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WP 17-3 Global Competition and the Rise of China

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Abstract

Using firm level data, the authors examine how global industrial concentration has changed over the last decade in relation to the rise of China. Between 2006 and 2014, global concentration has declined in most industries and is falling on average across all industries, while firms at the top of the distribution are experiencing significant churning. The resulting enhanced industrial competition is partly attributable to the rising market shares of firms from China and other emerging markets at the expense of incumbent industry leaders. The authors further show evidence of global allocative efficiency—highly productive firms tend to be larger and grow faster. Global concentration has, however, risen significantly in several industries where Chinese state-owned enterprises (SOEs) dominate, and China's SOEs are on average too large and expanding too fast given their low levels of productivity.

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INTRODUCTION

As trade and foreign direct investment increase worldwide, global industrial concentration becomes relevant for assessing competition in most industries, yet previous studies of market structure focus exclusively on domestic concentration. US data, which are most frequently used, show evidence of increasing industrial concentration since the mid-1990s, raising concerns about competition and reversing a trend of declining concentration since the 1970s.[1] The increase in US concentration, however, may be less indicative of rising market power if global competition is intensifying. Although the top US firms are relatively larger than in the past, they are also now competing more intensely with large and growing firms from foreign markets.

Arguably the single most important change affecting global competition has been the rise of China. In 2014, China surpassed the United States to become the largest economy in the world (when measured at purchasing power parity). Supporting China's rise is a group of fast-growing companies, many of which are state-owned and that are now industry leaders. In 2006, only 41 Chine se firms ranked in the global top 1,000 by revenue. By 2014, Chinese companies occupied 136 of the top spots, of which 70 percent are state owned. The rise of China could reduce global concentration if the new large firms are competing with existing large firms from industrial countries. But if the new companies are somehow different, either because of China's market size or the high share of state ownership, they could enhance concentration.

The same economic concerns that relate to domestic concentration are likely to extend to global concentration. Higher concentration could indicate a worrisome trend toward the excessive market power of a handful of firms and ultimately higher prices (Bain 1951). It could also have negative consequences for volatility if supply depends largely on a few firms, especially if they are geographically concentrated (Roll 1992, Di Giovanni and Levchenko 2012). But concentration is not always bad for economic outcomes. Higher concentration could also reflect cost saving and greater efficiency in some industries, as the most efficient global producers expand or take advantage of returns to scale. Indeed, much of the empirical literature concludes that greater industrial concentration is associated with enhanced economic efficiency and innovation (Peltzman 1977, Brozen 1982).[2] Hefty investment by state firms, however, could reduce the efficiency gains of concentration, as state support is likely to lead to an inefficient rationalization in some industries, with relatively unproductive firms attracting too much investment (Bai, Hseih, and Qian 2006; Dollar and Wei 2007).

The main contribution of this paper is a first attempt to measure global industrial concentration. There is little existing work on global concentration, but there is a perception that big companies are dominating markets more than in the past. For example, the *Economist* magazine recently issued a special report on the

1. White (2002) shows that aggregate concentration in the United States fell from the 1970s to the early 1990s. Furman and Orszag (2015) report an increase in the 50-firm concentration ratio in a number of US industries since the mid-1990s.

2. Autor et al. 2017 show more recent evidence of efficiency, innovation, and concentration.

world's most powerful companies, with the header "A small group of giant companies—some old, some new—are once again dominating the global economy." Other researchers highlight mammoth corporation size by comparing their revenues to countries' or governments' GDPs, for example, Walmart to Norway or ExxonMobil to Greece.[3]

Measuring global industrial concentration was not possible until now because the data required were not available.[4] This study uses data from the Bureau van Dijk Orbis database to examine global concentration from 2006 to 2014. The problem with using earlier vintages of the data for this purpose is that the data were not gathered in enough countries systematically.

The data show that global concentration on aggregate in most industries and on average across industries has decreased since 2006. Examining the top four firms' share of total revenues, the concentration ratio has declined on average by about 4 percentage points, and three-quarters of the 84 industries have recorded a decline. As compared with domestic data, this is a sizable decline, especially over a relatively short period. Petzman's (1977) US analysis focuses on the four-firm concentration ratio of 165 industries from 1947 to 1967, during which there was an average increase of about one percentage point. The *Economist* uses a four-firm concentration ratio for 893 industries from 1997 to 2012 and finds a weighted average increase of 6 percentage points. Furman and Orzag (2015) use the 50-firm concentration in 13 broad sectors from 1997 to 2007 and find an average increase of 4 percentage points.

Dynamic competition at the global level is also relatively intense. A high level of churning among the largest firms indicates that the threat of competition remains strong. Across industries, on average, one-third to one-half of the top four firms (and the top ten) are distinct in 2014 as compared with 2006. In comparison, Fogel, Morck, and Yeung (2008) calculate stability indices at the country level in 44 countries from 1975 to 1998. Over this relatively long period, they find that on average 60 percent of the top ten companies at the country level are new.

The fall in global concentration and robust churning suggest that the rise of China and other emerging markets may have contributed to more intense global competition, as fast-growing firms from these countries take some market share from industrial country firms. The global composition of many industries reflects this conclusion. A good example is information services, where the number of Chinese firms in the

3. Global Policy Forum, at https://www.globalpolicy.org/images/pdfs/Comparison_of_Corporations_with_GDP_of_Countries_table.pdf (accessed on February 1, 2017).

4. Estimates using aggregate data exist. De Grauwe and Camerman (2002), for example, use the growth in sales of the 50 largest companies relative to the growth in GDP of the 50 largest countries to estimate changes in corporate concentration. They find that the ratio declined from 1980 to 2000, though differences between how sales and value added are measured make this an unsatisfactory measure. Sales are a gross figure while GDP is value added, so changes in the production structure toward more or less vertical specialization could show large swings in concentration even when there is little change. There are also a number of individual country studies, in addition to those of the United States mentioned above. World Bank 2003 finds that concentration declined slightly from 1983 to 1992 in Japan but notes that the absence of comprehensive data precludes the calculation of global sectoral concentration. The Organization for Economic Cooperation and Development (OECD 2010) finds that in China the share of highly concentrated sectors, measured using the Herfindahl-Hischman index, declined from 1998 to 2008.

top 650 rose from 19 to 147 during 2006–14 and the four-firm concentration ratio fell by 12 percentage points.

But averages obscure significant variation across industries. Examining the correlates of the change in concentration across industries with industry characteristics offers some important insights. An increasing number of emerging-market (or Chinese) firms in an industry is associated with a small but significant drop in concentration. For every ten new emerging-market firms in an industry, the four-firm concentration ratio falls by half of one percentage point. However, when Chinese state-owned enterprises (SOEs) dominate an industry, concentration rises. The correlation is economically meaningful: The presence of a Chinese SOE in the top four firms in an industry is associated with a 3 to 6 percentage point rise in concentration from 2006 to 2014. A good example is coal, where China Shenhua Energy Company had a 4.6 percent market share in 2006 and a 10.2 percent market share in 2014 and the four-firm concentration ratio increased by more than 3.5 percentage points, very distinct from the declines experienced in most other industries.

The change in concentration may be a sign of improved global allocative efficiency if the correlation between size and productivity is high and becoming tighter over time. The data show that more productive firms are larger and are growing faster; this is especially true in tradable industries, where global competition matters most. However, state-owned firms, especially from China, tend to be too large and growing too fast given their productivity level. Their excessive size thus appears to be reducing global allocative efficiency in some industries.

Relatively stronger allocative efficiency in tradable industries is consistent with new trade models, showing that openness to trade encourages the most productive firms in an industry to expand in world markets, while the less productive firms shrink when faced with competition (Melitz 2003). These models also predict that trade liberalization leads to greater domestic industrial concentration, as the most productive firms in an industry grow and the least productive firms exit. In a sample of 50 countries, Di Giovanni and Levchenko (2012) find that trade opening makes the largest firms more important, raising industrial concentration within countries, consistent with the theoretical predictions. Economic reform and globalization can affect global concentration differently than domestic concentration, depending on which countries are most affected. If reforms are concentrated in China and other emerging markets, global concentration could fall, even as domestic concentration increases within countries, because the most productive firms from these economies take market share from former industry leaders.

Overall, the decline in global concentration and a relatively high level of churning in most industries implies that global competition is strengthening. Evidence on the correlation between size and productivity is supportive of global allocative efficiency—the better firms are bigger and grow faster—especially in tradable sectors. The rise in concentration in industries associated with Chinese SOEs coupled with evidence that the SOEs are too large given their productivity, however, indicates that state ownership is reducing global competition and efficiency in a handful of industries.

MEASURES OF CONCENTRATION

There are three important issues to measuring concentration. One relates to which data to use: revenues, value added, employment, etc. Another is the specific index to use: four-firm concentration, eight-firm concentration, Herfindahl-Hirschman, etc. And the third issue reflects concerns specific to the Orbis dataset and the scale over which concentration is measured.

In terms of which variable to use, value added is the best measure since it reflects the contribution of a given firm and does not suffer from the double counting that is present when revenues are used. Unfortunately, value-added data are frequently missing. Of the top 1,000 firms by revenues, only 343 report valued-added data. Employment data are also frequently missing.

Because of data availability, this paper focuses on revenues to analyze concentration, which requires a comprehensive sample. The main concern with revenues is that the inputs used in production by one firm will be counted as part of its size, which will tend to exaggerate the size of assembly and distribution firms.[5] Still, the change in concentration measured using revenues will be a useful indicator of concentration, provided that *within* industries the value-added share across the firms is similar or does not change much over time. In addition, by focusing on within-industry concentration, distribution is separated from production.

