automobile manufacturers considered in each market and year.

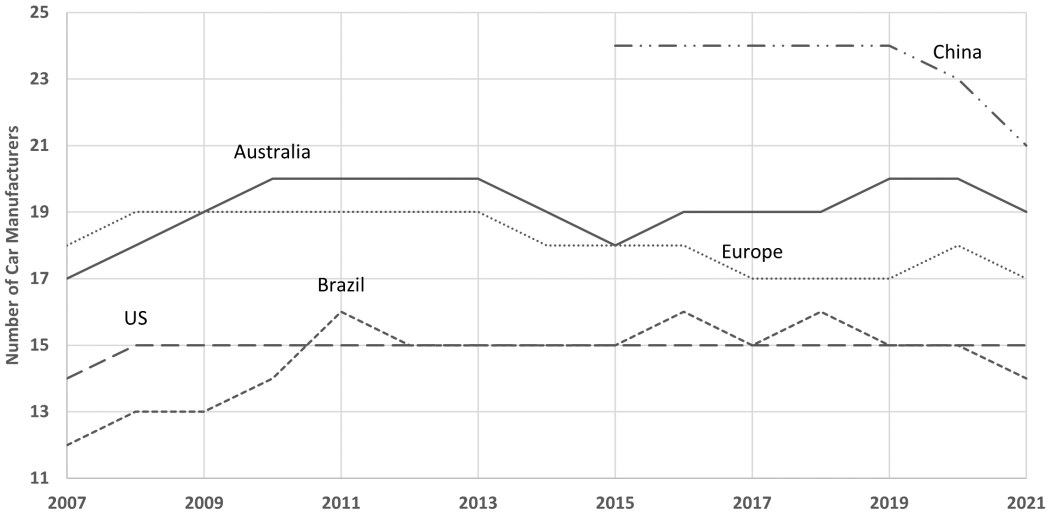

Figure E.1
Regional Number of Car Manufacturers

Figure E.2 reports the (arithmetic) average profit weight over the cross-pairs of car manufacturers active in each regional market in each year. As before, we report formulations

[3] For Europe, we aggregate the (volume) sales of passenger car models sold across the European Economic Area and the UK (with the exception of Bulgaria, Iceland, Liechtenstein, Malta, and Norway, which are not included in the data obtained from JATO). For China, the data obtained from JATO covers solely the period 2015-2021.

of the profit weight that account and do not account for the cross-ownership links in the industry. 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 Figure E.2 suggest the same *qualitative* patterns for the regional markets as those found for the global automobile industry as a whole. First, the average baseline *regional* profit weight has increased steadily over time from just (roughly) 0.05 in 2007 to between 0.10–0.12 in (almost all cases) 2017 and has decreased slightly since then. This implies that profit weights in the regional automobile markets are also lower when compared to the set of S&P 500 firms. Finally, the plots also suggest that accounting for the cross-ownership links in more granular regional markets is also important. In particular, we find that the average regional profit weight accounting for cross-ownership links is between 44–199% higher in Australia, between 28–99% higher in Brazil, between 33–68% higher in China, between 44–172% higher in Europe, and between 33–198% higher in the US, depending on the years and on how control rights are measured.

To examine these biases in more detail, Figure E.2, Panels C1-C5 and D1-D5 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. Figure E.2, Panels C1-C5 considers the case in which control rights are measured by voting rights. The results confirm the same *qualitative* patterns as those identified for the global automobile industry as a whole. In particular, and although the quantitative results depend on the region, we find that (a) cross-ownership links do alter the extent of existing common-ownership: the share of positive baseline profit weights that do change when we account for cross-ownership links is sizeable (between 58–68% for baseline profit weights between zero and 0.5, which account for between 91–97% of the profit weights, and between 48–71% for baseline profit weights greater than 0.5, which account for between 2–6% of the profit weights); (b) the changes are mostly positive: the changes in baseline profit weights between zero and 0.5 are concentrated between 1–25% (between 23–28% out of 58–68%) and above 100% (between 20–27% out of 58–68%) while the changes in baseline profit weights greater 0.5 are concentrated in increases between 1–25% (between 18–40% out of 48–71%); and (c) cross-ownership links can induce otherwise non-existent common-ownership: when we account for cross-ownership links, between 8–90% of the zero baseline profit weights (which account for between 0–7% 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 E.2, Panels D1-D5.

