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Urban Agglomeration and CEO Compensation

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Abstract

We examine the relation between the agglomeration of firms around big cities and chief executive officer (CEO) compensation. We find a positive relation among the metropolitan size of a firm's headquarters, the total and equity portion of its CEO's pay, and the quality of CEO educational attainment. We also find that CEOs gradually increase their human capital in major metropolitan areas and are rewarded for this upon relocation to smaller cities. Taken together, the results suggest that urban agglomeration reflects local network spillovers and faster learning of skilled individuals, for which firms are willing to pay a premium and which are therefore important factors in CEO compensation.

I. Introduction

Since the latter part of the 1800s, labor economists (e.g., Marshall (1920), Weber (1968)) have noted that the agglomeration of highly skilled individuals in large metropolitan areas provides positive externalities that are primary determinants of local productivity and wages.[1] In contrast, a recent line of research (see, e.g., Kedia and Rajgopal (2009)) contends that because of the high mobility of chief executive officers (CEOs), managerial compensation is determined by a national labor market and not by the business environment at the hiring firm's locale. In this article we propose and examine one channel, urban agglomeration, through

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[1]There is an extensive labor and urban economics literature, going back to Marshall (1920), that addresses location issues and their effect on workers. For excellent reviews, see Fujita and Thisse (2002) and Duranton and Puga (2004).

which the geographical clustering of skilled economic agents in and around big cities creates local segmentation in managerial labor markets that significantly affects the level and structure of CEO pay.

The economics literature provides ample evidence that firms clustered in large metropolitan areas pay their workers significantly more than their nonurban counterparts, even after adjusting for cost of living factors.[2,3] This pay gap holds for any profession or industry and becomes especially large for white collar, highly skilled individuals (Möller and Haas (2003), Gould (2007), and Bacolod, Blum, and Strange (2008)). There are several potential explanations for these findings. First, affluent, high-ability individuals are attracted to densely populated areas with a wealth of consumption amenities and employment opportunities and are therefore paid the value of their marginal product in competitive labor markets (Helsley and Strange (1991), Glaeser, Kolko, and Saiz (2001)). Second, economic density provides workers with positive externalities, such as access to private information and business connections, that foster the accumulation of human capital that lead to better performance and higher wages (see, e.g., Christoffersen and Sarkissian (2009), Audretsch and Feldman (1996), and Gould (2007)). Third, firms based in large cities can afford to pay higher wages because of higher local demand in product markets and/or lower production costs (Henderson, Kuncoro, and Turner (1995)). And fourth, certain individuals may require a compensating premium for bearing, arguably, a lower quality of life in highly congested urban areas (Roback (1982)) or for moving away from their home state (Yonker (2016)).

These potential channels predict that for any occupational group or industry, real wages and incentive pay schemes designed to attract, retain, and reward appropriate talent should be significantly higher in large metropolitan areas. This should be the case, especially for high-ability individuals such as CEOs who tend to be attracted to big cities and therefore are more likely to benefit from their positive externalities (Christoffersen and Sarkissian (2009)).[4] In this article, we empirically test this prediction by using CEO compensation data to examine whether firms headquartered in large metropolitan areas provide managers with higher and more incentive-based pay.

We start our analysis by merging CEO compensation data with demographic information from the U.S. Census about firms' headquarters locations and find a clear, positive relation between the size of the city where the firm is headquartered and its median total and equity-based CEO compensation. This relation is especially pronounced for the 10 most highly populated U.S. metropolitan areas.

[2]For example, Wheeler (2001) and Di Addario and Patacchini (2008), among others, find that real wages are higher in large cities, with large concentrations of employment, compared to smaller cities. Wheaton and Lewis (2002), Combes, Duranton, and Gobillon (2008), and Fu (2007) find evidence that wages increase with concentration of employment in an individual's own occupation or industry. Many of these studies also find a positive link between wages and the human capital associated with employment concentration.

[3]We use the words metropolitan areas, urban areas, and cities interchangeably. City size refers to the population of the city.

[4]Christoffersen and Sarkissian (2009) provide evidence that highly skilled fund managers are drawn to densely populated financial centers, where they gain valuable experience and perform better than their counterparts based in smaller cities.

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To analyze the relation between city size and CEO compensation in more detail, we follow Coval and Moskowitz (1999) and Glaeser and Maré (2001), among others, and aggregate headquarters locations by metropolitan statistical areas (MSAs), classifying them into three groups: urban agglomerate, urban, and rural. These classifications are based on the population size of the metropolitan where the firm is headquartered and its distance from other major population clusters.[5] Comparing the structure and size of CEO compensation across these three location groups, we find several striking results. First, controlling for firm, industry, and CEO characteristics and adjusting for cost of living, we find that the total compensation of CEOs in urban agglomerate (urban) metropolitan areas is about 25% (7%) higher than the total pay of their rural counterparts. Second, the equity-based portion of urban agglomerate (urban) firms' CEO pay is almost one-third (3%) higher than that of comparable CEOs in rural areas. These results provide compelling evidence that, all else equal, spatial clustering within the 10 most highly populated metropolitan areas has an economically meaningful impact on the level and structure of CEO compensation.

Next, we explore potential channels that could explain the cross-sectional variation of CEO compensation across metropolitan areas of different sizes. To the extent that the observed urban wage premium that characterizes CEO compensation data is the result of more able CEOs sorting into big cities, we should find a positive correlation between city size and observable measures of CEO ability. Using data from BoardEx about CEO educational attainment and matching it with the location of CEOs in our data set, we find a positive relation among metropolitan size, the proportion of local CEOs who were educated in elite U.S. universities, and the proportion of local CEOs with graduate degrees. However, a significant premium in urban agglomerate CEO compensation remains after controlling for managerial ability. This highlights the need to go beyond the simple ability-sorting channel to develop a more complete explanation of the urban pay advantage.

An additional channel that could explain the urban premium in CEO compensation is that managers become better in bigger cities through their interactions with others in the local area, which is then reflected in higher, more incentive-driven pay (Glaeser (1999)). This could occur because CEOs in densely populated areas have better networking opportunities with other local executives, investment bankers, institutional investors, customers, and suppliers (see, e.g., Coval and Moskowitz (1999), (2001), Massa, Yasuda, and Zhang (2011)), or because such CEOs are more likely to serve on the board of a nearby firm and gain valuable access to private information (Kono, Palmer, Friedland, and Zafonte (1998), Ivković and Weisbenner (2005)). In either case, the key empirical prediction is that CEOs in big cities have more networking opportunities that facilitate access to private information and result in faster learning and higher, more incentive-driven compensation.[6]

[5]Specifically, urban agglomerates represent the 10 largest metropolitan areas of the United States, based on the 2000 Census Bureau. Urban areas have at least 1,000,000 residents that are not urban agglomerates, and rural areas are at least 250 kilometers away from the center of urban agglomerates or urban areas (discussed in more detail in Section III).

[6]The finance literature has many examples of managerial learning that occurs within local clusters of economic agents. Such learning could come, for example, from local social interaction or

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Consistent with this networking channel, we find a positive, significant relation between CEO total and equity-based compensation and managerial experience that is gained in the same city in which the CEO is employed. This relation is especially pronounced for firms headquartered in urban agglomerates and for more able CEOs. Similarly, we find a positive relation between CEO pay and the performance of other local firms in the urban area. On the contrary, we find no positive returns to experience, or to the performance of local peers, among managers employed in nonurban firms.

Finally, we examine whether there are other channels that are driving our results. For example, total compensation and equity incentives could be higher in the metro area because big cities make local firms more productive (Henderson et al. (1995)) or because certain CEOs may require a compensating premium for living in an urban area (Roback (1982), Yonker (2016)). Given these possibilities, CEOs who move into larger cities should experience an immediate increase in total and incentive pay, and CEOs leaving a large city and relocating to a smaller city should experience an immediate reduction in total and incentive pay.

Controlling for differences in the cost of living across locations, we find that the relocation of a CEO from a small city to a large metropolitan area does not result in an immediate pay premium. Additionally, the compensation premium for managing a firm located in a large metropolitan area persists if the CEO moves to a smaller, less central location. These findings are consistent with studies in the economics literature that attribute a human capital accumulation effect to large metropolitan areas that results in greater ability and wages, especially for highly skilled and talented individuals who are more prone to take advantage of the positive externalities in urban areas (see, e.g., Christoffersen and Sarkissian (2009), Audretsch and Feldman (1996)).

Our article contributes to both the finance and economics literatures. There is limited work on the role of managerial heterogeneity in explaining CEO compensation.[7] Here, we build on this literature by identifying an important source of managerial ability that has not been acknowledged in the executive compensation literature, namely, the acquisition of human capital by being located in urban agglomerates. To the extent that human capital acquired in (large) cities is transferable to other (rural) areas in the country, living in cities could be considered not just a decision about location of residence, but also an investment in human capital that has an effect on the extent that managers are successful and, therefore, how they are compensated. These issues have not been addressed in the CEO compensation literature.

Our work also contributes to the recent literature on social networks in finance. Hwang and Kim (2009) and Engelberg, Gao, and Parsons (2013) find that the quality and size of an executive's social network predicts CEO pay and/or firm performance, with information spillover being the key driver behind such network effects. Because people are most likely to come in contact with those who live or

imitation (Hong, Kubik, and Stein (2004)), interlocking directorates in locally headquartered firms (Kono et al. (1998), Mace (1986)), localized informational cascades (Bikhchandani, Hirshleifer, and Welch (1992)), or herding propensities of managers based in the same area (Massa et al. (2011)).

[7]See Iranzo, Schivardi, and Tosetti (2008) for recent work about the effect of latent managerial ability on CEO pay.

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work nearby (Hong, Kubik, and Stein (2004), (2005)), our study provides additional evidence that CEOs are compensated for their valuable, portable network of local social connections that confer information to the firm.

This article is related to a growing body of finance literature that identifies the importance of geography on the behavior of investors and corporate managers. Evidence indicates that the geographic clustering of economic agents results in information spillovers, reflected, for instance, in investors' preference toward stocks of nearby firms (Coval and Moskowitz (1999), (2001), Ivković and Weisbenner (2005)), higher acquisition gains on local deals (Kedia, Venkatesh, and Uysal (2008)), strong sensitivity to investment and financing decisions (Dougal, Parsons, and Titman (2015)), and cash holdings and acquisition decisions of local firms (Almazan, Motta, Titman, and Uysal (2010)).