A difference with country studies pertains to the definition of a firm. Country-level concentration, such as calculated by the US Census, uses the firm's total revenue earned in the United States. In contrast, global concentration uses the total revenue from the firm, irrespective of where it is earned.

The two indices used in this analysis are the four-firm concentration ratio and the Herfindahl-Hirschman (HH) index. The advantages of the four-firm concentration ratio are that it is simple to understand and it reflects the importance of the largest firms. Despite using a truncated sample, as data are only consistently available for the largest 650 firms in an industry, the four-firm concentration ratio also captures skewness along the full distribution, assuming the data are drawn from a Pareto distribution.[6] Higher concentration would imply that the distribution is becoming more skewed over time.

The HH index, which is the sum of the squares of market shares, captures skewness throughout the distribution, as all firms' market shares are considered. To see the difference, consider the following example: If the four largest firms have a market share of 20 percent each, or the top firm has 50 percent and the next three have 10 percent, the four-firm concentration ratio will be the same: 80 percent. In contrast,

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5. An additional concern is that some firms may operate in more than one sector, but firm revenues are aggregates. Unfortunately, there is no way to disaggregate firm revenue to a particular sector. To the extent that the sectors are fairly broad, 84 total, this concern should be ameliorated.

6. The top portion of the firm size distribution is well known to closely follow a power law. As a result, the share of the top four firms in the top x can be represented as $(4/x)^{(e-1)/e}$, where e is the power law exponent, such that a higher e indicates less concentration. The important point is that even when the distribution is truncated, it is sensible to compare the ratios over time.

the HH index will record higher concentration in the latter case. The US Department of Justice also uses the HH index when analyzing mergers and acquisitions for market concentration. They use a threshold of 1,500 to identify moderately concentrated industries and 2,500 to identify highly concentrated industries.[7]

Finally, the Orbis data raise two other concerns. First, they are not comprehensive: Coverage for private firms is limited, and coverage improves over time. Using the full data available as the denominator would thus bias in favor of a reduction in concentration, since the denominator would be increasing in part because of rising coverage. To deal with this problem, data from the top of the distribution, where the coverage tends to be good throughout the period, are the primary focus. In particular, the largest 5,000 firms per industry were downloaded for analysis (in some industries, the total number of firms is fewer than 5,000).[8]

To the extent that coverage improves disproportionately outside the top four but within the top 650, the results could still be biased in favor of a decrease in concentration, since some firms may be missing in the first period and replaced with smaller firms, reducing the denominator. A further robustness test uses the top 250 incumbent firms, which reverses the bias to favor an increase in concentration, since the likelihood that a top 250 firm at the end of the period was not covered in the early period is greater than that a top four firm was not covered. As a result, the denominator is likely to be biased down in the latter period, because many of the recently listed firms in the top 250 will be excluded from the sample in favor of smaller incumbent firms.

The second concern is double counting. Orbis lists both unconsolidated and consolidated financial accounts, so firm revenues may be counted multiple times because the sample includes both the consolidated accounts of parent firms (with their subsidiaries) and the unconsolidated accounts of both parent and subsidiary firms. Other studies using Orbis data have attempted to tackle this issue by dropping from their samples the consolidated accounts of parent firms. For this study, this approach is unsatisfactory. Since precisely the very largest firms across industries are of interest, dropping consolidated accounts would remove these firms from the sample. In addition, not all firms list both consolidated and unconsolidated accounts, and in many cases the sum of the subsidiaries' accounts is significantly less than the consolidated account. To avoid double counting and still retain information on large parent firms, the subsidiaries of firms with consolidated accounts that appear in the data are dropped.[9] Double counting also arises because

7. For the broad sectors, globally, two qualify as concentrated or highly concentrated in 2014: Other Mining and quarrying (HH 3312) and Services to buildings and landscape activities (HH 1550). For the more disaggregate tradables sectors, three are highly concentrated in 2014: Mining and quarrying n.e.c. (HH 4121); Manufacture of irradiation, electromedical and electrotherapeutic equipment (HH 3123); and Manufacture of knitted and crocheted apparel (HH 2990). Eight additional tradable sectors are moderately concentrated.

8. The tobacco industry is excluded because there are very few firms in this sector, as well as sectors relating to household production, as these have no large firms.

9. Only the largest observations by revenue for every corporate group (global ultimate owner, or GUO) is retained—in this way, the possibility of duplicates appearing in the data is attenuated.

cross-listed firms are listed more than once, with unique owner ids. To address this problem, firm names and revenues are compared to eliminate duplicates.[10] Once subsidiaries and cross-listed firms are dropped, the preferred sample is the top 650 firms in each industry. All of the results are also shown using the 1,000 largest firms by industry from the raw data.

The data also include information on state ownership, where state-owned firms are defined as having more that 50 percent government ownership. Although the global ultimate owner for state firms is the same, for these firms, smaller firms with the same owner id are not removed because the accounts of separate state-owned firms are not consolidated.

As a first look at the data and to compare it with other sources, aggregate concentration indices from Orbis are compared with those calculated using data on top firms from the *Financial Times* and *Forbes*. There are differences between the data definitions that affect the level of measured concentration. The *Financial Times* and *Forbes* consider only publicly listed companies, and the *Financial Times* selects firms for the list based on market capitalization, while *Forbes* takes an average of sales, profits, assets, and market value to create its list. Despite these differences in how the groups of firms are chosen, if concentration is in fact moving in one direction, the three series should report changes in the same direction.

Table 1 records the results. All three series record declines in concentration, whether using the four-firm concentration ratio or the HH index. They are steepest using the *Financial Times*; Orbis and *Forbes* report similar, albeit small, reductions. All three series also show an increase in the share of emerging-market firms. The number of Chinese firms in each list increased by more than a factor of three over the period.

The declines in firm concentration are consistent with declines in the global concentration of aggregate income. Measured using nominal $US GDP, global concentration of aggregate income during the period fell slightly. The share of the top four countries in a balanced panel of countries fell from 0.48 to 0.47 over the period, and the HH index dropped from 1,014 to 847, as emerging-markets countries grew faster than the rich world.

From an aggregate perspective, the results are consistent with the rise of the Southern hemisphere being associated with more efficient global markets and lower industrial concentration. Research shows that an important element of industrial growth is the lifecycle dynamics of firms—the extent to which the most productive firms can grow rapidly into large firms. Hsieh and Klenow (2014), for example, estimate that the failure of small firms to grow into large firms reduced productivity growth in manufacturing by 25 percent in Mexico and India compared with the United States. As emerging markets have grown, lifecycle dynamics have improved, with some highly productive firms growing fast and contributing to aggregate

10. The cross-listed firms, which have different GUOs, are identified by matching the first seven characters of the name and the revenues; the results are then manually compared to ensure cross-listed firms are captured. There are 109 such firms.

productivity growth. These firms also affect global market structure as they access world markets and compete with industrial country leaders.

INDUSTRY AGGREGATES

Even if aggregate concentration declines slightly, *within* industry concentration could be increasing or decreasing, as the top 1,000 global firms (table 1) are dominated by industries with very large firms, such as banks and oil companies, and include only a handful of firms from other industries.

Using the NACE (Nomenclature of Economic Activities) revision 2 classification of 85 industries, figure 1 shows the four-firm concentration ratio in 2006 versus concentration in 2014 over time, where the size of the point reflects the size of the industry (as reflected by revenues of the top 650 firms in each industry in 2014). Overall, industry concentration has been decreasing. On average, concentration has fallen by 4.1 percentage points, and 80 percent of industries report a decrease.

Table 2 records average declines in concentration and weighted concentration, as well as HH indices, using the three samples discussed above. Whether measured using the four-firm concentration index or the HH index, the preferred sample of 650 firms (column 1), incumbent firms (column 2), or raw data from the top 1,000 (column 3), there is a decline in concentration.[11]

The lower panel of table 2 shows results excluding China. On average, the change in concentration is very similar. For example, in the preferred sample of 650 firms, concentration declined by 3.6 percentage points, only a fraction smaller than the 4.1 decline in the full data.

CHURNING

While concentration indices present a useful snapshot of static competition, competition can still be weak if there is little threat from new firms replacing incumbents over time. Churning measures the extent to which fast-growing firms replace incumbent superstars in a sector. Greater churning would imply that even if concentration is high, the threat of competition is strong. Fogel, Morck, and Yeung (2008) show in a sample of 44 countries that more churning among the top 10 firms in a country is associated with faster productivity and income growth. They interpret this as evidence of the importance of Schumpeterian creative destruction for growth. Economies perform better when new highly productive firms can displace old stagnant firms.

To measure churning, a stability index is calculated for the top four and top ten firms in the sector. The index shows the share of firms that are present in the group at both ends of the period. For example, if three of the top four firms in 2014 are the same as in 2006, the stability index is 0.75. A lower stability

11. Tradable sectors show an average decline in concentration of 1.6 percent, and manufacturing industries record a decline of 3.6 percent.

index indicates more churning, where zero means all the firms are new and one means all the firms are the same. Table 3 records the results. Overall there is a significant amount of churning for both the top four and top ten firms, with nearly half of the top firms being replaced over the period, using either the raw data or the unique data.

Again, the problem of improving coverage could lead to overestimated churning. While some firms in the top four are in fact new firms, others may not be. For example, Facebook was not in the top 1,000 firms in "Computer programming and related activities" in 2006, but it was a top ten firm in 2014. In this case, Facebook is a new firm that is a real part of churning. It is possible, however, that other firms enter the sample but are not actually new firms and instead represent data that was missing in 2006. For robustness, the stability index is also recalculated using the sample of incumbent firms—firms that were in the top 250 in both 2006 and 2014. This recalculation significantly biases the stability index upward because fast growing new firms like Facebook will be absent, but it provides an upper bound for stability.