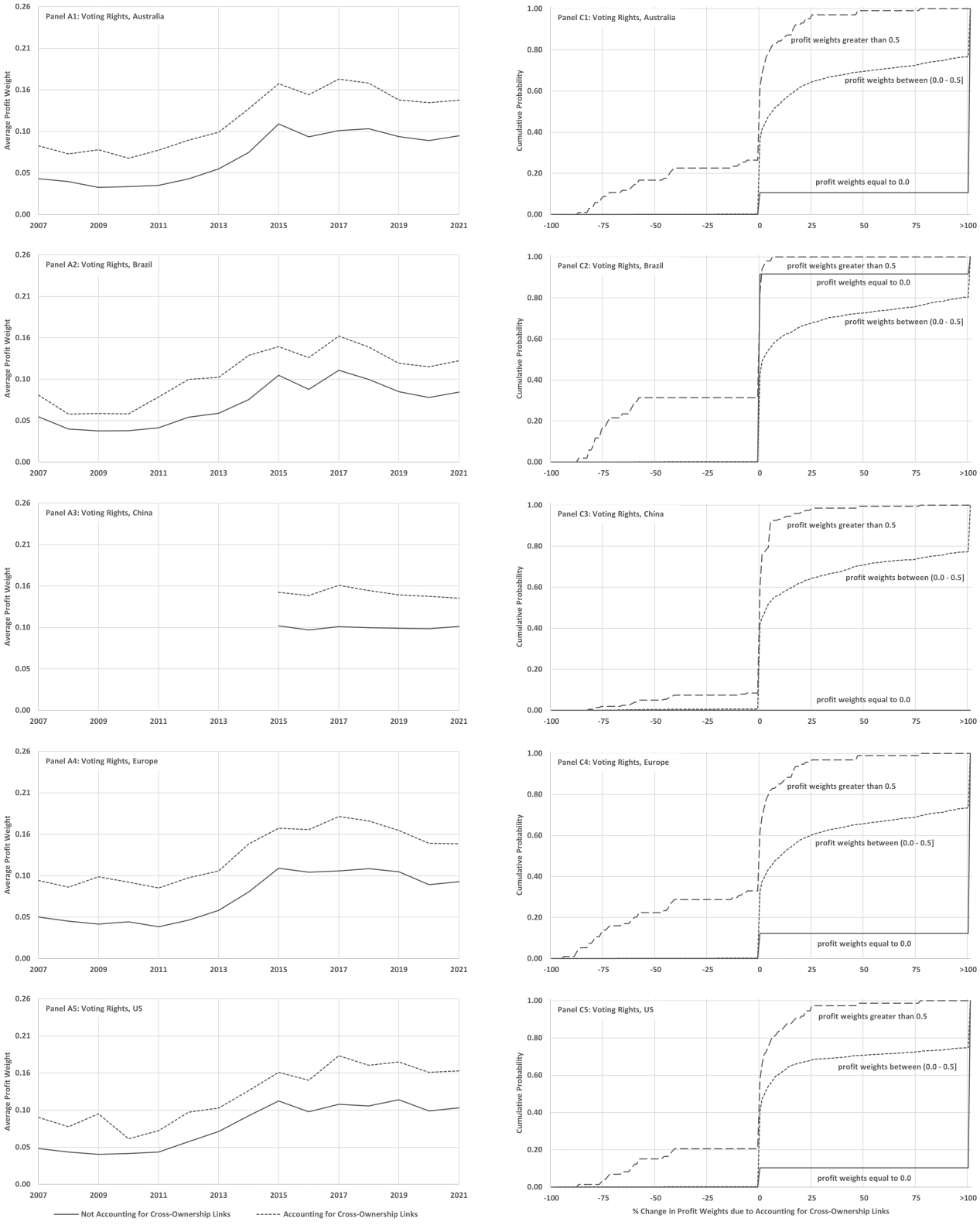

Figure E.2
Regional Average Profit Weights

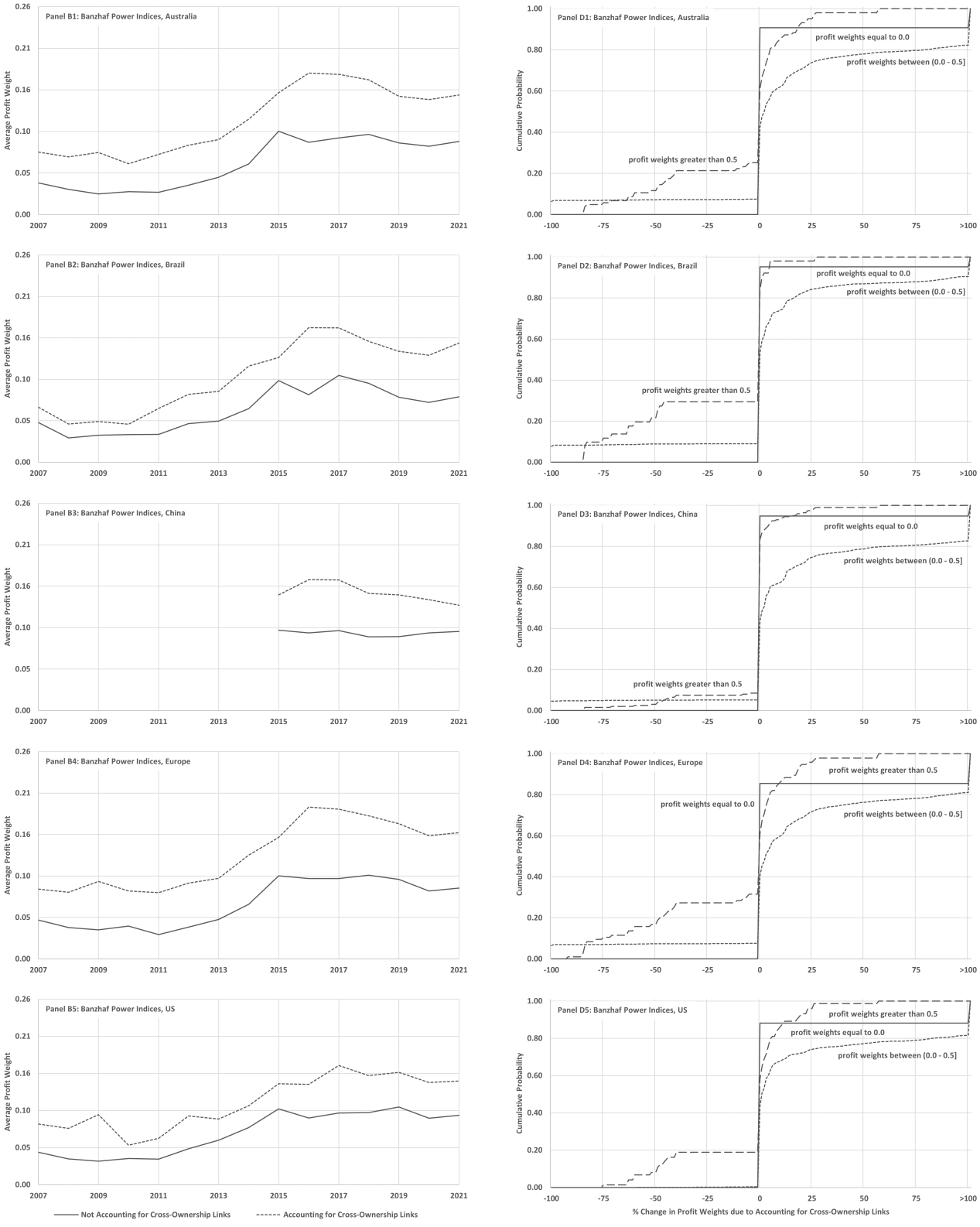

Figure E.2
Regional Average Profit Weights (Cont.)

Appendix F. Regional Markets

Australia

BMW (2007-2021), Chrysler (2007-2013), FCA(2014-2020); Fiat (2007-2013), Ford (2007-2021), Geely (2010-2021), GM (2007-2021), Great Wall (2009-2014; 2019-2021), Honda (2007-2021), Hyundai (2007-2021), Mazda (2007-2021), Mercedes (2007-2021), Mitsubishi (2007-2021), Nissan, (2007-2021), PSA (2007-2020), Renault (2007-2021), SAIC (2016-2021), Stellantis (2021); Subaru (2007-2021), Suzuki (2007-2021), Tata (2008-2021), Toyota (2007-2021), Volkswagen (2007-2021).

Brazil

BMW (2009-2021), FCA (2014-2020); Fiat (2007-2013), Ford (2007-2021), Geely (2011; 2016; 2018-2021), GM (2007-2021), Honda (2007-2021), Hyundai (2007-2021), Mercedes (2007-2021), Mitsubishi (2007-2021), Nissan (2007-2021), PSA (2007-2020), Renault (2007-2021), Stellantis (2021), Suzuki (2011-2018), Tata (2008; 2010-2021), Toyota (2007-2021), Volkswagen (2007-2021).

China

