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ABSTRACT

We use administrative registration records with information on the owners of all Chinese firms to document the importance of "connected" investors, defined as state-owned firms or private owners with equity ties with state-owned firms, in the businesses of private owners. We document a hierarchy of private owners: the largest private owners have direct investments from state-owned firms, the next largest private owners have equity investments from private owners that themselves have equity ties with state owners, and the smallest private owners do not have any ties with state owners. The network of connected private owners has expanded over the last two decades. The share of registered capital of connected private owners increased by almost 20 percentage points between 2000 and 2019, driven by two trends. First, state owned firms have increased their investments in joint ventures with private owners. Second, private owners with equity ties to state owners also increasingly invest in joint ventures with other (smaller) private owners. The expansion in the "span" of connected owners from these investments with private owners may have increased aggregate output of the private sector by 4.2% a year between 2000 and 2019.

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A data appendix is available at http://www.nber.org/data-appendix/w28170

1. Introduction

In the late 1990s, a young Chinese auto manufacturer called Chery found itself up against what seemed like an unsurmountable obstacle.[1] Chery was successfully producing low-priced knockoffs of the Volkswagen Jetta, but it did not have a license to make cars. It had appealed to Chinese central planners multiple times for the necessary license, but the authorities were adamant that companies such as Chery were not part of their plan for China's automobile industry. The goal of the Chinese authorities at the time was to consolidate production around a small number of state-led giants such as Shanghai Automobile and First Auto Works. Small companies such as Chery that would compete with the industrial giants were forbidden.

In desperation Chery turned to Shanghai Automobile. It struck a deal where the state-owned giant took a 20% equity stake in Chery. Legally, this made Chery a "subsidiary" of Shanghai Automobile, which enabled Chery to get a car license from the Chinese authorities. Shanghai Automobile eventually sold its 20% equity stake back to Chery, which has gone on since then to become the largest exporter of cars and the 10th largest car producer in China today.

The role played by Shanghai Automobile in Chery's growth is an example of the critical role of what the Chinese call a "politically-connected investor" or a "protective umbrella" in enabling firms to grow. In this paper we use administrative registration data on the universe of Chinese firms from 2000 to 2019 to document the importance of "connected" investors such as Shanghai Automobile in the growth of Chinese private owners over the last two decades. A key feature of the registration data is that it provides information on the owner of every Chinese firm, which we use to identify firms with "connected" investors defined as state-owned firms or private owners with equity ties to state-owned firms.

This ownership information reveals two key facts. First, there is a clear hierarchy of private owners in terms of the closeness of their equity links with state owners. In 2019 state owners have equity stakes in the firms of about one hundred thousand private owners. These private owners are the largest in China and also hold equity in the companies of other, typically smaller, private owners. In turn, these private owners

[1] This account of Chery is from Dunne (2011).

also invest in other, even smaller, private owners and so on. At the very bottom of the hierarchy are owners that are up to forty steps away from the state owners at the top of the hierarchy and that do not invest in other owners. The very smallest private owners thus do not have any equity ties, direct or indirect, with state owners.

Our second finding is that the hierarchy of private owners with connected investors is relatively recent phenomena. In 2000 private owners with connected investors only accounted for at most 16% of registered capital. By 2019, private owners with connected investors owned about 35% of all registered capital in China. The 19.5 percentage point increase in the share of connected private owners from 2000 to 2019 contributes a significant part of the increase in the share of *all* private owners over this period.

The growth of this hierarchy of connected owners is driven, in a proximate sense, by two related trends. First, in 2000 only 12% of state owners had joint ventures with private owners. By 2019, about a quarter of all state owners had such joint ventures. In addition, conditional on investing in private owners, state owners on average had investments with 6 distinct private owners in 2000. By 2019, the average state owner had projects with 15 distinct private owners. The result is that the number of private owners with joint ventures with state owners increased from about 20 thousand in 2000 to more than *one hundred* thousand by 2019.

Second, private owners associated with the state also now undertake more investments with other private owners. For example, the 20 thousand private owners with joint ventures with state owners in 2000 themselves had joint ventures with less than 1.5 other private owners in that year. In 2019, the hundred thousand private owners directly connected with state owners were themselves the "connected investor" for 3.5 other private owners on average. The result is that number of private owners invested by the directly connected private owners (i.e., two steps away from the state) increased from 23 thousand in 2000 to more than three hundred thousand by 2019. This effect is particularly dramatic for connected owners distant from the state. In 2000 for example, there were just around 5 thousand owners six or more steps away from the state. By 2019, there were more than *1.5 million* such owners.

By 2019 the net effect of the increase in the number of connected private owners, and the growth of such owners after they became connected with a "connected investor," was that the assets of connected private owners accounted for 35% of total

assets in China, or about 45% of total assets of all private owners. At the same time, the share of connected state owners, the owners at the "top of the food chain" of the connected sector, is merely 21%, 60% less than the share of connected private owners. This is because politically connected investors are rarely the controlling shareholders. In the case of Chery, Shanghai Auto's stake was 20%. For the average private owner with joint ventures with state owners, the share of state owners was also around 20% in 2019.

We then filter these facts through the lenses of a simple model where connected investors reduce "frictions" faced by private owners. In the model, an increase in the benefits provided by connected investors increases the number of connections per worker, total number of connected owners, the share of connected owners in the economy, and an increase in aggregate output. We calibrate the increase in the benefits provided by connected owners from data on the number of connections made by each connected investor. We then filter this number through the model to estimate the contribution of the expansion of connected private owners to aggregate output. We find that this mechanism can explain a 4.2% annual growth in aggregate output of private sector between 2000 and 2019.

The closest predecessors of this paper are Bai et al. (2019) and Huang (2008). Bai et al. (2019) highlights the importance of informal institutions in the form of "special deals" by local governments and Huang (2008) argues that state connected agents in China frequently get special deals. This paper focuses on a specific informal institution, namely connected *investors*, including private individuals that are connected to state owners, taking equity stakes in private owners. Our findings challenge the views that informal institutions are often locally effective and hard to substitute for formal institutions. The effects from a special deal can be transmitted through the hierarchy in which private owners closer to the state undertaking investment with those further from the state, extending the coverage of the informal institution to a significant proportion of private owners.

More generally, Chandler (1977) shows that the managerial revolution in American industrial firms in the early 20th century enabled them to scale new productive techniques in larger establishments. Hsieh and Rossi-Hansberg (2019) argue that over the last four decades, new technologies enabled top firms in the U.S. to scale the delivery of local services over a large number of geographic locations. In this paper, we highlight

the ownership network that emerged in China as an important institutional change that has enabled connected investors to scale their "connections" over a large number of owners, even over owners that they do not have equity stakes in.

Four recent papers use the same registration data we use to explore the growth of China's private sector. Dai et al. (2019) identify community origins of entrepreneurs and investigate how the origin-based connections affect firm entry. Shi et al. (2020) finds a causal relationship between transfer of local government leaders and inter-regional investment flows. Brandt et al. (2019) show that a growing fraction of firms are started by serial entrepreneurs. Allen et al. (2019) construct a firm-to-firm equity investment network and estimate the effects of the firm's network. Although all the papers, including ours, shed light on the rapid growth of China's private sector from different perspectives, our focus is on the connection between state and private owners. We document a hierarchy of owners that transmits the benefit of special deals from state owners at the top to millions of private owners. We also document a rapid expansion of the hierarchy and argue that it may be a crucial force behind the growth of the private sector in China.

The paper proceeds as follows. The next section describes the firm registration data. We then use the case of the East Hope Group and Shanghai Automobile to illustrate the importance of connected owners. The following section presents six key facts about connected owners. We then present a model of connected investors and use the model to calibrate the effect of a change in the value of becoming connected. The last section concludes.

2. Data

We use the firm registration records of the State Administration for Market Regulation. *All* Chinese firms are legally obligated to register with this body.[2] The data are the registration records for all firms, including those that have been closed, with the following information for each firm: registration year, exit year (if the firm has been closed), location, industry, total registered capital, and the firm's *immediate* owners and the registered capital share of each owner.

[2]We exclude the self-employed from our analyses.

The registration records identify the *immediate* owners of each firm. The immediate owners can be an individual person (with encrypted personal ID in the data), another firm (a "legal person" owner), or the publicly held shares of a publicly listed company (a "collective" owner). An important feature of the registration data is all Chinese legal person owners also have to be registered and thus also appear in the data. Therefore, we can also identify the immediate owners of all Chinese legal person owners. However, the registration data has no information on the owners of foreign legal persons or the identity of owners of the publicly traded shares of a listed company.

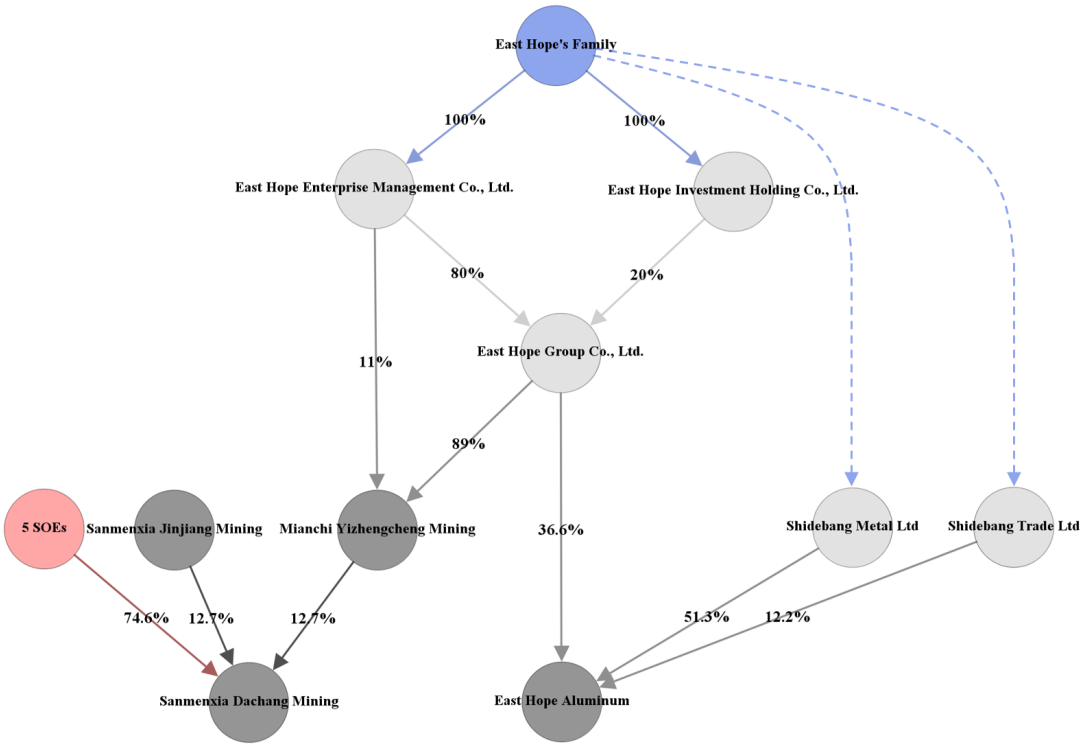
The majority of the legal person owners are other firms, but we know from several case studies that some of them are holding shells. Take, for example, the East Hope Group, a large conglomerate with multiple companies in the heavy metals and animal food processing industries. The two dark circles at the bottom of Figure 1 represent two companies in the Group. East Hope Aluminum is one of the largest alumina producers in China. Dachang Mining is a bauxite prospecting company and a business services provider. The circles directly linked to the two firms represent their immediate owners. We distinguish different types of owners by color – light gray for suspected holding shells, dark gray for "real" private companies, red for state-owned firms, and blue for individual owners.

