Intangibles and Industry Concentration:

A Cross-Country Analysis

Supplementary materials

Appendix A. Robustness and Alternative Explanations

While we rely on CR8 as our baseline measure of concentration throughout the paper, we also test whether the results are robust to using other measures of concentration: CR4, CR20, and the Herfindahl-Hirschman index. Table A1 replicates Table 3 using 4-year changes in the Herfindahl-Hirschman index as the outcome variable, instead of 4-year changes in CR8. The results are very similar to those using CR8, with intangible investment intensity positively statistically significantly associated with changes in the Herfindahl-Hirschman index (at 5% or 1% significance level) in all specifications except the one relying on R&D tax incentives as the sole instrument (column 5), as was the case when using CR8 as the dependent variable. Similarly, the estimated relationship based on the largest 8 firms in each country and industry (column 1 of Table 6) is robust to considering only the largest 4 firms (columns 7 and 8 of Table A2) or broadening the group to the largest 20 firms (columns 9 and 10 of Table A2).

Table A1. Industry Concentration Changes and Intangible Investment – Herfindahl-Hirschman Index

	(1)	(2)	(3)	(4)	(5)	(6)
Outcome Variable:	4-Year Change in the Herfindahl-Hirschman Index					
Estimation Method:	OLS	OLS	OLS	IV	IV	IV
Instrumental Variables:				Other countries	Tax incentives	Both
Intangible Investment Intensity	0.114***	0.113***	0.118***	0.119**	0.163	0.121**
	(0.043)	(0.043)	(0.043)	(0.060)	(0.151)	(0.061)
4-Year Growth in Real Output		-0.017**	-0.017**	-0.017**	-0.017**	-0.017**
		(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
Tangible Investment Intensity			-0.008	-0.008	-0.024	-0.009
			(0.035)	(0.033)	(0.045)	(0.032)
Country-Year FE	Y	Y	Y	Y	Y	Y
Industry-Year FE	Y	Y	Y	Y	Y	Y
N	4812	4812	4812	4812	4812	4812
First-Stage F-Statistic	n/a	n/a	n/a	97.5	21.2	60.2
Hansen J-Test P-Value	n/a	n/a	n/a	n/a	n/a	0.73

Notes: *** 1%, ** 5%, * 10%. The table shows results of regressions at the country–A64 industry–year level. Columns 1 to 3 present OLS regressions and columns 4 to 6 present second stage IV estimates (the first stage estimates are reported earlier in Table B2). The reported first-stage F-statistic is the Kleibergen-Paap cluster-robust weak instrument statistic. Robust standard errors clustered at the country–A21 industry level (the level of aggregation of the intangible data) are in parentheses.

Table A2. Alternative Difference Lengths and Concentration Measures

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Outcome Variable:	4-Year Change in CR8		2-Year Change in CR8		6-Year Change in CR4		4-Year Change in CR4		4-Year Change in CR20	
Estimation Method:	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV
Intangible Investment Intensity	0.198***	0.195**	0.179***	0.275*	0.232**	0.238**	0.193***	0.180**	0.232***	0.248**
	(0.070)	(0.093)	(0.060)	(0.163)	(0.097)	(0.118)	(0.067)	(0.085)	(0.072)	(0.097)
4-Year Growth in Real Output	-0.071***	-0.071***					-0.057***	-0.057***	-0.093***	-0.093***
	(0.013)	(0.013)					(0.011)	(0.011)	(0.015)	(0.015)
2-Year Growth in Real Output			-0.041	-0.041						
			(0.028)	(0.028)						
6-Year Growth in Real Output					-0.084***	-0.084***				
					(0.017)	(0.017)				
Tangible Investment	-0.043	-0.042	-0.020	-0.054	-0.068	-0.070	-0.046	-0.041	-0.039	-0.045
	(0.053)	(0.055)	(0.035)	(0.049)	(0.077)	(0.080)	(0.051)	(0.051)	(0.055)	(0.058)
Country-Year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Industry-Year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
N	4812	4812	5196	5196	4004	4004	4812	4812	4812	4812

Notes: *** 1%, ** 5%, * 10%. The table shows results of OLS and IV regressions at the country–A64 industry–year level. Robust standard errors clustered at the country–A21 industry level (the level of aggregation of the intangible data) are in parentheses.

Our choice to focus on 4-year changes in CR8 concentration in the baseline specification is driven by the trade-off between explaining medium-term concentration developments (rather than short-run volatility) and having a sufficiently large number of observations for the estimation. Robustness checks using shorter or longer time windows (columns 3-6 of Table A2) confirms the robust positive correlation between intangible investment and concentration changes.

We also document that the main result on intangible investment intensity is robust to excluding any particular country (Table A3) or industry (Table A4).

Table A3. Ind. Concentration Changes and Int. Invest. – Dropping One Country at a Time

Panel A	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Excluded Country:	None	BEL	DEU	DNK	ESP	FIN	FRA
Outcome Variable:	4-Year Change in CR8						
Intangible Investment	0.198***	0.201**	0.206***	0.242***	0.208***	0.231***	0.197***
	(0.070)	(0.079)	(0.075)	(0.073)	(0.070)	(0.074)	(0.075)
4-Year Growth in Real Output	-0.071***	-0.068***	-0.070***	-0.069***	-0.075***	-0.071***	-0.082***
	(0.013)	(0.014)	(0.013)	(0.012)	(0.013)	(0.014)	(0.010)
Tangible Investment	-0.043	-0.038	-0.047	-0.065	-0.027	-0.024	-0.050
	(0.053)	(0.055)	(0.062)	(0.055)	(0.058)	(0.049)	(0.056)
N	4812	4428	4488	4468	4405	4416	4368