These results are also recorded in table 3. Even using the upward biased statistic, significant churning is evident over the period, with about one third of top four firms and about one quarter of top 10 firms being new. In all cases, churning is slightly weaker when China is excluded.

Figure 2 shows the geographical distribution of the leading firms in 2006 and 2014, as classified by broad sector, where a leading firm is a top four firm in any one of the 84 industries. Big gains are evident in China, matched by losses in Europe, where national champions have been replaced by Chinese firms in 11 industries. In contrast, the flip side of rising US concentration has been that large US corporations have maintained their global ranking.

VARIATION ACROSS SECTORS

The results show that on average industrial concentration is falling and churning is strong, and that the change may be attributable in part to the rise of new firms from China and other emerging markets as industry leaders. The rise of China would reduce global concentration if new fast-growing firms are competing with established firms from the United States, Europe, and Japan and spreading production around the globe more evenly. However, China's rise could enhance concentration if the top Chinese firms are relatively larger, perhaps because of domestic market size or the prevalence of state-owned firms.

An additional change over the period that might affect concentration is a boom in mergers and acquisitions (M&A) worldwide. Of the 30 largest deals in history, nearly half have occurred since 2005, including huge cross-border mergers such as Anheuser-Busch Inbev with SAB Miller and Royal Dutch Shell with BG Group PLC. M&A activity has been concentrated, with over half of the total value occurring in just 13 industries. Because mergers and acquisitions are clustered in a handful of industries, aggregates and averages could still contract even if M&A activity raises concentration in some industries.

To explore the causes for the decline in average concentration, the characteristics of industries with rising and declining concentration are examined next. An interesting pattern emerges when looking at the sectors with the greatest changes in concentration (appendix table A.1). The sectors with the fastest falling concentration tend to be nontradables services, such as travel, research, maintenance, and legal. Only one manufacturing industry falls in this category: electronics. This pattern is consistent with the rise in China and other emerging markets reducing global concentration in some sectors. As their companies grow, global concentration falls. That this concentration decrease is most prevalent in the nontradables may be because the companies in these sectors largely reflect the income distribution of countries.

In contrast, the sectors with rising concentration are sectors where state-owned firms have been more prevalent, such as mining and civil engineering, and also sectors where mergers and acquisitions boomed, such as in oil and gas and in beverages.

To examine the effect of emerging-market growth, SOEs, and mergers and acquisitions on the change in concentration, table 4 presents partial correlations with the change in the four-firm concentration ratio, using the preferred sample of 650 unique firms. Column 1 regresses the change in the four-firm concentration ratio from 2006 to 2014 on the change in the number of emerging-market firms in the industry, controlling for the initial level of concentration.[12] The coefficient is negative and significant, indicating a greater number of new emerging-market firms reduces concentration. Specifically, the coefficient of –.05 implies that ten additional emerging-market firms in an industry over the period reduce concentration by about one-half of one percentage point. Column 2 repeats the exercise, separating the change in number of emerging-market firms into the number of Chinese firms and of other emerging-market firms. The effects of both variables are of similar magnitudes and not significantly different from each other.[13] Column 3 includes an SOE effect, defined as an indicator for whether there is an SOE in the top four firms in 2014. The large positive coefficient implies concentration expands when state-owned enterprises are present in the top four. Column 4 disaggregates the effect into Chinese SOEs and SOEs from other countries.[14] The effect is driven by Chinese SOEs: The effect of other SOEs is not significant, the coefficient is much smaller, and one can reject that it is equal to the coefficient on Chinese SOEs.[15] The point estimate implies that an additional state-owned firm from China in the top four raises concentration by nearly 6 percentage points. To ensure that the effect is not picking up Chinese firms in the top four more broadly, column 5 includes a variable for Chinese top four non-SOEs. The coefficient is not significant. Finally, the last two columns include controls for mergers and acquisitions. The M&A variable is one if the sector is a top

12. Controlling for initial levels allows for some mean reversion, where industries with higher concentration may be more likely to see concentration fall (or less likely to see it rise further).

13. An F test that the coefficients are the same cannot be rejected (P-value 0.87).

14. Twenty of a total of 42 SOEs in the top four are Chinese.

15. An F test that coefficients on China SOEs and other SOEs are equal is rejected at the 10 percent level (P-value 0.07).

ten sector for M&A activity (by value, see table A.2).[16] There is some evidence that extensive mergers and acquisitions have also increased concentration (column 6); however, the effect of Chinese SOEs reduces their importance (column 7), consistent with mergers occurring in part in response to competition from state-owned firms. Overall, the results show that while more emerging-market firms in an industry tend to reduce concentration, the presence of Chinese state-owned enterprises expands it. Note that the long-run effects would be somewhat larger because the coefficient on the initial value indicates that concentration is persistent over time.[17]

While the effect of China on concentration is negative and statistically significant, it is also quite small. In contrast, the effect of China's SOEs is positive and relatively large. Overall, the effects broadly balance each other, such that the aggregate effect of China on average concentration, estimated on average values of the dependent variables, is positive but small. This coincides with earlier results showing that, on aggregate, the decline in average concentration is slightly smaller in data excluding China (table 2).

Appendix tables A.3a and A.3b repeat the exercise on the sample of raw data and the sample of the top 250 incumbent firms. Results are robust.

Table 5 reports results from using the natural logarithm difference of the HH index from 2006 to 2014. In this case, SOEs are measured by an index using all data, similar to the HH index, giving a higher weight to the existence of SOEs at the top of industry rankings. Specifically, the SOE index is constructed as the sum of 0.5 to the power of the revenue rank of SOEs within an industry. If there are no SOEs in an industry, the index is zero, and if all firms are SOEs, the index approaches 1. As an example, if there are two SOEs, one ranked 2 and one ranked 7, the index is $0.5^2 + 0.5^7 = 0.258$.

Results using the HH index as the dependent variable are similar to previous results using the four-firm concentration ratio. The rise of emerging-market firms has reduced concentration, but the rise of SOEs, and particularly Chinese SOEs, has expanded concentration significantly. Appendix tables A.4a and A.4b report the results on the raw data and the incumbent firm sample; results are robust.

The results show that the presence of Chinese SOEs at the top of the distribution in an industry is associated with rising concentration, but that does not mean Chinese SOEs cause concentration to rise. There are two other possibilities: (1) Other firms merge to compete with China SOEs, or (2) China supports firms in industries where concentration is rising. To examine the importance of Chinese SOEs, the four-firm concentration ratio in the 15 sectors where Chinese SOEs are present at the top of the distribution is calculated, with and without the SOEs. On average, excluding the SOEs, concentration would have fallen by half a percentage point; including the SOEs, concentration rose by 3 percentage points on average.

16. Using the top industries in terms of number of mergers and varying the number of industries included in the variable was also tried. The coefficient is always positive but is never significant at conventional levels.

17. As a partial adjustment model, the long-run effects of the independent variables can be calculated as the coefficients divided by the negative of the coefficient on the initial value.

The importance of SOEs for the direction and magnitude of the change in concentration offers additional evidence that Chinese SOEs are distorting competition. Together with the regression results, which control for other determinants of concentration, the results imply that SOEs led to a 3 to 6 percent increase in concentration in industries where they are at the top of the distribution.

Appendix table A.5 records the industries where Chinese SOEs are among the top 4 firms, the name of the SOEs, and the change in concentration with and without the SOEs. There are five sectors where Chinese SOEs have especially large effects—oil, fabricated metal, civil engineering, real estate, and professional activities. The fact that only the first two industries are traded goods could indicate a smaller effect of SOEs on global competition in the other sectors. For example, the industry most dominated by Chinese SOEs and where the concentration effect is most striking, civil engineering, largely reflects China's infrastructure boom. It would be a mistake, however, to assume that because an industry has largely served the domestic market, global competition is unaffected. As infrastructure projects have slowed in China, the SOEs dominating the civil engineering industry began competing for the world's largest projects. The scale is large: China State Construction Engineering Corporation (CSCEC) is renovating the Alexander Hamilton Bridge in New York, working on a tower in Moscow, and building a tourist resort in the Bahamas; China Railway Construction Corporation is building Mecca's new metro system; and China Communications Construction is building a highway in Jamaica.[18] These are precisely the type of contracts that formerly went to industry leaders from Europe, Japan, and the United States. Engineering and construction also have large spillovers to trade, as large infrastructure projects generate exports of machinery and equipment. As with civil engineering, China is also increasingly looking outward in real estate investment and professional services.

In order to get a better sense of how pure tradables are affected, the next analysis focuses on goods only, using data at the 3-digit level for 93 goods industries. While only some services are traded, all goods are traded. Because these industries are more disaggregated, this exercise is limited to the top 400 unique firms in each industry.

The results are reported in table 6. The same pattern holds—the presence of emerging-market firms reduces concentration—but SOEs and especially Chinese SOEs expand concentration. Tables A.6a and A.6b in the appendix repeat the exercise for the raw sample and incumbent firms and results remain similar.[19]

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18. "Great wall builders: Chinese firms are the new challengers in the global construction business," *Economist*, October 27, 2012, http://www.economist.com/news/business/21565244-chinese-firms-are-new-challengers-global-construction-business-great-wall-builders (accessed on February 1, 2017).

19. The one exception is that the coefficient on Chinese SOEs in the incumbent sample (appendix table A.5) remains large, but is no longer significant at conventional levels. A potential explanation is that in some tradable industries, the large SOEs are a result of new or merged firms, so they do not appear in this sample. Indeed over this period, new SOEs were formed and large SOEs were consolidated into industrial conglomerates (Hsieh and Zheng 2016).