East Hope Aluminum is wholly owned by the family of the founder of the East Hope Group. This family, which we call "East Hope's family," owns East Hope Aluminum through five holding shells.[3] The immediate owners of East Hope Aluminum are three companies, two of which are registered outside of China and one in China. We do not know for sure, but we have circumstantial evidence that the two "foreign" holding companies are fully owned by East Hope's family.[4] As for the domestic holding shell East Hope Group Ltd., its immediate owners are two other holding shells, East Hope Investment Holding Ltd. and East Hope Enterprise Management Ltd. In the registration data, these two holding shells are fully owned by East Hope's family, which we represent by the blue circle at the top of Figure 1.

[3]We define "East Hope's family" as the founder of East Hope, his wife, and his son.

[4]The two "foreign" holding companies are Shidebang Metal Ltd. and Shidebang Trade Ltd. We identify them by an announcement made by Mingsheng Bank (`http://stock.finance.sina.com.cn/hkstock/go/CompanyNoticeDetail/code/01988/aid/488702.html`). More generally, we may fail to identify some companies of a domestic owner because of their ownership through firms registered outside China.

Figure 1: Owners of East Hope Aluminum and Dachang Mining



Note: The circles represent the owners of East Hope Aluminum and Dachang Mining, shown as dark gray circles at the bottom of the figure. Dark gray circles represent "real" private companies, light grey (suspected) holding shells, red for state owned firms, and blue for individual owners.

Dachang Mining is a joint venture between East Hope's family and six other companies. The immediate owners of Dachang Mining are five state owned firms (denoted by the red circle) and two private companies. One of the private companies is Mianchi Yizhengcheng Mining which is fully owned by East Hope's family through a sequence of holding shells. The other private company is Sanmenxia Jinjiang Mining which is fully owned by a large private conglomerate called the Hangzhou Jinjiang Group.

In this paper we focus on the ownership links between the *ultimate* owners. That is, we work through the ownership chain to identify each firm's *ultimate* owners, which can be state owned firms, private individuals, foreign legal persons, or collective owners. The ultimate owner of East Hope Aluminum is East Hope's family. The ultimate owners of Dachang Mining are East Hope's family and the ultimate owners of the five state owned firms and the Hangzhou Jinjiang Group.

The only economic information in the data is the firm's registered capital. Chinese Company Law stipulates that the owners of a firm need to subscribe a fixed amount of funds known as registration capital when the firm is established. These funds represent the maximum liability of the owners and is viewed as a signal of the company's financial resources. For example, a firm's potential creditors pay close attention to registration capital because it represents the maximum they can collect in the event of a default. Chinese law stipulates the minimum amount of registered capital for firms in certain sectors, but generally registered capital is determined by the amount of real business the firm needs to undertake. Therefore, registered capital of holding shells is minimal and a poor measure of the value of its assets, but it is a reasonable proxy of the value-added of a "real" firm.[5]

We have access to the registration records in 2013 and 2019. We use the 2019 records to identify the ultimate owners (and their share of registered capital) of the active firms in that year. We also want to identify the ultimate owners and their ownership stake in previous years, e.g. 2000 and 2010. We use the 2013 registration records to do this. Specifically, for a given year prior to 2013, we assume a firm is active if it was established prior to that year and also had not exited by that year. We then infer the ultimate owners and their ownership share of each active firm from the information in 2013. The assumption is that the immediate owner of a firm is constant over time. In Appendix B, we check the error due to this assumption by comparing the ownership in 2013 inferred from the 2019 data with the ownership measured directly from the 2013 data.

Table 1 shows the number of active firms and ultimate owners from 2000 to 2019 inferred using this procedure. The first column shows that the number of active firms increased 8 fold between 2000 and 2019. The number of ultimate owners increased by more than 10 times (column 2). The third column shows that all of this growth is due to the growth in private individual owners. The last three columns show the number of state-owned ultimate owners, defined as firms wholly and directly owned by all the levels of the Chinese government (central, provincial, city- and county-level

[5]In Appendix A we use the data from the Chinese Annual Industrial Survey with high quality information on sales and total assets of industrial firms to check the data on registered capital from the registration data. We match the firms in the Industrial Survey to the firms in the registration data. For example, in this sample of firms matched in the two data-sets, a regression of the firm's log registered capital (from the registration data) on the log value of its total assets (from the firm survey) in 2013 yields a coefficient of 0.93 (s.e = 0.000) with a R^2 of 0.48.

Table 1: Number of Firms and Ultimate Owners, 2000-2019

	Active Firms	Ultimate Owners				
		All	Individuals	State	Foreign	Collective
2000	4,405,139	5,332,032	5,255,522	35,029	41,235	246
2010	10,122,468	20,055,478	19,932,816	32,296	90,085	281
2019	37,546,275	62,865,027	62,689,037	40,672	134,864	454

Note: Table shows number of active firms and ultimate owners in each year in the firm registration data. It also shows number of individual owners, state owners, legal person owners registered outside of China and the collective owners of public traded companies.

governments), foreign firms, and collective owners.[6] In 2019, these last three groups of owners account for less than 0.3% of all ultimate owners in China.

Table 2 shows the share of registration capital owned by each group of owner. We impute the *total* registered capital of each ultimate owner as the weighted sum of the registered capital of all the firms she has a stake in, where the weights are the owner's share of the firm's registered capital.[7] Table 2 delivers two messages. First, the 40 thousand state owners in China are large and own about 21% of total registered capital in China. Second, the share of private individual owners in registered capital has increased from about 50% in 2000 to almost 70% by 2019.

3. Owners of East Hope and Shanghai Automobile

Earlier in the paper, we use SAIC's investment in Chery to illustrate the role played by connected investors in Chery's growth. Empirically this shows up in the registration data as an ownership link between SAIC and the other owners of Chery. In this section, we illustrate the prevalence of such links by examining SAIC and the East Hope Group

[6] See Appendix C for details on how we identify state owners.

[7] This measure of an owner's total registered capital includes the registered capital of the holding shell companies. Ideally we should exclude holding shell companies from the firms owned by each owner, but we can not identify all the holding shells in the data. However, the registration capital of holding shells is minimal. We can check this by measuring the total registration capital of industrial firms in the Annual Industrial Survey that belong to a given owner and comparing this number to the total registered capital in the registration data including the registration capital of all the intermediate owners. A regression of log registered capital of firms in the industrial data that belong to the same owner on the log registered capital of all firms that belong to the same owner, including all the intermediate firms in the registration data, yields a coefficient of 0.83 and an R^2 of 0.80.

Table 2: Registered Capital Share of Ultimate Owners, 2000-2019

	Individuals	State	Foreign	Collective
2000	52.1%	35.8%	8.5%	3.5%
2010	59.5%	29.4%	9.1%	2.0%
2019	68.9%	21.4%	6.7%	3.1%

Note: Table shows registered capital share of individual owners, state owners, legal person owners registered outside of China and the collective owners of public traded companies.

in more detail.

East Hope Aluminum, the company we described earlier, was created in 2003 as a joint venture between East Hope's family and Huanghe Aluminum and Electricity, a state owned firm owned by the city of Sanmenxia (Henan Province). Huanghe initially owned 24% of East Hope Aluminum but sold its share to East Hope in 2006. East Hope Aluminum is currently one of the largest alumina producer in China.

After it established East Hope Aluminum, the East Hope Group has created new companies as joint ventures with the Sanmenxia local government. Dachang Mining was created in 2009 as a joint venture between East Hope and several state owned firms in Sanmenxia. More generally, East Hope has used joint ventures with local governments to enter into new markets. The East Hope Group started in the animal feed business in Sichuan and expanded its animal feed business to other provinces through joint ventures with local state-owned enterprises. Two examples are a joint venture with a county-level grain bureau in Henan province and another joint venture with a local state-owned animal feed producer in Anhui province. East Hope has also used joint ventures to enter into new industries. In addition to East Hope Aluminum, the East Hope Group also created two companies in Chongqing and Inner Mongolia as joint ventures with local state owned firms to enter into the coal mining industry. These state owned firms are the "connected" investors that made it possible for the East Hope Group to expand beyond its original business of selling animal feed in Sichuan.

Table 3 uses the registration records to identify all the ultimate owners involved in joint ventures with the East Hope Group in 2019. We define the East Hope Group as the collection of companies where East Hope's family owns, directly or indirectly, at

Table 3: Owners of the East Hope Group

	East Hope's Family	State Owners	Other Private Owners
# of Owners	1	15	11
Firms per Owner	236	599	305
East Hope's Joint Ventures	27	15	12
Capital per Owner	26.5	226	5.1

Note: East Hope Group is defined as companies where East Hope's family owns at least a 10% equity share. East Hope's family consists of the founder of East Hope, his wife, and his son. State owners and other private owners own at least one company in the East Hope Group. Capital is registered capital owned by each ultimate owner in billion yuan.

least a 10% equity share.[8] The first column in Table 3 shows that the East Hope Group consists of 236 firms of which 209 are wholly owned by East Hope's family and 27 are joint ventures with other owners.

