Urban vibrancy, human capital and firm valuation in China

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Abstract

Purpose – This paper intends to study how geographic heterogeneity in urban vibrancy, especially in human capital creation, helps explain persist firm valuation dispersion across cities in China.

Design/methodology/approach – This paper studies geographic differences in firm valuations of 1,023 listed companies headquartered in 35 major cities in China from 2001 to 2018. The authors estimate panel regressions of local firm Tobin's q on city fixed effects or city endowed attributes in human capital creation after controlling industry-year fixed effects as well as a set of firm and city time variant attributes.

Findings – The results show persistent, significant city-to-city differences in Tobin's *q*, especially among large, mature or high labor-intensive firms. To explain such geographic differences in firm valuations, the authors identify several factors of the endowed city competitive advantages in creating human capital that play important roles in explaining the persistent geographic firm valuation premia.

Originality/value – This paper provides the first systematic analysis of urban vibrancy in human capital supply in explaining persistent geographic firm valuation dispersion in China. The evidence suggests that city endowed comparative advantages in supplying human capital have created long-lasting, and growing, shareholder wealth by attracting and retaining talents and human resources in local firms.

Keywords Urban vibrancy, Tobin's *q*, Geographic valuation premium, Human capital

Paper type Research paper

1. Introduction

The determinants of firm valuation have been one of the central topics in finance research on China stock markets. While traditional research typically links firm valuations to firm attributes related to industries (Chen *et al.*, 2010), firm financials (Zhu *et al.*, 2016) and risks (Liu *et al.*, 2019), the more recent research has started to incorporate geographic factors in the understanding of firm valuations in China.

This line of emerging research has focused on various attributes of the firm headquarter cities. For example, researchers have shown that local firm investment behavior (Zhao *et al.*, 2017), local stock demand relative to supply (Dong *et al.*, 2020), high-speed rail connections (Autore *et al.*, 2021) and air pollution (Xue *et al.*, 2021), among others, help to explain local firms' market valuations in China. The thrust of these findings is that improving local environments that enhance local firm productivity or investor demand for local stocks are associated with higher market valuations of local firms.

What appears missing from the existing research, however, is the understanding of whether *city endowed vibrancy* is associated with market valuations of local firms. Here we refer *city endowed vibrancy* to the locational or historical comparative advantages of a city's

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production factors, such as capital, labor and technology. These geographic comparative advantages tend to be persistent across time as they generate positive feedback to sustain, and sometime enlarge, the resource gaps between cities. Such endowed vibrancy may be derived from superior geographic locations, historical connections to natural or political resources, pleasant climate, strong craftsmanship, excellent educational institutions, entrepreneurial cultures and more. Each city may have a unique set of endowed attributes related to firm productions, which can be difficult to quantify collectively. Advantages in these endowed attributes can result in higher firm productivity and possibly higher profitability that accrue to shareholders over a long period of time.

In this paper, we take the first attempt to examine whether city endowed vibrancy in human capital supply is a determinant of market valuations of A-share listed companies in China. We first examine the "unique" city endowed vibrancy through persistent geographic differences –city fixed effects – in local firm valuations. We next focus on the "observable" city vibrancy, specifically in local human capital creations, measured by two categories of variables: city geographic location and early human capital supply.

Our main sample includes 1,023 China A-share listed companies whose business headquarters are located in 35 major cities in China and 12,248 firm-year observations from 2001 to 2018 [1]. We measure firm valuation by Tobin's q, defined as firm market value over its invested capital. We use panel regressions to explain local firm Tobin's q by city heterogeneity as well as measures of city endowed vibrancy in creating human capital. Our regressions control for year-industry fixed effects to account for industry-specific effects in each given year. We also control for a set of time-varying firm attributes, including firm size, return on assets (ROA), gross profitability, share turnover, free cash flow and the number of shareholders, as well as city time-varying attributes, such as gross domestic product (GDP) growth and population growth, to account for the dynamics of firms, local economy and population.

Our key findings are two. First, we show that there are significant, persistent geographic differences in average local firm valuations. With all controls, we find the city fixed effects produce a significant joint F-statistic and increase the R-squared by 1.9% points or 7% on a relative scale. Additional subsample analyses show that city fixed effects are significantly stronger among large than small firms, among more mature than young firms, among high than low labor intensity firms, where labor intensity is measured by nonfixed assets relative to total assets or by the number of employees scaled by revenues. This evidence suggests that large, mature or labor-intensive firms' valuations are more sensitive to geographic heterogeneity in production factors at the city level.

After establishing the existence of persistent geographic valuation premia, we turn to examining the human capital element among the set of endowed city vibrancy, by using city time-invariant factors related to early cumulation of human capital supply and geographic locations. Krugman (1994) finds that the economic growth of East Asian countries mainly depends on large-scale capital accumulation and intensive labor input. Zhong *et al.* (2018) show that China's listed companies are concentrated in high administrative grade cities, in which education and labor quality is typically higher. Thus, city supply of human capital is likely an important determinant of firm productivity that may translate to creation of shareholder valuation.

Specifically, we attempt to capture cross-city differences in endowed city human capital using two categories of factors: (1) city geographic location factors, which include the north/south dichotomy, winter and summer climate and being port city, and (2) city early human capital supply factors, which include the city educational attainment and population measured in 2000, prior to the beginning of our sample period. We can view early year cumulated human capital of a city as a result of not only city geographic locations but also local natural resources, policies, cultural resources and more. All of these city endowment factors are time-invariant in our sample period. We hypothesize that they help explain the persistent geographic firm valuation premia.

Our tests find that several of such city endowment factors are significant determinants of city heterogeneity in firm valuations. Specifically, we find that higher initial educational attainment and population size as well as the typical January climate in a city exert significant and positive impacts on local firm valuations for the full sample period. Our estimates show that for a one standard deviation increase in early year education and population size, average Tobin's *q* in a city increases by 0.061 and 0.068 or 3% on a relative scale, and a same size increase in January temperature increases average Tobin's *q* by 0.084 or 4% on a relative scale. More importantly, we find their impacts visibly increase from the first to the second half of the sample, sometimes by a factor of 2 to 3.