Appendix table A.7 reports the industries where SOEs were present at the top of the distribution in the 3-digit tradables industries and the change in concentration. On average, concentration in these industries increased by over 4 percentage points. Excluding the SOEs, the average increased by less than 2 percentage points. China's SOEs are common in a number of export sectors, such as metals and electrical equipment, but also in some import-competing sectors, such as petroleum and coal and aircraft. While the effects of state enterprises in export industries are well known, and trade remedies exist to address them, SOEs in sectors where China is a net importer can also affect global competition. If they act as monopsony buyers, they reduce exporter profitability and attract the most competitive suppliers, potentially raising prices for other importers (Lustgarten 1975). Also, the fact that many of the industries where SOEs are important are upstream implies that price effects feed into other sectors. Finally, in some sectors the direction of external orientation could change as these firms grow; for example, as recently as 2004, China was a net importer of steel (Berger and Martin 2011).

The finding that SOEs are increasing global concentration in some industries is not inconsistent with a large body of work by Nicholas R. Lardy and others, which shows that the state share of production has fallen dramatically over the last three decades, as the private sector grew rapidly and state firms were privatized. The results on SOEs presented here pertain to a handful of relatively disaggregated industries and the specific period 2006–14. Lardy (2014) also finds that the decline in the state share of production has slowed in recent years, and that for some products, such as coal and metals, SOEs remain very important. The Organization for Economic Cooperation and Development (OECD 2010) finds that while the share of sectors where SOEs dominate has declined and the share of sectors with high concentration has declined from 1998 to 2008, there were still 21 sectors where the share of SOEs in output was above 50 percent and the sectors remained highly concentrated (using US Department of Justice thresholds of the HH index). Finally, even as the state share of a sector declines or the HH index falls, the rationalization of SOEs can result in a single state firm that is relatively large in some industries. Studies of the privatization process show that China has retained and merged the largest Chinese state firms into huge companies. Huang (2008) finds that China's privatization in the 1990s was accomplished by releasing small firms, while the state retained the largest firms. Hsieh and Zheng (2016) find that China converted SOEs into large industrial groups under the ownership of the state and has created new SOEs since 1998.

ALLOCATIVE EFFICIENCY

From an efficiency perspective, it is not the extent of concentration that matters but the relationship between firm size and productivity. Aggregate productivity in an industry will be greatest when the most productive firm is also the largest firm. When firms compete in a global market, the most productive firm in an industry should grow to be the largest firm, irrespective of the size of the home market, implying that allocative efficiency is likely to be strongest in industries open to trade.

While the data do not offer enough detail to allow a calculation of total factor productivity for many of the firms, the correlation between the very simple measure of output per worker and size is positive. Figure 3 shows the average productivity of firms by percentile for each industry, controlling for industrial differences.[20] There is a strong upward slope, showing that the firms at the top of the distribution are more productive than firms lower down. The productivity measure is in logs, so the interpretation is that a firm at the 80th percentile is 40 percent more productive than a firm at the 20th percentile. Figure 4 shows the average productivity of Chinese SOEs against their relative size. Chinese SOEs tend to be about 20 percent less productive than firms in the same industry of a similar size. The difference does not necessarily reflect weaker allocative efficiency, however. As productivity is measured as revenues per worker, this could reflect endowments or technology that makes Chinese production more labor intensive than other countries within industries.

Next, the robustness of the results in figures 3 and 4 is tested by examining the correlation between size and labor productivity using the firm-level data and controlling for other factors. Both revenue per worker and value-added per worker are used for the 2006 and 2014 data. Value-added per worker more accurately captures productivity but is available for fewer observations. The basic regression equation is:

$$(1)\quad \ln Size_{ijt} = \alpha_0 \ln Productivity_{ijt} + \alpha_1 SOE_{ijt} + X_{ijt} + \varepsilon_{ijt}$$

Where α_0 is the coefficient on productivity, which is expected to be positive if more productive firms are larger; α_1 is the coefficient on SOEs, and a positive coefficient would indicate that these firms are relatively large given their productivity. X_{jt} is a vector of fixed effects (country, industry, and year; country-industry and year; or country-year and industry-year), which will control for the larger size of firms in some industries and countries, as well as other country or industry specific characteristics, such as technology and resource endowments. The country-year and industry-year fixed effects will control for demand or supply shocks that might affect firms in specific industries or countries in particular years. Finally, ε_{ijt} is the error term; errors are assumed to be correlated within industries, so all results are reported with standard errors clustered at the industry level. This specification is amended by disaggregating the effect of productivity on size in traded and untraded sectors and also by comparing Chinese SOEs with SOEs from other countries.

The results are reported in table 7. Columns 1-6 report results using revenue per worker. Columns 1 and 2 show that a 10 percent increase in productivity translates into a 2.8 percent increase in size in tradable sectors and a 1.6 percent increase in size in other sectors. They also show that Chinese SOEs are more than twice as large as would be expected given their productivity. Note that country or country-year fixed effects are included in the regression, so this effect is not about China but specifically about Chinese SOEs. Column 3 includes country-industry and year-fixed effects and results are even stronger.

20. The figure reports residuals from a regression controlling for industry-fixed effects.

Columns 4-6 repeat the exercise in differences, including country and industry effects. This specification tests whether more productive firms and/or firms with faster productivity growth grow faster; the results show that they do in the tradable sectors. For other sectors, only productivity growth is correlated with size growth. The results also show that while Chinese SOEs are growing too fast given their productivity level and growth, SOEs from other countries are shrinking. While SOEs in general have tended to shrink over the period, Chinese SOEs grew in size, by about 20 percent (exp(.187)=1.21).

Columns 7-10 repeat the regressions for data using value added per worker. Because of the more limited number of observations, only the specification with country, year, and industry effects can be used in levels, and in growth (columns 9-10) there are not enough observations to estimate a separate tradables effect. Even so, the results are similar. The correlation between size and productivity is positive, significant, and stronger in tradable sectors. Chinese SOEs are too large given their productivity, and they are growing too fast.

Table 8 shows the regression table for the firms in the more disaggregate tradable industries (without the interaction terms since all sectors are tradable). The results remain similar: There is evidence of allocative efficiency—more productive firms are larger and grow faster—but Chinese SOEs are too large and growing too fast for their level of their productivity.

Overall, the results from this section show that more productive firms are larger, tend to grow faster, and productivity growth is correlated with size growth. The results are magnified in tradable sectors, where global competition is more intense. There is also evidence that Chinese SOEs are too large and have grown too fast given their productivity.

CONCLUSION

This paper shows that from 2006 to 2014, global concentration fell on average and in most industries, while churning at the top of the distribution was robust. The fall in concentration is partly attributable to growing competition from emerging markets, especially China. This more intense global competition to some extent eases concerns about growing monopoly power within individual countries, especially the United States. A few firms may dominate domestic production in some industries, but they compete with similarly large foreign firms, keeping monopoly power in check. Monopoly power concerns, however, are likely to become more relevant if protection rises in some countries, sheltering the now larger corporations from foreign competition.

Despite the average decline in concentration, there are several sectors where global concentration is rising and may warrant concern. These include: natural resources, metals, mining, real estate, civil engineering, and agriculture. Many of the sectors with increasing concentration tend to be dominated by Chinese state-owned firms. Results show that sectors with Chinese SOEs at the top have seen concentration rates rise by

3 to 6 percentage points more than other sectors, suggesting that state firms are different from large private firms, in terms of their dominance in a sector. There is also evidence that the SOEs are reducing allocative efficiency. They are too large given their productivity level and are growing too fast.

The importance of large Chinese SOEs for global efficiency resonates with concerns about reforms in China. The state sector has always been viewed as a drag on China's growth and productivity because it crowds out investment in more productive private firms. Dollar and Wei (2007), for example, find that China could have grown at the same rate with the investment intensity of GDP reduced by 5 percent if investment had been allocated more efficiently—in particular, away from state firms. Lardy (2014) shows that China's private sector drove growth over the last three decades, but state firms continued to absorb too much investment and maintained a monopoly or near monopoly position in several sectors. The mammoth size of some state firms was a result of the privatization process, which focused on small firms and used the revenue from their sale to finance investment in the large firms retained by the state. Several policy initiatives in the 1990s supported ever large SOEs through tax and debt relief and special licenses (Huang 2008).

So far, however, estimates of the effect of state capitalism on the global economy have focused mainly on individual sectors or regions.[21] This paper shows that distortions to global concentration attributable to Chinese state-owned firms are present in several industries. Moreover, many of the industries are upstream, so effects are likely to carry over through cheap inputs to downstream sectors.[22]

Increasing concentration, especially resulting from state-owned firms, also raises political economy anxieties. Large multinationals can influence their government to modify and enforce rules to their advantage, and special treatment may be easier for the government to justify when the competition is foreign. Such incentives are that much stronger when the state owns the country's largest firms. Ironically, state monopolies result in the same kind of problem that Karl Marx ascribed to runaway capitalism and monopoly: Firms fused with the government write the rules of the game. As these firms compete in global markets, rising state intervention also affects foreign producers. From the perspective of China's competitors, free trade will become less desirable if the competition has government backing, making trade rules that discipline the behavior of SOEs important.

21. See for example the European Council on Foreign Relations, "The Scramble for Europe," July 2011, and the *Economist,* "State Capitalism," January 21, 2012.

22. Tang, Wang, and Wang 2014 show the important role of SOEs in China's upstream industries, their rising domestic value added since 2007, and hence their contribution to overall export value added.