The second and third columns in Table 3 focuses on the 15 state owners and 11 private owners with joint ventures with East Hope's family. The 15 state owners operate on average 600 companies with total registered capital of 226 billion yuan. The registered capital of state owners linked with East Hope's family is almost nine times larger than that of the East Hope's family itself. These state firms are the connected owners in the East Hope Group and are significantly larger than East Hope itself.

This is not the case for the private owners that operate joint ventures with East Hope's family. For these owners, East Hope's family is itself the "connected" investor. These private owners are significantly *smaller* than the businesses owned by East Hope's family, with a total registered capital averaging 5 billion yuan which is about 20% of the registered capital of the businesses owned by East Hope's family.

Table 4 provides the same information for the SAIC Group, where the Group is defined as the collection of firms where SAIC owns at least a 10% equity share. Different from East Hope's family, SAIC is a state owner. The first column in Table 4 shows that there are 586 companies in the SAIC Group and SAIC's registered capital in these companies totals 169 billion Yuan. Among these 586 companies, 226 companies are wholly

[8]We define East Hope's family as the founder of East Hope, his wife, his son and several overseas holding shells, which to the best of our knowledge, are owned by the three individuals.

owned by SAIC and 360 are joint ventures with other 60 state owners and 155 private owners. The state owners directly connected to SAIC are of comparable size to SAIC as measured by the number of firms and total registered capital. Among the private owners, ten of them are linked with SAIC via 57 joint ventures with Anbang Insurance, Shanghai-VW, and Shanghai-GM.[9] These ten owners are significantly larger than the remaining 145 private owners. On average the registered capital of these 145 private owners is 1.4 billion yuan, which is about 1% of SAIC's registered capital.

Table 4: Owners of Shanghai Automobile

	SAIC	State Owners	Anbang, VW, and GM	Other Private Owners
# of Owners	1	60	10	145
Firms per Owner	586	423	19.4	24.1
SAIC Joint Ventures	360	173	57	157
Capital per Owner	169	193	10.9	1.4

Note: Shanghai Automobile is defined as collection of companies where SAIC owns at least a 10% equity share. State owners, Anbang, VW, GM, and other private owners own at least one company in Shanghai Automobile. Anbang, GM, and VW refer to the ultimate private owners (10 in total) of Anbang, Shanghai-GM and Shanghai-VW. Capital is registered capital owned by each ultimate owner in billion yuan.

Remember that East Hope's family has joint ventures with a number of private owners that are themselves even smaller than the East Hope Group. The same is true for the private owners directly connected to SAIC. In this case, the registration data indicates the 145 private owners directly connected to SAIC (excluding the owners of Anbang, VW, and GM) also operate joint ventures with 817 private owners. These owners are significantly smaller, with an average of 8.6 firms and total registered capital of 0.24 billion yuan. Because these owners are connected to SAIC through their joint ventures with the 145 private owners with direct ties with SAIC, we will say that these 817 private owners are "indirectly connected" with a state owner (SAIC).[10]

An example of an owner indirectly connected to SAIC is an entrepreneur (whom we call Mr. X) who established a car dealership in Yantai (Shangdong Province) in 2010.

[9] Two of these owners are obviously GM and VW.

[10] The 817 private owners do not have joint ventures with other state owners.

This company was a joint venture with two private owners with joint ventures with SAIC. Before 2010 Mr. X's only company was a car dealership in Hunan Province but after creating his Yantai company, Mr. X created 23 new car dealerships in Guizhou, Hebei, Jiangsu, Shanghai and Heilongjiang.[11] By 2019, Mr. X owned 26 companies with a registered capital of 134 million Yuan. This evidence is only suggestive but at least the timing suggests that the indirect ties Mr. X formed with in 2010 when he set up the car dealership in Yantai may have been an important factor behind the expansion of his business. In this sense, the private owners directly connected to SAIC were Mr. X's connected investors that enabled him to grow beyond his original car dealership in Hunan, in the same way that SAIC was the connected investor for Chery that made it possible for the company to get the critical license.

We take three messages from these cases. The first message is the prevalence of equity links with multiple owners in SAIC and the East Hope Group. SAIC has joint ventures with 60 state owners and 155 private owners; the East Hope Group has joint ventures with 15 state owners and 11 private owners.

Second, there is a clear hierarchy of owners in terms of the size of the owners and the number of connections with other owners. At the very top are state owners that are the key connected investor for many private owners. These state owners are large and undertake investments with a large number of private owners such as East Hope's family. These private owners form the next tier of owners and are themselves the connected investors for other private owners such as Mr. X in the case of SAIC. Compared to their state-owned investors, these private owners are smaller and are connected to smaller number of private owners. The next tier after that are owners such as Mr. X that are even smaller.

Third, connected investors have equity ties in only a subset of the businesses of their partners. State owners in the East Hope Group are involved in 15 of the 236 companies in East Hope. SAIC has equity stakes in 57 of the 194 companies in Anbang, VW, and GM. Among the other private owners directly tied to SAIC, the state giant has equity in 157 of the almost 3,500 companies of these owners. Of course the companies connected investors have invested in could be the larger ones. In the next section, we will show this evidence for all connected owners in China.

[11] Mr. X also started a car parts manufacturer after 2010.

4. Connected State and Private Owners

In this section we show that the ownership links between state and private owners documented in the case studies of the East Hope Group and SAIC hold more generally across all ultimate owners in the Chinese economy. We will use the following definitions:

- **Owners**: Ultimate owners of a firm. Owners can be state or private, where private are either individuals, foreign legal persons, or collective owners.
- **Owner's Capital**: Sum of registered capital of all the firms the owner has an equity stake in weighted by the owner's equity share in each firm.
- **"Directly Connected" Private Owners**: Private owners with joint ventures with state owners such as East Hope's family in the case of the East Hope Group.
- **"Indirectly Connected" Private Owners**: Private owners whose only connection with a state owner is through a joint venture with another private owner. Mr. X in the case of SAIC is an indirectly connected private owner.
- **"Distance" to the State**: The minimum number of other private owners between the private owner and the state. The distance of owner i is $d_i = \min_{j \in O(i)} d_j + 1$ where $O(i)$ represents the set of owners directly connected to owner i. Distance = 1 for directly connected private owners such as East Hope's family. Mr. X's distance from the state is 2 because his tie with SAIC is only through the two private owners (with distance = 1) with joint ventures with SAIC.
- **"Downward" Connections and Connected Investor**: Consider two connected owners A and B that have a joint venture together. If owner B is more distant from the state than owner A, then owner A has a "downward" connection with owner B. Owner A is also owner B's connected investor.

We summarize the ownership links between state and private owners as six key facts.

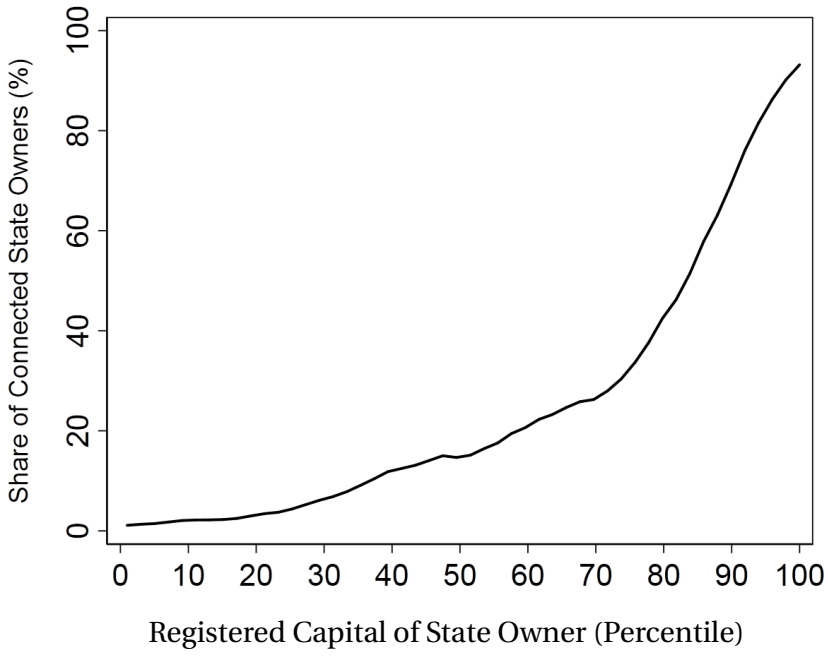
Fact 1: Large Owners are "Connected"

Table 5: Connected Owners Among Top Owners, 2019

	Top 100	Top 1,000	Top 10,000	Top 100,000
# State Owners	63	458	2,438	6,826
# Connected	63	452	2,305	5,243
# Private Owners	37	542	7,562	93,174
# Directly Connected	31	358	3,466	17,236
# Indirectly Connected	3	73	1,953	37,360

Note: Table shows number of top state and private owners among each group of top owners, where the size of an owner is measured by the sum of its registered capital in all the firms it owns. Connected state owners have joint ventures with a private owner. Directly connected private owners have joint ventures with a state owner. Indirectly connected private owner have a joint venture with another private owner that has a connection with a state owner.

Figure 2: State Owners with JVs with Private Owners by Size, 2019



Note: Figure shows share of state owners in 2019 that have joint ventures with private owners by percentiles of total registered capital of the state owner.

Table 5 shows the number of connected owners among the top 100 owners ranked by total registered capital in 2019. Every single one of 63 state owners among the top 100

owners have joint ventures with private owners. Among the 37 private owners among the top 100, 31 are directly connected to state owners and 3 are indirectly connected. This fact suggests that the distinction between state and private sectors in China is blurry for the very largest owners. Large private owners are deeply connected to the state and large state owners have deep ties with private owners.