Locating in northern China has a positive effect in the first half but not in the second half of the sample period. Typical July climate or being a port city is generally unrelated to firm valuations. The overall evidence suggests that winter climate and early advantages in population size and educational levels of local residents have long lasting impacts in creating geographic firm valuation premium by attracting, creating and retaining a large number of high-quality and skilled labor forces.

Our paper contributes to the broad research on the influence of human capital in urban economics and finance, with much evidence, however, coming from the USA. Dougal *et al.* (2015, 2018) show that geographic factors determine firm investment and valuations. Hornbeck and Moretti (2021) examine geographical differences in productivity growth manufacturing. High-skilled work share in local population is positively related to higher initial schooling levels (Berry and Glaeser, 2005) and leads to subsequent employment growth (Shapiro, 2006). Warm winters and cooler, less-humid summers attract migration of high-quality workforce and leads to more subsequent innovations (Rappaport, 2007). These locational factors attract individuals to relocate and impact their portfolio holdings (Branikas *et al.*, 2020), which indirectly influences firm valuation. Our results extend some of these prior findings in the USA to China using data from the past two decades, when rapid growth in the regional economy and firm productivity have taken place and benefited shareholders of local firms.

2. Data

Our sample includes the publicly listed firms in China A-share markets from the China Stock Market and Accounting Research Database (CSMAR) database from 2001 to 2018. We select firms incorporated prior to 2001 and headquartered in 35 major cities covered in the Annual China Statistical Yearbook. We restricted the sample to firms that have not changed their headquarter offices during the full sample period by excluding 60 firms that have. The 35 cities, plotted in Figure 1 on the map of China, cover the four municipalities, 25 capital cities (Tibet is only capital city excluded due to many missing data) and five planned municipalities designated by the state. Following the convention, we exclude financial firms and firms with the special treatment (ST) status. Our final sample includes 1,023 unique A-share listed firms.

Tobin's *q* of the firm, defined as the market value of firm equity plus book debt over total book assets, is used as the main measure of firm valuation. In robustness checks, we also measure firm valuations with logarithmic Tobin's *q* (*LogTobinQ*) or logarithmic market-to-book equity (*LogMB*).

We proxy firm city with the headquarter city by following the conventions in the prior literature. Firm headquarter city heterogeneity in human capital creation is measured by using six variables from two categories. One category includes factors measuring the initial cumulated city human capital: average educational attainment in 2000, before the sample

Figure 1.
City locations

Note(s): This figure plots the locations of the 35 headquarter cities in our sample

period (*Education, 2000*) and population size in 2000 (*Population 2000*). The other category includes city geographic factors: typical January climate measured by the average January temperature over the sample period (*Jan Temp*), typical July climate measured similarly for July (*Jul Temp*), the northern city indictor (*Northern*) and the port city indicator (*Port*).

As these city human capital variables stay constant over the sample period, they help capture the city historical endowed or geographic comparative advantages in attracting, training and retaining talents and human resources. Local average education attainment levels, population size, winter and summer climate are shown to attract more high-skill employees (Berry and Glaeser, 2005; Shapiro, 2006; Rappaport, 2007; Tang *et al.*, 2019). Historically, northern cities in China have a locational advantage as they are closer to the center of political power (Beijing) and agricultural lands as well as natural resources (Sheng *et al.*, 2018; Xu *et al.*, 2021). Most of the world's developed regions are located along the coasts and rivers; thus, port cities in China, such as those coastal, near Yangtze River Delta or the Pearl River Delta have natural advantages to attract human capital (e.g. Zhong *et al.*, 2018; Dai, 2004). We use the six city endowment factors in two separate categories or jointly to capture various aspects of city endowed vibrancy in human capital supply.

Our firm-level panel regressions include the city-level control variables, such as GDP growth and population growth, as well as firm-level controls such as firm size, ROA, gross profitability, share turnover, free cash flow and the number of shareholders, all defined in the Appendix. The city-level controls help account for local economic growth and population migration, while firm attributes help explain time-varying firm valuations in relation to firm fundamentals. The city-level data are obtained from the Statistical Yearbook of each city and the 5th Census Bulletin and the 6th Census Bulletin. And the firm accounting data are obtained from CSMAR. All firm-level financial variables are winsorized at the 1 and 99%

level by year. Table 1 reports the summary statistics of the firm valuation measures, various city human capital supply variables and firm- or city-level control variables.

3. Empirical analysis

This section presents our empirical results to explain firm valuations with city fixed effects or with local city human capital supply factors. Following prior literature on urban economics and finance, we expect firm valuations to exhibit persistent city fixed effects and city endowed vibrancy heterogeneity to have a persistent impact on geographic dispersion in firm valuations.

3.1 City fixed effect and Tobin's Q

We first test whether there are systematic, persistent geographic variations in firm values across cities by estimating the following firm-level panel regressions of Tobin's q of firm i in city j in year t:

$$Tobin\ Q_{i,j,\ t} = \sum_{j=1}^{N} \alpha_j * City_{j,t} + \ \gamma_i \ * Firm\ Controls_{i,t} + \ \eta_j \ * City\ Controls_{j,t} + Industry \ \times Year\ FEs + \varepsilon_{i,j,t} \tag{1}$$

The key explanatory variables are the 35 city dummies to help estimate city fixed effects, α_j, which represent the city average Tobin's q across listed firms, after controlling for the set of