Finally, our article contributes to the urban economics literature that studies the effect of agglomeration on worker productivity and wages. Although many of the empirical findings in this literature are based on lower level, observationally equivalent workers, the availability of data on executive compensation allows us to perform a detailed analysis of wages, skills, turnover, and relocation decisions across firms, industries, and cities. This allows us to disentangle competing theories and present evidence about how high-ability workers are compensated across different metro areas.

The remainder of the article is organized as follows: Section II describes the data, variables, and methodology. Section III presents the baseline empirical findings about the effect of location on CEO compensation. Section IV presents theoretical discussion and empirical evidence on the channels that could explain the cross-sectional variation in CEO compensation across cities of various sizes. Section V provides several robustness checks, and Section VI concludes.

II. Data

A. Sample and Methodology

Our primary data set for executive compensation and CEO characteristics comes from the ExecuComp database. Because a firm's CEO makes most major corporate decisions and exerts the greatest influence on the firm among senior executives, we focus on compensation and incentive provisions for CEOs.

We control for cost of living and per capita income differentials across localities. Cost of living information for every metropolitan area in our sample is collected from ACCRA Cost of Living Index, obtained from the Community and Economic Research report (C2ER), which collects quarterly cost of living data that are based on surveys with professional and executive households in the top income quintile. We also collect per capita income data from the U.S. Bureau of Economic Analysis (http://www.bea.gov/regional/).[8] To remove the inflation effect from our results, compensation data are presented in real terms by adjusting nominal pay with the Consumer Price Index.

[8]Controlling for the MSA median housing price from the National Association of Realtors produces qualitatively similar results.

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To assign firms to urban agglomerate (URBAN_AGGLOMERATE), urban (URBAN), or rural (RURAL) locations we follow a number of authors, including Coval and Moskowitz (1999), Ivković and Weisbenner (2005), and Loughran and Schultz (2005), and use a company's headquarters as a proxy for its location. We obtain headquarters locations from Compustat, ExecuComp, and Hoover's, and account for relocations by using proxy statements, prospectuses, and 8K and 10K filings, where applicable. We then find the latitude and longitude data for each firm's headquarters using the U.S. Census Bureau's Gazetteer city–state files. We classify a company as belonging to an urban agglomerate area if it is headquartered in 1 of the 10 largest consolidated metropolitan statistical areas (CMSAs) in the United States according to the 2000 Census. These include New York City, Los Angeles, Chicago, Washington, DC–Baltimore, San Francisco, Philadelphia, Boston, Detroit, Dallas, and Houston. Companies located in a suburb of one of these cities are also assigned to the urban agglomerate portfolio. A company is classified as belonging to an urban area if it is not located in an urban agglomerate and if it is headquartered in an MSA with at least 1 million residents as defined by the U.S. Census. Finally, firms are assigned to a rural area if they are headquartered at least 250 kilometers away from the center of urban agglomerate and urban areas and based in MSAs with less than 1 million residents. Thus, by definition, a rural location reflects metropolitan areas with lower population sizes that are also farther away from the influence of potential agglomeration externalities provided by large and central metropolitan areas. This categorization allows us to identify firms that are clearly urban and clearly rural, and directly test whether urban agglomeration affects CEO compensation.

For a firm to be included in our sample, data on the headquarters location, population size, assets, sales, analyst coverage, total pay and composition of CEO pay, tenure, percentage of shares held by the CEO, return on assets, and market-to-book ratio must be available. A total of 10,107 CEO-year observations representing 777 publicly traded firms covering 1992–2004 meet these criteria.

B. Description of Variables

Our dependent variable of interest is CEO compensation. We use the logarithm of the total compensation variable, which includes base salary, bonuses, options, restricted stocks, and other compensation (TOTAL_COMPENSATION). We also separately analyze the logarithm of the equity-based portion of compensation, defined as the total value of options and restricted stock awarded to the CEO divided by total compensation (EQUITY_COMPENSATION). We use CEO-specific, firm-specific, and demographic control variables in our analysis. CEO-specific measures include CEO_AGE and CEO tenure (TENURE) in years. Older executives and/or those who have been in office longer could receive compensation because they are more reputable (Milbourn (2003)) or because longer tenure strengthens the CEO's ability to influence the board's compensation decisions (Baker and Gompers (2003)). To capture this dimension of managerial experience, we measure TENURE as the difference between the current year and the year when the CEO was appointed by the company.

In addition, to account for CEO unique skills, we collect information from BoardEx about a CEO's educational attainment and denote latent CEO ability

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(TOP_SCHOOL) as a dummy variable that equals 1 if the CEO has graduated from 1 of the top 25 U.S. universities, as identified by Engelberg et al. (2013). Such information covers a little more than 80% of the observations in our sample. We also obtain other measures of ability by collecting information about whether the CEO has a graduate degree, including master of business administration (MBA) or other graduate degree (GRAD_DEGREE, MBA, OTHER_GRAD_DEGREE). If skilled CEOs are more likely to sort into large cities, we should find a positive relation between such latent ability and city size.

Our firm-specific variables are obtained primarily from Compustat and include headquarters location, firm's asset size in log (LOG(ASSETS)), firm profitability (ROA), and firm's market-to-book ratio (MARKET_TO_BOOK). We calculate ROA as the ratio of earnings before interest, tax, depreciation, and amortization, divided by total assets. For MARKET_TO_BOOK, we use the end of the previous year's Center for Research in Security Prices market value of equity scaled by the prior fiscal year's book value (defined as book value of equity plus balance-sheet deferred taxes and investment credit minus the book value of preferred stock). Because the literature suggests that firms facing larger risk with respect to their prospects tend to provide higher pay to their managers (e.g., Core, Guay, and Larcker (2003)), we also account for firm risk using the prior 5-year average Black–Scholes (1973) percentage volatility (VOLATILITY).

We next account for firm-level information asymmetry. Our information asymmetry proxy is the number of analysts following the firm (LOG(1 + ANALYSTS)). Analyst coverage is defined as the number of analysts reporting current fiscal-year annual earnings estimates before June of year t. These data are collected from the Institutional Brokers' Estimate System (IBES). Firms without IBES coverage are assigned a value of 0 analysts. Existing work has shown that the information production role of analysts increases with their proximity to target firms (Bae, Stulz, and Tan (2006)) and is associated with greater information accuracy and availability (Malloy (2005)). To the extent that location affects executive pay through information dissemination by the firm's analysts and informed traders, once we control for information dissemination we should observe a significant reduction in the effect of urban agglomeration on a firm's CEO compensation contract.

C. Summary Statistics

We segment our sample into firms headquartered in urban agglomerate (5,000 observations), urban (3,923 observations), and rural (1,184 observations) areas. Table 1 presents the distribution of our sample across the three location groups, the major city, population size, and the Census Bureau's code associated with each CMSA/MSA during 1992–2004. Overall, there are 143 distinct CMSAs/MSAs (10 urban agglomerate CMSAs, 39 urban MSAs, and 94 rural MSAs) hosting the firms in our sample. According to the 2000 Census, their population sizes range from 28,149 in Yazoo City, MS to about 21.2 million in New York City's CMSA.

Table 2 provides summary statistics for the variables used throughout the analysis. In Panel A we compare firm, managerial, and institutional characteristics across firms located in urban agglomerate, urban, and rural areas. Rural firms are

TABLE 1

Distribution of Sample across Metropolitan Areas

Table 1 provides a summary of the number of firm-year observations used in the analysis, across firm headquarters location and metropolitan/consolidated metropolitan statistical areas (MSA/CMSA). The data set comprises 10,107 observations associated with 777 firms over 1992–2004. Urban agglomerate firms are those headquartered in a New York City, Los Angeles, Chicago, Washington, San Francisco, Philadelphia, Boston, Detroit, Dallas, or Houston CMSA. Urban firms are located in metropolitan areas of at least 1 million people that are not one of the 10 urban agglomerate areas. Rural companies are located at least 250 kilometers away from urban agglomerate and urban firms.

Classification	MSA/CMSA Code	Representative Major City, State	Population Size	No. of Obs.	Percent
Urban agglomerate	5602	New York, NY	21,199,865	1006	9.95
	4472	Los Angeles, CA	16,373,645	695	6.88
	1602	Chicago, IL	9,157,540	552	5.46
	8872	Washington, DC–Baltimore	7,608,070	405	4.01
	7362	San Francisco, CA	7,039,362	429	4.24
	6162	Philadelphia, PA	6,188,463	495	4.90
	1122	Boston, MA	5,819,100	312	3.09
	2162	Detroit, MI	5,456,428	404	4.00
	1922	Dallas, TX	5,221,801	283	2.80
	3362	Houston, TX	4,669,571	419	4.15
		Total		5,000	49.47
Urban	520	Atlanta, GA	4,112,198	357	3.53
	4992	Miami, FL	3,876,380	172	1.70
	7602	Seattle, WA	3,554,760	150	1.48
	6200	Phoenix, AZ	3,251,876	152	1.50
	5120	Minneapolis, WI	2,968,806	171	1.69
	1692	Cleveland, OH	2,945,831	104	1.03
	7320	San Diego, CA	2,813,833	166	1.64
	7040	St. Louis, MO	2,603,607	173	1.71
	2082	Denver, CO	2,581,506	166	1.64
	8280	Tampa, FL	2,395,997	153	1.51
	6280	Pittsburgh, PA	2,358,695	189	1.87
	6442	Portland, OR	2,265,223	117	1.16
	1642	Cincinnati, OH	1,979,202	87	0.86
	6922	Sacramento, CA	1,796,857	92	0.91
	3760	Kansas City, MO	1,776,062	86	0.85
	5082	Milwaukee, WI	1,689,572	107	1.06
	5960	Orlando, FL	1,644,561	71	0.70
	3480	Indianapolis, IN	1,607,486	52	0.51
	7240	San Antonio, TX	1,592,383	46	0.46
	5720	Norfolk, VA	1,569,541	62	0.61
	4120	Las Vegas, NV	1,563,282	50	0.49
	1840	Columbus, OH	1,540,157	51	0.50
	1520	Charlotte, NC	1,499,293	82	0.81
	5560	New Orleans, LA	1,337,726	51	0.50
	7160	Salt Lake City, UT	1,333,914	76	0.75
	3120	Greensboro, NC	1,251,509	68	0.67
	640	Austin, TX	1,249,763	79	0.78
	5360	Nashville, TN	1,231,311	86	0.85
	6480	Providence, RI	1,188,613	74	0.73
	6640	Raleigh, NC	1,187,941	55	0.54
	3280	Hartford, CT	1,183,110	70	0.69
	1280	Buffalo, NY	1,170,111	81	0.80
	4920	Memphis, TN	1,135,614	58	0.57
	8960	West Palm Beach, FL	1,131,184	64	0.63
	3600	Jacksonville, FL	1,100,491	60	0.59
	6840	Rochester, NY	1,098,201	50	0.49
	3000	Grand Rapids, MI	1,088,514	49	0.48
	5880	Oklahoma City, OK	1,083,346	82	0.81
	4520	Louisville, KY	1,025,598	64	0.63
		Total		3,923	38.81
Rural		Rest	<1,000,000	1,184	11.71
		Total		10,107	100.00

significantly younger and smaller than firms headquartered elsewhere, whereas urban agglomerate firms are the oldest and largest in the sample.