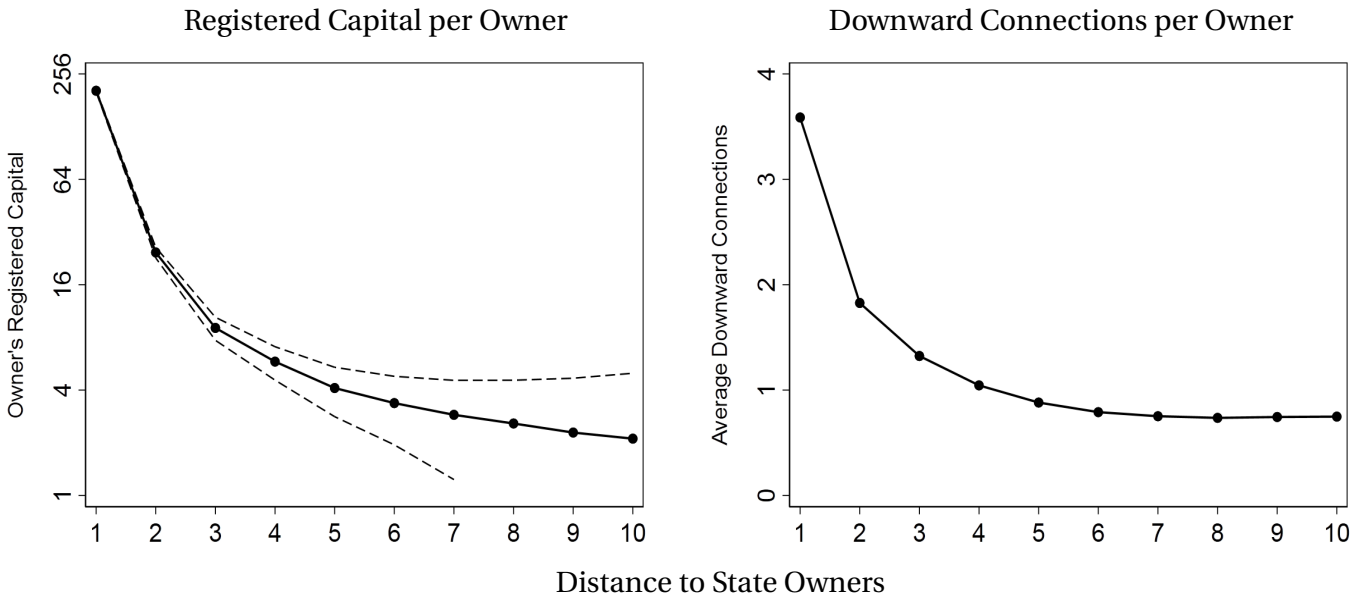
Table 5 also shows that the prevalence of these ties falls among smaller owners. Among the 93 thousand largest private owners in 2019, 17 thousand are directly connected and 37 thousand are indirectly connected to state owners. Figure 2 focuses on state owners and shows the share of state owners with joint ventures with private owners as a function of the registered capital (in percentiles) of the state owner in 2019. Less than 20% of the bottom half of state owners have joint ventures with private owners but more than 60% of state owners among the top 10% of state owners are connected with private owners.

Fact 2: A Private Owner's Position in the Hierarchy of Connected Owners Depends on Distance to the State

Figure 3 shows the importance of distance to the state for private owners in terms of the size of the private owner and the number of downward connections it has with other owners. The left panel shows total registered capital of connected private owners (relative to unconnected private owners) as a function of the owner's distance to the state. Private owners directly connected to state owners (distance = 1) are around 200 times larger than unconnected private owners. The gap in registered capital falls as the distance of the owner from the state gets larger. The right panel shows that private owners closer to the state also have more downward connections with other private owners. Private owners directly connected with the state have on average joint ventures with more than 3 other private owners, while owners five steps away from state owners have on average only one downward link.

Figure 4 shows the average capital productivity of firms owned by a private owner is also related to her distance to the state. By merging the 2013 firm registration records with the 2013 Chinese Annual Industrial Survey, we can calculate the average capital productivity of a private owner if at least one firm in the survey is owned by her. The results shows that capital productivity of firms owned by the directly connected pri-

Figure 3: Capital and Downward Connections of Private Owners, 2019



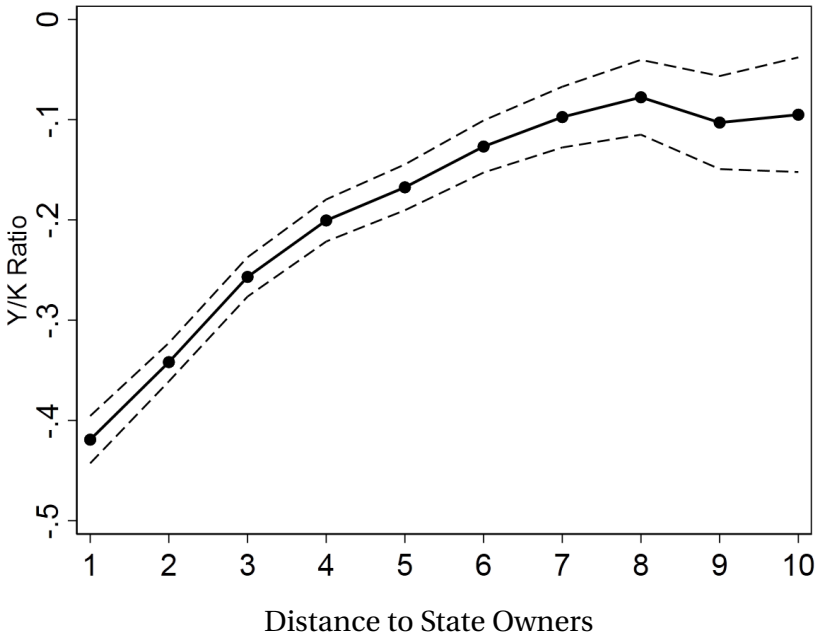
Note: Left panel shows the ratio of the average registered capital of connected private owners to the average registered capital of unconnected private owners by distance to the state (dashed lines represent 95% confidence intervals). Right panel shows the average number of downward connections of connected private owners by distance to the state.

vate owners are on average 40% lower than those firms owned by unconnected private owners. The gap falls as the distance of the private owner from the state gets larger.

Fact 3: Connected Investors Are Not Controlling Shareholders

We now show the share of the investment by an owner's connected investors in the total registered capital of the owner. Figure 5 shows the investment of the connected investors as a share of its partner's investment in the joint venture only (left panel). The connected investor typically owns 50% of the joint venture. The right panel shows the investment of the connected investor as a share of the total registered capital of its partner, taking into account all the businesses of the partner. For private owners directly tied to the state (distance = 1), this share is only about 20%. For private owners more distant from the state, the share of the upward owner rarely exceeds 40%. So a private owner that takes on connected investors is typically still the controlling shareholder of her businesses.

Figure 4: Capital Productivity of Private Owners, 2013



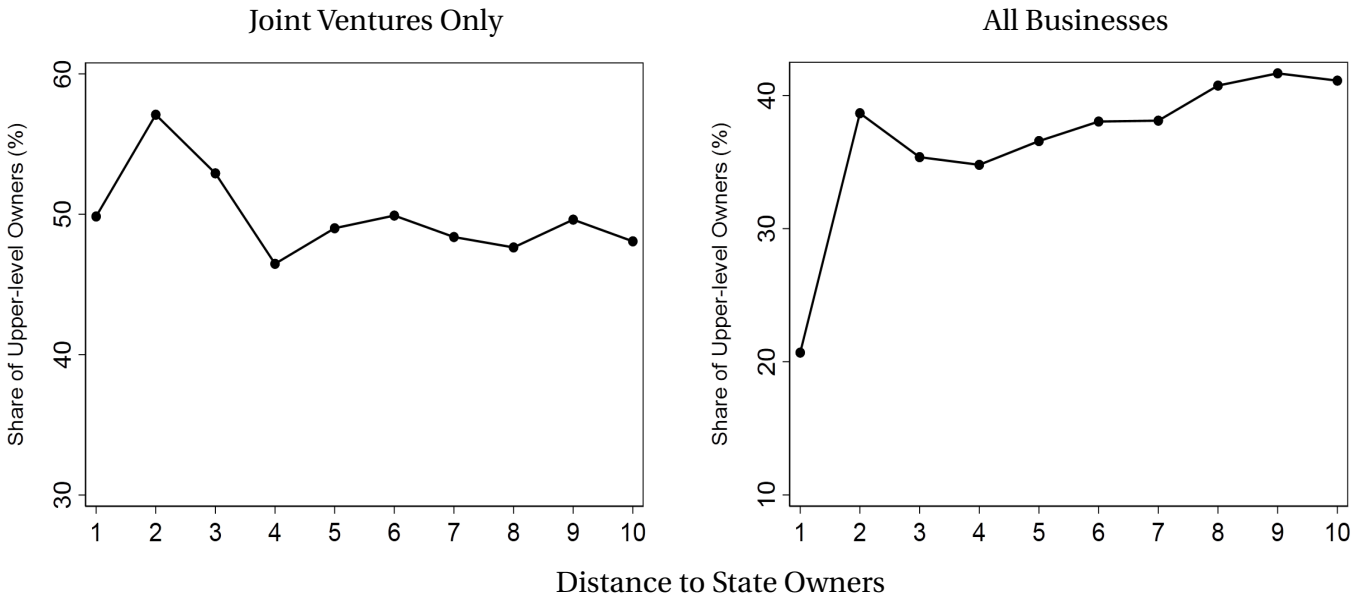
Note: Figure shows the average Y/K ratio (in log term) of firms owned by a connected private owner compared with firms owned by unconnected private owners by distance to the state (dashed lines represent 95% confidence intervals).

Fact 4: More Private Owners Have Become Connected

The number of private owners directly connected to state owners is the product of the number of state owners that undertake investments with private owners and the number of private owners each state owner invests in. The former is shown in the left panel in Figure 6 and the latter in the right panel. The left panel shows that the fraction of state owners that invest in joint ventures with private owners increased from 12% in 2000 to 25% in 2019. The right panel shows that, conditional on investing with a private owner, the average state owner is connected with 6 private owners in 2000. This number increases to more than 15 in 2019.

The product of the number of state owners connected to private owners (left panel in Figure 6) and the average number of downward connections per state owner (right panel in Figure 6) is the number of private owners directly connected with state owners. The right panel in figure 7 shows that the number of private owners that have joint

Figure 5: Share of Connected Investors in Private Owner's Capital, 2019



Note: Left panel shows the equity share of the connected investor in the joint venture with its downward owner. Right panel shows the ratio of the registered capital of the joint ventures owned by the connected investor to *total* registration capital of the downward owner. For two connected owners, the connected investor is closer to the state compared to the downward owner.