Panel B	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Excluded Country:	GBR	GRE	ITA	JPN	PRT	SWE	USA
Outcome Variable:	4-Year Change in CR8						
Intangible Investment	0.186**	0.153***	0.208***	0.192***	0.199**	0.171**	0.187**
	(0.072)	(0.054)	(0.075)	(0.070)	(0.079)	(0.076)	(0.071)
4-Year Growth in Real Output	-0.068***	-0.066***	-0.078***	-0.069***	-0.065***	-0.068***	-0.074***
	(0.013)	(0.016)	(0.011)	(0.014)	(0.013)	(0.013)	(0.013)
Tangible Investment	-0.050	-0.049	-0.039	-0.029	-0.056	-0.049	-0.032
	(0.055)	(0.043)	(0.056)	(0.055)	(0.054)	(0.059)	(0.053)
N	4452	4477	4368	4526	4468	4416	4464

Notes: *** 1%, ** 5%, * 10%. The table shows results of OLS regressions at the country–A64 industry–year level. All regressions control for country-year and industry-year fixed effects. Column 1 above repeats the baseline regression of column 4 in Table 3. Robust standard errors clustered at the country–A21 industry level are in parentheses.

Table A4. Industry Concentration Changes and Intangible Investment – Dropping One Industry at a Time

Panel A	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Excluded Industry:	None	10	13	16	17	18	19
Outcome Variable:	4-Year Change in CR8						
Intangible Investment	0.198***	0.197***	0.204***	0.206***	0.205***	0.194***	0.195***
	(0.070)	(0.071)	(0.071)	(0.069)	(0.069)	(0.071)	(0.069)
4-Year Growth in Real Output	-0.071***	-0.072***	-0.070***	-0.071***	-0.072***	-0.071***	-0.082***
	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.011)
Tangible Investment	-0.043	-0.043	-0.042	-0.044	-0.039	-0.045	-0.041
	(0.053)	(0.052)	(0.052)	(0.052)	(0.052)	(0.053)	(0.053)
N	4812	4657	4657	4669	4681	4657	4765

Panel B	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Excluded Industry:	20	21	22	23	24	25	26
Outcome Variable:	4-Year Change in CR8						
Intangible Investment	0.193***	0.189***	0.201***	0.196***	0.203***	0.197***	0.195***
	(0.070)	(0.067)	(0.071)	(0.070)	(0.071)	(0.070)	(0.070)
4-Year Growth in Real Output	-0.070***	-0.071***	-0.070***	-0.071***	-0.074***	-0.071***	-0.073***
	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
Tangible Investment	-0.037	-0.040	-0.043	-0.044	-0.042	-0.039	-0.047
	(0.053)	(0.051)	(0.052)	(0.052)	(0.053)	(0.053)	(0.053)
N	4669	4681	4657	4669	4681	4657	4693

Panel C	(15)	(16)	(17)	(18)	(19)	(20)	(21)
Excluded Industry:	27	28	29	30	31	33	41
Outcome Variable:	4-Year Change in CR8						
Intangible Investment	0.189***	0.207***	0.193***	0.190***	0.202***	0.216***	0.204***
	(0.072)	(0.071)	(0.071)	(0.070)	(0.070)	(0.073)	(0.072)
4-Year Growth in Real Output	-0.077***	-0.070***	-0.069***	-0.067***	-0.071***	-0.058***	-0.070***
	(0.014)	(0.012)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
Tangible Investment	-0.044	-0.046	-0.042	-0.041	-0.041	-0.052	-0.050
	(0.053)	(0.053)	(0.053)	(0.053)	(0.053)	(0.053)	(0.059)
N	4657	4669	4681	4693	4680	4680	4669

Panel D	(22)	(23)	(24)	(25)	(26)	(27)	(28)
Excluded Industry:	47	49	50	51	52	53	55
Outcome Variable:	4-Year Change in CR8						
Intangible Investment	0.179**	0.198***	0.196***	0.207***	0.199***	0.205***	0.198***
	(0.069)	(0.072)	(0.071)	(0.072)	(0.072)	(0.069)	(0.072)
4-Year Growth in Real Output	-0.070***	-0.071***	-0.075***	-0.076***	-0.071***	-0.068***	-0.071***
	(0.013)	(0.013)	(0.012)	(0.014)	(0.013)	(0.013)	(0.013)
Tangible Investment	-0.051	-0.040	-0.036	-0.061	-0.046	-0.014	-0.043
	(0.053)	(0.059)	(0.055)	(0.055)	(0.058)	(0.052)	(0.054)
N	4669	4684	4746	4722	4696	4726	4657

Panel E	(29)	(30)	(31)	(32)	(33)	(34)	(35)
Excluded Industry:	58	59	61	62	71	72	73
Outcome Variable:	4-Year Change in CR8						
Intangible Investment	0.182**	0.217**	0.138**	0.193***	0.217***	0.206***	0.208***
	(0.080)	(0.089)	(0.059)	(0.066)	(0.071)	(0.071)	(0.075)
4-Year Growth in Real Output	-0.069***	-0.068***	-0.071***	-0.070***	-0.073***	-0.071***	-0.069***
	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
Tangible Investment	-0.050	-0.055	-0.025	-0.025	-0.042	-0.040	-0.041
	(0.056)	(0.058)	(0.049)	(0.052)	(0.054)	(0.053)	(0.054)
N	4694	4670	4683	4659	4680	4704	4668

Panel F	(36)	(37)	(38)
Excluded Industry:	77	78	79
Outcome Variable:	4-Year Change in CR8		
Intangible Investment	0.223***	0.193***	0.205***
	(0.069)	(0.073)	(0.068)
4-Year Growth in Real Output	-0.069***	-0.072***	-0.069***
	(0.013)	(0.013)	(0.013)
Tangible Investment	-0.061	-0.037	-0.069
	(0.054)	(0.057)	(0.049)
N	4676	4688	4688

Notes: *** 1%, ** 5%, * 10%. The table shows results of OLS regressions at the country–A64 industry–year level. All regressions control for country-year and industry-year fixed effects. Column 1 above repeats the baseline regression of column 4 in Table 3. Robust standard errors clustered at the country–A21 industry level are in parentheses.