Consistent with Malloy (2005) and others, we find that rural companies have less analyst coverage in comparison to their urban and urban agglomerate counter-

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TABLE 2
Comparative Descriptive Statistics

Panels A and B in Table 2 provide mean, median, and differences in means and medians across location groups' summary statistics of firm, managerial, institutional, and CEO compensation data employed in the analysis. The variables include: asset size (ASSETS); return on assets (ROA); leverage in % (LEVERAGE); annual volatility in % (VOLATILITY); market value, which is the firm's market capitalization (MARKET_VALUE) (in $M); FIRM_AGE (years); number of analysts (ANALYSTS); analyst forecast error (ANALYST_FORC_ERR); percentage of observations with analyst coverage (%_ANALYST_COV); percentage of shares owned by the CEO (SHARES_OWNED); CEO_AGE; CEO tenure (TENURE); percentage of CEOs who graduated from a top university (%_TOP_SCHOOL) or have a graduate degree (%_GRAD_DEGREE); total compensation (TOTAL_COMP) ($K); equity-based pay (EQUITY_COMP) ($K); cash-based pay (CASH_COMP) ($K); and salary (SALARY), bonus (BONUS), and option (OPTION) compensation ($K). Numbers without parentheses are medians, and numbers within parentheses are averages. The *t*-statistic values represent differences in means (Panel A). χ^2 statistic represents differences in medians (Panel B). *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Panel A. Firm, Managerial, and Institutional Characteristics

Variable	All Firms: Mean (Median)	Rural 1	Urban 2	Urban Agglomerate 3	*t*-Stat. 1−2	*t*-Stat. 1−3	*t*-Stat. 2−3
ASSETS ($billions)	12.466 (1.597)	5.931	9.154	16.614	−3.035***	−5.283***	−6.115***
ROA (%)	3.881 (4.381)	2.425	3.971	4.156	−2.117**	−2.670***	−3.957***
LEVERAGE (%)	22.139 (20.294)	28.385	22.482	20.391	2.328**	4.655***	1.967**
VOLATILITY (%)	41.895 (36.021)	36.375	39.816	44.833	−5.161***	−11.143***	−10.210***
MARKET_VALUE ($M)	7,218.545 (1,587.655)	3,700.062	5,413.364	9,468.066	−3.565***	−7.095***	−2.978***
FIRM_AGE (years)	33.857 (29.358)	29.374	33.485	35.211	−1.675*	−3.793***	−1.844*
ANALYSTS	5.362 (4.237)	2.381	4.388	6.833	−5.461***	−7.775***	−10.080***
ANALYST_FORC_ERR	0.055 (0.052)	0.103	0.062	0.039	2.978***	3.050***	2.627***
%_ANALYST_COV	36.924 (35.131)	15.383	35.382	43.234	−5.925***	−5.925***	−7.607***
SHARES_OWNED (%)	4.219 (1.480)	3.583	4.195	4.389	−2.018**	−2.301**	−1.587
CEO_AGE (years)	55.747 (56.00)	55.290	55.920	55.719	−1.981**	−1.333	−0.971
TENURE (years)	6.303 (4.00)	5.544	6.193	6.569	−3.009***	−4.596***	−2.560**
%_TOP_SCHOOL	21.239	19.477	19.710	22.859	−0.177	−2.519**	−3.598***
%_GRAD_DEGREE	19.056	17.960	17.749	20.343	0.166	−1.986**	−3.092***

Panel B. CEO Compensation

Variable	All: Median (Mean)	Rural 1	Urban 2	Urban Agglomerate 3	χ^2 Statistic 1−2	χ^2 Statistic 1−3	χ^2 Statistic 2−3
TOTAL_COMP ($K)	2,625.821 (5,276.262)	2,089.024	2,196.072	3,236.732	−2.303	−210.698***	−112.077***
EQUITY_COMP ($K)	1,211.177 (3,476.886)	838.7585	971.971	1,651.707	−8.278***	−213.695***	−140.803***
CASH_COMP ($K)	984.361 (1,384.067)	847.585	950.674	1,045.803	−13.448***	−30.543***	−32.275***
SALARY ($K)	584.253 (632.138)	558.341	563.055	601.231	−0.127	−27.884***	−27.444***
BONUS ($K)	400.002 (751.929)	300.664	375.001	450.027	−15.460***	−55.089***	−33.335***
OPTIONS ($K)	1,054.423 (3,052.814)	719.628	813.501	1,429.002	−4.612**	−162.982***	−226.459***

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parts. This finding suggests that remote rural-based firms have lower visibility and familiarity, along with greater information asymmetry, compared to both urban and urban agglomerate companies. In addition, the percentage of CEOs educated in elite universities or CEOs with a graduate degree tends to be significantly higher for urban agglomerate firms compared to those in urban and rural locations. This is consistent with Christoffersen and Sarkissian (2009) among others, who find that big cities tend to attract the best and brightest workers.

In Panel B of Table 2 we examine how CEO compensation is affected by location. The median total pay of the CEOs in our sample is $2.6 million, with rural CEOs earning the lowest pay ($2.1 million) compared to those in urban ($2.2 million) and urban agglomerate ($3.2 million) areas. Rural firms' CEOs also earn the lowest equity pay compared to their urban and urban agglomerate counterparts, with median equity pay of $0.8 million, $1 million, and $1.7 million, respectively. All incentive pay differentials are statistically significant at least at the 1% level. Consistent with a higher level of overall median pay for urban agglomerate CEOs, all components of pay are significantly higher for large-city CEOs compared to their rural counterparts.

We continue the analysis by examining the relation between location and CEO compensation. Figure 1 shows the median total compensation of the CEOs in our sample (Graph A) and their equity incentives (options and stocks) as a percentage of total pay (Graph B) across the 49 largest CMSAs/MSAs in the United States, sorted by population size. Graph A shows a clear, positive relation between the population size of the major city associated with the CMSA/MSA where the firm is headquartered and the median total CEO compensation for the most highly populated metropolitan areas in the United States. As the graph shows, this positive relation is the most prominent in urban agglomerate areas. Similar evidence is illustrated in Graph B, where we see a positive relation between the population size of the metropolitan area where the CEO is employed and the proportion of equity incentives.

Figure 2 illustrates the distribution of the median total CEO pay (Graph A) and average equity pay as a percentage of total pay (Graph B) over time and across the three location groups. Consistent with the univariate results in Table 2, on average, urban agglomerate CEOs exhibit the highest total pay during each year of the sample period, and rural CEOs the lowest. Urban agglomerate executives also receive, on average, the highest level of equity pay as a percentage of total compensation for every year during 1992–2004. The similarity of pay patterns across the three location groups over time, as shown in Figure 2, indicates that the level and structure of compensation contracts across firms in various areas are not driven by macroeconomic conditions that are specific to a certain region.

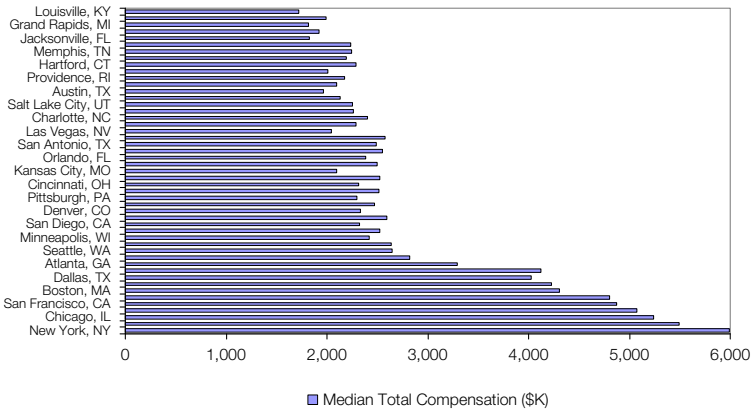
III. Empirical Results

Because total CEO pay can differ across firm locations if there are systematic differences in firm, local, or managerial characteristics, we use regression analysis to examine whether changes in executive compensation contracts are attributable to the firm's location demographic features or to systematic differences in firm and CEO characteristics.

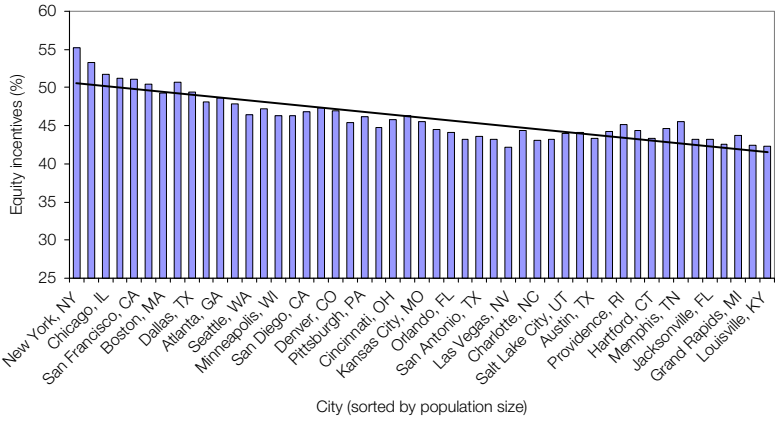
FIGURE 1
Cities and CEO Compensation

Graph A in Figure 1 shows the median total compensation ($K) of CEOs based in the 49 largest U.S. cities, sorted by the population size of the CEO's firm headquarters metropolitan/consolidated metropolitan statistical areas. Graph B shows the size of equity incentives (options and stocks) as a percentage of total CEO pay, sorted by the headquarters MSA/CMSA population size in the 49 largest U.S. cities. Population size data are from the 2000 Census (http://www.census.gov/population/www/cen2000/briefs/phc-t3/tables/tab03.txt). The data cover 10,107 firm-year observations over 1992–2004.