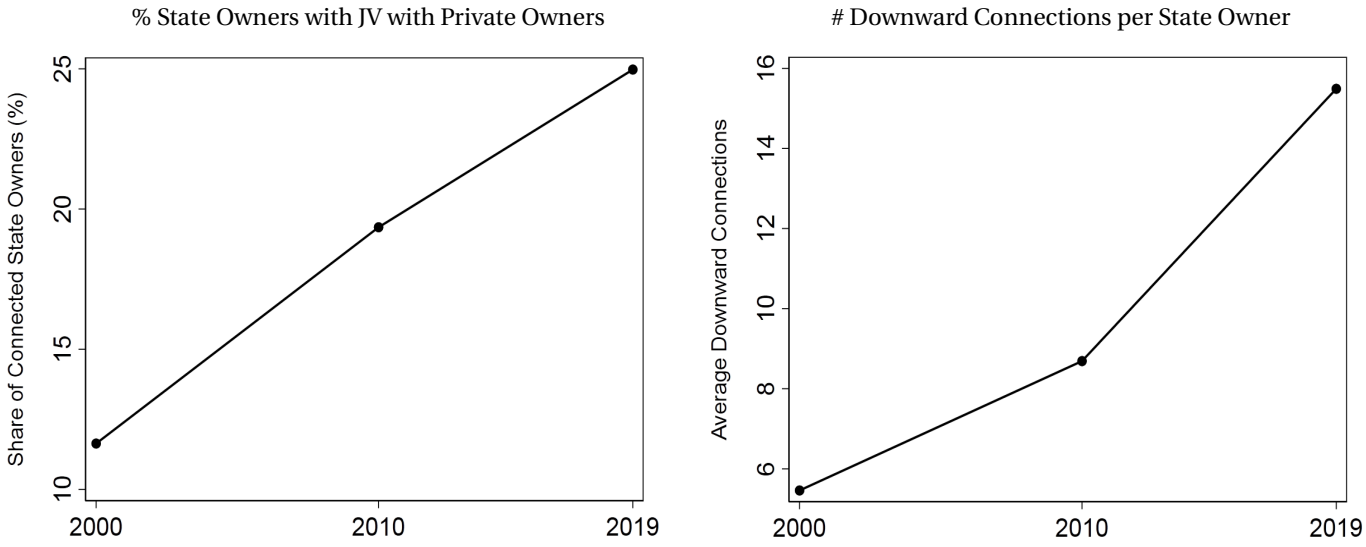
ventures with state owners (distance = 1) increases a *five*-fold from 2000 to 2019 from 20 thousand to more than one hundred thousand. The right panel also shows that the number of private owners indirectly connected to the state also increased dramatically. This effect is particularly dramatic for owners very distant from the state. The number of owners with distance ≥ 6 increased from around 5 thousand in 2000 to more than 1.5 million by 2019.

The huge increase in the number of indirectly connected owners is driven, in a proximate sense, by the significant increase in the number of private owners directly connected to the state and by the increase in the number of downward connections per private owner. The latter is shown in the left panel in Figure 7.

Fact 5: Private Owners Grow Faster After They Become Connected

Here we show the estimates of "event" studies to measure the effect of becoming connected on a private owner. Specifically, we estimate the following empirical model

Figure 6: Expansion of State Investment in Private Owners, 2000-2019



Note: Left panel shows the share of state owners with joint ventures with private owners. Right panel shows the average number of private owners a state owner has joint ventures with, conditional on investing with a private owner.

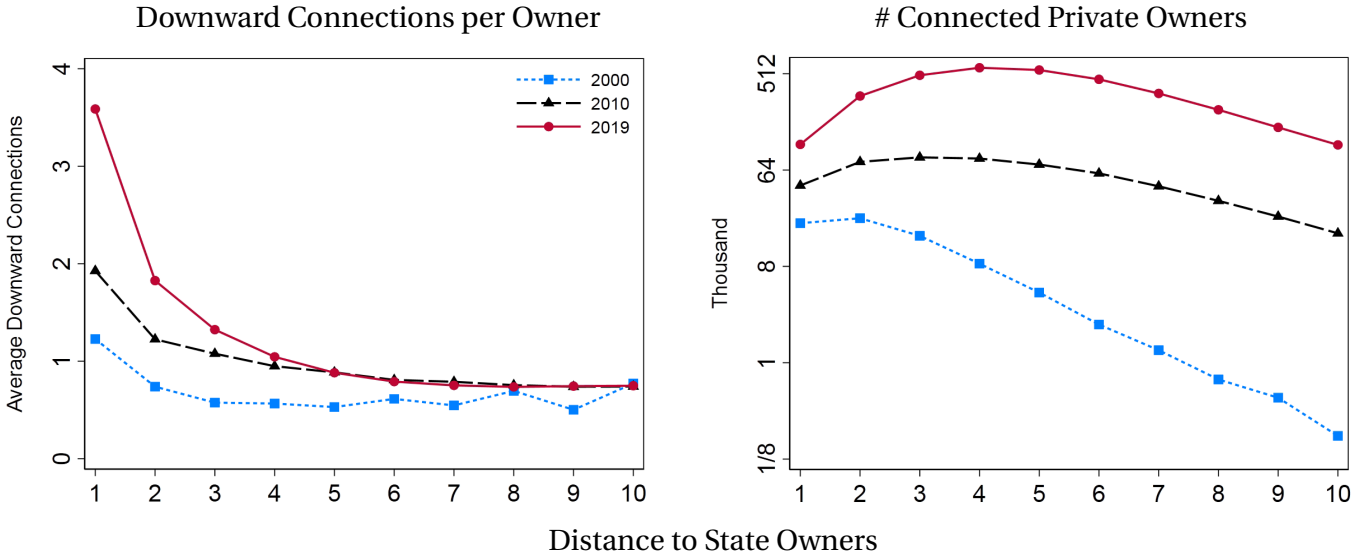
for the panel of owners between 2004 and 2019:

$$y_{i,t} = \alpha + \mu_i + \lambda_t + \sum_{\tau=-14}^{\tau=15} \theta_\tau \text{Direct}_{i,t-\tau} + \sum_{\tau=-14}^{\tau=15} \beta_\tau \text{Indirect}_{i,t-\tau} + \epsilon_{i,t}, \tag{1}$$

where $y_{i,t}$ is a measure of owner i's businesses; μ_i and λ_t denote owner and year fixed effects; $\text{Direct}_{i,t}$ is an indicator variable for an owner that creates a joint venture with a state owner at t and; $\text{Indirect}_{i,t}$ is an indicator variable for an owner that becomes indirectly connected (distance = 2) to the state at t. The excluded group are private owners who are never connected to the state during 2004-2019. The coefficients of interest are θ_τ and β_τ, which summarize the values of y in the year τ before and after the "event" (becoming connected). Here, we use 2019 data to infer historical 2004-2018 data and estimate equation (1).

Figure 8 shows the results for the number of firms owned by an owner (row 1), number of provinces the owner operates in (row 2), and number of 2-digit industries the owner operates in (row 3). The first column shows the effect for owners that become

Figure 7: Expansion of Connected Private Owners, 2000-2019



Note: Left panel shows the average number of downward connections per private owner by distance to the state from 2000 to 2019. Right panel shows the total number of connected private owners by distance to the state from 2000 to 2019.

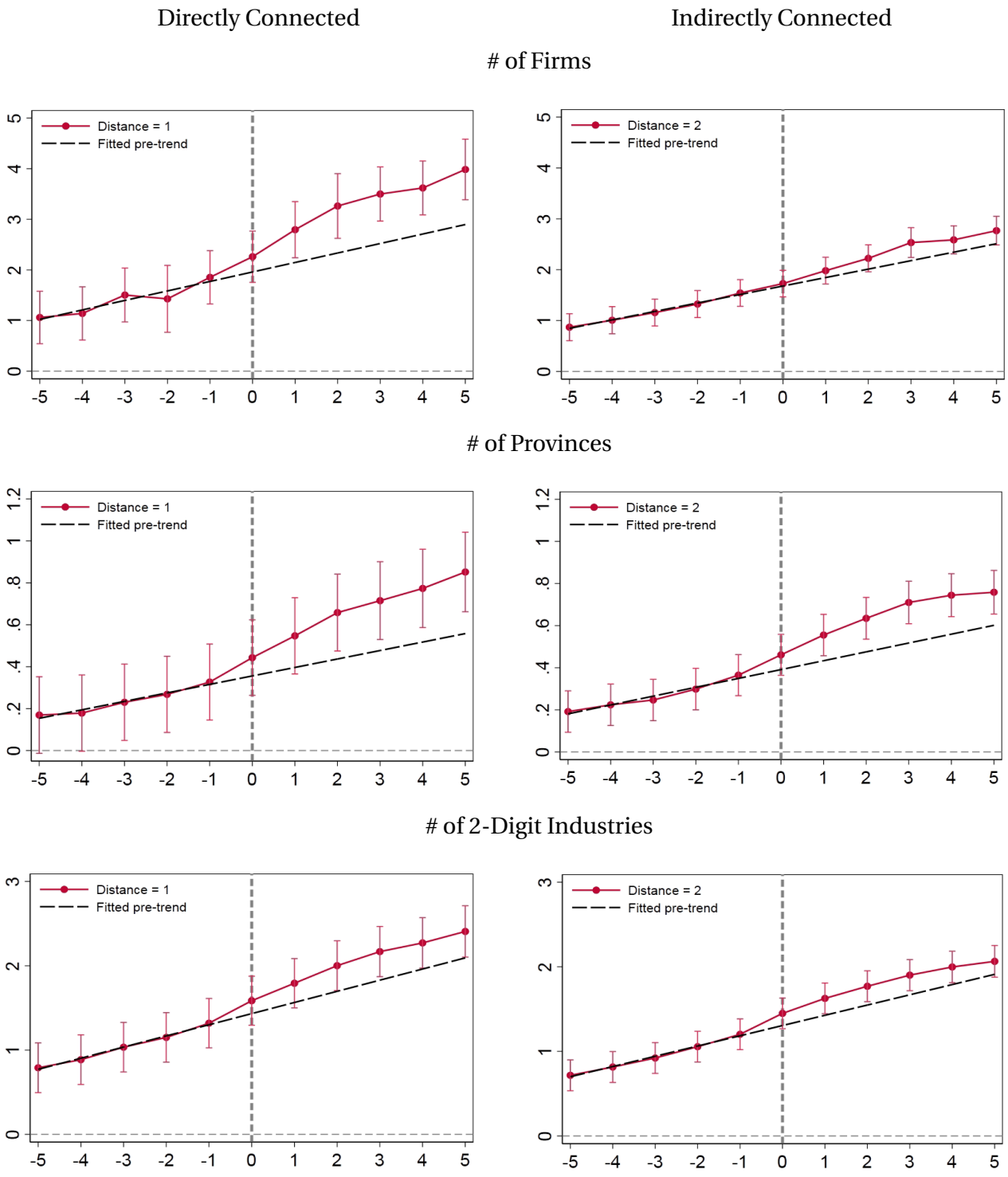
directly connected to state owners; the second column shows the effect for owners that become connected to a private owner that is directly connected to the state. The coefficient estimates and the standard errors are shown in red; the black dashed line fits and extrapolates the pre-trend.