One concern with our primary explanatory variable is that intangible investment intensity could vary over time not only because of changes in intangible investment but also because of changes in the denominator (industry value added). For this reason, we test the robustness of our main results (columns 3 and 6 in Table 3) to using a time-invariant denominator. We report

the results in Table A5. Columns 1 and 2 fix the denominator at the beginning of the sample period, and columns 3 and 4 use for each country and industry the average across all years of the denominator. With both types of the fixed denominator, we see a sizeable and statistically significant association between concentration changes and the intangible investment intensity. The point estimates are somewhat smaller when the initial-period denominator is used.[1] When we fix the denominator at the average value across years, the point estimates are very similar to the baseline.

Table A5. Industry Concentration Changes and Intangible Investment – Fixed Denominator of the Intangible Investment Intensity

	(1)	(2)	(3)	(4)
Estimation Method:	OLS	IV	OLS	IV
Outcome Variable:	4-Year Change in CR8			
Intangible Investment Intensity (denominator fixed in the initial year)	0.116**	0.134**		
	(0.053)	(0.065)		
Intangible Investment Intensity (denominator fixed at the mean value)			0.187***	0.206**
			(0.071)	(0.098)
Country-Year FE	Y	Y	Y	Y
Industry-Year FE	Y	Y	Y	Y
N	4812	4812	4812	4812

Notes: *** 1%, ** 5%, * 10%. The table shows results of regressions at the country–A64 industry–year level. All regressions include (4 year) growth in industry sales and tangible investment intensity as control variables, which are omitted for parsimony. Robust standard errors clustered at the country–A21 industry level (the level of aggregation of the intangible data) are in parentheses.

Weak antitrust enforcement of mergers and acquisitions has been proposed as an explanation for divergent concentration trends, with the acquisition of innovative start-ups by incumbent firms potentially weakening future competition (e.g., Cunningham et al., 2018; Gutiérrez and Philippon, 2019). If intangible investment is correlated with M&As, M&As could be an omitted variable biasing our results for intangibles. We explore the possible connection between concentration changes and mergers and acquisitions in Table A6. In columns 1-6, we include different measures of M&As as controls. Columns 1 and 2 include a dummy equal to one when at least one large M&A (with value above the 95th percentile among all M&As observed in a given country over the sample period)[2] took place in a given country, industry, and year.

[1] Since industry value-added grows over time, using initial period value-added as the denominator will tend to overstate intangible intensity in later years. Consequently, the effect of a given change in intangible intensity on concentration will be understated, consistent with our smaller point estimates.

[2] Using instead a threshold at the 50th, 75th, 90th or 99th percentile has no material effects on the results.

Columns 3 and 4 include M&A intensity, measured as the total value of M&As in a given country, industry, and year relative to industry value added. Columns 5 and 6 include the logarithm of the total number of M&As that took place in a given country, industry, and year. We find no statistically significant relationship between concentration changes and any of the three different measures of M&As, and controlling for the occurrence of M&As has no significant effect on the coefficient for intangible investment intensity, irrespective of the M&A measure used.

In columns 7-10 of Table A6, we take an alternative approach to testing the role that M&As could play in the relationship between concentration changes and intangibles. Like in Figure B4, discussed in section 2.2 of the main text, we decompose the total changes in concentration into (1) organic changes that would be observed if business group ownership structure remained unchanged throughout the period and (2) M&A-related changes obtained as the difference between the total and organic changes in concentration. The results reveal that intangible investment intensity is strongly correlated with the organic concentration changes but does not seem to be connected to M&A-related concentration changes.

Together, the results in Figure B4 and Table A6 indicate that M&As accounted only for a small part of the observed concentration increase, and their role was independent of the role played by intangibles, the main focus of our paper.

Next, we examine whether the relationship between intangibles and concentration is affected by controlling for other commonly cited factors that might be related to concentration trends (Table A7). A large literature suggests that globalization increases the toughness of competition and leads to reallocation of production to larger firms, which are able to expand through exports and benefit from a wide range of imported inputs (Melitz, 2003; Melitz and Ottaviano, 2008).[3] We add 4-year changes in trade openness, measured as the average of exports and imports relative to value added, to the regression. Accounting for changes in trade openness has no effect on the estimated coefficient for intangible investment, and we do not find any evidence of a link between changes in trade openness and changes in concentration (columns 1 and 2).[4] Thus, whilst globalization magnifies the impact of intangibles on concentration (Table 5), globalization itself does not appear to directly impact concentration (Table A7).

[3] Autor et al. (2020) discuss globalization as a potential explanation for the recent concentration increases in the US.

[4] Trade openness is defined at the level of A64 industries rather than A21 industries. Clustering standard errors at the country-A64 industry level, rather than country-A21 industry level, does not affect the results.