Graph A. Median Total Compensation ($K) by City (1992–2004)



Graph B. Equity Incentives as a Percentage of Total CEO Pay, by City (1992–2004)



A. Main Results

Table 3 reports the main regression results, with URBAN_AGGLOMERATE and URBAN dummy variables used as proxies for the size and centrality of the metropolitan area in which a CEO's firm is headquartered. The primary specification is the following:

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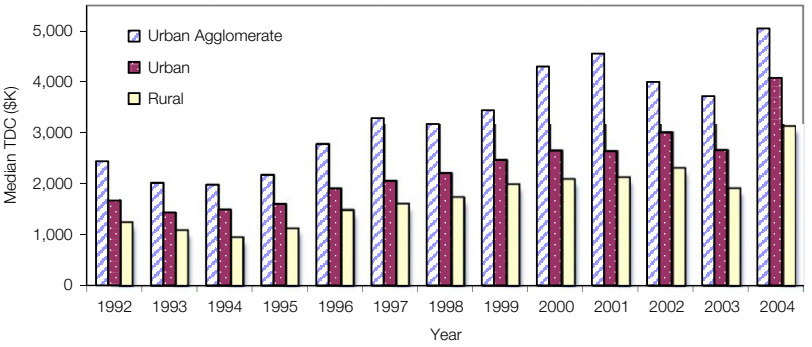
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FIGURE 2

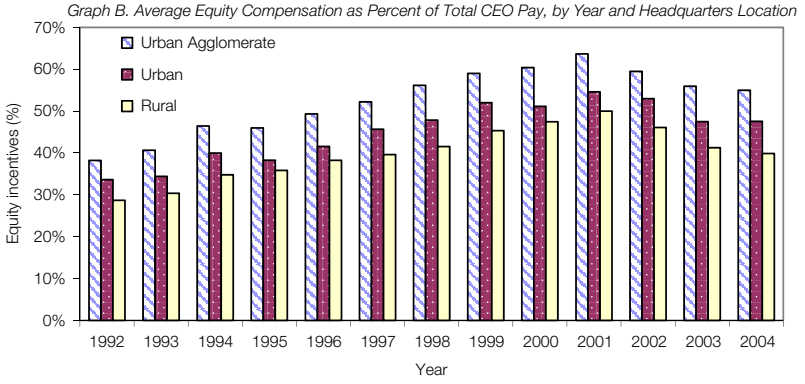
Annual Trends in CEO Compensation and Headquarters Location

Graph A of Figure 2 shows the median CEO compensation sorted by year and firm headquarters location. TDC is total CEO compensation (ExecuComp variable TDC1). Graph B shows average equity compensation as a percentage of total pay, sorted by location and time. Urban agglomerate firms are those headquartered in a New York City, Los Angeles, Chicago, Washington, San Francisco, Philadelphia, Boston, Detroit, Dallas, or Houston consolidated metropolitan statistical areas. Urban firms are located in metropolitan areas of at least 1 million people, as defined by the 2000 Census, that are not one of the 10 urban agglomerate areas. Rural companies are those located at least 250 kilometers from urban agglomerate and urban firms. The data include 10,107 observations (5,000 urban agglomerate, 3,923 urban, and 1,184 rural) during 1992–2004.

Graph A. Median Total Compensation, by Year and Headquarters Location



Graph B. Average Equity Compensation as Percent of Total CEO Pay, by Year and Headquarters Location



$$(1)\quad \text{LOG(COMPENSATION}_{it}) = \alpha_0 + \alpha_1 \times \text{URBAN_AGGLOMERATE}_i + \alpha_2 \times \text{URBAN}_i + [\text{CONTROLS}_{it-1}] + \text{INDUSTRY_FE} + \text{YEAR_FE}.$$

Unless otherwise noted, LOG(COMPENSATION$_{it}$) represents the log of total CEO pay or the log of equity pay divided by total pay. The coefficient α_1 (α_2) represents the difference in CEO compensation between urban agglomerate (urban) firms and rural-based firms. The lagged control variables are as specified in the previous section. We include industry fixed effects, using the Fama–French (1997) 48-industry dummies, and year dummies. In all regressions, we use robust standard errors, clustered at the CMSA/MSA level.

Column 1 of Table 3 shows the results of a panel regression, where the dependent variable is the log of total CEO compensation. We find, consistent with our conjecture, that both the urban agglomerate and urban dummies are positive and statistically significant at the 1% level, indicating that CEOs in larger cities earn significantly higher compensation than CEOs in rural areas. To be specific, controlling for cost of living and adjusting for log transformation, column 1 shows that CEOs based in firms headquartered in one of the 10 largest CMSAs in the United States receive total compensation that is 25.3% higher than those of rural firms.[9] Similarly, although not as dramatic, CEOs of firms in urban areas receive total compensation that is 7.4% higher than that received by CEOs of rural firms.

In columns 2 and 3 of Table 3, we run the primary regression using the log of equity or cash pay divided by total compensation. Adjusting for log transforma-

TABLE 3
Urban Agglomeration and CEO Compensation

Table 3 estimates coefficients from regressing different components of CEO compensation on firm headquarters location dummies (URBAN_AGGLOMERATE and URBAN) and various control variables, including: firm asset size (LOG(ASSETS)); volatility, which denotes the prior 5-year average Black–Scholes (1973) volatility in % (VOLATILITY); return on assets in % (ROA); CEO tenure in years (TENURE); market-to-book ratio (MARKET_TO_BOOK); PER_CAPITA_INCOME;and COST_OF_LIVING. The intercept and industry and year fixed effects are included but not reported. Column 1 shows the results of a panel regression, where the dependent variable is the log of total CEO compensation (ExecuComp variable TDC1). Total CEO compensation consists of salary, bonus, value of restricted stock granted, value of options granted (using Black–Scholes (1973)), long-term incentive payouts, and other compensation; columns 2 and 3 run the regression using the log of the equity and cash-based portion of CEO compensation, respectively. *p*-values calculated from robust standard errors clustered at the metropolitan/consolidated metropolitan statistical area level are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Variable	Dependent Variable: Total Compensation 1	Dependent Variable: Equity-Based Portion of Pay 2	Dependent Variable: Cash-Based Portion of Pay 3
URBAN_AGGLOMERATE	0.098***	0.122***	−0.102***
	(0.000)	(0.000)	(0.000)
URBAN	0.031**	0.011***	−0.003***
	(0.029)	(0.009)	(0.000)
LOG(ASSETS)	0.452***	0.090***	−0.141***
	(0.000)	(0.000)	(0.000)
VOLATILITY	0.245***	0.399***	−0.441***
	(0.000)	(0.000)	(0.000)
ROA	0.002***	0.001***	0.0002
	(0.007)	(0.000)	(0.719)
TENURE	0.023*	0.004**	0.003***
	(0.055)	(0.000)	(0.009)
MARKET_TO_BOOK	0.084***	0.029***	−0.080***
	(0.000)	(0.000)	(0.000)
PER_CAPITA_INCOME	0.001***	0.001***	0.002***
	(0.000)	(0.000)	(0.000)
COST_OF_LIVING	0.002***	0.003	0.007
	(0.000)	(0.448)	(0.204)
Adj. R^2	0.616	0.604	0.572
No. of obs.	10,107	10,107	10,107

[9]When the explanatory variable is continuous, the coefficient represents the change in compensation for a 1% change in the explanatory variable. Because the URBAN_AGGLOMERATE dummy variable is not continuous, the coefficient represents the change in log compensation for a change in the dummy variable from 0 to 1. A coefficient of 0.098 on the URBAN_AGGLOMERATE dummy therefore translates to an increase in compensation of $10^{0.098} = 1.253$, or a 25.3% increase in total compensation.

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tion, we find that the composition of equity incentives is significantly higher for urban agglomerate and urban CEOs compared to their rural counterparts, whereas the opposite is obtained for cash compensation. The results are also economically meaningful. For example, in column 2, the coefficient on the average portion of equity pay is 0.122, suggesting that the portion of equity incentives for an urban agglomerate CEO is 32.4% higher than that of a CEO employed at a rural company. In column 3, the effect of location on the cash-based portion of pay is negative and smaller in magnitude, with a negative coefficient of −0.102, indicating that the level of cash-based pay as a percentage of total pay for rural CEOs is 20.9% higher than that of their urban agglomerate counterparts.

The coefficient estimates of the control variables used in the regressions all bear their expected signs and are statistically significant at conventional levels. More important, however, is that the relation between CEO compensation and city size is significant at the 1% level for all model specifications. Thus, these findings corroborate the univariate results that CEOs employed in larger cities, especially the most highly populated urban agglomerates, enjoy a significant wage premium.

We further explore the effect of city size on equity- and cash-based components. To do so, we examine separately the option-, stock-, salary-, and bonus-based portions of compensation. Results are reported in Table 4. Columns 1 and 2 contain regression results for options and stocks, with salary and bonus regressions results reported in columns 3 and 4. Columns 1 and 2 show that there is a positive and highly significant differential in option and stock compensation between urban agglomerate and rural CEOs. In contrast, for the salary and bonus regressions (columns 3 and 4), the URBAN_AGGLOMERATE and URBAN dummy variable coefficients are negative and significant, indicating that CEOs in rural areas obtain a larger part of their compensation as salary and bonus than CEOs in urban and urban agglomerate areas. Taken together, these findings indicate that the wage premium enjoyed by urban agglomerate CEOs, and to a much lesser extent their urban counterparts, is due entirely to the equity component of compensation, which more than offsets the lower portion of salary and bonus that they receive. This higher equity-based portion of pay for CEOs in large cities is mainly attributable to stock compensation, and the higher cash-based portion of pay for CEOs in rural areas is mainly attributable to differences in salary.

These data suggest that if we were to move a company from, say, rural Little Rock, AR to New York City, the CEO's portion of real salary (bonus) would decline by 16.8% (10.5%), and the portion of real stock (option) pay would increase by 36.8% (30.9%). Thus, these results indicate that headquarters location is an important determinant of the level and structure of CEO compensation.

IV. Channels

Our results so far are consistent with those found by Glaeser and Maré (2001) and Gould (2007), among others, who document a higher wage for workers in large cities that is also increasing in worker skill. In this section, we outline and empirically examine the main theoretical explanations for the "city premium" we observe in real CEO total and equity compensation data.