Figure 8 delivers three messages. First, there is clearly a pre-trend in all the outcome variables for owners that become connected. We interpret this as saying that owners that were growing quickly are more likely to become connected. Second, there is a clear change in the trend for all three outcomes once the owner becomes connected. Third, the magnitude of the change in the trend is larger for owners that become directly connected compared to owners that become indirectly connected.

Fact 6: *State-Connected* Private Owners Account For A Large Part of Total Private Owner Growth

A central fact about China's growth is the decline in the size of the state sector and the expansion of the private sector. Table 6 (column 1) shows that, in the registration

Figure 8: Effect of Becoming "Connected" for Private Owners



Note: Figure plots the average # of firms (row 1), provinces (row 2), and 2-digit industries (row 2) of owners that become connected to state owners (column 1) or to private owners that are themselves connected to state owners (column 2) before and after the owner became connected. x-axis is number of years relative to the year the owner became connected (year 0).

data, the share of private owners in total registered capital increased by 14.4 percentage points between 2000 and 2019.[12] Here we document that the growth of private owners is mostly due to the expansion of *state-connected* private owners. The share of private owners directly connected to state owners increased from 10.3% in 2000 to 16.7% by 2019. Meanwhile, the share of private owners indirectly connected to state owners rose from 5.6% in 2000 to 18.7% by 2019. The share of all connected private owners, including directly and indirectly connected owners, increased by 19.5 percentage points between 2000 and 2019. Note that the share of all private owners shown in the first column increased by only 14.4 percentage points during this period. In other words, the share of unconnected private owners dropped by 5.1%.

At the same time, the share of state owners has declined, even among the state owners that have invested in private owners. The last column in Table 6 shows that the registered capital share of connected state owners fell by 12.2 percentage points between 2000 and 2019. Of course this does not say that connected state owners have shrunk in absolute terms. It is just that the growth of the private owners that state owners have enabled is much larger than the growth of the state owners that facilitated this process in the first place.

Table 6: Share of Connected Owners in Registered Capital, 2000-2019

	Private Owners			Connected State Owners
	All Private	Directly Connected	Indirectly Connected	
2000	64.2%	10.3%	5.6%	33.0%
2010	70.6%	13.6%	11.3%	28.0%
2019	78.6%	16.7%	18.7%	20.8%

Note: Private Owners are defined as individuals, collective owners, and foreign legal persons. Directly connected private owners have joint ventures with state owners. Indirectly connected private owners are linked to the state through another private owner. All private includes unconnected and connected private owners. Connected state owners have joint ventures with private owners.

There are two limitations of the numbers shown in Table 6. First, we infer the historical (2000 and 2010) registered capital share of private owners using the most recent registration data (2013). This is inaccurate if ownership links and registered capital of a

[12] Private owners are defined as private individuals, foreign legal persons, and collective owners.

given owner changes over time. For example, Chery and East Hope Aluminum bought back the equity stakes of state investors. We can gauge the bias due to this by measuring the share of connected owners in the 2013 registration data and comparing this to the share inferred using the 2019 registration data (see Table A.III in the appendix). The share of connected private owners in 2013 is 28.2% (13.3% for directly connected and 14.9% for indirectly connected) in the 2013 registration data and 25.2% (14.1% for directly connected and 11.1% for indirectly connected) inferred from the 2019 registration data. Using inferred historical registration data might *understates* the share of connected owners in the past so it is likely that the change the share of connected owners in Table 6 *overstates* the growth in the importance of connected private owners. Nevertheless, our main findings remain robust. Using the actual registration data in 2013, we still find a 7-percentage-point increase in the asset share of connected private owners between 2013 and 2019.

Second, registration capital may not be a good measure of the economic importance of connected owners. We can gauge this by measuring the share of connected owners in the Industrial Firm Survey in 2004 and 2013. In this data, the sales share of the industrial firms owned by connected private owners increased from 21.9% in 2004 to 33.5% in 2013. The corresponding change in the registration capital share of the same industrial firms is from 22.6% in 2004 to 36.9% in 2013. The percentage point increase in sales share of industrial firms of connected private owners is just slightly less than the increase in the share of the same firms in registered capital (11.7 percentage point increase in the sales share vs. a 14.2 percentage point increase in the registered capital share).

5. A Model of Connected Investors

In this section, we build a simple model to highlight the mechanisms that are behind the stylized facts we documented in the previous section. There are two key features of the model. The first is the idea that connected investor allows a private owner to grow. The second is that a private owner that becomes connected also has the ability to provide assistance to other private owners and thus undertakes joint ventures with other

smaller owners. This second feature of the model is key in "explaining" the hierarchy of connected owners see in the data.

5.1. Model Economy

Consider an economy with private owners indexed by i. Revenues Y_i of a firm owned by owner i is:

$$Y_i = (1 - \tau + \gamma_i) A_i.$$

Here A_i represents owner i's productivity, τ denotes the frictions faced by all private owners, and γ_i is a reduced form representation of the benefits owner i gets from her connections to the state. For example, γ captures the benefit to Chery provided by Shanghai Automobile in Chery's early years. We further assume an owner can own multiple firms and the cost of owning m firms is $\frac{\theta-1}{\theta} m^{\frac{\theta}{\theta-1}}$, where $\frac{\theta}{\theta-1} > 1$. *Total* revenues of owner i is therefore:

$$\overline{Y}_i = m_i Y_i = (1 - \tau + \gamma_i)^{\theta} A_i^{\theta}. \tag{2}$$

Total revenues depends on the owner's TFP A_i and the benefits she gets from being connected γ_i.[13]

We make four key assumptions. First, we assume $\gamma_i > 0$ for private owners that become connected to state owners (and zero otherwise). We further assume that the magnitude of this benefit is only a function of the owner's distance from the state d and decreases with the owner's distance from the state. That is, $\gamma_i = \gamma_d$ where the subscript d denotes owner i's distance from the state and γ_d is decreasing in distance from the state d.

Second, an owner chooses the distance at which they are connected to the state depending on the benefit and costs of becoming connected. This choice of distance then determines the benefits they get from being connected. It is easy to see from equation (2) that higher TFP owners derive more benefits from being closer to the state.

[13] We can generalize the model by introducing capital and labor and the associated resource misallocation. For example, consider $Y_i = (1 - \tau + \gamma_i) A_i L_i^{1-\eta}$ with a labor wedge τ_i^L. Our main results are robust to such extension.

Therefore, if all owners face the same cost of becoming connected at a given distance, higher TFP owners will sort into closer connections to the state.

Third, the cost of a connection is determined endogenously by the number of owners that choose to become connected and the number of connected investors providing these connections. Specifically, the marginal cost of a connection at distance d is given by

$$MC_d = \lambda \, \alpha \, \left(\frac{N_d}{N_{d-1}} \right)^{\alpha - 1}, \tag{3}$$

where $\alpha > 1$ and $\frac{N_d}{N_{d-1}}$ is the ratio of the number of owners that choose to become connected at distance d to the number of owners at distance $d-1$ providing these connections. We assume that connected investors charge a price on each downward connection and there is perfect competition among connected investors at each distance d. Therefore, the price for downward connection is equal to the marginal cost in Equation (3). Moreover, all owners at the same distance from the state provide connections to the same number of downstream owners, as assumed in Equation (3). The marginal cost of a connection is increasing in the number of owners that choose to become connected and decreasing in the number of owners that provide these connections, with an elasticity $\alpha - 1 > 0$.

The last two assumptions generate endogenous sorting of owners by their TFP. High TFP owners benefit more from closer connections with the state. The cost of such connections rise as more owners sort into these connections. In equilibrium, connections that provide more value will have more owners choosing to have these connections, and the cost of these connections will be correspondingly higher.

Fourth, once a private owners becomes connected, she can also provide benefits to other owners. The gain to an owner from being connected at distance d is thus the sum of her revenues plus the net payment she receives from her downward owners minus the cost she pays to her connected investor:

$$
\begin{aligned}
U(d|A_i) = (1-\tau+\gamma_d)^{\theta} A_i^{\theta} \\
+ \lambda(\alpha-1)\left(\frac{N_{d+1}}{N_d}\right)^{\alpha} \\
- \lambda\alpha\left(\frac{N_d}{N_{d-1}}\right)^{\alpha-1}.
\end{aligned}
\tag{4}
$$

The first term is owner i's revenues from connecting at distance d; the second term is the net gain to owner i from being the connected investor itself to other private owners; the third term is the price owner i pays to her strategic investor (at distance $d-1$).

5.2. Equilibrium

We assume private owners choose d to maximize $U(d|A_i)$ defined by equation (4) taking as given the number of owners at each distance N_d, where the latter is determined in equilibrium by the number of owners that sort into each distance d. The maximum distance d^* and the cutoff TFP A^{d^*} at this distance are defined by:

$$
(1-\tau+\gamma_{d^*})^{\theta}\left(A^{d^*}\right)^{\theta} - \lambda\alpha\left(\frac{N_{d^*}}{N_{d^*-1}}\right)^{\alpha-1} = (1-\tau)^{\theta}\left(A^{d^*}\right)^{\theta},
$$

where no owner is connected at distance $> d^*$ and owners with TFP $A_i < A^{d^*}$ choose to be unconnected. For owners with TFP $A_i \geq A^{d^*}$, the cutoff TFP for a connection at distance $d < d^*$ is defined by $U(d|A^d) = U(d+1|A^d)$ where all owners with TFP $A_i \geq A^d$ sort into connections closer to the state (distance $\leq d$) and owners with TFP $A_i < A^d$ (and $\geq A^{d^*}$) choose to be connected at distances more distant from the state (distance $> d$).