REFERENCES

Autor, David, David Dorn, Lawrence Katz, Christina Patterson, and John Van Reenen. 2017. *Concentrating on the Fall of the Labor Share*. Paper presented at the 2017 meetings of the American Economic Association.

Bai, Chone-en, Chang Tai Hsieh, and Yingyi Qian. 2006. *The Return to Capital in China*. Brookings Papers in Economic Activity. Washington: Brookings Institution.

Bain, Joe. 1951. Relation of Profit Rate to Industry Concentration: American Manufacturing, 1936–1940. *The Quarterly Journal of Economics* 65, no. 3: 293–24.

Berger, Brett, and Robert Martin. 2011. *The Growth of Chinese Exports: An Examination of the Detailed Trade Data.* Board of Governors of the Federal Reserve System, International Finance Discussion Papers, Number 1033 (November). Washington: Federal Reserve System.

Brozen, Yale. 1982. *Concentration, Mergers, and Public Policy.* New York: Macmillan.

De Grauwe, P., and F. Camerman. 2002. How Big are the Big Multinational Companies? *Tijdschrift voor Econornie en Management* XLVII.

Dollar, David, and Shang-jin Wei. 2007. *Das (Wasted) Kapital: Firm Ownership and Investment Efficiency in China*. NBER Working Paper 13103. Cambridge, MA: National Bureau of Economic Research.

Di Giovanni, Julien, and Andrei Levchenko. 2012. Country Size, International Trade and Aggregate Fluctuations in Granular Economies. *Journal of Political Economy* 120, no. 6: 1082–132.

Fogel, Kathy, Randall Morck, and Bernard Yeung. 2008. Big Business Stability and Economic Growth: Is What's Good for General Motors Good for America? *Journal of Financial Economics* 89 (2008): 83–108.

Furman, Jason, and Peter Orszag. 2015. *A Firm-Level Perspective on the Role of Rents in the Rise in Inequality.* Presentation at "A Just Society" Centennial Event in Honor of Joseph Stiglitz. New York: Columbia University.

Hsieh, Chang-Tai, and Peter Klenow. 2014. The Life Cycle of Plants in India and Mexico. *Quarterly Journal of Economics* 129, no. 3: 1035–84.

Hsieh, Chang-Tai, and Michael Song Zheng. 2016. *Grasp the Large, Let Go of the Small: The Transformation of the State Sector in China.* Brookings Papers on Economic Activity, Spring, 295-346. Washington: Brookings Institution.

Huang, Yasheng. 2008. *Capitalism with Chinese Characteristics: Entrepreneurship and the State.* Cambridge, England: Cambridge University Press.

Lardy, Nicholas R. 2014. *Markets over Mao: The Rise of Private Business in China*. Washington: Peterson Institute for International Economics.

Lustgarten, Steven. 1975. The Impact of Buyer Concentration in Manufacturing Industries. *The Review of Economics and Statistics* 57, no. 2 (May): 125–32

Melitz, M. 2003. The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity." *Econometrica* 71: 1695–725.

OECD (Organization for Economic Cooperation and Development). 2010. *OECD Economic Surveys: China* (February). Washington.

Peltzman, Sam. 1977. The Gains and Losses from Industrial Concentration. *Journal of Law and Economics* 20, no. 2, article 2.

Roll, R. 1992. Industrial Structure and the Comparative Behavior of International Stock Market Indices. *Journal of Finance* 47: 3–42.

Tang, Heiwai, Fei Wang, and Zhi Wang. 2014. *The Domestic Segment of Global Supply Chains in China under State Capitalism.* World Bank Policy Research Working Paper 6960. Washington: World Bank.

White, Lawrence. 2002. Trends in Aggregate Concentration in the United States. *Journal of Economic Perspectives* 16(4): 137–60.

World Bank. 2003. *Changes in Global Business Organizations*. Global Economic Prospects Report. Washington.

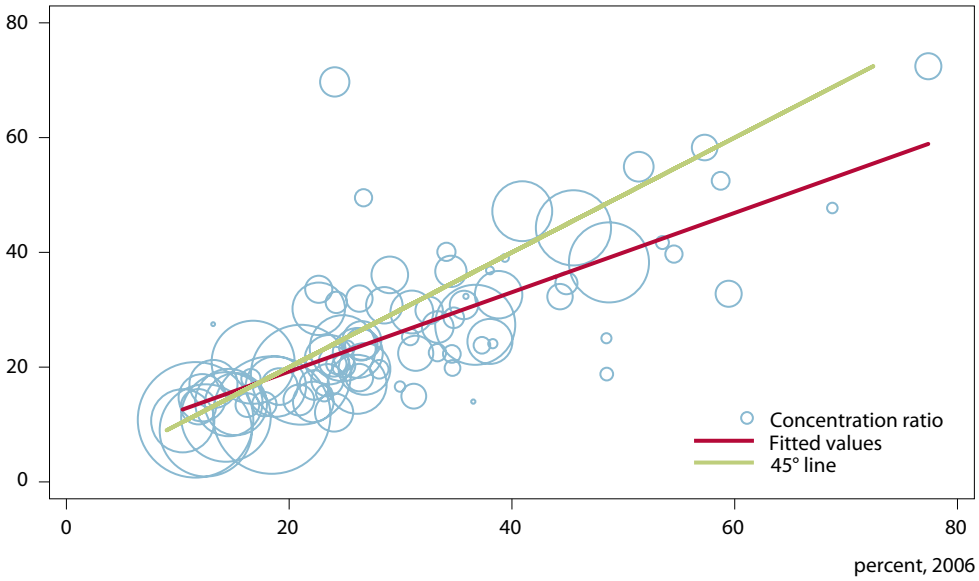
Table 1 Global concentration indices

	Orbis (Top 1,000 firms)	Financial Times (500 firms)	Forbes (2,000 firms)
	Four-firm concentration (percent)		
2006	5.7	11.5	5.0
2014	4.8	10.2	4.6
	Herfindahl-Hirschman index		
2006	27.7	80.9	22.6
2014	24.1	77.3	21.4
	Stability (percent)		
Top 4	75	75	75
Top 10	50	50	40
	Number of emerging-market firms		
2006	138	56	321
2014	249	86	582
	Number of Chinese firms		
2006	41	7	64
2014	136	32	207

Sources: Orbis, *Financial Times*, and *Forbes*. Figures based on authors' calculations.

Figure 1 Top four firms' share of top 650 revenue

percent, 2014



Note: The circles represent 84 industries; the size of the circles represent the total revenue of firms in the industry.

Source: Data from Orbis, authors' calculations.

Table 2 Four-firm concentration indices, averages across industries

	Top 650 unique firms	Top 250 incumbent firms	Top 1,000 firms
	Average levels (percent)		
2006	30.6	34.4	25.1
2014	26.6	33.5	21.8
	Weighted levels (percent)		
2006	29.9	34.4	21.6
2014	25.5	34.0	19.6
	Percent change		
Average	–4.1	–0.9	–3.3
Weighted	–4.4	–0.4	–2.1
Share (–)	76	57	75
	Herfindahl-Hirschman index		
2006	452.9	563	316.3
2014	352.5	499.9	249.1
Average percent change	–6.9	–0.8	–6.7
Percent share (–)	80	62	78
	Without China **Average levels** (percent)		
2006	31.3	34.9	25.8
2014	27.5	34.1	22.4
	Weighted levels (percent)		
2006	30.7	35.0	22.3
2014	26.5	34.5	19.7
	Herfindahl–Hirschman index		
2006	473.6	580.1	334.6
2014	382.5	517.8	270.2

Note: Weights constructed by industry revenue totals.

Source: Orbis, figures based on authors' calculations.

Table 3 Stability indices (percent)

All countries	Top 650 unique firms	Top 250 incumbent firms	Top 1,000 firms
Top four firms	54	66	53
Top ten firms	56	72	54
Without China			
Top four firms	55	68	55
Top ten firms	59	74	56

Note: Stability captures the average percentage of firms present in the top four/top ten firms in both 2006 and 2014, across industries.

Source: Orbis; figures based on authors' calculations.