	Mean	Std. dev	10%	25%	50%	75%	90%
Dependent variable							
Tobin Q	1.89	1.36	1.04	1.17	1.45	2.05	3.09
LogTobinQ	0.50	0.46	0.39	0.15	0.37	0.71	1.13
LogMB	1.24	0.59	0.60	0.85	1.17	1.53	1.93
Key independent variables							
Education 2000	8.45	0.77	7.42	7.92	8.50	8.82	9.59
Population 2000	15.06	0.83	14.04	15.29	15.74	16.23	16.40
Jan Temp	3.02	7.01	−5.96	−2.62	4.16	5.70	15.40
Jul Temp	27.12	1.70	25.26	26.80	27.56	27.98	28.90
Northern	0.33	0.47	0.00	0.00	1.00	1.00	1.00
Port	0.63	0.49	0.00	0.00	1.00	1.00	1.00
Firm-level control variables							
Size	22.38	1.20	20.94	21.49	22.27	23.13	23.98
ROA	0.03	0.06	0.00	0.01	0.03	0.06	0.09
Gross Prof	0.66	0.58	0.19	0.32	0.53	0.83	1.30
Turnover	1.41	1.19	0.26	0.51	1.07	1.96	3.07
Free Cash Flow	0.03	5.48	−0.28	−0.07	0.03	0.12	0.26
Shareholder	10.52	0.90	9.39	9.91	10.50	11.12	11.70
Age	10.74	6.55	2	5	10	16	20
LaborInt-nonfix	0.05	0.08	0.00	0.00	0.03	0.06	0.13
LaborInt-emp	0.27	0.05	0.21	0.24	0.27	0.31	0.34
City-level control variables							
GDP Growth	0.13	0.06	0.07	0.09	0.12	0.16	0.19
Pop. Growth	0.02	0.03	0.00	0.01	0.01	0.02	0.05

Note(s): This table reports the summary statistics of our main variables. All variables are defined in the Appendix. Accounting variables are winsorized at the 1 and 99% by year

Table 1. Summary statistics

firm and city time variant attributes and adjusting for the industry-year fixed effects. We standardize all the continuous independent variables before running panel regressions and cluster standard errors by firm.

We report the baseline regression results for the full sample period (2001–2018) in Table 2, columns (1) and (2), where we estimate the Tobin's q regressions without and with city fixed effects. Here, we find a significant positive coefficient on ROA and turnover and a significant negative coefficient on firm size, gross profitability and the number of shareholders. The city fixed effects joint F-statistic is 10.46 (p-value = 0.00), suggesting that the regression coefficients of the city fixed effects are jointly different from zero. Moreover, comparing to column (1), we find that the R-squared increases by 0.019 or 7% after adding city fixed effects, indicating city fixed effects help explain an economically meaningful fraction of the cross-sectional variations in Tobin's q.

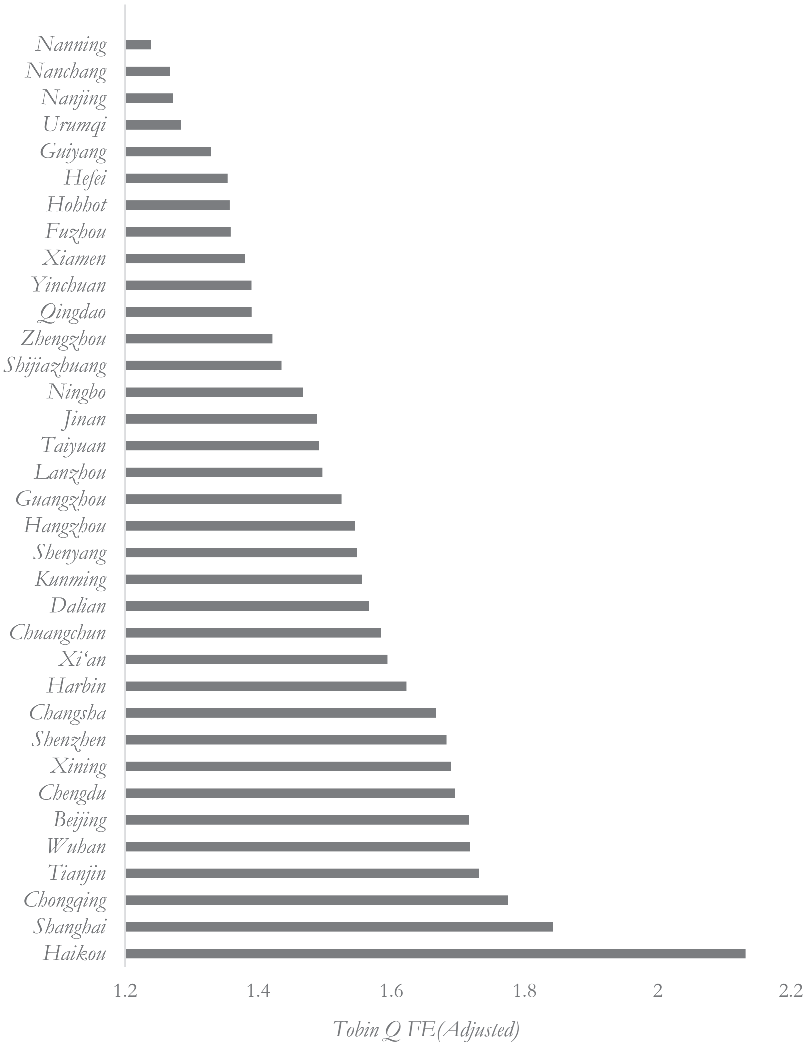
Next, we report the results for the early (2001–2009) and later (2010–2018) periods in columns (3) and (4). In both periods, city fixed effects F-statistic is statistically significant at the 1% level. We find an increase of the F-statistic from 5.83 in the earlier period to 7.65 in the latter period, but the difference is not statistically significant. Overall, the evidence suggests that city heterogeneity in firm valuation is present in both periods, but no significant change is detected.

We further plot the city fixed effects for the full sample period in Figure 2, where city fixed effects correspond to the estimated α_j's for the 35 sample cities. The estimates represent the adjusted city average Tobin's q, adjusting for the differences in firm attributes, industry and city GDP and population growth. And all coefficient estimates are significant at 1% level.