To illustrate the intuition behind the equilibrium, consider a simplified version of the model where only owners directly connected to the state receive benefits. That is $\gamma_1 > 0$ and $\gamma_d = 0 \; \forall \; d > 1$. In this case, connected private owners do not provide benefits to other private owners so $N_d = 0$ for $d > 1$. If we further assume that A_i follows a Pareto distribution (say with scale parameter 1 and shape parameter k) the number of private owners that are connected to the state N_1 is given by:

$$N_1 = \frac{N_p}{(A^1)^k}$$

where N_p is the total number of private owners and A^1 is the cutoff productivity such that firms with $A_i \geq A^1$ choose to become connected. Since the net gain from a connection is zero for the owner with the cutoff productivity A^1, this cutoff is given by:

$$A^1 = \left[\frac{\lambda \alpha}{(1-\tau+\gamma_1)^\theta - (1-\tau)^\theta} \left(\frac{N_p}{N_0} \right)^{\alpha-1} \right]^{\frac{1}{\theta+k(\alpha-1)}}.$$

We highlight two features of this equilibrium. First, an increase in the value of being connected γ_1 increases the number of connected owners. The intuition here is that more owners choose to become connected when the benefits of being connected is higher. As more owners choose to become connected, this raises the marginal cost of a connection. In equilibrium, the increase in the marginal benefit of a connection of the owner with the cutoff productivity is exactly equal to the (higher) marginal cost of a connection.

Second, an increase in the number of agents providing the connection N_0 (in this case state owners) also raises the number of connected private owners. In this case, more agents providing connections lowers the marginal cost of a connection, prompting more owners to choose to become connected with the state. Here again, the marginal cost of a connection increases as more downstream owners choose to become connected. The new equilibrium then is when there is enough entry into the "connected" sector such that the marginal benefit of a connection of the owners with the cutoff productivity is equal to the marginal cost.

Of course, an important aspect of the connections we see in China is that private owners also provide connections to other private owners. There is no closed form expression for the equilibrium when this is the case, but the intuition is similar to the simple model. The number of connections a given private owner has depends on the benefits she provides to her partners. More agents providing connections lowers the marginal cost of providing a connection to downstream owners, which also increases the number of downstream owners that become connected. The expansion in the number of connected owners (Fact 4) then comes from the increase in γ and the propagation

of its effect by increasing the number of connected owners that become the connected investor for other owners.

More generally, higher γ increases the benefit from becoming connected, leading to more entry into the connected sector. In turn, more entry increases the marginal cost of a connection. In the data, the average number of downward connections falls with distance (Fact 2). This fact indicates that a close connection with the state provides more benefits than a connection further away from the state. The data also indicates that the average number of downward connections has increased over time (Fact 4). In the model, this fact tells us that the value of a connection with the state has increased over time. In the next section, we will try to measure empirically how much γ must differ across d and over time to "explain" the two facts we observe in the data.

We summarize the equilibrium in four propositions.[14]

Proposition 1. *There is a unique distance d^* and TFP A^{d^*} such that there are owners connected with each distance $d \in [1, d^*]$, no owner is connected with distance $d > d^*$ and all owners with $A_i \geq A^{d^*}$ are connected and all owners with $A_i < A^{d^*}$ are not connected.*

High TFP owners are connected while low TFP owners are not. This is consistent with our empirical finding under Fact 1 that connected owners are larger compared to unconnected owners.

Proposition 2. *Among the set of private owners that are connected, owners with $A_i \in [A^d, A^{d-1})$ choose to connect at distance d where $\{A^d\}_{d=0}^{d^*}$ is a strictly decreasing sequence in d.*

Among the set of connected owners, higher TFP owners sort into connections that are closer to the state. The positive sorting comes from the assumption that connections closer to the state delivers greater benefits and that this gain is increasing in A_i. This is consistent with our empirical finding that owners closer to the state are larger (Fact 2).

Proposition 3. *The average number of downward connections per owner $\frac{N_{d+1}}{N_d}$ is decreasing in distance from the state for $d \in [0, d^* - 1]$.*

[14] Full proofs are in Appendix D. In the data only a subset of private owners are connected with the state. We therefore focus on an equilibrium where this condition holds. Appendix D also states the conditions under which this is the case.

The result comes from the assumption that the benefit from connecting with the state is decreasing in the distance to the state and the cost of providing a connection is convex in the number of connections. Owners more distant from the state provide less benefits to its downstream partners and thus choose to provide fewer connections. This is consistent with the fact that the average number of connections is decreasing in distance from state (Fact 2).

Proposition 4. *A non-decreasing change in γ_d increases: (i) the number of connected owners; (ii) the maximum distance from the state d^*; (iii) the average number of downward connections per owner for some d; and (iv) aggregate output.*

This result is consistent with the observed increase in the average number of connections per owner, maximum distance of a connected owner from a state, and total number of connected owners (Fact 4). It is also consistent with the increase in the share of connected owners in the economy as a whole (Fact 6). The intuition is straightforward. Increasing the benefits from connecting makes it profitable for some owners to increase the number of downward connections. More owners thus choose to become connected and the share of the connected owners in the economy increases both because there are more connected owners and because connected owners grow.

5.3. Model Calibration

The model is summarized by three forcing variables and four parameters. The forcing variables are the benefits provided by the connected investor γ_d and the number and TFP distribution of private owners. The four parameters are the level and convexity of the cost of providing connections, λ and α, the span of control parameter of the owners θ, and the friction faced by the private owners τ. In this section we back out the values of these variables and parameters.

We proceed as follows. First, we infer τ from the difference in the average size of firms owned by directly connected private owners and firms owned by unconnected private owners. Second, we take the number of private owners from the data and back out the distribution of TFP of firms owned by private owners from the empirical dis-

tribution of measured firm TFP in the data.[15] Third, the remaining parameters and the distribution of TFP of private owners collectively determine the number of owners at each distance from the state and the average firm size and total size of the private owner.

Table 7: Model Parameters

Parameter	Description	Value	S.D.
τ	Frictions Faced by Private Owners	0.9	–
θ	Owner Span of Control	2.32	0.15
λ	Level of Connection Cost	0.0158	0.0051
α	Convexity of Connection Cost	2.50	0.06

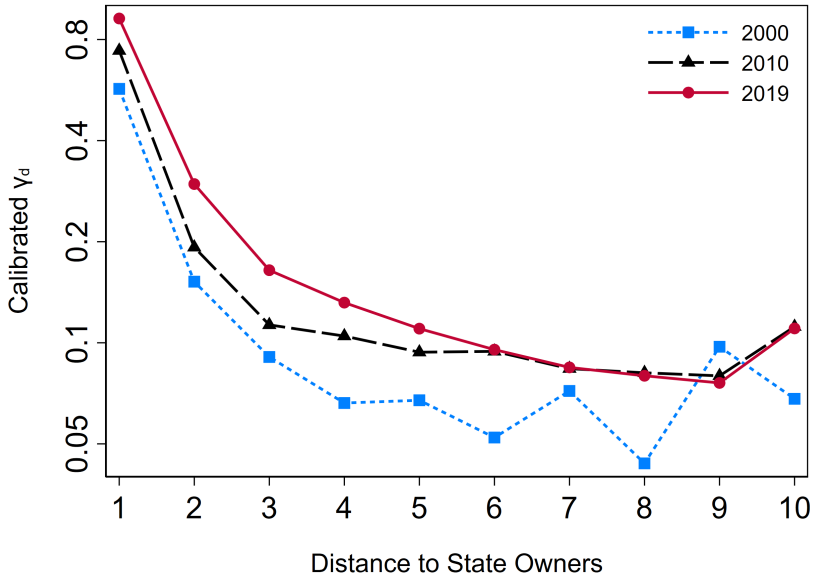
We use the 2000, 2010 and 2019 data on the number of connected owners, average registered capital of firm and average registered capital of owner at each distance from the state to back out the benefits from taking on a connected owner γ_d in 2000, 2010 and 2019, respectively, and the parameters θ, λ and α.[16] The resulting estimates of the parameters are shown in Table 7. The estimate of θ is 2.32 which implies that the elasticity of an owner's size with respect to TFP is about 2.3. The convexity of the cost of establishing downward connection α is 2.5, which implies that the cost of establishing connections rises rapidly with the number of connections. $\alpha = 2.5$ implies that average cost of downward connections increases 11-fold if the owner increases her downward connections from 1 to 5. Without the hierarchy, special deals would only benefit a very small group of directly connected private owners.

In the estimation, we calibrate γ_d to match exactly N_d in the data. Figure 9 shows γ_d for each distance d in 2000, 2010 and 2019 inferred from this procedure. In all years, γ falls with distance from the state, which says that private owners that are closer to the state get larger benefits. This is what our procedure infers to match the fact that

[15] Following Hsieh and Klenow (2009), we measure firm TFP as the residual of firm value-added after controlling for the average product of labor and capital of the firm. We can only do this for firms in the industrial survey (remember we only observe registered capital in the registration records) so we estimate firm TFP from the 2013 industrial survey. To simplify the calibration, we calculate the average of firm TFP of owners for each distance d and fit a Pareto distribution to average firm TFP by distance from the state d. This yields a Pareto shape parameter of 272. See Appendix E for more details.

[16] See Appendix E for the fit of the model in each year.

Figure 9: Calibrated Benefit from Connected Owners



Note: Figure plots benefit from a connected owner γ_d in 2019, 2010, and 2000.

connected owners closer to the state have more downward connections. The figure also shows that the distribution of γ shifts to the right over time. This is what we infer to match the increase in the the number of connected owners and the number of downward connections per owner from 2000 to 2019.

5.4. Effect of Connected Investors

Aggregate output from private owners in the model is given by:

$$\text{Aggregate Output} = \sum_{d=1}^{d^*} \left[(1-\tau+\gamma_d)^\theta \sum_{i \in d} A_i^\theta \right] + \sum_{i \in \text{not connected}} (1-\tau)^\theta A_i^\theta.$$

The first term is aggregate output of connected private owners; the second term is aggregate output from unconnected private owners.

There are therefore two sources of growth in the model. The first is the growth in the number of private owners and the shift in the distribution of TFP of these owners, holding the distribution of γ fixed. The second is the rightward shift in the distribution of γ shown in Figure 9, which shows up as an increase in the number of connected owners N_d. We now measure how much the rightward shift in γ explains economic growth. To do this, we change γ while holding fixed the number of private owners and the TFP distribution of these owners.[17]

Table 8: Aggregate Output Growth From Connected Investors, 2000-2019

	2000-2019	2000-2010	2010-2019
Output Growth in Data (% per year)	10.2%	11.6%	8.6%
Output Growth in Model (% per year):			
$\Delta\gamma_d, d \geq 1$	4.2%	3.4%	5.1%
$\Delta\gamma_d, d = 1$ only	2.4%	2.4%	2.3%
$\Delta\gamma_d, d \geq 2$ only	1.9%	1.1%	2.8%
Output Growth in Model (% per year):			
Directly Connected Owners	2.5%	2.4%	2.5%
Indirectly Connected Owners	2.4%	1.5%	3.4%

Note: Output growth in data is annual GDP growth from private owners calculated from the share of private owners in Table 2 and real GDP growth from 2000-2010 and 2010-2019 from the China Statistical Yearbook (2019) and China's Statistical Communique on the 2019 National Economic and Social Development. Output growth from "connected" private owners is average annual GDP growth in the model due to the change in γ we infer between 2000 and 2019.