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TABLE 4

Urban Agglomeration and Compensation Components

Table 4 estimates coefficients from regressing CEO compensation components on firm headquarters location dummies (URBAN_AGGLOMERATE and URBAN) and various control variables, including: firm asset size (LOG(ASSETS)); VOLATILITY, which denotes the prior 5-year average Black–Scholes volatility (1973) (in %); return on assets in % (ROA); CEO tenure in years (TENURE); market-to-book ratio (MARKET_TO_BOOK); PER_CAPITA_INCOME; and COST_OF_LIVING. The intercept and industry and year fixed effects are included but not reported for brevity. Columns 1 and 2 show the results of a panel regression, where the dependent variable is log of option compensation and the log of restricted stock divided by total pay, respectively. Columns 3 and 4 present the results using the log of the value of salary and bonus compensation divided by total pay, respectively. *p*-values based on robust standard errors clustered at the metropolitan/consolidated metropolitan statistical area level are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	Dependent Variable			
	Option Compensation	Stock Compensation	Salary Compensation	Bonus Compensation
Variable	1	2	3	4
URBAN_AGGLOMERATE	0.117***	0.136***	−0.080**	−0.048**
	(0.000)	(0.000)	(0.025)	(0.061)
URBAN	0.007***	0.021***	−0.005*	−0.009**
	(0.004)	(0.000)	(0.073)	(0.013)
LOG(ASSETS)	0.076***	0.082***	−0.235***	−0.002*
	(0.008)	(0.000)	(0.000)	(0.091)
VOLATILITY	0.528***	−0.408**	−0.370***	−0.448***
	(0.000)	(0.020)	(0.000)	(0.000)
ROA	0.001***	−0.003	−0.001*	0.000
	(0.006)	(0.253)	(0.052)	(0.536)
TENURE	0.002*	0.006*	0.003**	0.0001*
	(0.091)	(0.063)	(0.019)	(0.089)
MARKET_TO_BOOK	0.030***	0.037***	−0.088***	−0.062***
	(0.000)	(0.000)	(0.000)	(0.000)
PER_CAPITA_INCOME	0.0008*	0.0001*	0.0001**	0.0001*
	(0.072)	(0.081)	(0.068)	(0.076)
COST_OF_LIVING	0.001***	0.001	0.002**	0.001***
	(0.000)	(0.339)	(0.013)	(0.000)
Adj. R^2	0.614	0.612	0.601	0.603
No. of obs.	10,107	10,107	10,107	10,107

A. Ability Sorting

A potential explanation for the urban premium in real CEO compensation is that employers in cities attract and retain higher quality workers than those in nonurban areas, and these skills are not reflected fully in measured variables. There are several reasons why highly skilled and motivated CEOs may be particularly attracted to large metropolitans. First, the thick labor market in cities allows for easier matching between high ability and better jobs (Helsley and Strange (1991)). Second, if cities increase the flow of information spillovers, this might be more valuable to individuals who have high human capital (Glaeser and Maré (2001)). And third, cities are centers of consumption, a feature that caters to the rich and well educated (Glaeser et al. (2001)). To the extent that high-ability CEOs are attracted to big cities, the outcome of such labor market sorting is an equilibrium in which urban CEOs realize higher pay and incentive pay schemes designed to attract, retain, and reward appropriate managerial talent than CEOs located in nonurban areas.

The ability sorting hypothesis offers several testable implications. First, there should be a positive correlation between city size and measured CEO ability. Second, if personal ability is the primary explanation for the urban compensation

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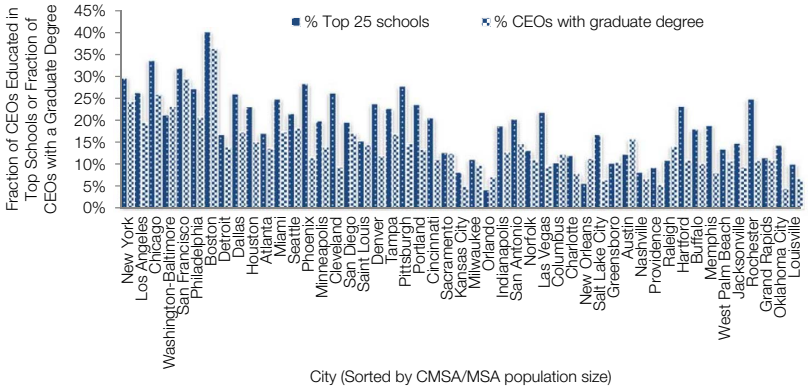
premium, controlling for measurable CEO skill, there should be no difference in real measures of compensation between urban and nonurban CEOs.

To provide evidence that high-ability individuals are attracted to big cities, we first look at the direct relation between CEO skill and city size. Figure 3 suggests a strong positive relation between metropolitan size and its fraction of CEOs educated in one of the top 25 U.S. universities, as well as its fraction of CEOs with a graduate degree. Seven (8) of the top 10 fractions of CEO elite school affiliation (graduate degree holders) areas also number among the top 10 CMSAs in terms of population size. To the extent that school choice and educational attainment provide information about CEO latent ability or productivity, and elite schools, in particular, train a disproportionate number of high ability individuals, Figure 3 provides preliminary evidence of big city ability sorting.

We now proceed with a set of tests to examine the role of CEO ability in compensation contracts across cities of various sizes. We start by following Engelberg et al. (2013) and augment the baseline specification in equation (1) by including an observable measure of CEO skill, TOP_SCHOOL (MBA, OTHER_GRAD_DEGREE), that is a dummy variable that equals 1 if the CEO has graduated from 1 of the top 25 U.S. universities (has an MBA or any other graduate degree), and 0 otherwise. Table 5 presents the regression results. Columns 1–3 contain the results where log of total CEO compensation is the dependent variable, and columns 4–6 contain the results where the log of equity compensation divided by total compensation is the dependent variable. As expected, the coefficients on the TOP_SCHOOL, MBA, and OTHER_GRAD_DEGREE dummy variables are positive and significant, indicating that CEOs who attend elite universities, have MBAs, or have other graduate degrees earn higher compensation. More important however, the point estimates for URBAN_AGGLOMERATE (URBAN) are

FIGURE 3
Geographical Distribution of CEO Latent Ability

Figure 3 shows the percentage of CEOs educated in 1 of the top 25 U.S. universities and the percentage of CEOs with a graduate degree by the central city of the consolidated metropolitan/metropolitan statistical areas (CMSA/MSA) of headquarters employment. Cities are sorted by the population size of the 49 largest U.S. MSA/CMSA. PMSA/CMSA population size data are from the 2000 Census (http://www.census.gov/population/www/cen2000/briefs/phc-t3/tables/tab03.txt). Information about CEO education is from BoardEx, and top school affiliation is as in Engelberg, Gao, and Parsons (2013).



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TABLE 5

CEO Pay, Cities, and Skill

Table 5 estimates coefficients from regressing CEO compensation on firm headquarters location dummies (URBAN_AGGLOMERATE and URBAN) and various control variables, including: firm asset size (LOG(ASSETS)); VOLATILITY, which denotes the prior 5-year average Black–Scholes (1973) volatility (in %); return on assets in % (ROA); CEO tenure in years (TENURE); market-to-book ratio (MARKET_TO_BOOK); PER_CAPITA_INCOME;and COST_OF_LIVING. The intercept and industry and year fixed effects are included but not reported for brevity. Columns 1–3 and 4–6 show the results of a panel regression, where the dependent variable is the log of total CEO compensation or the log of the CEO's equity-based portion of total pay, respectively, including a dummy variable, TOP_SCHOOL (MBA or OTHER_GRAD_DEGREE) to denote whether the CEO has attended 1 of the top 25 U.S. universities (or has an MBA or another graduate degree). *p*-values calculated from robust standard errors clustered at the metropolitan/consolidated metropolitan statistical area level are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	Dependent Variable					
Variable	Total Compensation 1	Total Compensation 2	Total Compensation 3	Equity Compensation 4	Equity Compensation 5	Equity Compensation 6
URBAN_AGGLOMERATE	0.091*** (0.000)	0.093*** (0.000)	0.089*** (0.000)	0.114*** (0.000)	0.111*** (0.000)	0.113*** (0.000)
URBAN	0.026** (0.031)	0.023** (0.030)	0.021** (0.036)	0.008** (0.041)	0.009** (0.012)	0.007*** (0.010)
LOG(ASSETS)	0.446*** (0.000)	0.445*** (0.000)	0.451*** (0.000)	0.092*** (0.000)	0.088*** (0.000)	0.091*** (0.000)
VOLATILITY	0.258*** (0.000)	0.251*** (0.000)	0.248*** (0.000)	0.403*** (0.000)	0.391*** (0.000)	0.0399*** (0.000)
ROA	0.004*** (0.000)	0.003*** (0.000)	0.002*** (0.007)	0.001*** (0.000)	0.002*** (0.000)	0.001*** (0.000)
TENURE	0.031** (0.022)	0.036* (0.054)	0.018* (0.052)	0.003*** (0.000)	0.004*** (0.000)	0.003*** (0.000)
MARKET_TO_BOOK	0.080*** (0.000)	0.081*** (0.000)	0.086*** (0.000)	0.032*** (0.000)	0.033*** (0.000)	0.030*** (0.000)
PER_CAPITA_INCOME	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)
COST_OF_LIVING	0.001*** (0.000)	0.001*** (0.000)	0.002*** (0.000)	0.002* (0.083)	0.002 (0.108)	0.002* (0.096)
TOP_SCHOOL	0.045** (0.017)			0.008** (0.033)		
MBA		0.052* (0.071)			0.009* (0.082)	
OTHER_GRAD_DEGREE			0.036* (0.068)			0.004* (0.086)
Adj. R^2	0.621	0.620	0.620	0.611	0.611	0.611
No. of obs.	8,166	8,166	8,166	8,166	8,166	8,166

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between 0.089 and 0.091 (0.021 and 0.026) for total pay and between 0.111 and 0.114 (0.007 and 0.009) for the equity portion of pay, which are essentially unchanged from the earlier estimates. In sum, controlling for cost of living, CEO and firm characteristics, and a CEO's educational attainment as a measure of latent skill, an ordinary least squares regression identifies after adjusting for log transformation about a 23% (5%) advantage in total compensation and about a 29% (2%) advantage in the equity portion of compensation for urban agglomerate (urban) CEOs, compared to their rural counterparts. The fact that we still identify a significant urban agglomerate pay premium highlights the need to go beyond the simple ability sorting hypothesis to develop a more complete explanation of the big city compensation advantage.

B. Learning in the Big City

The results of the previous section indicate that after controlling for the heterogeneity in CEO skill measured by educational attainment, managers in large metropolitan areas receive a sizable compensation and equity incentive premium. Glaeser and Maré (2001) argue that much of this premium is likely to be a wage growth effect, varying with the duration of residency in the city. The reason for this gradual wage growth effect appears to stem from the learning hypothesis.