Table A6. Accounting for M&As

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Outcome Variable:	4-Year Change in CR8 Concentration									
CR8 Change:	Total Concentration		Total Concentration		Total Concentration		Organic Concentration		M&A-Related Concentration	
Estimation Method:	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV
Intangible Investment Intensity	0.198***	0.193**	0.199***	0.196**	0.200***	0.225**	0.186***	0.213***	-0.010	-0.044
	(0.070)	(0.093)	(0.070)	(0.093)	(0.072)	(0.094)	(0.062)	(0.073)	(0.024)	(0.027)
Large M&A Dummy	0.007	0.007								
	(0.005)	(0.005)								
M&A Intensity			-0.003	-0.003						
			(0.003)	(0.003)						
Number of M&As					0.002	0.002				
					(0.004)	(0.004)				
Country-Year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Industry-Year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
N	4812	4812	4812	4812	4171	4171	3399	3399	3399	3399

Notes: *** 1%, ** 5%, * 10%. The table shows results of OLS and IV regressions at the country–A64 industry–year level. All regressions include (4 year) growth in industry sales and tangible investment intensity as control variables, which are omitted for parsimony. The large M&A dummy reflects at least one large M&A in a given country, industry, and year; large M&As are those with a value above the 95th percentile among all M&As observed in a given country over the sample period. M&A Intensity is calculated as the total value of M&As in a given country, industry, and year relative to industry value added. We include log number of M&As in a country, industry, and year in columns 5 and 6. Organic concentration is calculated fixing firm ownership data (i.e., the business group structure) in the initial year, 2002. M&A-related concentration changes reflect the differences between total concentration changes and those attributable to organic growth. Robust standard errors clustered at the country–A21 industry level (the level of aggregation of the intangible data) are in parentheses.

Table A7. Industry Concentration Changes, Intangible Investment, and Other Factors

	(1)	(2)	(3)	(4)
Estimation Method:	OLS	IV	OLS	IV
Intangible Investment Intensity	0.208***	0.213**	0.232***	0.261***
	(0.071)	(0.089)	(0.075)	(0.088)
4-Year Change in Trade Openness	-0.007	-0.007		
	(0.010)	(0.010)		
4 Year Change in Product Market Regulation			-0.086**	-0.086**
			(0.041)	(0.041)
Country-Year FE	Y	Y		
Country FE			Y	Y
Industry-Year FE	Y	Y	Y	Y
N	4400	4400	3608	3608

Notes: *** 1%, ** 5%, * 10%. The table shows results of OLS and IV regressions at the country–A64 industry–year level. All regressions include (4 year) growth in industry sales and tangible investment intensity as control variables, which are omitted for parsimony. Country-year fixed effects are replaced by country fixed effects in specifications 3 and 4 as Product Market Regulation is measured at the country-year level. Robust standard errors clustered at the country–A21 industry level (the level of aggregation of the intangible data) are in parentheses.

The increasing concentration could also reflect increasing barriers to entry due to regulation (Bailey and Thomas, 2017). As stricter regulations can be associated with weaker investment in general, and in intangibles in particular (e.g., Corrado et al., 2018), the positive estimated coefficient for intangibles could be reflecting the role of regulations. We explore this possibility by including 4-year changes in the OECD Product Market Regulation (PMR) Index[5] in the regression. Columns 3 and 4 of Table A8 show that the estimated coefficient on intangible investment remains unchanged when the PMR index is included, but it also points to a statistically significant negative relationship between product market regulations and concentration. A one-standard-deviation greater 4-year *reduction* in PMR corresponds to a 1.1-percentage-point larger change in industry concentration. The PMR index is a very broad measure of regulation, and thus these results should be taken with caution. That said, increasing concentration appears to be associated with *deregulation* rather than increasing regulation in our sample.[6]

[5] A greater value of the PMR index indicates more regulated product markets.

[6] We test the robustness of this somewhat surprising result in online Appendix Table A8. Not controlling for country fixed effects leads to a smaller coefficient on the PMR index (column 2). The coefficient is not affected by excluding intangible investment intensity from the regression (column 3) and by dropping outlier PMR

Table A8. Industry Concentration Changes and Changes in Product Market Regulation

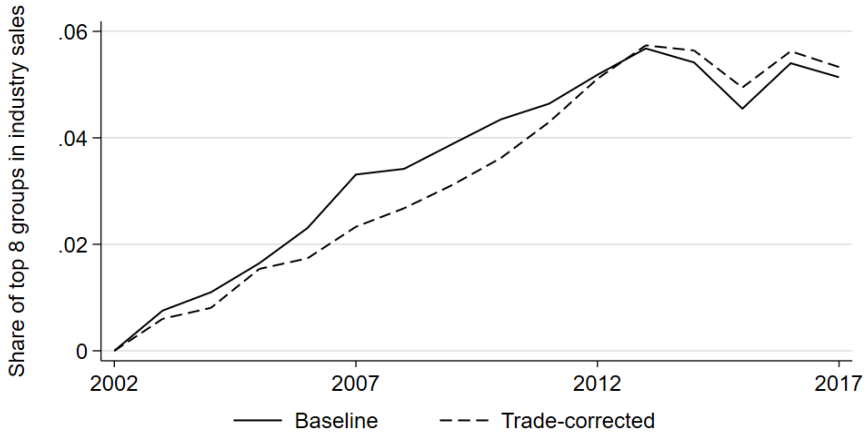
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Outcome Variable:	4-Year Change in CR8						
Intangible Investment	0.235***	0.241***		0.229***	0.226***	0.224***	0.236***
	(0.067)	(0.034)		(0.067)	(0.066)	(0.068)	(0.067)
4-Year Change in Product Market Regulations	-0.092**	-0.047***	-0.088*	-0.094**			
	(0.042)	(0.015)	(0.043)	(0.042)			
4-Year Change in Barriers to Trade and Investment					-0.012		
					(0.068)		
4-Year Change in Barriers to Entrepreneurship						-0.050	
						(0.029)	
4-Year Change in State Control							-0.039**
							(0.017)
Country FE	Y		Y	Y	Y	Y	Y
Industry-Year FE	Y	Y	Y	Y	Y	Y	Y
N	3586	3586	3586	3528	3441	3441	3441