Figure 2a Geographical distribution of top 4 firms in 2006, by industry

number of firms

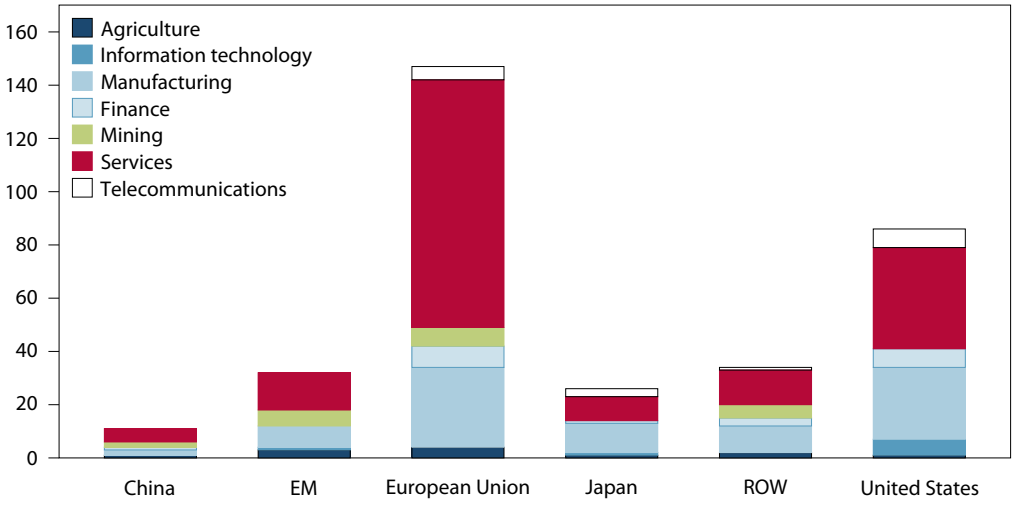
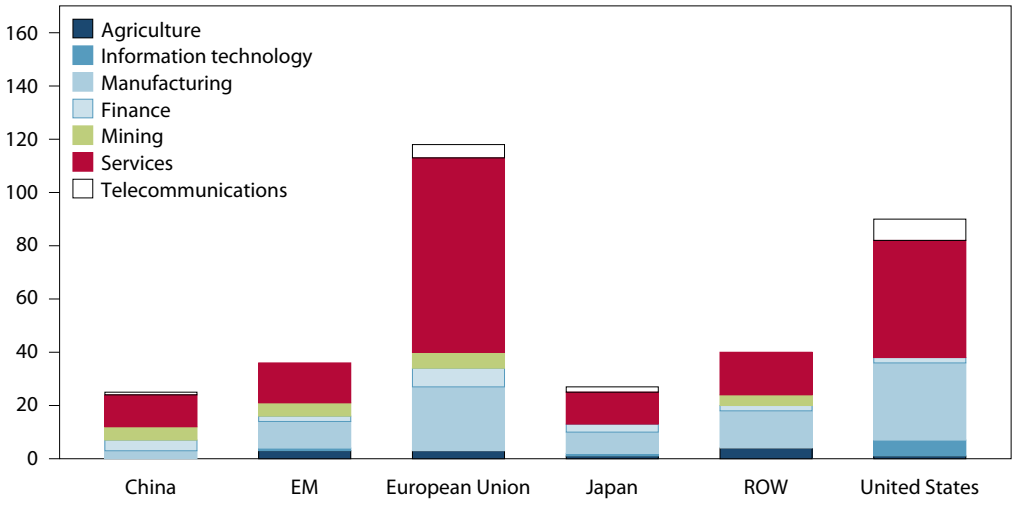


Figure 2b Geographical distribution of top 4 firms in 2014, by industry

number of firms



EM = emerging markets; ROW = rest of world

Note: The y axis lists the number of firms in the top 4 by revenue rank, of 84 global industries, divided by broad sectors and geographic origin.

Source: Data from Orbis, authors' calculations.

Table 4 Emerging-market firms, SOEs, and concentration (top 650 unique firms)

	Dependent variable: Percentage change in four-firm concentration ratio (2006–14)						
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
EM change	–0.054*		–0.063**	–0.073***	–0.072***	–0.046*	–0.068***
	(0.029)		(0.025)	(0.027)	(0.027)	(0.027)	(0.025)
China change		–0.054*					
		(0.028)					
Other EM change		–0.050					
		(0.041)					
SOEs			3.706***				
			(1.127)				
Chinese SOEs (top 4)				5.958***	5.893***		5.284***
				(1.565)	(1.552)		(1.142)
Other SOEs (top 4)				1.682			
				(1.536)			
Other Chinese firms (top 4)					–2.869		
					(3.292)		
M&As						6.887	3.552
						(4.374)	(3.596)
Initial concentration	–0.394***	–0.394***	–0.415***	–0.401***	–0.389***	–0.372***	–0.379***
	(0.103)	(0.104)	(0.105)	(0.102)	(0.101)	(0.099)	(0.100)
R^2	0.25	0.25	0.35	0.38	0.37	0.3	0.38
N	84	84	84	84	84	84	84

EM = emerging market; M&As = mergers and acquisitions; SOE = state-owned enterprise

Note: * $p<0.1$; ** $p<0.05$; *** $p<0.01$. 'Change' variables capture the change in the number of firms in the sample between 2006 and 2014. SOE variables capture the number of SOEs in the top 4 by revenue, in 2014. The dependent variable is the percentage point change in concentration between 2006 and 2014. M&As is a dummy variable, taking value 1 if a sector belongs to a top 10 sector by number of M&As, according to the Institute for Mergers, Acquisitions and Alliances (IMAA). Robust standard errors in parentheses.

Source: Orbis; figures based on authors' calculations.

Table 5 Emerging-market firms, SOEs, and HH (top 650 firms)

	Dependent variable: Change in log Herfindahl-Hirschman index (2006–14)					
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
EM change	–0.003		–0.003**	–0.004**	–0.002	–0.004**
	(0.002)		(0.001)	(0.002)	(0.002)	(0.002)
China change		–0.003*				
		(0.002)				
Other EM change		–0.003				
		(0.002)				
SOE weight			0.957***			
			(0.261)			
Chinese SOE weight				1.336***		1.197***
				(0.351)		(0.278)
Other SOE weight				0.434		
				(0.346)		
M&As					0.400	0.201
					(0.252)	(0.209)
Initial HH	–0.001***	–0.001***	–0.001***	–0.001***	–0.001***	–0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
R^2	0.16	0.16	0.26	0.29	0.20	0.29
N	84	84	84	84	84	84

EM = emerging market; HH = Herfindahl-Hirschman index; M&As = mergers and acquisitions; SOE = state-owned enterprise

Note: * $p<0.1$; ** $p<0.05$; *** $p<0.01$. SOE weight variables are constructed as the sum of 0.5 to the power of the revenue rank of SOEs within an industry. The dependent variable is the ln difference of the HH index between 2006 and 2014. Robust standard errors in parentheses.

Source: Orbis; figures based on authors' calculations.

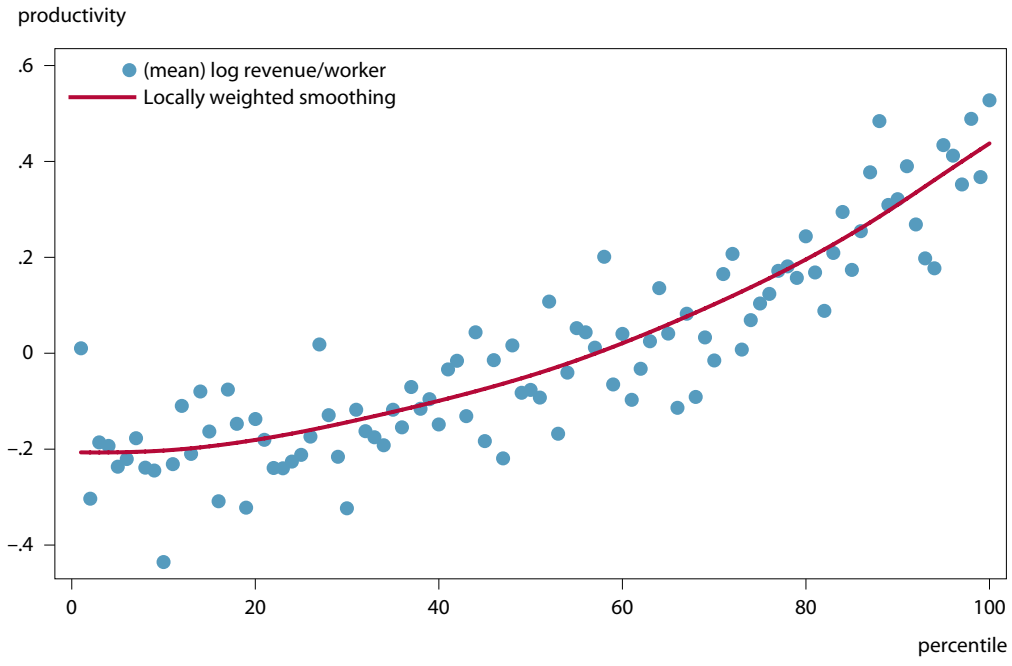
Table 6 Concentration in tradable industries (top 400 firms)

	Dependent variable: Percentage change in four-firm concentration ratio (2006–14)					
	(1)	(2)	(3)	(4)	(5)	(6)
EM Change	–0.055*		–0.060*	–0.057*	–0.055*	–0.055*
	(0.033)		(0.032)	(0.031)	(0.033)	(0.032)
China change		–0.047				
		(0.031)				
Other EM change		0.042				
		(0.07)				
SOEs (top 4)			4.589***			
			(1.714)			
Other SOEs (top 4)				2.715		
				(2.474)		
Chinese SOEs (top 4)				5.684*		6.536**
				(2.978)		(2.747)
M&As					0.113	–2.307
					(3.194)	(2.598)
Initial concentration	–0.38***	–0.341***	–0.401***	–0.395***	–0.38***	–0.396***
	(0.072)	(0.075)	(0.078)	(0.077)	(0.075)	(0.078)
R^2	0.22	0.25	0.27	0.28	0.22	0.28
N	93	93	93	93	93	93

EM = emerging market; M&As = mergers and acquisitions; SOE = state-owned enterprise

Note: * $p<0.1$; ** $p<0.05$; *** $p<0.01$. 'Change' variables capture the change in the number of firms in the sample between 2006 and 2014. SOE variables capture the number of SOEs in the top 4 by revenue, in 2014. The dependent variable is the percentage point change in concentration between 2006 and 2014. M&As is a dummy variable, taking value 1 if a sector belongs to a top 10 sector by number of M&As, according to the Institute for Mergers, Acquisitions and Alliances (IMAA). Robust standard errors in parentheses.