The learning hypothesis postulates that cities speed up the rate of human capital accumulation. For example, Glaeser (1999) contends that urban density accelerates the rate of interaction between people and that when people learn through interaction, human capital accumulation is accelerated. He argues that these externalities are significantly more likely to be present in large cities because of the increased contact between knowledgeable and highly skilled people that cities tend to have in abundance. This conjecture is supported empirically. For example, Lucas (1988), Audretsch and Feldman (1996), Yankow (2006), Gould (2007), and others find a positive association between individual earnings and the average level of skill accumulation in cities.

The learning hypothesis offers several testable implications. First, individuals become more productive with time spent in the city, and therefore, there should be a gradual growth in CEO compensation over time in the city, but not in the nonurban area. Second, to the extent that cities speed up the rate of learning from local peers, CEO pay should be positively related to the performance of other local companies in the city but not in the nonurban area. Third, because higher ability individuals tend to learn faster, the pay return to experience should be even steeper for higher ability CEOs. Fourth, CEOs moving into cities will not experience substantial, immediate real wage gains but rather will exhibit a gradual increase in total pay and incentive-driven compensation. And fifth, CEOs leaving big cities should not experience substantial compensation losses except through that portion of pay related to cost of living differences.

To explore the implications of learning in the urban area in more detail, we estimate the relation between CEO compensation and city experience for firms located in urban agglomerate, urban, and rural areas separately. We use a regression setting similar to equation (1), except in this framework, we compare CEO compensation for firms based in our three location groups rather than using the URBAN_AGGLOMERATE and URBAN dummy variables as in the baseline

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regression. To examine whether the pay return to big city work experience is larger for highly skilled CEOs, we also include the dummy variable TOP_SCHOOL and its interaction with TENURE in the estimation.

In Table 6, columns 1–3, we report panel regression results for each of the three types of firms separately where the dependent variable is the log of total CEO compensation. Columns 4–6 contain the regression results for rural, urban, and urban agglomerate firms where the dependent variable is the log of equity pay divided by total pay.

According to the learning hypothesis, managers earn more as they gain more experience in larger city firms, especially if they are highly skilled and therefore more prone to take advantage of the positive networking externalities in urban areas (Audretsch and Feldman (1996)). As such, we expect the slope on the TENURE variable to be significantly more positive for urban and urban agglomerate firms than for rural firms, ceteris paribus. In addition, we expect the interaction

TABLE 6
CEO Pay and Experience in Big Cities

Table 6 shows the estimation results from regressing CEO compensation components on managerial city experience (measured as tenure) and various control variables. Control variables include: firm asset size (LOG(ASSETS)); VOLATILITY; return on assets in % (ROA); CEO tenure in years (TENURE); TOP_SCHOOL dummy denoting whether the CEO has attended 1 of the top 25 U.S. schools; market-to-book ratio (MARKET_TO_BOOK); PER_CAPITA_INCOME; and COST_OF_LIVING. The intercept and industry and year effects are included but not reported for brevity. Columns 1–3 show the results of a panel regression, where the dependent variable is the log of total CEO compensation, and the subsamples examined are those representing rural, urban, and urban agglomerate firms, respectively. Columns 4–6 show the regression results, where the dependent variable is the log of the equity-based portion of CEO compensation divided by total pay, and the subsamples examined are those representing rural, urban, and urban agglomerate firms, respectively. *p*-values calculated from robust standard errors clustered at the metropolitan/consolidated metropolitan statistical area level are reported in parentheses. The *F*-test (U-R or UA-R) compares the coefficient on experience (TENURE) across locations. In a pooled regression including all observations and the same control variables, it tests the equality of the coefficient estimates on TENURE × D(M) and TENURE × (1 − D(M)), where D(M) is a dummy for URBAN or URBAN_AGGLOMERATE firms. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	Dependent Variable					
	Total Compensation			Equity-Based Portion of Pay		
	Rural	Urban	Urban Agglomerate	Rural	Urban	Urban Agglomerate
Variable	1	2	3	4	5	6
LOG(ASSETS)	0.526*** (0.000)	0.439*** (0.000)	0.421*** (0.000)	0.206*** (0.000)	0.111*** (0.000)	0.073*** (0.000)
VOLATILITY	0.183*** (0.000)	0.376*** (0.000)	0.088** (0.032)	0.814*** (0.000)	0.359*** (0.000)	0.382*** (0.000)
ROA	0.0002* (0.141)	0.001*** (0.000)	0.002** (0.041)	−0.003 (0.191)	0.001** (0.067)	0.009** (0.023)
TENURE	−0.0009 (0.119)	0.002* (0.071)	0.009*** (0.000)	−0.012 (0.129)	0.003*** (0.000)	0.009*** (0.000)
TOP_SCHOOL	0.007* (0.068)	0.021*** (0.000)	0.038*** (0.000)	0.001* (0.072)	0.004** (0.019)	0.009*** (0.000)
TENURE × TOP_SCHOOL	0.001 (0.171)	0.003** (0.046)	0.010*** (0.000)	0.0007 (0.126)	0.001*** (0.001)	0.003*** (0.000)
MARKET_TO_BOOK	0.004*** (0.000)	0.084** (0.022)	0.101*** (0.000)	0.020*** (0.000)	0.041*** (0.000)	0.131*** (0.000)
PER_CAPITA_INCOME	0.001*** (0.000)	0.002*** (0.000)	0.002*** (0.001)	0.002*** (0.000)	0.002*** (0.000)	0.001*** (0.001)
COST_OF_LIVING	0.005*** (0.000)	0.003*** (0.001)	0.002*** (0.000)	0.002*** (0.000)	0.002*** (0.000)	0.003*** (0.000)
No. of obs.	942	3,129	4,095	942	3,129	4,095
F-test (U-R or UA-R) *p*-value		3.53* (0.061)	9.78*** (0.002)		3.38* (0.062)	5.74** (0.014)

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between managerial skill and experience to be more positive for CEOs employed by big city firms than for their counterparts in rural communities. We first compare the slope coefficient on managerial experience (TENURE) across different locations. Consistent with the learning hypothesis, we see a strong positive relation between experience and both total and equity-based pay for managers employed in larger cities, with magnitudes substantially higher and more statistically significant for urban agglomerate CEOs. On the contrary, we find no evidence of learning among CEOs located in rural areas, as the slope coefficient on the managerial experience variable is insignificant for CEOs in rural-based companies. In addition, the positive relationship between big city experience and pay is most highly pronounced for more able managers, as evident by the larger slope coefficient on the interaction term between skill and experience in urban agglomerate firms. *F*-tests of whether the slope on managerial experience is the same for firms in big cities and firms in small rural communities are provided at the bottom of columns 2, 3, 5, and 6 in Table 6. The difference in coefficients is statistically significant in all cases for both measures of CEO compensation. This indicates that managers learn faster and gain more experience in urban agglomerate firms, which is reflected in significantly higher total and equity-based pay.

To gain additional insight into the effect of urban information spillovers on a local CEO's compensation package, we reestimate the regressions reported in Table 6 and include an additional variable, LOCAL_ROA, and its interaction with a CEO's elite school affiliation, in the compensation regressions.[10] This variable is based on work by Dougal et al. (2015) who show that the success of firms in vibrant urban areas strongly affects the growth and corporate policies of other local urban firms. This variable is the annual weighted average ROA of firms headquartered in the same CMSA/MSA of the focal firm, with asset size as weights. To the extent that information spillovers across firms based in the same urban area can facilitate CEOs' access to private information about local product markets, innovations, and competitive threats, and can result in faster learning from other local, well-performing companies, we expect the coefficient of LOCAL_ROA to be positive and economically more meaningful for urban and urban agglomerates than for rural firms, ceteris paribus. In addition, we expect talented CEOs to be more prone to learning from the performance of other big city local peers than less talented managers.

Table 7 reports the results from regressing CEO compensation measures on the regular set of independent variables included in the baseline regression, LOCAL_ROA as a measure of performance of local firms, and the interaction between managerial latent skill (TOP_SCHOOL) and local firm performance (LOCAL_ROA × TOP_SCHOOL). Columns 1–3 contain results when the dependent variable is log of total pay, and columns 4–6 the log of equity divided by total pay. As in Table 6, we present separate results for each of the three firm groups: rural, urban, and urban agglomerate. Consistent with the learning hypothesis, when we compare the slope coefficient on the average performance of other local firms (LOCAL_ROA) across different locations, we see a stronger positive relation between LOCAL_ROA and both total and equity-based compensation for

[10]We thank the referee for making this suggestion.

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managers employed in larger cities. In contrast, we find no evidence of learning from the performance of other firms in rural areas. Similarly, the coefficient on the interaction term, LOCAL_ROA × TOP_SCHOOL, is more positive for CEOs in urban agglomerates than for CEOs in smaller cities. This is consistent with the interpretation that learning from the experience of others is especially pronounced for high-ability individuals who are more prone to take advantage of the positive network externalities in big cities (Christoffersen and Sarkissian (2009), Audretsch and Feldman (1996)).

Thus, the results in Tables 6 and 7 provide support for the city learning hypothesis and suggest that managers in big cities learn more over time compared to their peers working in small towns. This learning environment improves