Notes: *** 1%, ** 5%, * 10%. The table shows results of OLS regressions at the country–A64 industry–year level. All regressions include (4 year) growth in industry sales and tangible investment intensity as control variables, which are omitted for parsimony. Barriers to Trade and Investment, Barriers to Entrepreneurship and State Control are the three components of the aggregate Product Market Regulations Index. Column 4 excludes observations with a 4-year change in the PMR more than two standard deviations above or below the mean 4-year change in the PMR in the estimation sample. As the PMR index is a country-level measure, we cluster standard errors by countries rather than country-industry pairs throughout the table. Robust standard errors are clustered at the country level in parentheses.

changes, defined as a 4-year change in the PMR that is more than two standard deviations away from the mean PMR change in the estimation sample (column 4). Finally, when we split the aggregate PMR index into its three components, we estimate negative coefficients for all of them, although only the coefficient for State Control is statistically significant.

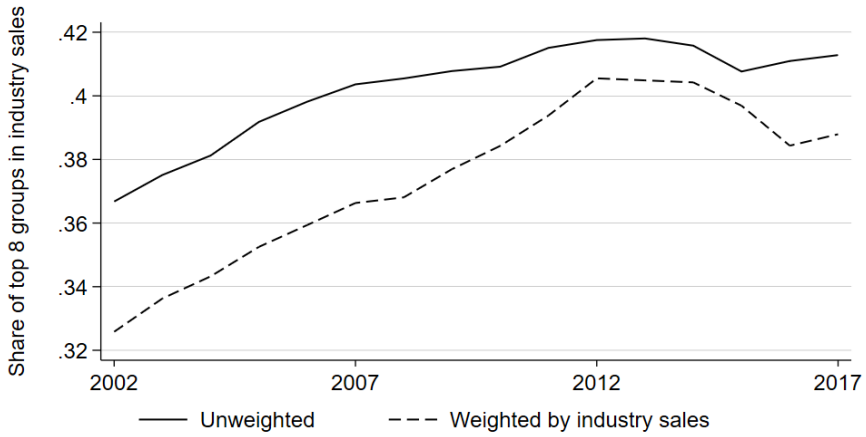
Appendix B. Additional Tables and Figures

Figure B1. Trends in top 8 concentration in manufacturing controlling for international trade



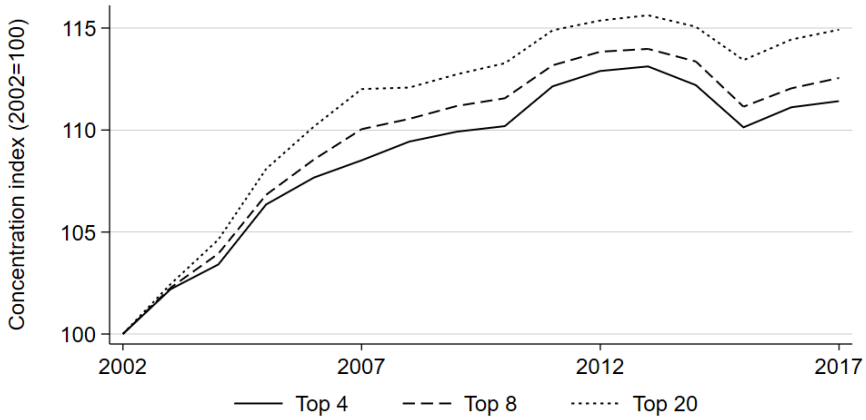
Notes: The figure shows changes in the unweighted mean concentration across country-industry pairs. The denominator of the baseline concentration measure is given by industry output. The denominator of the trade-corrected measure is given by industry output to which industry imports are added and from which industry exports are subtracted. Countries included are BEL, DEU, DNK, ESP, FIN, FRA, GBR, GRE, FRA, JPN, PRT, SWE and USA. Included 2-digit industries cover manufacturing.

Figure B2. Trends in top 8 concentration



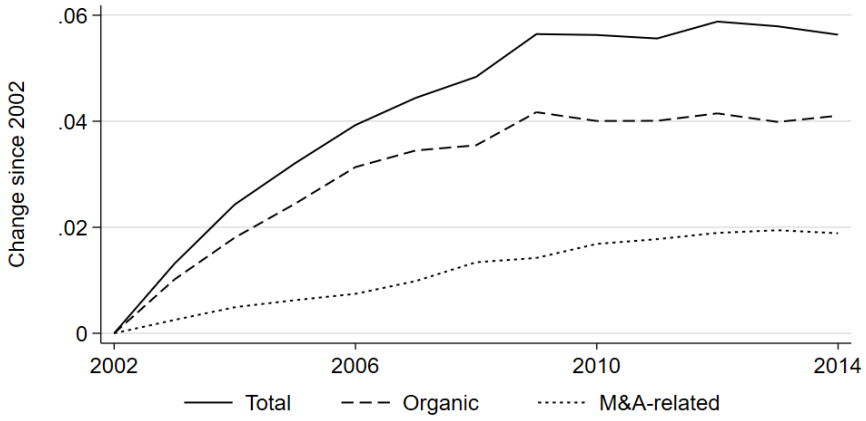
Notes: The figure shows changes in the unweighted and weighted mean concentration across country-industry pairs. The weighted mean reweights concentration across industries within each country based on time-varying weights given by the share of each industry in the total country-level sales. Countries included are BEL, DEU, DNK, ESP, FIN, FRA, GBR, GRE, FRA, JPN, PRT, SWE, and USA. Included 2-digit industries cover manufacturing, construction, and non-financial market services.