	Dependent variable: *Tobin Q*			
	Full sample 2001–2018		First half 2001–2009	Second half 2010–2018
	(1)	(2)	(3)	(4)
Size	-0.218^{***} (-5.37)	-0.217^{***} (-5.41)	-0.201^{***} (-6.60)	-0.179^{***} (-2.97)
ROA	0.076^{***} (2.63)	0.073^{***} (2.61)	0.006 (0.27)	0.167^{***} (3.09)
Gross Prof	-0.050^{**} (-2.29)	-0.049^{**} (-2.43)	-0.032^{*} (-1.85)	-0.063^{**} (-2.19)
Turnover	0.196^{***} (5.01)	0.208^{***} (5.51)	0.047 (1.28)	0.284^{***} (6.22)
Free Cash Flow	0.002 (0.24)	0.000 (0.05)	0.003 (1.18)	-0.361^{**} (-2.40)
Shareholder	-0.192^{***} (-6.53)	-0.212^{***} (-7.00)	-0.106^{***} (-5.36)	-0.317^{***} (-5.93)
GDP Growth	-0.024 (-1.37)	0.005 (0.36)	0.001 (0.06)	0.011 (0.39)
Pop. Growth	0.007 (0.36)	0.004 (0.39)	0.008 (0.21)	0.004 (0.39)
City FEs	No	Yes	Yes	Yes
Industry × *Year FEs*	Yes	Yes	Yes	Yes
N	12,248	12,248	5,221	7,037
R^2	0.271	0.290	0.395	0.259
City F-stat	n/a	10.46	5.83	7.65
p-value	n/a	(0.000)	(0.000)	(0.000)
City F-stat diff.			Second half (4) – First half (3) 2.82	
p-value			(0.136)	

Note(s): This table reports estimates of panel regressions of firm-level annual Tobin's q with city fixed effects from 2001 to 2018 and two subsamples, with controls for firm- and city-level attributes and Industry × Year fixed effects. Column (1) reports the baseline estimates without fixed effects. Columns (2)–(4) report the estimates with city fixed effects for the full sample and the two subperiods. All variables are defined in the Appendix, and the continuous independent variables are standardized. Regression coefficients are reported with t-statistics below in parentheses, where t-statistics are based on standard errors clustered by firm. *City F*-stat refers to the F-value of the joint test for city fixed effects. *City F*-stat diff. refers to the two sample differences in City F-statistics, with bootstrapped p-values reported in parentheses underneath. Statistical significance at the 1, 5 and 10% levels is indicated by ***, ** and *, respectively

Table 2.
Tobin's q regressions with city fixed effects (FEs)



Note(s): This bar chart shows each city's adjusted city fixed effect (average Tobin's *q*), defined as the coefficient on the city's dummy variable from a regression of firm Tobin's *q* on city fixed effects, industry-year fixed effects, and firm- and city-level controls, estimated in regression (2) in Table 2. All coefficient estimates are significant at the 1% level

Figure 2. City adjusted Tobin's *Q*

Among the 35 cities, Haikou has the highest adjusted city Tobin's *q* value of 2.13, almost 73% higher than the lowest city, Nanning (1.24).

3.2 City fixed effect and Tobin's Q: firm subsample analysis

To further analyze which type of firms benefits more from the fixed urban factors, we split our sample based on the median firm size, firm age of ten years since initial public offering

(IPO) and the medians of two measures of labor intensity: *LaborInt-nonfix*, defined by nonfixed assets relative to total assets, and *LaborInt-emp*, defined by logarithmic number of the employees scaled by logarithmic revenues.

Firm size or age represent the scope and scale of firm production and operation, which can be heavily influenced by various production factors, especially human capital, in the city. In China, the largest share of firms is in the manufacturing category, which is highly dependent on labor resources. He *et al.* (2007) showed that labor supply affects the geographic pattern of manufacturing in China and large manufacturers tend to concentrate in regions with abundant high-skill workers. We follow Ni and Zhu (2016) to measure labor intensity in production or asset composition, which may also help capture firms' sensitivity to local human capital supply.

For each subsample based on the size, age or labor intensity split, we re-estimate the model as Eqn (1). Table 3 reports the city fixed effects F-statistics for each subsample while suppressing the reporting of coefficient estimates. Across all firm subsamples, we find significant F-statistics for the joint firm fixed effect tests. More importantly, the F-value is significantly higher for large than for small firms, for more mature than for young firms and for more than for less labor-intensive firms, using both labor intensity measures, based on the bootstrapped tests of two-sample differences. The evidence suggests that larger, more mature and higher labor-intensive firms' valuations are more sensitive to persistent geographic factors.

One possible explanation for the above subsample regression results is that firm Tobin's q is sensitive to human capital. Some cities have historically attracted talents, owing to geographic location, pleasant climate, educational institutions and population size. These local comparative advantages are built over a long period of time and difficult to alter. In particular, we conjecture some cities possess endowed advantages in creating and retaining human capital, which lead to persistent city premia in firm valuations, and such premia are more evidence among larger, more mature and more labor-intensive firms as they tend to have greater firm productivity sensitivity to human capital supply.

3.3 City human capital and Tobin's Q

Our next tests are therefore focused on this dimension of urban endowed vibrancy factors, the creation of human capital. Prior research in urban economics has confirmed that human capital, as a high-value scarce resource, is a significant determinant of enterprise value creation (Dougal *et al.*, 2015, 2018; Park, 2006). For firms to create shareholder values, they need to attract high-skilled workers with stronger technical and soft skills (Bacolod *et al.*, 2009). Due to differences in natural resources, national policies and economic development, there has been historically a large and persistent gap between the human capital supply of different regions in China. These historical heterogeneities in city endowments in human capital supply may derive from geographic location, climate, educational levels, ease of transportation and nearness to political power and natural resources, and they tend to persist. Thus, we test whether two categories of city persistent human capital supply factors help explain persistent city heterogeneity in firm valuations.