BAIC (2015-2021), BMW (2015-2021), Changan (2015-2021), Dongfeng (2015-2021), FAW (2015-2021), FCA (2015-2020), Ford (2015-2021), Geely (2015-2021), GM (2015-2021), Great Wall (2015-2021), Honda (2015-2021), Hyundai (2015-2021), Mazda (2015-2021), Mercedes (2015-2021), Mitsubishi (2015-2021), Nissan (2015-2021), PSA (2015-2020), Renault (2015-2019), SAIC (2015-2021), Stellantis (2021), Subaru (2015-2021), Suzuki (2015-2020), Tata (2015-2021), Toyota (2015-2021), Volkswagen (2015-2021).

Europe

BMW (2007-2021), Chrysler (2007-2009; 2011-2013), Daihatsu (2007-2010), FCA (2014-2020), Fiat (2007-2013), Ford (2007-2021), Geely (2010-2021), GM (2007-2016), Honda (2007-2021), Hyundai (2007-2021), Mazda (2007-2021), Mercedes (2007-2021), Mitsubishi (2007-2021), Nissan (2007-2021), PSA (2007-2020), Renault (2007-2021), SAIC (2020-2021), Stellantis (2021), Subaru (2007-2021), Suzuki (2007-2021), Tata (2008-2021), Toyota (2007-2021), Volkswagen (2007-2021).

US

BMW (2007-2021), Chrysler (2007-2013), FCA (2014-2020), Fiat (2012), Ford (2007-2021), Geely (2010-2021), GM (2007-2021), Honda (2007-2021), Hyundai (2007-2021), Mazda (2007-2021), Mercedes (2007-2021), Mitsubishi (2007-2021), Nissan (2007-2021), Stellantis (2021), Subaru (2007-2021), Suzuki (2007-2009), Tata (2008-2011; 2013-2021), Toyota (2007-2021), Volkswagen (2007-2021).

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