Figure B3. Proportional changes in top 4, top 8 and top 20 industry concentration



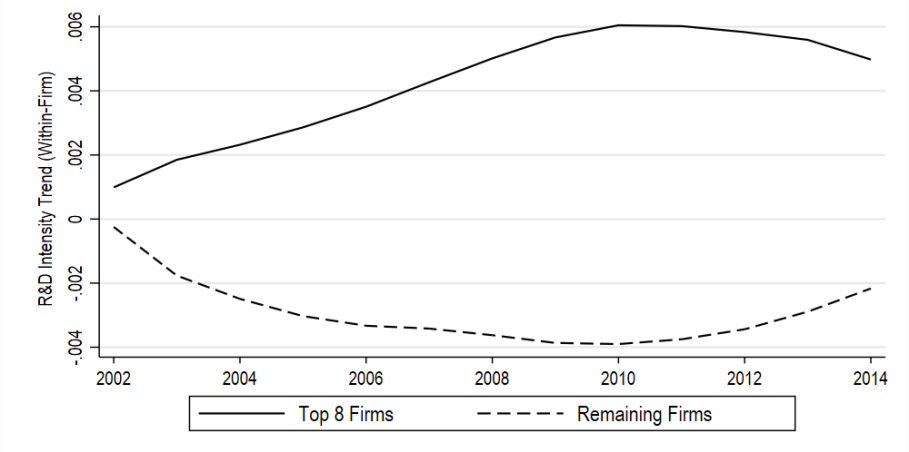
Notes: The figure shows proportional changes in the (unweighted) mean concentration across country-industry pairs. Proportional rather than absolute changes in concentration are shown for reasons of comparability. The countries include BEL, DEU, DNK, ESP, FIN, FRA, GBR, GRE, FRA, JPN, PRT, SWE and USA. Included industries cover 2-digit manufacturing, construction, and non-financial market services. Concentration is measured by the share of top 4, top 8 and top 20 business groups in the sales of each industry in each country.

Figure B4. Trends in top 8 concentration by source of business group growth – organic growth vs ownership changes



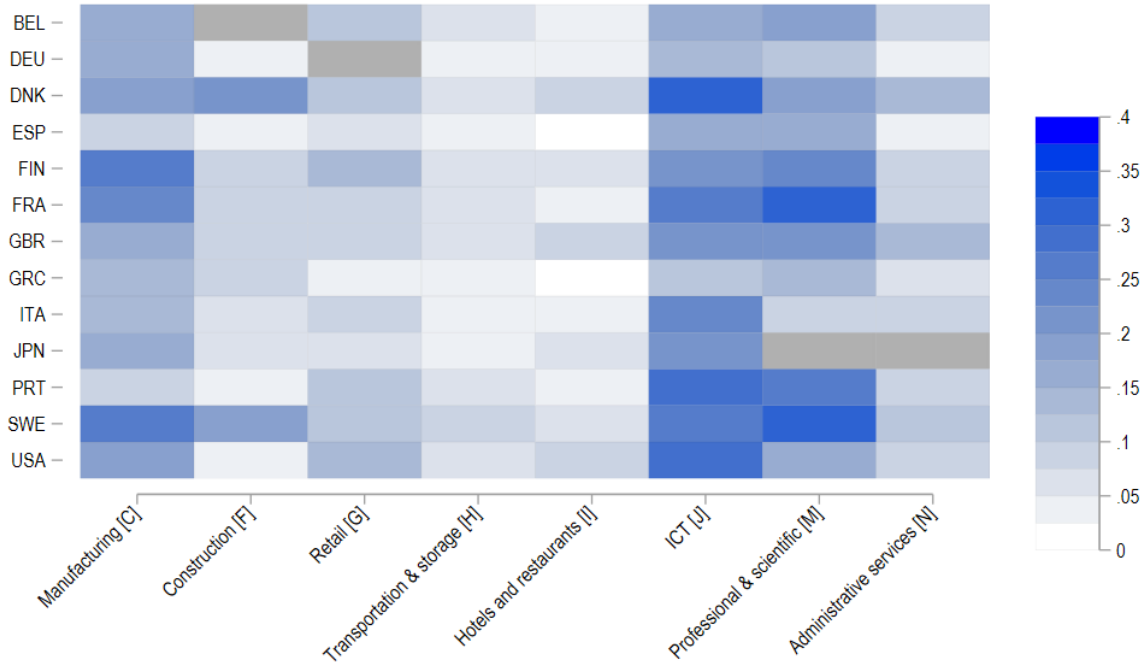
Notes: The figure shows changes in the (unweighted) mean concentration across country-industry pairs compared to the base year 2002. Countries included are BEL, DEU, DNK, ESP, FIN, FRA, GBR, GRE, FRA, JPN, PRT, SWE, and USA. Included 2-digit industries cover manufacturing, construction, and non-financial market services. Organic concentration is calculated fixing firm ownership data (i.e. the business group structure) in the initial year, 2002. M&A-related concentration changes reflect the differences between total concentration changes and those attributable to organic growth.