We estimate the following panel ordinary least squares (OLS) regressions of Tobin's q of firm i in city j in year t on six proxies for city endowment in human capital supply together with controls and industry-year fixed effects:

$$\begin{aligned} Tobin\,Q_{i,j,t} &= \alpha_0 + \beta_1 \times Education\,2000_j + \beta_2 \times Population\,2000_j \\ &\quad + \gamma_i \times Firm\,Controls_{i,t} + \eta_j \times City\,Controls_{j,t} + Industry \times Year\,FEs + \varepsilon_{i,j,t} \end{aligned} \tag{2}$$

Table 3. Variation of Tobin's q city fixed effects by firm characteristics

Dependent variable: *Tobin Q*	*Size*		*Age*		*LaborInt-nonfix*		*LaborInt-emp*	
	Large (1)	Small (2)	Mature (3)	Young (4)	High (5)	Low (6)	More (7)	Less (8)
City F-stat	7.46***	4.29***	8.58***	4.27***	7.73***	4.75***	10.20***	5.91***
p-value	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
City F-stat diff.	Large–Small 3.17***		Mature−Young 4.31***		High–Low 2.98**		More–Less 4.29**	
p-value	(0.006)		(0.002)		(0.036)		(0.015)	
Controls	*Size, ROA, Gross Prof, Turnover, Free Cash Flow, Shareholder, GDP Growth, Pop. Growth as in* Table 2							
Fixed effects	*City FEs* and *Industry* × *Year FEs included as in* Table 2							
N	7,456	4,782	6,249	5,981	6,147	6,101	6,213	6,018
R^2	0.371	0.332	0.260	0.406	0.278	0.306	0.353	0.292

Note(s): This table reports joint *F*-tests of city fixed effects in panel regressions of local firms' Tobin's q across subsamples by various firm characteristics (firm size, firm age and labor intensity) from 2001 to 2018. Panel regression specifications are identical to that in Table 2, column (2), with estimates for control variables suppressed in reporting. *City F*-stat refers to the *F*-value of the joint test for city fixed effects. Columns (1)–(2) report City *F*-statistics for subsample based on whether the firm's market capitalization at the end of prior year is above or below the median. Columns (3)–(4) report subsample tests based on whether firm age, measured by the number of years since firm IPO, is above or below 10. Columns (5)–(6) report subsample tests based on whether firm labor intensity measured by nonfixed assets (*LaborInt-nonfix)* at the end of prior year is above or below the median. Columns (7)–(8) report subsample tests based on whether firm labor intensity measured by logarithmic number of employees scaled by logarithmic annual revenues (*LaborInt-emp)* in the prior year is above or below the median. *City F*-stat diff. refers to the two sample differences in City *F*-statistics, with bootstrapped *p*-values reported in parentheses underneath. All variables are defined in the Appendix. Statistical significance at the 1, 5 and 10% levels is indicated by ***, ** and *, respectively

$$Tobin\ Q_{i,j,t} = \alpha_0 + \beta_3 \times Jan\ Temp_j + \beta_4 \times Jul\ Temp_j + \beta_5 \times Southern_j + \beta_6 \times Port_j + \gamma_i \times Firm\ Controls_{i,t} + \eta_j \times City\ Controls_{j,t} + Industry \times Year\ FEs + \varepsilon_{i,j,t} \tag{3}$$

In regression (2), our key independent variables are measures of early city human capital supply: city education and population in 2000. In regression (3), they are measures of city geographic factors, including average January temperature, average July temperature, a northern city indicator and a port city indicator. All key independent variables stay constant for a city in the full sample period and thus capture elements of the city fixed effects. Firm controls, city controls and industry-year fixed effects are the same as in regression (2) in Table 2. Again, we standardize all continuous independent variables before running panel regressions and cluster standard errors by firm.

The regression results are shown in Table 4. In columns (1)–(3), we estimate for the full sample period 2001–2018, where column (1) reports estimates for regression (2), column (2) reports estimates for regression (2) and in column (3) we include all six key independent variables. We also report in columns (4)–(9) estimates of similar regressions but based on the early (2001–2009) and later (2010–2018) periods.

In columns (1) and (3), we can find that *Education 2000* and *Population 2000* have a positive coefficient, both significant at the 1% level. The estimates imply that a one standard deviation change in *Education 2000* and *Population 2000* corresponds to a 0.058 and 0.042 change in Tobin's *q* or 3.0 and 2.2% on a relative to the mean (1.89).

These two variables are measured prior to the beginning of the sample, representing the historical city heterogeneity in the size and quality of the talent pool. It is not surprising that initial advantages in city residents' educational levels and in population size positively impact local firm valuation, as quality human capital enhances firm productivity and a large human capital pool increases the chance of finding talents with needed skills. What is surprising here, however, is the persistence and size of its impact; the initial endowed human capital quality and pool have had a large, long-lasting impact in the next 18 years, probably due to their persistent, positive feedback effects.

In columns (2), we find a positive and significant coefficient on January temperature; here a one standard deviation change in *Jan Temp* corresponds to a 0.029 change in Tobin's *q* or 1.5% on a relative to the mean. July temperature has an insignificant coefficient. The evidence suggests that mild winter climate is a positive factor to attract and retain talents. Neither the *Northern* nor the *Port* indicator is significant.

In column (3), we include all six city human capital factors and find that the three (*Education 2000*, *Population 2000* and *Jan Temp*) remain significant determinants of local firm valuations in the full sample period. Interestingly, all three coefficient estimates have increased in size, especially that of *Jan Temp* experiencing an increase of nearly three folds (from 0.029 to 0.084). Thus, the joint economic impact of these city factors is larger than when we consider them separately.

In Figure 3, we present the scatter plots and fitted lines of the average adjusted Tobin's *q* in each city on the city's *Education 2000*, *Population 2000* and *Jan Temp*, respectively, in Panels A, B and C. The fitted lines show the positive relationships between firm valuations and each of the three variables, while some outliers are observed in each plot.