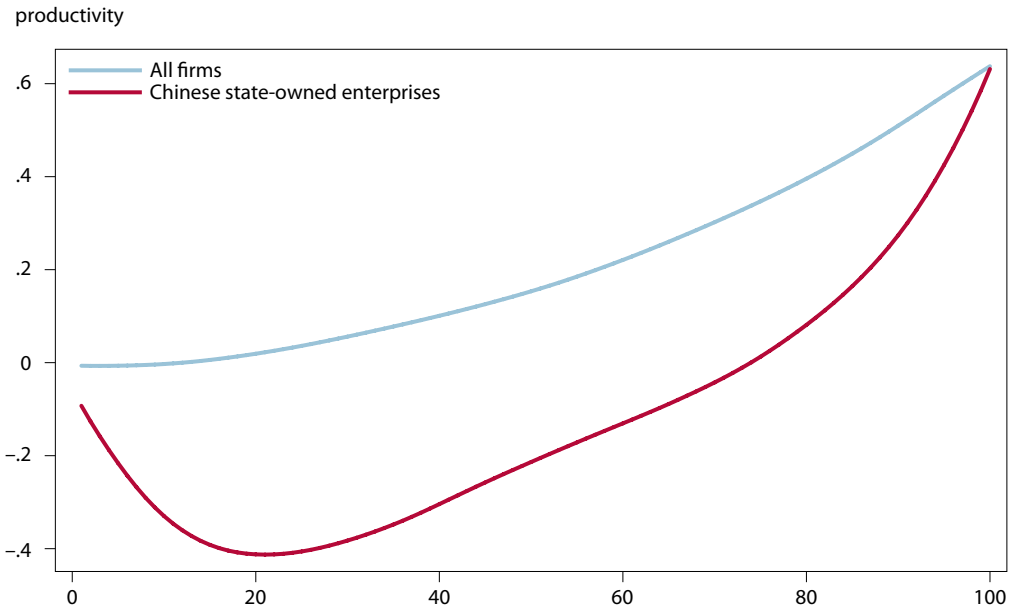
Figure 3 Revenue per worker, by industry revenue percentile, 2006–14



Note: The figure reports residuals from a regression controlling for industry fixed effects. Observations are averages of the logs of productivity by industry revenue percentile.

Source: Data from Orbis, authors' calculations.

Figure 4 The productivity gap, 2006–14



Note: The lines represent the locally weighted smoothing of the average productivity of firms by industry revenue percentile, for a sample of all firms, and Chinese state-owned enterprises.

Source: Data from Orbis, authors' calculations.

Table 7 Productivity, firm size, and SOEs

	Dependent variable: ln size									
	Revenues per worker						Value added per worker			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Productivity										
Traded sector	0.279***	0.275***	0.395***				0.210***	0.279***		
	(0.063)	(0.060)	(–0.041)				(0.032)	(–0.034)		
Other sector	0.163***	0.160***	0.242***				0.148***	0.181***		
	(0.018)	(0.017)	(–0.025)				(0.018)	(–0.02)		
SOE										
Chinese SOE	1.074***	1.069***	1.312***	0.212***	0.187***	0.255***	1.715***	2.541***	0.381**	0.767***
	(0.135)	(0.156)	(0.189)	(0.078)	(0.075)	(0.087)	(0.332)	(–0.352)	(0.170)	(0.162)
Other SOE	0.420***	0.410***	0.245**				0.263***	0.174*		
				–0.107***	–0.107***	–0.105***			–0.102***	–0.091***
	(0.090)	(0.086)	(0.097)	(0.022)	(0.022)	(–0.029)	(0.086)	(0.089)	(0.024)	(0.030)
Change in productivity										
Traded sector				0.339***	0.399***	0.389***			0.118***	0.147***
				(0.056)	(0.058)	(0.064)			(0.024)	(0.029)
Other sector				0.244***	0.250***	0.272***			0.135***	0.136***
				(0.026)	(0.026)	(0.029)			(0.026)	(0.028)
Productivity level 2006										
Traded sector					0.092***	0.030**				
					(0.016)	(0.132)				
Other sector					0.013	0.037***				
					(0.009)	(0.012)				
R^2	0.67	0.68	0.62	0.27	0.28	0.35	0.65	0.63	0.16	0.28
N	84,343	84,343	84,343	16,999	16,999	16,999	45,213	45,213	9,333	9,333
Fixed effects										
Country	X			X	X		X		X	
Industry	X			X	X		X		X	
Year	X		X				X	X		
Country-year		X								
Industry-year		X								
Industry-country			X			X		X		X

SOE = state-owned enterprise

Note: * $p<0.1$; ** $p<0.05$; *** $p<0.01$. Productivity measured as ln(revenue/worker) in columns 1–6 and ln(value added/worker) in columns 7–10. Columns 1–3 and 7–8 are in levels. Columns 4–6 and 9–10 are in changes. Errors clustered at the industry level.

Source: Orbis; figures based on authors' calculations.

Table 8 Productivity, firm size, and SOEs in tradable industries

	Dependent variable: ln size									
	Revenues per worker						Value added per worker			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Productivity	0.320***	0.304***	0.343***				0.263***	0.272***		
	(0.024)	(0.023)	(0.025)				(0.024)	(0.025)		
SOE										
Chinese SOE	1.213***	1.213***	1.093***	0.200*	0.176*	0.087***	2.147***	1.245***	0.508*	0.395
	(0.173)	(0.170)	(0.152)	(0.104)	(0.101)	(0.095)	(0.381)	(0.348)	(0.282)	(0.605)
Other SOE				–0.220***	–0.198***	–0.105***	0.498***	0.542***	–0.208*	–0.056
				(0.054)	(0.051)	(0.051)	(0.085)	(0.143)	(0.106)	(0.131)
Change in productivity				0.375***	0.431***	0.441***			0.173***	0.173***
				(0.026)	(0.027)	(0.031)			(0.017)	(0.021)
Productivity level 2006					0.095***	0.098***				
					(0.010)	(0.012)				
R^2	0.60	0.62	0.64	0.37	0.38	0.50	0.57	0.63	0.22	0.41
N	59,899	59,899	59,899	13,231	13,231	13,231	30,760	7,478	7,478	7,478
Fixed effects										
Country	X			X	X		X		X	
Industry	X			X	X		X		X	
Year	X		X				X	X		
Country-year		X								
Industry-year		X								
Industry-country			X			X		X		X

SOE = state-owned enterprise

Note: * $p<0.1$; ** $p<0.05$; *** $p<0.01$. Productivity measured as ln(revenue/worker) in columns (1)–(6) and ln(value added/worker) in columns (7)–(10). Columns (1)–(3) and (7)–(8) are in levels. Columns (4)–(6) and (9)–(10) are in changes. Errors clustered at the industry level.

Source: Orbis; figures based on authors' calculations.

APPENDIX TABLES

Table A.1 Sectors with largest increases and decreases in concentration, 2006–14
(percent)

Largest decreases		Largest increases	
Gambling and betting activities	–29.7	Other mining and quarrying	45.6
Travel agency and tour operator reservation services	–26.7	Public administration and defense	22.8
Residential care activities	–23.4	Libraries, archives, museums and other cultural activities	14.3
Veterinary activities	–22.5	Crop and animal production, hunting and related service activities	10.9
Forestry and logging	–21.0	Civil engineering	7.5
Specialized construction activities	–16.2	Publishing activities	7.1
Water collection, treatment and supply	–14.9	Printing and reproduction of recorded media	7.0
Scientific research and development	–14.8	Mining support service activities	6.2
Fishing and aquaculture	–14.2	Manufacture of leather and related products	6.0
Manufacture of electrical equipment	–13.6	Manufacture of wearing apparel	5.6
Repair and installation of machinery and equipment	–13.6	Manufacture of computer, electronic and optical products	4.1
Social work activities without accommodation	–13.3	Real estate activities	3.9
Information service activities	–12.3	Mining of coal and lignite	3.6
Activities of membership organizations	–12.0	Construction of buildings	2.5
Warehousing and support activities for transportation	–12.0	Manufacture of beverages	2.2

Source: Orbis; figures based on authors' calculations.

Table A.2 Highest value of mergers and aquisitions by industry, since 1985

	Value (billions of US dollars)	**Share of total** (percent)
Banks	5,013.9	7.82
Oil and gas	4,639.4	7.23
Metals and mining	3,006.0	4.69
Pharmaceuticals	2,621.2	4.09
Power	2,592.4	4.04
Telecommunications services	2,538.3	3.96
Food and beverage	2,252.3	3.51
Wireless	2,099.2	3.27
Insurance	2,049.9	3.20
Transportation and infrastructure	1,936.8	3.02

Source: Institute for Mergers, Acquisitions and Alliances (IMAA); available at: https://imaa-institute.org/m-and-a-by-industries/ (acccessed on February 2, 2107).

Table A.3a Emerging-market firms, SOEs, and concentration (top 250 incumbent firms)

	Dependent variable: Percentage change in four-firm concentration ratio (2006–14)						
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
EM change	–0.083		–0.085	–0.136*	–0.127*	–0.088	–0.133*
	(0.075)		(0.073)	(0.074)	(0.071)	(0.074)	(0.073)
China change		–0.154					
		(0.102)					
Other EM change		0.001					
		(0.110)					
SOEs (top 4)			2.249**				
			(0.937)				
Chinese SOEs (top 4)				4.831***	4.754***		4.263***
				(1.423)	(1.379)		(1.505)
Other SOEs (top 4)				0.094			
				(1.298)			
Other Chinese firms (top 4)					–5.748**		
					(2.725)		
M&As						4.933**	2.547
						(2.305)	(2.365)
Initial concentration	–0.210***	–0.213***	–0.204***	–0.211***	–0.213***	–0.206***	–0.209***
	(0.061)	(0.061)	(0.060)	(0.058)	(0.056)	(0.060)	(0.057)
R^2	0.13	0.14	0.19	0.24	0.28	0.16	0.25
N	84	84	84	84	84	84	84

EM = emerging market; M&As = mergers and acquisitions; SOE = state-owned enterprise

Note: * $p<0.1$; ** $p<0.05$; *** $p<0.01$.