Figure B5. Trends in R&D Intensity Within Firms



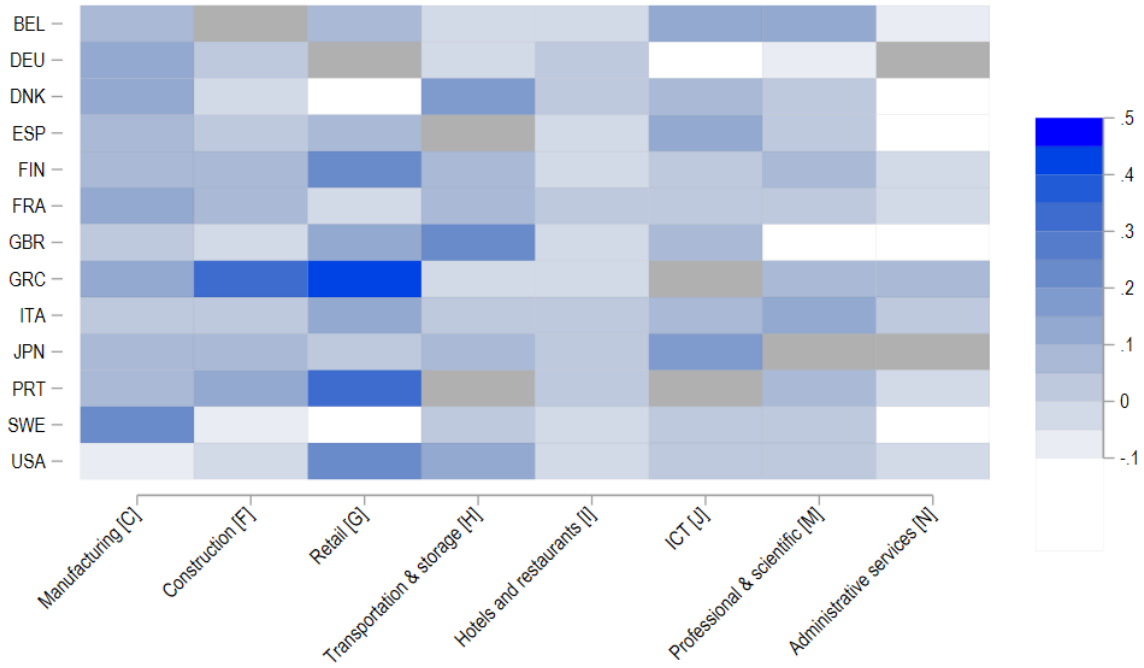
Notes: Presents results firm-level regressions on R&D intensity using the largest 100 firms in each country-industry, including firm-fixed effects. We include separate time dummies for largest 8 firms and the rest of the firms – the coefficients of which are reported in the figure above. We calculate R&D expenditure at the business-group level (consistent with our measure of sales concentration), by aggregating reported R&D expenditure in their individual underlying subsidiaries and expressing this as a share of (aggregated) sales.

Figure B6. Intangible investment intensity by country and industry



Notes: Average intangible investment intensity over the period shown by country and A21 industry. Grey colour indicates intangible data is not available.

Figure B7. Long difference (2002-2017) changes in top 8 concentration by country and industry



Notes: Long difference (2002-2017) of changes in CR8 concentration shown by country and A21 industry. Grey colour indicates intangible data is not available.

Table B1. Intangible and concentration correlations with country characteristics

Panel A: Intangibles	(1)	(2)	(3)	(4)	(5)	(6)
Outcome Variable:	Intangible Investment Intensity					
Country Characteristic:	Financial Development Index (IMF)	Financial Development (Rajan Zingales)	Market Size	IT Intensity	Tertiary Education	R&D Employment
Country Characteristic	-0.025	0.003	-0.006	0.478*	0.167**	0.664***
	(0.100)	(0.020)	(0.005)	(0.225)	(0.063)	(0.089)
N	4812	4812	4812	4812	4812	3733

Panel B: Concentration	(1)	(2)	(3)	(4)	(5)	(6)
Outcome Variable:	4-Year Change in CR8 Concentration					
Country Characteristic:	Financial Development Index (IMF)	Financial Development (Rajan Zingales)	Market Size	IT Intensity	Tertiary Education	R&D Employment
Country Characteristic	-0.030	-0.005	-0.002	0.023	0.034*	0.115**
	(0.024)	(0.005)	(0.001)	(0.059)	(0.018)	(0.042)
N	4812	4812	4812	4812	4812	3733

Notes: *** 1%, ** 5%, * 10%. The table shows regressions at the country–A64 industry–year level of intangible investment intensity (panel A) or changes in concentration (panel B) on initial country characteristics (measure in 2002). Financial development index is from the IMF, the financial development measure in column 2 follows Rajan and Zingales (1998) is the sum of stock market capitalisation and domestic credit as a share of GDP taken from the World Bank. Market size is real gross output taken from OECD STAN. IT intensity is the country-level Gross Fixed Capital Formation in IT as a share of Total Gross Fixed Capital Formation, from OECD STAN. The share of tertiary education enrolment is taken from OECD world indicators skills for employment and R&D employment as a share of total employment again from the OECD. All regressions include industry-year fixed effects. Robust standard errors clustered at the country- level (the level of aggregation of the country characteristic data) are in parentheses.

Table B2. First-Stage Regressions

	(1)	(2)	(3)
Outcome Variable:	Intangible Investment Intensity		
IV – Other Countries	0.398***		0.386***
	(0.040)		(0.038)
IV – R&D Subsidies		1.003***	0.434**
		(0.218)	(0.169)
Country-Year FE	Y	Y	Y
Industry-Year FE	Y	Y	Y
N	4812	4812	4812

Notes: *** 1%, ** 5%, * 10%. The table shows first-stage regressions at the country–A64 industry–year level, corresponding to the second stage results displayed in columns 4-6 of Table 3. All regressions include (4 year) growth in industry sales and tangible investment intensity as control variables, which are omitted for parsimony. Robust standard errors clustered at the country–A21 industry level are in parentheses.