Next, we compare the estimates between the early and later sample periods. Here comparing columns (6) and (9), we find the coefficient on *Education 2000* more than tripled from the first (0.022, $t = 3.23$) to the second half period (0.075, $t = 3.51$). Similarly, the coefficient on *Population 2000* increases by nearly 80% from 0.049 ($t = 3.13$) in 2001–2009 to

Table 4. Tobin's q regressions on city human capital factors

	Dependent variable: *Tobin Q*								
	2001–2018			2001–2009			2010–2018		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Education 2000	0.058*** (3.21)		0.061*** (3.57)	0.022*** (3.07)		0.022*** (3.23)	0.066*** (3.75)		0.075*** (3.51)
Population 2000	0.042*** (3.39)		0.068*** (3.45)	0.032*** (3.26)		0.049*** (3.13)	0.059*** (3.06)		0.088*** (3.65)
Jan Temp		0.029*** (2.94)	0.084*** (3.24)		0.047** (2.13)	0.076*** (3.23)		0.007 (0.22)	0.081*** (2.94)
Jul Temp		0.040 (1.43)	0.012 (0.75)		0.009 (0.74)	0.018 (1.28)		0.054 (0.44)	0.012 (0.46)
Northern		0.066 (1.46)	0.095 (1.47)		0.117* (1.71)	0.145** (2.21)		0.001 (0.02)	0.043 (0.52)
Port		0.014 (0.39)	0.043 (1.20)		0.020 (0.62)	0.033 (1.04)		−0.008 (−0.15)	0.033 (0.58)
Controls	*Size, ROA, Gross prof, Turnover, Free cash flow, Shareholder, GDP growth, Pop. growth as in Table 2*								
Fixed effects	*Industry × Year FEs included*								
N	12,248	12,248	12,248	5,211	5,211	5,211	7,037	7,037	7,037
R^2	0.273	0.272	0.274	0.377	0.376	0.378	0.236	0.235	0.237

Note(s): This table reports the results of panel regressions of firm annual Tobin's q on city geographical and early human capital factors, with controls for firm- and city-level attributes and Industry × Year fixed effects as in Table 2, column (2). The city early human capital factors include measures of early year city education (*Education, 2000*) and early year population size (*Population 2000*), and the city geographic factors include winter climate (*Jan Temp*), summer climate (*Jul Temp*), location in north China (*Northern*) and port city (*Port*). Control variables are the same as in Table 2. The sample period is split into the first half (2001–2009) and the second half (2010–2018). All variables are defined in the Appendix, and the continuous independent variables are standardized. Regression coefficients are reported with t-statistics below in parentheses, where t-statistics are based on standard errors clustered by firm. Statistical significance of coefficients at the 1, 5 and 10% levels is indicated by ***, ** and *, respectively

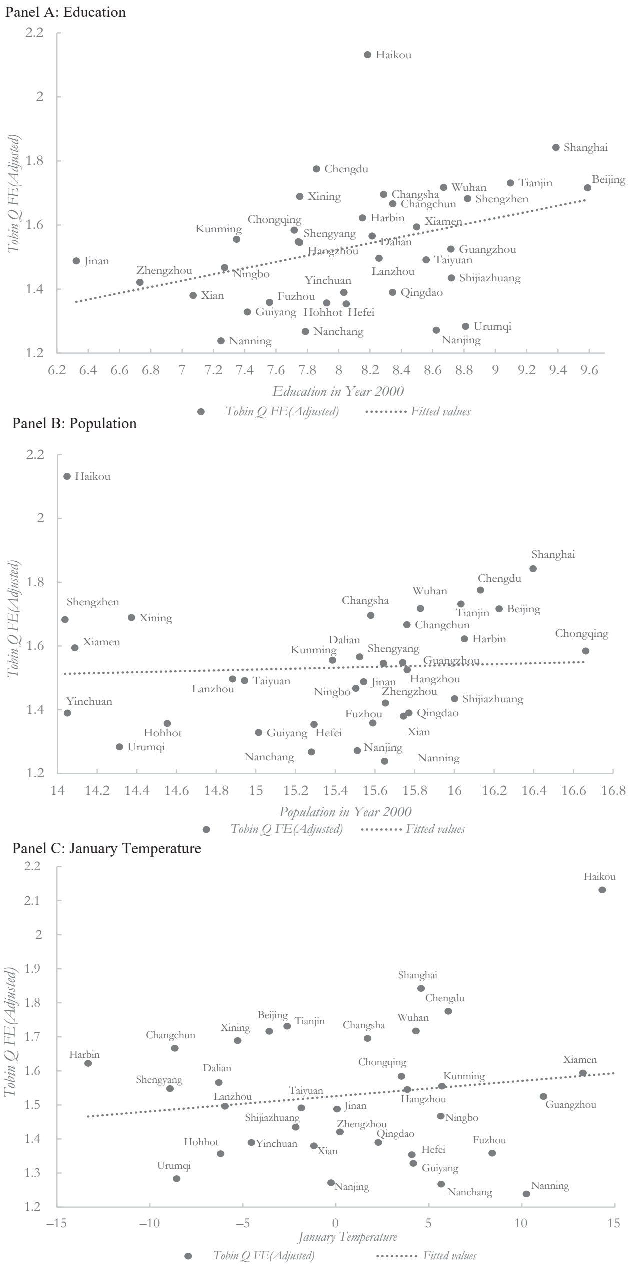


Figure 3.
City adjusted Tobin's Q versus city characteristics

Note(s): This plot shows each city adjusted year-level fixed effect Tobin's q versus each city's average resident education level in 2000, city population size in 2000 and average January temperature over the sample period. The adjusted fixed effect Tobin's q is defined as the city fixed effect coefficient from a regression of firm Tobin's q on city, industry interaction year fixed effects estimated in regression (2) in Table 2 and reported in Figure 2

0.088 (t = 3.65) in 2010–2018. The coefficient on *Jan Temp* also increases by 6.6% when moving to the later sample period. The pattern here is that city comparative advantages in winter climate, early population and education levels become more important factors in determining the geographic valuation premia in the recent decade.