TABLE 7
CEO Pay and Local Spillover Effects

Table 7 shows the estimation results from regressing CEO compensation components on managerial city experience, the performance of other local firms (LOCAL_ROA), and various control variables. LOCAL_ROA is the weighted average ROA of same metropolitan/consolidated metropolitan statistical area (MSA/CMSA) firms (excluding the focal firm's ROA), with asset size as weights. Control variables include: firm asset size (LOG(ASSETS)); VOLATILITY, which denotes the prior 5-year average Black–Scholes (1973) volatility (in %); return on assets in % (ROA); CEO tenure in years (TENURE); TOP_SCHOOL dummy variable to denote whether the CEO graduated from a top university; market-to-book ratio (MARKET_TO_BOOK); PER_CAPITA_INCOME; and COST_OF_LIVING. The intercept and industry, firm, and year effects are included but not reported for brevity. Columns 1–3 show the results of a panel regression, where the dependent variable is the log of total CEO compensation, and the subsamples examined are those representing rural, urban, and urban agglomerate firms, respectively. Columns 4–6 show the regression results, where the dependent variable is the log of equity compensation divided by total pay, and the subsamples examined are those representing rural, urban, and urban agglomerate firms, respectively. *p*-values calculated from robust standard errors clustered at the CMSA/MSA level are reported in parentheses. The *F*-test (U-R or UA-R) compares the coefficient on the local performance of other firms (LOCAL_ROA) across locations. In a pooled regression including all observations and the same control variables, it tests the equality of the coefficient estimates on (LOCAL_ROA) × D(M) and (LOCAL_ROA) × (1 − D(M)), where D(M) is a dummy for urban or urban agglomerate firms. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	Dependent Variable					
	Total Compensation			Equity-Based Portion of Pay		
	Rural	Urban	Urban Agglomerate	Rural	Urban	Urban Agglomerate
Variable	1	2	3	4	5	6
LOG(ASSETS)	0.521***	0.418***	0.406***	0.217***	0.121***	0.084***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
VOLATILITY	0.173***	0.361***	0.094**	0.818***	0.315***	0.371***
	(0.000)	(0.000)	(0.018)	(0.000)	(0.000)	(0.000)
ROA	0.0002	0.001**	0.003**	−0.001	0.001*	0.007**
	(0.126)	(0.010)	(0.038)	(0.224)	(0.061)	(0.033)
LOCAL_ROA	0.0003	0.0004**	0.002***	0.001	0.0006***	0.004***
	(0.110)	(0.016)	(0.000)	(0.223)	(0.000)	(0.000)
TENURE	−0.0006	0.004*	0.007***	−0.017	0.004***	0.009***
	(0.108)	(0.088)	(0.000)	(0.138)	(0.000)	(0.000)
TOP_SCHOOL	0.004*	0.023***	0.035***	0.002*	0.003**	0.008***
	(0.076)	(0.001)	(0.000)	(0.079)	(0.014)	(0.000)
LOCAL_ROA × TOP_SCHOOL	0.0001	0.0002**	0.001***	0.0001	0.0003***	0.002***
	(0.131)	(0.039)	(0.000)	(0.163)	(0.000)	(0.000)
MARKET_TO_BOOK	0.001***	0.068**	0.121***	0.026***	0.042***	0.121***
	(0.000)	(0.017)	(0.000)	(0.000)	(0.000)	(0.000)
PER_CAPITA_INCOME	0.001***	0.001***	0.001***	0.001***	0.002***	0.002***
	(0.002)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
COST_OF_LIVING	0.003***	0.002***	0.002***	0.002***	0.002***	0.003***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
No. of obs.	942	3,129	4,095	942	3,129	4,095
F-test (U-R or UA-R)		3.03*	9.11***		3.18*	5.49**
p-value		(0.082)	(0.002)		(0.082)	(0.028)

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their overall pay and incentive-driven compensation for good performance, ceteris paribus.

C. Other Channels

Our results so far suggest a time-dependent return to urban residency, as well as a positive return to the performance of local urban firms and to CEO skill that are associated with a compensation premium for urban CEOs. However, other channels could also be driving our results. In this section, we start by briefly discussing each of these potential channels and then provide empirical support for/against each one.

One channel that could explain the higher total and incentive pay of urban CEOs is related to firm productivity. The firm-level productivity hypothesis asserts that the marginal product of labor is higher for city-based firms because of production and consumption benefits of urban density (Ciccone and Hall (1996)). This could be driven, for example, by a lower cost of transporting goods to the product market, a lower cost of acquiring inputs from local suppliers, or a greater local demand, which would in turn allow urban firms to pay higher wages and incentives for good performance.

A second possibility is that certain CEOs may require a compensating wage premium along with high-powered retaining pay incentives for bearing a lower quality of life in highly congested urban areas (Roback (1982)) or for moving away from their home state (Yonker (2016)). A third possibility is that there could be peer effects in CEO compensation settings within cities. Although the benchmarking of CEO compensation is typically done against similar size, performance, and operational-complexity firms (Bizjak, Lemmon, and Nguyen (2011)), urban companies could potentially benchmark a CEO's compensation against a group of self-selected, highly paid local peers. This could occur, perhaps, because of the large prevalence of compensation consultants in big cities.[11]

These potential explanations offer a very clear empirical prediction: CEOs moving into big cities should receive real, sizable, and immediate pay and incentive pay gains, whereas CEOs leaving big cities should experience immediate (and symmetrical) pay and incentive pay reductions. These channels, however, do not predict that managers are able to acquire "extra" human capital that is transferable back to the rural area. If this is the case, controlling for cost of living and holding everything else the same, CEOs moving into large cities should not experience substantial and immediate real wage gains, but rather exhibit a gradual increase in overall pay and incentives. Likewise, CEOs leaving big cities should not experience real wage losses.

To test whether other potential explanations, unrelated to the ability-sorting or learning-network spillovers associated with large cities, could be driving our results, we collect data from ExecuComp on CEO turnover and map it to the

[11] For example, Kedia and Rajgopal (2009) find that a firm's rank-and-file employee option granting policy is affected by neighboring firms' option granting practices. Although these authors find that executive option grants are not affected by the option granting practices of neighboring firms, there could potentially be a "local norm" in setting overall compensation or other equity-based incentives that has little to do with CEO innate ability, skill building, or knowledge spillover in the city. We thank the referee for suggesting this potential channel.

migration of these CEOs across cities. Such migration allows us to hold the CEO constant but vary his presence in (or out of) large metropolitans and thus examine the net effect of location on managerial compensation. To identify relocating CEOs, we first map the zip code of each headquarters in our sample into CMSAs/MSAs on an annual basis and then identify in ExecuComp, LexisNexis, and the Eisfeldt and Kuhnen (2013) data set on CEO turnover, all CEOs who have moved from urban agglomerate CMSAs into urban/rural MSAs or those that have moved in the opposite direction over our sample period. By focusing on CEOs that changed CMSAs/MSAs, we ensure that we exclude managers that have moved locally from one city to another within the same CMSA/MSA (37 moves). Because CEOs' moves that are part of headquarters relocations may result in downward rigidity in executive compensation for a given firm, we also exclude CEO turnovers that are due to headquarters relocations (108 migrations).[12] Our final relocation sample of executives consists of 96 migrations over 1992–2004, from which 63 represent moves from rural/urban to urban agglomerate areas and 33 represent moves in the opposite direction.

To measure the effect of relocation on CEO compensation, we adopt a difference-in-differences approach. For each relocating executive, we first measure the total or equity-based portion of pay 1 year before and 1 year after the move, and calculate the 3-year change in total or the equity-based portion of compensation as the corresponding difference. This controls for the impact of time-invariant characteristics on pay, such as industry membership or CEO fixed effects. We then calculate the same change in the total and equity-based portion of compensation for control firms over the same period. We identify a control sample by using all ExecuComp CEOs in our sample over 1992–2004 that are not included in the relocating CEOs' sample. Firm characteristics also change after the relocation event. Such changes can potentially confound our analyses. To address this issue, we use the following standard difference-in-differences model:

$$\begin{aligned}(2)\qquad \Delta(\text{COMPENSATION}) \;=\; & \alpha_0 + \alpha_1 \text{RELOCATION} \\ & + \beta\,\Delta\text{CONTROLS} \\ & + \text{YEAR_DUMMIES} + \varepsilon,\end{aligned}$$

where Δ(COMPENSATION) is defined as the 3-year logarithmic difference in total compensation or equity-based portion of compensation between the post- and pre-relocation periods (i.e., $\text{LOG}(\text{COMPENSATION}_{t+1}) - \text{LOG}(\text{COMPENSATION}_{t-1})$). RELOCATION is a dummy variable that equals 1 for relocating executives, and 0 for control CEOs. CONTROLS represent the usual set of control variables (see, e.g., Table 3). Because we investigate the change in compensation, we use the lagged 3-year change in control variables in our regressions. Finally, we include year dummies to control for year-specific effects.

Table 8 presents results for the effect of CEO moves across cities on total compensation (columns 1 and 2) and the equity-based portion of compensation (columns 3 and 4). Columns 1 and 3 report results for a sample of rural/urban

[12] We thank the referee for making this suggestion.

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TABLE 8
Evidence from CEO Relocation

Table 8 reports regression results of the following difference-in-differences equation for the 3-year period $t-1$ to $t+1$, where t is the relocation year:

$$\Delta(\text{COMPENSATION}) = \alpha_0 + \alpha_1 \text{RELOCATION} + \beta \Delta\text{CONTROLS} + \text{YEAR_DUMMIES} + \varepsilon.$$

Δ(COMPENSATION) is defined as the 3-year logarithmic difference in the total or equity-based portion of compensation between the post- and pre-relocation periods (i.e., LOG(COMPENSATION$_{t+1}$) – LOG(COMPENSATION$_{t-1}$)). RELOCATION is a dummy variable that equals 1 for relocating CEOs and 0 for non-relocating, control CEOs. CONTROLS represent the usual set of control variables (see, e.g., Table 3). CEO turnover data are from Eisfeldt and Kuhnen (2013), where we determine relocation destination using ExecuComp's EXECID variable. CEO turnovers that are due to headquarters relocations are excluded. The sample of relocating CEOs includes 96 migrations over 1992–2004, from which 63 represent moves from rural/urban to urban agglomerate areas and 33 represent moves in the opposite direction. Our control sample includes all firms in our sample over 1992–2004 that are not included in the relocating CEOs sample. Note that because we are interested in examining the migration of CEOs from small to large cities and vice versa, CEOs who moved from rural to rural or from urban/urban agglomerate to urban/urban agglomerate firms are excluded from the sample. The dependent variable in columns 1 and 2 is the change in total compensation, whereas the dependent variable in columns 3 and 4 is the change in the equity-based portion of pay. Columns 1 and 3 represent rural to urban/urban agglomerate relocations, with rural non-relocating firms as controls. Similarly, columns 2 and 4 represent moves from urban agglomerate/urban areas to rural areas, with urban agglomerate/urban as a control sample. To conserve space we report only the results for the RELOCATION variable. p-values calculated from robust standard errors, clustered at the CMSA/MSA level, are reported in parentheses. * indicates significance at the 10% level.

	Dependent Variable: Change in Total Compensation		Dependent Variable: Change in Equity-Based Portion of Pay	
	Rural/Urban to Urban Agglomerate	Urban Agglomerate to Urban/Rural	Rural/Urban to Urban Agglomerate	Urban Agglomerate to Urban/Rural
Variable	1	2	3	4
RELOCATION	0.008	−0.011*	0.018	−0.021*
	(0.137)	(0.076)	(0.262)	(0.083)
Adj. R^2	0.492	0.575	0.492	0.574
No. of obs.	5,046	4,918	5,046	4,918

to urban agglomerate relocations with rural/urban, nonrelocating firms as controls, and columns 2 and 4 show results for moves from urban agglomerate to urban/rural areas, with non-relocating urban agglomerate firms as a control sample. To conserve space we report only the results for the RELOCATION variable.