The results are shown in Table 8. The first row shows the growth rate of private sector GDP in the data. The second row shows the effect of the change in γ and the resulting expansion in the size of the connected sector on aggregate output growth in the model. From 2000-2019, the expansion of the connected sector increased the aggregate growth rate by an average of 4.2% per year, so almost half of the growth of the private sector

[17] We follow the standard approach of chaining. For example, we compute growth between 2000 and 2010 allowing γ to change from 2000 to 2010 values but holding the other forcing variables at their 2000 values. Then we compute growth between 2000 and 2010 by holding the other forcing variables at their 2010 values and allowing γ to change from 2010 to 2000 values. We take the average of these two estimates of growth from changing γ. We do the same for 2010-2019 and cumulate the growth to arrive at an estimate from 2000-2019.

in the data. The expansion of the connected sector in the first decade of the period contributed less to growth, namely 3.4% per year. The expansion of the connected sector in the most recent decade had a larger effect on aggregate growth, raising output growth by an average 5.1% per year.

The message then is that, when filtered through the lens of our model, the observed expansion of the connected sector in China over the last two decades had a substantial effect on growth, explaining almost half of the growth in the data. In addition, the effect of the expansion of the connected sector is larger in the most recent decade compared to 2000-2010.

The next two rows in Table 8 decomposes the effect to the increase in benefits from state owners to private owners directly connected to the state vs. the increase in benefits that private owners bestow on their partners. Here, we first calculate the effect of only changing γ for $d = 1$ and holding γ for all other distances d unchanged. That is, we only change the benefit that private owners directly connected to the state get. The third row shows that the effect of this exercise. The change in γ_1 between 2000 and 2010 contributes 2/3 of the growth effect while the change in γ_1 between 2010 and 2019 contribute almost half of the growth effect.

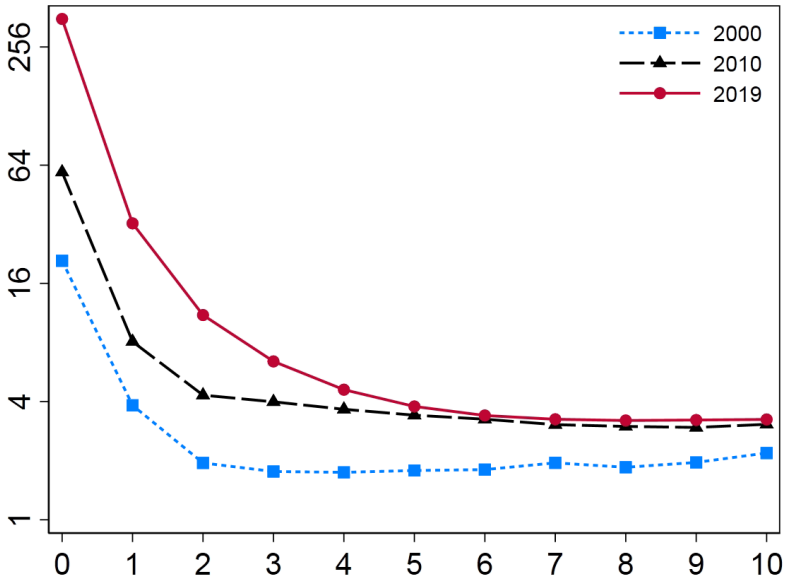
This result may seem surprising given that the change in the benefit from a direct connection with a state owner γ_1 is smaller than the change of γ for other distances (see Figure 9). To understand why, it is useful to introduce the idea of the multiplier effect of an additional connected owner. Specifically, we define the "multiplier" as the effect of one additional owner at distance d on the total number of connected owners, holding fixed the average number of downward connections per owner:

$$\text{Multiplier}_d = 1 + \sum_{i=d+1}^{d^*} \left\{ \prod_{j=d}^{i-1} \frac{N_{j+1}}{N_j} \right\}.$$

Figure 10 shows the multiplier effect of an additional owner implied by the average number of downward connections in the data shown in Figure 7. It says that if one private owner establishes a joint venture with a state owner in 2019 (distance = 1), the multiplier effect of this new connection is that 50 additional private owners become "connected." The reason the multiplier is this large is because of the hierarchy of owners we document. The newly connected private owner establishes joint ventures with

only 3 to 4 additional private owners. The multiplier comes from the fact that these private owners in turn will also have joint ventures themselves with additional private owners, and so on.

Figure 10: Multiplier by Distance to State Owners



Note: This figure shows how many more owners would become connected by adding one more owner at distance d, taking as given the number of downward connections per owner shown in Figure 7.

Figure 10 shows that the multiplier at distance 1 is much larger than those for other distances, which explains why the change in γ_1 has relatively larger growth effect. The figure also shows that the multiplier at distance 1 through 5 is larger in 2019 compared to previous years. The reason is because, as seen in Figure 7, the average number of downward connections of connected private owners is higher in 2019 compared to previous years so the "multiplier" effect of an additional connection in 2019 is larger than in 2010 or 2000.

In the model, the increase in the average downward connections of private owners comes from the change in γ for connected private owners. The fourth row of Table 8 therefore holds γ_1 constant and changes γ for all the other distances $d \geq 2$. That

is, we change the "benefits" that connected *private* owners provide to other private owners, while holding constant the benefits that state owners provide to private owners directly connected to the state. We see that a large part of the higher growth from the expansion of the connected sector in 2010-2019 compared to 2000-2010 is coming from the increase in the benefits that *private* owners provide to other private owners. Remember however that this counterfactual holds γ_1 constant, and an important effect comes from the fact that the same increase in γ_1 has a larger effect when the benefits provided by private owners also increase.

The last two rows in Table 8 show the effect of the contribution of the expansion of private owners directly connected to the state vs. the expansion of private owners that are only indirectly connected to the state. Obviously both groups of private owners expand in respond to the rightward shift in γ so this decomposition should be thought as a an examination of the channels via which the change in γ affects aggregate output. The message here is that around 50% of the contribution of connected owners to growth comes from directly connected owners over this period, although the role of indirectly connected owners is larger in the last nine years.

6. Conclusion

In this paper, we use detailed administrative data from the Chinese registration records to document the importance of "connected" investors. We report two key findings. First, in recent years there is a hierarchy of private owners with state-owned firms at the very top of the chain. These state owners hold equity in companies owned by a large number of private owners. In 2019 there were a hundred thousand private owners. These owners are the largest private owners and also hold equity in companies owned by other, smaller, private owners. In turn, these owners are even smaller and also hold equity in other companies with other owners themselves, and so on. In 2019 this hierarchical chain extends to owners that are more than ten steps away from the state owners.

Our second fact is that the magnitude of this hierarchy of connected private owners is a recent phenomena. In 2019 connected private owners account for 35% of all

registered capital in China. In 2000, connected private owners only accounted for at most 16% of registered capital. The increase in the share of connected private owners over this time period contributes a significant part of the entire increase in the share of all private owners in China over the same period. The rise of the connected private sector is driven by two related facts. First, state owned firms increasingly invest in more private owners. Second, a typical connected private owners themselves also invest in more private owners.

We leave several important questions for future research. First, our estimate of the change in the share of connected owners over time assumes that a given firm does not undergo ownership changes. This assumption is obviously not true, and our estimates using the contemporary registration data in 2013 suggest some bias in the inferred historical data. It may be possible to unearth contemporaneous registration data in earlier years. When such data is available, we can update our estimates correspondingly.

Second, we assume that connected owners are those that are tied to state owned firms and that private owners become "connected" only when they become linked to state owned firms, directly or indirectly, through equity ties. Of course some of the private individuals themselves could be the connected investors, and perhaps even more connected that the state owned firm that they are linked with. We think this is likely to be true in many cases. It also raises the question why connected individuals would choose to "share" their equity with official state owners when the latter are less politically connected. One explanation is that the equity ties with state owned firms could give the connected owners cover to provide favors to these firms. We do not currently have a way of identifying such individuals but this is also something that future research can address.

Finally, we use a very simple model to show that the expansion in the "span" of connected investors may have increased growth by 4.2% a year between 2000 and 2019. This number is obviously tentative, and an important agenda for future research is to examine the effect of these networks on aggregate productivity with richer models.

References

Allen, Franklin, Junhui Cai, Xian Gu, Jun "QJ" Qian, Linda H. Zhao, and Wu Zhu, "Ownership Network and Firm Growth: What Do Five Million Companies Tell About Chinese Economy," 2019.

Bai, Chong-En, Chang-Tai Hsieh, and Zheng Michael Song, "Special Deals with Chinese Characteristics," *NBER Macroeconomics Annual*, 2019.

Brandt, Loren, Ruochen Dai, Gueorgui Kambourov, Kjetil Storesletten, and Xiaobo Zhang, "Serial Entrepreneurship in China," 2019.

Chandler, Alfred, *The Visible Hand: The Managerial Revolution in American Business*, Harvard University Press, 1977.

Dai, Ruochen, Dilip Mookherjee, Kaivan Munshi, and Xiaobo Zhang, "The Community Origins of Private Enterprise in China," 2019.

Dunne, Michael, *American Wheels, Chinese Roads: The Story of General Motors in China*, John P. Wiley, 2011.

Hsieh, Chang-Tai and Esteban Rossi-Hansberg, "The Industrial Revolution in Services," 2019.

__ and Peter J Klenow, "Misallocation and Manufacturing TFP in China and India," *Quarterly Journal of Economics*, 2009, *124* (4), 1403–1448.

Huang, Yasheng, *Capitalism with Chinese Characteristics*, Cambridge University Press, 2008.

Shi, Xiangyu, Tianyang Xi, Xiaobo Zhang, and Yifan Zhang, ""Moving Umbrella": Identifying Collusion Through Bureaucratic Transfers And Investment Flows," 2020.