In column (6), the *Northern* indicator has a significant positive coefficient (0.145, t = 2.21) during 2001–2009. However, *Northern* becomes insignificant during 2010–2018 and is so for the full sample period. The evidence shows that northern China cities have an advantage only in earlier years while port cities do not have any.

In the first half period 2001–2008, China joined the World Trade Organization (WTO) in 2001 and grew to the world's factory with the advantage of low labor cost. During this period, the demographic dividend permeates the value creation of enterprises, and sufficient labor resources play an important role in value creation. However, due to the development of information economy and industrial restructuring, in the second half period 2010–2018, China transitions to a focus of technology and information, during which high-quality human capital becomes a more crucial factor in determining firm productivity, relatively to the nearness to political power or natural resources. This transition is reflected in the growing importance of the relative education levels, population size and winter climate of a city. It is also reflected in the declining northern city advantage, which is consistent with the dynamic development trend of "fast in the south and slow in the north, strong in the south and weak in the north." Lastly, the observation of relatively stable influence of winter climate may be attributed to growing popularity of heat and air-conditioning over the sample period, which likely mitigates the negative impact of extreme weather.

3.4 Robustness

So far, our results are presented based on Tobin's q as a measure of firm valuation. Here we consider two variants of the dependent variable: logarithmic Tobin's q (*LogTobinQ*) and logarithmic market-to-book equity (*LogMB*). Logarithmic transformation helps to transform a highly skewed distribution to a more normalized one, and market-to-book equity is more sensitive to the equity valuation than the market-to-book asset.

We then redo the analyses in Tables 2–4 for the full sample period and report the robustness test results in Table 5. Panel A shows that city fixed effects are jointly significant when using both alternative measures of firm valuations. Again, we observe large, mature and high labor intensity firms exhibit greater city heterogeneity than small, young and low labor intensity firms. The results here are consistent with our main findings in Tables 2 and 3

Panel B reports the full sample estimates of regressions of *LogTobinQ* and *LogMB* on the six measures of city human capital creation. We again observe significant positive coefficients on *Education 2000*, *Population 2000* and *Jan Temp*, and insignificant coefficients on the other factors, confirming early advantages in education and population size as well as winter climate are key city human resource factors in determining firm valuations.

In Table 6, we report additional robustness checks based on balanced panels and the subperiod 2008–2018, when the new China Accounting Standards are in place. In the first set of tests, we restrict the sample to a balanced panel, in which each firm has annual observations for all of the 18 years in the full sample. This restriction limits the sample to having roughly 2/3 of the original firm-year observations. We then redo the analyses in Tables 2–4 and find that the main results are consistent with the original findings.

In the second set of tests, we address the concern that the new China "Accounting Standards for Business Enterprises" issued by the Ministry of Finance in 2006 and implemented in 2007 may cause inconsistent measurement of firm valuations. Thus, we restrict the sample to starting in 2008, when firm valuations and other accounting variables

Table 5.
Panel regressions of alternative firm valuation measures

Panel A: City fixed effects and firm attributes

	Dependent variable			
	LogTobinQ		*LogMB*	
	City F-stat diff	*p*-value	*City F*-stat diff	*p*-value
Full sample	16.74***	(0.000)	8.99***	(0.000)
Large–Small (*Size*)	4.56***	(0.000)	3.79***	(0.000)
Mature–Young (*Age*)	7.43***	(0.000)	4.63***	(0.000)
High–Low (*LaborInt-nonfix*)	3.99***	(0.000)	2.34*	(0.056)
More–Less (*LaborInt-emp*)	2.07*	(0.089)	3.04**	(0.030)

Panel B: City endowment and local firm valuations

	LogTobinQ			*LogMB*		
	(1)	(2)	(3)	(1)	(2)	(3)
Education 2000	0.025*** (3.26)		0.025*** (3.17)	0.015*** (3.27)		0.020*** (3.56)
Population 2000	0.021*** (3.41)		0.034*** (3.27)	0.007*** (3.35)		0.018*** (2.81)
Jan Temp		0.014** (2.13)	0.042*** (3.35)		0.012*** (2.62)	0.032*** (2.95)
Jul Temp		0.015 (1.58)	0.009 (1.28)		0.015 (1.56)	0.013 (1.53)
Northern		−0.037 (−1.62)	−0.057 (−0.67)		−0.053 (−0.78)	−0.100 (−0.63)
Port		0.000 (0.04)	0.014 (1.28)		0.037 (1.48)	0.038 (1.53)
Controls	*Size, ROA, Gross Prof, Turnover, Free Cash Flow, Shareholder, GDP Growth, Pop. Growth as in Table 2*					
Fixed effects	*Industry × Year FEs included*					
N	12,248	12,248	12,248	12,124	12,124	12,124
R^2	0.425	0.423	0.426	0.292	0.292	0.293

Note(s): This table reports the robustness checks of Tables 2 and 3 in Panel A and those of Table 4 in Panel B by replacing the dependent variable of Tobin's q with *LogTobinQ* and *LogMB* for the period 2001–2018. *LogTobinQ* is logarithmic Tobin's q. *LogMB* is logarithmic market-to-book equity. In Panel A, specifications are identical to those in Table 2, Column (2) and in Table 3. *City F*-stat refers to the F-value of the joint test for city fixed effects or the City F-statistic difference between two subsamples split by firm size, firm age, labor intensity measured by nonfixed assets (*LaborInt-nonfix)* and logarithmic number of employees scaled by logarithmic annual revenues (*LaborInt-emp)*, with bootstrapped p-values reported in parentheses. In Panel B, specifications are identical to those in Table 4. Continuous independent variables are standardized. Regression coefficients are reported with t-statistics below in parentheses. Standard errors are clustered by firm. All variables are defined in the Appendix. Statistical significance at the 1, 5 and 10% levels is indicated by ***, ** and *, respectively