Source: Orbis, figures based on authors' calculations.

Table A.3b Emerging-market firms, SOEs, and concentration (top 1,000 firms)

	Dependent variable: Percentage change in four-firm concentration ratio (2006–14)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
EM Change	–0.022**		–0.026***	–0.029***	–0.028***	–0.014	–0.022**
	(0.009)		(0.009)	(0.008)	(0.008)	(0.009)	(0.008)
China change		–0.020**					
		(0.009)					
Other EM change		0.002					
		(0.014)					
SOEs (top 4)			3.520***				
			(1.014)				
Chinese SOEs (top 4)				5.479***	5.432***		4.424***
				(1.311)	(1.315)		(1.312)
Other SOEs (top 4)				1.195			
				(1.421)			
Other Chinese firms (top 4)					0.426		
					(1.84)		
M&As						9.028***	6.675***
						(2.523)	(2.476)
Initial concentration	–0.350***	–0.327***	–0.371***	–0.353***	–0.344***	–0.308***	–0.314***
	(0.074)	(0.073)	(0.070)	(0.069)	(0.068)	(0.070)	(0.066)
R^2	0.22	0.26	0.32	0.36	0.35	0.32	0.41
N	85	85	85	85	85	85	85

EM = emerging market; M&As = mergers and acquisitions; SOE = state-owned enterprise

Note: * $p<0.1$; ** $p<0.05$; *** $p<0.01$.

Source: Orbis; figures based on authors' calculations.

Table A.4a Emerging-market firms, SOEs, and HH (top 250 incumbent firms)

	Dependent variable: Percentage change in log Herfindahl-Hirschman index (2006–14)					
	(1)	(2)	(3)	(4)	(5)	(6)
EM change	–0.006		–0.006*	–0.008**	–0.007*	–0.008**
	(0.004)		(0.004)	(0.004)	(0.004)	(0.003)
China change		–0.008				
		(0.005)				
Other EM change		–0.005				
		(0.006)				
SOE weight			0.626***			
			(0.191)			
Chinese SOE weight				1.099***		1.01***
				(0.257)		(0.282)
Other SOE weight				0.069		
				(0.281)		
M&As					0.277**	0.095
					(0.118)	(0.121)
Initial HH	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
R^2	0.18	0.18	0.28	0.34	0.23	0.34
N	84	84	84	84	84	84

EM = emerging market; HH = Herfindahl-Hirschman; M&As = mergers and acquisitions; SOE = state-owned enterprise

Note: * $p<0.1$; ** $p<0.05$; *** $p<0.01$.

Source: Orbis; figures based on authors' calculations.

Table A.4b Emerging-market firms, SOEs, and HH (top 1,000 firms)

	Dependent variable: Percentage change in log Herfindahl-Hirschman index (2006–14)					
	(1)	(2)	(3)	(4)	(5)	(6)
EM change	–0.001*		–0.002**	–0.002***	–0.001	–0.001*
	(0.001)		(0.001)	(0.001)	(0.001)	(0.001)
China change		–0.001*				
		(0.001)				
Other EM change		0.000				
		(0.001)				
SOE Weight			1.024***			
			(0.297)			
Chinese SOE weight				1.412***		1.166***
				(0.383)		(0.386)
Other SOE weight				0.437		
				(0.472)		
M&As					0.587***	0.439
					(0.182)	(0.181)
Initial HH	–0.001***	–0.001***	–0.001***	–0.001***	–0.001**	–0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
R^2	0.1	0.12	0.22	0.24	0.21	0.29
N	85	85	85	85	85	85

EM = emerging market; HH = Herfindahl-Hirschman index; M&As = mergers and acquisitions; SOE = state-owned enterprise

Note: * $p<0.1$; ** $p<0.05$; *** $p<0.01$.

Source: Orbis; figures based on authors' calculations.

Table A.5 Change in concentration, Chinese state-owned enterprises (SOEs) among top four firms (2006–14)

Sector	Firm	**Change in concentration** (percentage points)	**Change without SOEs** (percentage points)
Mining of coal and lignite	Shanxi Coking Coal Group	3.57	–1.61
	China Shenhua Energy Company		
Extraction of crude petroleum and natural gas	Petrochina	–1.27	–5.56
Other mining and quarrying	Jiangxi Copper Company	45.64	44.17
Mining support service activities	China National Petroleum Corporation	6.24	–4.72
Manufacture of other nonmetallic mineral products	China National Building Material Company	–8.95	–8.38
Manufacture of fabricated metal products, except machinery and equipment	Daye Nonferrous Metals Group	1.24	–1.93
Electricity, gas, steam and air conditioning supply	China Southern Power Grid Co, Ltd	–3.02	–3.33
Construction of buildings	Metallurgical Corporation of China	2.48	1.38
Civil engineering	China State Construction Engineering Corporation	7.48	–8.97
	China Railway Group		
	China Railway Construction Company		
	China Communications Construction Company		
Wholesale trade	Unipec	–0.79	–1.61
Telecommunications	China Mobile	–1.56	–1.69
Activities auxiliary to financial services	China National Chemical Corporation	–3.73	–3.6
Real estate activities	Greenland Holdings Corporation	3.9	0.2
	CITIC Limited		
Other professional, scientific and technical activities	Legend Holdings	–6.35	–11.52
Average across sectors		3.21	–0.51

Source: Orbis; figures based on authors' calculations.

Table A.6a Concentration in tradable industries (top 250 incumbent firms)

	Dependent variable: Percentage change in four-firm concentration ratio (2006–14)					
	(1)	(2)	(3)	(4)	(5)	(6)
EM change	–0.271***		–0.256***	–0.256***	–0.27***	–0.27***
	(0.092)		(0.090)	(0.091)	(0.092)	(0.092)
China change		–0.276***				
		(0.101)				
Other EM change		–0.253				
		(0.163)				
SOEs (top 4)			2.978**			
			(1.460)			
Chinese SOEs (top 4)				2.863		3.667
				(2.159)		(2.241)
Other SOEs (top 4)				3.109		
				(2.490)		
M&As					0.168	–0.985
					(2.242)	(2.331)
Initial concentration	–0.239***	–0.238***	–0.242***	–0.243***	–0.238***	–0.24***
	(0.057)	(0.057)	(0.056)	(0.056)	(0.058)	(0.058)
R^2	0.18	0.18	0.22	0.22	0.19	0.21
N	95	95	95	95	95	95

EM = emerging market; M&As = mergers and acquisitions; SOE = state-owned enterprise

Note: * $p<0.1$; ** $p<0.05$; *** $p<0.01$.

Source: Orbis; figures based on authors' calculations.

Table A.6b Concentration in tradable industries (top 900 firms)

	Dependent variable: Percentage change in four-firm concentration ratio (2006–14)					
	(1)	(2)	(3)	(4)	(5)	(6)
EM change	–0.013		–0.014*	–0.013	–0.012	–0.012
	(0.009)		(0.009)	(0.009)	(0.009)	(0.009)
China change		–0.005				
		(0.009)				
Other EM change		0.033*				
		(0.019)				
SOEs (top 4)			5.536***			
			(1.702)			
Other SOEs (top 4)				3.09		
				(3.140)		
Chinese SOEs (top 4)				6.785***		6.867***
				(2.172)		(2.301)
M&As					3.168	0.448
					(2.728)	(2.771)
Initial concentration	–0.408***	–0.346***	–0.425***	–0.419***	–0.394***	–0.409***
	(0.071)	(0.072)	(0.068)	(0.068)	(0.072)	(0.069)
R^2	0.27	0.32	0.34	0.35	0.28	0.34
N	95	95	95	95	95	95

EM = emerging market; M&As = mergers and acquisitions; SOE = state-owned enterprise

Note: * $p<0.1$; ** $p<0.05$; *** $p<0.01$.

Source: Orbis; figures based on authors' calculations.

Table A.7 Chinese state-owned enterprises (SOEs) among top four firms in 2014 (tradable industries)

Sector	Firm	Change in concentration (percentage points)	Change without SOEs (percentage points)
Support activities to agriculture	China Forestry Group	28.74	29.12
Mining of hard coal	Shanxi Coking Coal Group	26.78	30.57
	China Shenhua Energy Company		
Extraction of crude petroleum	Petrochina	–1.31	–5.55
Mining and quarrying n.e.c.	Jiangxi Copper Company	38.76	37.94
Support activities for petroleum and natural gas extraction	China Petroleum & Chemical Corporation	7.33	–3.69
Manufacture of other textiles	Jiangsu High Hope International Group	–1.21	–3.67
Manufacture of cement, lime and plaster	China National Building Material Company	–9.34	–11.43
Manufacture of basic precious and other nonferrous metals	Hesteel Company	–11.05	–10.55
Casting of metals	Wuhan Iron & Steel Company	–10.41	–9.67
	Baoshan Iron & Steel		
Manufacture of tanks, reservoirs and containers of metal	China International Marine Containers	5.1	6.22
Forging, pressing, stamping and roll-forming of metal	Daye Nonferrous Metals Group	9.79	–4.87
Manufacture of other electrical equipment	Shanghai Electric Group Company	–17.17	–18.63
Manufacture of parts and accessories for motor vehicles	SAIC	6.96	2.49
Manufacture of railway locomotives and rolling stock	CRRC Corporation	11.98	0.85
	CSR Corporation		
Manufacture of air and spacecraft	Aviation Industry Corporation of China	–6.33	–3.48
Manufacture of transport equipment n.e.c	China CNR Corporation	–9.47	–7.24
Average across sectors		4.32	1.78

Source: Orbis; figures based on authors' calculations.