Table B3. Balance test of Bartik shocks – correlations with initial country-industry characteristics

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Outcome Variable:	Bartik Shock (growth in foreign country-industry intangibles)											
Initial CR8 Concentration	0.089	0.072									0.100	0.072
	(0.106)	(0.098)									(0.102)	(0.096)
Initial Real Output			-0.033	-0.031							-0.029	-0.027
			(0.023)	(0.023)							(0.020)	(0.021)
Initial Tangible Investment Intensity					1.363*	1.368**					1.004	1.028
					(0.691)	(0.674)					(0.658)	(0.642)
Initial Trade Openness							-0.033	-0.034			-0.058	-0.053
							(0.066)	(0.064)			(0.061)	(0.060)
High Digital Intensity									0.015	0.013	-0.011	-0.005
									(0.045)	(0.045)	(0.037)	(0.039)
Country FE	N	N	N	N	N	N	N	N	N	N	N	N
Industry FE	N	N	N	N	N	N	N	N	N	N	N	N
Year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
N	46202	4893	46143	4882	44248	4666	45976	4869	46202	4893	44022	4642

Notes: *** 1%, ** 5%, * 10%. Reflects a cross-section regression of the Bartik shock (the growth in foreign country-industry intangibles) on a set of initial country-industry characteristics (measured in 2002). Even numbered columns represent regressions at the foreign country-industry level (i.e. the "shock level"), using the average Bartik exposure for each foreign country-industry as weights. Odd numbered columns are at the bilateral domestic-foreign country-industry level using the Bartik exposure weights (without averaging). Robust standard errors clustered at the foreign country–A21 industry level (the level of aggregation of the intangible data) are in parentheses.

Table B4. Industry Concentration Changes and Intangible Investment – US vs Countries in Other Regions

	(1)	(2)	(3)	(4)
Estimation Method:	OLS	IV	OLS	IV
Outcome Variable:	4-Year Change in CR8			
Intangible Investment Intensity	0.201***	0.203**	0.201***	0.204**
	(0.074)	(0.098)	(0.075)	(0.102)
Intangible Investment Intensity * USA	-0.017	-0.063	-0.018	-0.060
	(0.105)	(0.131)	(0.107)	(0.133)
Intangible Investment Intensity * JPN			-0.003	0.031
			(0.104)	(0.136)
Country-Year FE	Y	Y	Y	Y
Industry-Year FE	Y	Y	Y	Y
N	4812	4812	4812	4812

Notes: *** 1%, ** 5%, * 10%. The table shows results of regressions at the country–A64 industry–year level. All regressions include (4 year) growth in industry sales and tangible investment intensity as control variables, which are omitted for parsimony. Robust standard errors clustered at the country–A21 industry level (the level of aggregation of the intangible data) are in parentheses.

Table B5. Lagged, Contemporary and Lead Intangible Investment

	(1)
Estimation Method:	OLS
Outcome Variable:	4-Year Change in CR8
Lagged Intangible Investment Intensity	-0.079
	(0.182)
Contemporaneous Intangible Investment Intensity	0.354
	(0.264)
Lead Intangible Investment Intensity	0.018
	(0.198)
Country-year FE	Y
Industry-year FE	Y
N	3932

Notes: *** 1%, ** 5%, * 10%. The table shows results of OLS regressions at the country–A64 industry–year level. The outcome variable is defined as the change in concentration between *t* and *t+4*, and the lagged, contemporary and lead intangible investment intensities are respectively defined as 3-year average intensities across years *t-2*, *t-1* and *t* (lagged) *t+1*, *t+2* and *t+3* (contemporaneous) and *t+4*, *t+5* and *t+6* (lead). The regressions include (4 year) growth in industry sales and tangible investment intensity as control variables, which are omitted for parsimony. Robust standard errors clustered at the country–A21 industry level (the level of aggregation of the intangible data) are in parentheses.

Table B6. Intangible Investment Alternative Complementarities

	(1)	(2)	(3)	(4)	(5)	(6)
Outcome Variable:	4-Year Change in CR8 Concentration					
Exposure Variable:	Initial Tangible Investment Intensity		Initial Product Market Regulations		Initial Concentration	
Estimation Method:	OLS	IV	OLS	IV	OLS	IV
Intangible Investment	0.168***	0.173*	0.205***	0.222**	0.229***	0.233**
	(0.062)	(0.089)	(0.071)	(0.093)	(0.065)	(0.100)
Exposure variable	-0.019**	-0.017*			-0.035***	-0.029***
	(0.008)	(0.009)			(0.009)	(0.010)
Intangible Investment	0.091***	0.080**	0.009	-0.069	0.073*	0.031
* Exposure variable	(0.027)	(0.036)	(0.039)	(0.056)	(0.042)	(0.063)
Country-year FE	Y	Y	Y	Y	Y	Y
Industry-year FE	Y	Y	Y	Y	Y	Y
N	4776	4776	4776	4776	4776	4776

Notes: *** 1%, ** 5%, * 10%. The table shows results of OLS and IV regressions at the country–A64 industry–year level. All regressions include (4 year) growth in industry sales and tangible investment intensity as control variables, which are omitted for parsimony. All exposure variables reflect 2002 demeaned values (the start of our sample period), with the exception of the digital intensity indicator which uses 2001-2003 data. Robust standard errors clustered at the country–A21 industry level are in parentheses.

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