Consistent with our conjecture of a city learning effect, after controlling for differences in cost of living across locations, we find that moving from a smaller city to a large metropolitan (columns 1 and 3 in Table 8) does not lead to an immediate increase in total and equity-based pay as indicated by the insignificant coefficient on the RELOCATION dummy variable. Importantly, the coefficient on the same dummy in columns 2 and 4 (significant at the 10% level) suggests that managing a firm based in a large metropolitan generates a positive effect on compensation that does not fully disappear once the CEO moves to a smaller city. The point estimate for the RELOCATION dummy variable is −0.011 for changes in total pay and −0.021 for the equity-based portion of compensation. This estimate suggests that CEOs who move from large metropolitan areas to smaller cities see their total pay (equity-based portion of pay) fall by about 2.5% (4.7%) relative to the comparison group of nonmovers. This decline in pay, however, does not subsume the large differential of 15% (20%) in the total (equity portion of) pay between urban agglomerate CEOs and their smaller city counterparts.

In sum, the findings in this section are consistent with studies in the economics literature that attribute a human capital accumulation effect to large metropolitan areas that results in higher wages, especially for highly skilled individuals who are more prone to take advantage of the positive externalities in urban

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areas (Gould (2007)). These findings, however, are not consistent with firm-level productivity, compensating premium for negative city externalities or for home-state location preferences, or pay benchmarking against local peers.

V. Robustness Checks

We now proceed with a variety of robustness checks to see if the effect of urban agglomeration on CEO compensation goes away when we introduce additional variables that are known to influence CEO compensation, as controls or when we use alternative sample-selection criteria or alternative measures of geographic location in our model. These tests generate qualitatively similar results to those reported above. Panel A of Table 9 uses the log of total CEO pay as the dependent variable, and Panel B replicates the same set of tests using the log of the portion of equity-based pay as a dependent variable.

TABLE 9

Urban Agglomeration and Compensation: Additional Robustness Checks

Table 9 estimates coefficients from regressing the log of total CEO compensation (Panel A) and the log of the equity-based portion of CEO pay (Panel B) on firm headquarters location dummies (URBAN_AGGLOMERATE and URBAN) and various control variables, defined in Table 3. Column 1 runs the primary regression, excluding the five most highly populated consolidated metropolitan statistical areas; column 2 reports coefficients of a median regression; column 3 runs the regression for a subsample of the country's top 10 high-tech hubs (Seattle–Tacoma–Bellevue, WA; San Jose–Sunnyvale–Santa Clara, CA; San Francisco–Oakland–Fremont, CA; Portland–Vancouver–Beaverton, OR; Austin–Round Rock, TX; Raleigh–Cary, NC; San Diego–Carlsbad–San Marcos; Durham, NC; Boston–Cambridge–Quincy, MA–NH; Boulder, CO); column 4 excludes high-tech centers from the sample; and column 5 includes an additional control variable, LOG(1 + ANALYSTS). Intercepts and 48 Fama–French (1997) industry and year effects are included but not reported for brevity. The numbers in parentheses are robust standard errors, clustered at the metropolitan/consolidated metropolitan statistical area level. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A. Total Compensation

	Dependent Variable: Total Compensation				
	Excluding 5 Largest Cities	Median Regression	High-Tech Hubs	Excluding High-Tech Centers	Analyst Coverage
Variable	1	2	3	4	5
URBAN_AGGLOMERATE	0.071***	0.083***	0.094***	0.103***	0.086***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
URBAN	0.019**	0.014**	0.029***	0.033**	0.024**
	(0.000)	(0.001)	(0.001)	(0.000)	(0.031)
LOG(ASSETS)	0.397***	0.446***	0.449***	0.460***	0.441***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
VOLATILITY	0.217***	0.239***	0.248***	0.241***	0.254***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ROA	0.004***	0.003**	0.001***	0.002***	0.004***
	(0.000)	(0.019)	(0.000)	(0.000)	(0.000)
TENURE	0.019**	0.021***	0.026***	0.015***	0.031**
	(0.036)	(0.000)	(0.000)	(0.000)	(0.022)
MARKET_TO_BOOK	0.068***	0.086***	0.078***	0.051***	0.080***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
PER_CAPITA_INCOME	0.001***	0.002***	0.002***	0.002***	0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
COST_OF_LIVING	0.001***	0.001***	0.002***	0.001***	0.001***
	(0.001)	(0.000)	(0.002)	(0.000)	(0.000)
LOG(1 + ANALYSTS)					−0.018
					(0.176)
Adj./pseudo-R^2	0.581	0.617	0.552	0.601	0.616
No. of obs.	7,020	10,107	988	9,119	10,107

(continued on next page)

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TABLE 9 (continued)
Urban Agglomeration and Compensation: Additional Robustness Checks

Panel B. Equity-Based Compensation

	Dependent Variable: Equity-Based Portion of Compensation				
Variable	Excluding 5 Largest Cities	Median Regression	High-Tech Hubs	Excluding High-Tech Centers	Analyst Coverage
	1	2	3	4	5
URBAN_AGGLOMERATE	0.081*** (0.000)	0.097*** (0.000)	0.133*** (0.000)	0.088*** (0.000)	0.094*** (0.000)
URBAN	0.006** (0.071)	0.008*** (0.000)	0.014** (0.062)	0.003* (0.087)	0.009** (0.050)
LOG(ASSETS)	0.076*** (0.000)	0.091*** (0.000)	0.078*** (0.000)	0.094*** (0.000)	0.083*** (0.000)
VOLATILITY	0.241*** (0.000)	0.244*** (0.000)	0.238*** (0.000)	0.246*** (0.000)	0.293*** (0.000)
ROA	0.001*** (0.000)	0.002*** (0.000)	0.002*** (0.001)	0.001*** (0.000)	0.001*** (0.002)
TENURE	0.002** (0.063)	0.002** (0.014)	0.003*** (0.002)	0.001** (0.021)	0.003*** (0.000)
MARKET_TO_BOOK	0.018*** (0.000)	0.028*** (0.000)	0.033*** (0.000)	0.020*** (0.000)	0.002** (0.043)
PER_CAPITA_INCOME	0.001*** (0.000)	0.001*** (0.002)	0.002*** (0.000)	0.001*** (0.000)	0.003 (0.151)
COST_OF_LIVING	0.003 (0.426)	0.003 (0.427)	0.002 (0.291)	0.002 (0.398)	0.001 (0.241)
LOG(1 + ANALYSTS)					0.058* (0.081)
Adj./pseudo-R^2	0.580	0.617	0.552	0.602	0.618
No. of obs.	7,020	10,107	988	9,119	10,107

In column 1 of Table 9 we use a different geographic specification for large city location so that a firm is considered to be an urban agglomerate if it is headquartered in one of the five smaller urban agglomerate areas (Philadelphia, Boston, Detroit, Dallas, and Houston). The finding of a total and incentive-based urban pay premium continues to hold. In column 2 we estimate a median regression; the results are qualitatively similar to those we report above.

In columns 3 and 4 of Table 9 we present results for a subsample of high-tech hubs (Seattle–Tacoma–Bellevue, WA; San Jose–Sunnyvale–Santa Clara, CA; San Francisco–Oakland–Fremont, CA; Portland–Vancouver–Beaverton, OR; Austin–Round Rock, TX; Raleigh–Cary, NC; San Diego–Carlsbad–San Marcos, CA; Durham, NC; Boston–Cambridge–Quincy, MA–NH; Boulder, CO) and non-high-tech hub centers. This regression is performed to exam whether the results are being driven by the geographic concentration of firms belonging to this unique industry. The results, however, rule out the possibility that the urban CEO pay gaps are driven by geographic concentration of firms in the high-tech industry.

Finally, in column 5 of Table 9 we control for analyst coverage in our main regression. To the extent that information dissemination by analysts can result in more effective compensation and incentive pay, distance from major cities and large concentrations of analysts could further exacerbate the effect of rural location on CEO pay contracts. Using the number of analysts following the firm as a measure of information dissemination, we find that the coefficient on LOG(1 + ANALYSTS) is not significantly different from zero when the dependent variable

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is the CEO's total compensation (Panel A) but is statistically significant when the dependent variable is equity-based compensation (Panel B). This suggests that when there are more information intermediaries, principals have more incremental information to better structure managerial equity incentives. Importantly, however, although the URBAN_AGGLOMERATE and URBAN dummies are somewhat reduced in size compared to the baseline regression, they all remain both economically meaningful and statistically significant with positive coefficients.

VI. Conclusions

A large body of literature examines the role of urban agglomeration in firm innovation and productivity. Although earlier studies find a strong positive relation among urban agglomeration, employee skill, innovation, firm productivity, and wages for high-ability, lower level workers, there is no evidence regarding the implications of urban agglomeration for CEO compensation contracts. One reason is that the literature on CEO compensation has traditionally considered labor markets for top executives as nationally rather than regionally segmented (see, e.g., Kedia and Rajgopal (2009)). In this article we make the first attempt to examine the impact of city centrality on CEO pay, suggesting and testing the channels through which the spatial agglomeration of economic agents could explicitly affect CEO compensation.

Using CEO compensation data and segmenting firms into groups based on their headquarters geographic location size and centrality, we obtain several important results. First, controlling for firm, industry, and CEO characteristics and adjusting for cost of living, we document a 25% differential between total CEO pay for urban agglomerate and rural-based firms. Second, we find that the equity-based portion of CEO compensation is about 32% higher for CEOs based in urban agglomerates compared to their rural counterparts. Third, consistent with the ability sorting hypothesis, we find a strong positive relation between innate managerial ability and city size. And fourth, consistent with the hypothesis of positive learning externalities that exist in big cities but not in sparsely populated areas, we find a significant, positive relation between managerial experience in the same city and total and equity-based compensation in urban and urban agglomerate firms that is especially pronounced for urban agglomerate and high-ability CEOs. Similarly, we document a positive relation between CEO total and equity-based pay and the performance of other local firms in the urban area. On the contrary, we find no positive returns to experience, or to the performance of local peers, among managers employed in nonurban firms. Finally, we find that managers are rewarded for skill accumulation in the urban area upon relocation to a smaller city.

Taken together, the empirical evidence suggests that the spatial clustering of firms could reflect faster learning of skilled individuals, soft information spillovers, local social ties, and connections to the right people, for which local firms are willing to pay a premium and are, therefore, important factors for a CEO's compensation contract. This suggests that labor markets for top executives also have a regional component. Perhaps more important, because working in a large city can foster human capital accumulation that has an effect on the way managers are compensated, our article has implications regarding how CEOs

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balance their careers, human capital decisions, and location of residence over time, questions that have not been addressed in the existing literature about CEO pay and the effect of CEO characteristics on corporate policies.

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