Table 6. Panel regressions with balanced data and alternative subperiod

Panel A: City fixed effects and firm attributes

	Dependent variable: *Tobin Q*			
	2001–2018 (balanced)		2008–2018	
	City F-stat diff	*p*-value	*City F*-stat diff	*p*-value
Full sample	11.68***	(0.000)	8.30***	(0.000)
Large–Small (*Size*)	4.58***	(0.000)	2.79**	(0.043)
Mature–Young (*Age*)	4.39***	(0.000)	4.81***	(0.000)
High–Low (*LaborInt-nonfix*)	2.53**	(0.036)	3.23**	(0.017)
More–Less (*LaborInt-emp*)	3.50*	(0.058)	4.16**	(0.046)

Panel B: City endowment and local firm valuations

	Dependent variable: *Tobin Q*					
	2001–2018 (balanced)			2008–2018		
	(1)	(2)	(3)	(1)	(2)	(3)
Education 2000	0.028*** (3.55)		0.032*** (3.40)	0.064*** (4.05)		0.073*** (3.80)
Population 2000	0.050*** (3.64)		0.088*** (3.15)	0.055*** (3.22)		0.085*** (3.94)
Jan Temp		0.047** (2.44)	0.122*** (3.16)		0.012** (2.46)	0.082*** (3.25)
Jul Temp		0.002 (0.78)	0.047 (0.68)		0.047 (1.17)	0.016 (0.69)
Northern		−0.137 (−0.99)	−0.026 (−1.15)		−0.014 (−0.11)	−0.059 (−0.82)
Port		0.077 (0.06)	0.101 (0.40)		0.008 (0.08)	0.033 (0.64)
Controls	*Size, ROA, Gross Prof, Turnover, Free Cash Flow, Shareholder, GDP Growth, Pop. Growth as in Table 2*					
Fixed effects	*Industry × Year FEs included*					
N	8,874	8,874	8,874	8,291	8,291	8,291
R^2	0.257	0.256	0.259	0.239	0.238	0.240

Note(s): This table reports the robustness checks of Table 2 and in Panel A and those of Table 4 in Panel B with balanced panel data for the period 2001–2018 and the original panel data for the period 2008–2018, in which new China accounting rules are in place. *F*-stat represents the *F*-value of the joint test for city fixed effects or the City *F*-value difference between two subsamples split by firm size, firm age, labor intensity measured by nonfixed assets (*LaborInt-nonfix*) and logarithmic number of employees scaled by logarithmic annual revenues *(LaborInt-emp*), with bootstrapped *p*-values reported in parentheses. Continuous independent variables are standardized. Regression coefficients are reported with *t*-statistics below in parentheses. Standard errors are clustered by firm. Statistical significance at the 1, 5 and 10% levels is indicated by ***, ** and *, respectively are measured under the new accounting standards. Our findings are consistent with those based on the original full sample as well as the subperiod results for 2010–2018.

4. Conclusion

An emerging line of research in urban finance in China demonstrates the importance of time-varying geographic factors in creating shareholder values. In this paper, however, we show that firm market valuations exhibit surprisingly persistent city-to-city heterogeneity in China. More importantly, we show that the geographic firm valuation premia are in part explained by city locational or historical endowment in human capital supply that promotes and maintains urban vibrancy by attracting and producing more talents over time.

Our estimates show that adding city fixed effects produces a significant *F*-statistics and increases the *R*-squared, after controlling for firm and city time variant attributes and industry-year fixed effects. The geographic firm valuation gaps are greater among larger, more mature or higher labor intensity firms. Furthermore, city early advantages in education and population size and city mild winter climate appear to help attract, train and retain high-skill labor force, therefore exerting significant positive impacts on firm valuations. Their impacts on firm valuations have exhibited rising importance, a visible increase in the second half from the first half of the sample period. Taken together, our research suggests that locational and historical city comparative advantages in human capital creation can have long-lasting, and increasingly important, impacts on equity pricing in China financial markets.

Note

1. We deleted 60 firms that have moved their headquarters after initial registration. Thus, our sample firms all have the headquarter city same as their registry city and have not moved headquarters in the sample period.

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Appendix
Variable definitions

Variable	Definition
Tobin Q	Tobin's q, defined as the firm's year-end market capitalization plus non-tradable shareholder equity plus total debt, divided by total assets
LogTobinQ	Logarithmic *Tobin Q*
LogMB	Logarithmic year-end market capitalization over book equity
Education 2000	Average number of years of education for local residents in 2000
Population 2000	Logarithmic city population at the end of the 2000
Jan Temp	Average city January temperature over the years 1996–2000
Jul Temp	Average city July temperature over the years 1996–2000
Northern	An indicator variable that takes the value of one if the city locates in the north of the Qinling-Huaihe line, and zero otherwise
Port	An indicator variable that takes the value of one if the city has port, which includes Dalian, Tianjin, Qingdao, Shanghai, Ningbo, Fuzhou, Xiamen, Guangzhou, Shenzhen, Haikou, Nanjing, Hangzhou, Nanchang, Wuhan, Changsha, Nanning, Chongqing, and zero otherwise
Size	Logarithmic year-end market capitalization
ROA	Return on assets, defined as the year-end net income before extraordinary items scaled by total assets
Gross Prof	The ratio of gross profitability to total assets of a firm, measuring using the gross profitability and total assets in the annual report
Free Cash Flow	Net income plus amortization and depreciation minus changes in working capital expenditures, scaled by book equity for a firm in the annual report
Shareholder	Natural logarithm of the total number of shareholders for a firm in the annual report. It includes the number of corporate juridical persons and natural persons
Turnover	Average daily turnover rate of the year as a percentage of the number of shares outstanding for a firm
Pop. Growth	Annual logarithmic difference in local city population
GDP Growth	Annual logarithmic difference in local city GDP
Industry	Defined based on the first character of firms 2012 CSRC Industry classification code, which yields 19 industries
Age	The number of years since firm IPO
LaborInt-nonfix	The ratio of non-fixed assets to total assets of a firm. Non-fixed assets are defined as the year-end goodwill and other intangibles
LaborInt-emp	The logarithmic number of employees of a firm each year scaled by logarithmic annual revenue

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