Urban Economic Base as a Catalyst for Movements in Real Estate Prices

N. Edward Coulson

The Pennsylvania State University

Crocker H. Liu

Cornell University

Sriram V. Villupuram

Colorado State University

Published in *Regional Science and Urban Economics* (2013), 43, 1023-1040

<u>Author Note</u>

N. Edward Coulson, Department of Economics, Department of Risk Management. The Pennsylvania State University, University Park, PA 16802. Email: fyj@psu.edu. Phone: (814)863- 0625.

Crocker H. Liu, School of Hotel Administration, Cornell University, 440 Statler Hall. Ithaca, NY 14853-6902. Email: chl62@cornell.edu. Phone: (607) 255-3739.

Sriram V. Villupuram (*corresponding author*), Department of Finance and Real Estate, College of Business, Colorado State University, 1272 Campus Delivery, Fort Collins, CO 80523-1272. Email: snram.villupuram@business.colostate.edu. Phone: (970) 491- 3969. Fax: (970) 491 -7665.

We have greatly benefited from the comments of Daniel P. McMillen. We would also like to thank the session participants at the 2010 American Real Estate and Urban Economics Association meetings and seminar participants at Texas Tech University for their comments. All errors are ours.

Abstract

We examine the relation between housing prices in an MSA and its urban economic base. We create and employ new forward-looking employment growth indices that measure the urban economic strength of an MSA and find that it accounts for a significant and sizeable portion of the house price movements in that MSA. We argue that the forward looking measure is an indicator of future agglomeration growth for the MSAs. We further partition the urban economic growth into growth by various industries and track the attribution of their growth to housing prices over time. We find that for some MSAs, home prices are driven by the same set of industries over time, whereas for others, home prices are driven by a totally new set of industries in the later quarters, due to the birth of new industries. We also analyze the impact of the diversification of an urban economic base on home price volatility and observe that diversification decreases home price volatility. The result has larger implications for urban policymakers in selecting the appropriate type of industries relative to their existing mix of industries.

Keywords: Urban economics, Labor market, Attribution analysis, Real estate

JEL classification: R23, R31

Introduction

The demand for residential housing in a city is inexorably linked to conditions in the local labor market and the income generated in that market.[3] There is, however, little recognition in this literature that housing is partly an investment decision; housing prices are asset prices. This implies that current housing prices should not merely be a function of current local economic conditions, but should also reflect expectations about the future economic health of the region. Housing prices would be appropriately tied to other asset prices that reflect the health of the local economy. To rectify this, we propose the strategy of examining key firms in key export sectors using the Bloomberg Regional Indices to mimic movements in the economic base of a city. The Bloomberg regional index for a particular MSA is a price-weighted index designed to measure the performance of the MSA's economy. The index is created by selecting publicly traded corporations with the highest equity market capitalizations that have significant exposure to a particular MSA. We use the components (corporations) of each of the Bloomberg Regional Indices to form various urban economic base indices based on realized earnings and earnings projections of the corporations. For comparison purposes, we also employ an alternative strategy using publicly traded firms having Standard Industrial Classification (SIC) codes associated with regional location quotients greater than 1, from the Bureau of Labor Statistics. Because of our use of current and projected earnings of these corporations, we are able to construct a forward-looking measure of the economic health of a metropolitan area.

The use of the Bloomberg indices help solve a second issue, which is the identification of those industries which are responsible for regional economic growth. The leading theory of short run movements in urban economic aggregates, the base multiplier model, requires such

[3] See for example Abraham and Hendershott (1996), Malpezzi (1999), Capozza et al. (2002), and Jud and Winkler (2002) and more recently Hwang and Quigley (2006) and Callin (2006).

identification. Clearly influenced by the Keynesianism of the era, the base multiplier model, beginning with Hoyt and Weimer (1939), suggests a bifurcation of city employment into basic, or export employment, and local employment. The former is, as its name suggests, oriented largely toward a national or international market; the demand for the product of those firms generates revenue that is a kind of autonomous infusion into the community. This revenue goes partly to the workers in the city who spend a portion on locally produced goods and services. The employees of these establishments also do the same thing, so that the initial stimulus in the basic sector has a *multiplier effect* on the local economy.[4]

As noted, the firms that comprise the economic base of a local economy are not easily identified, although casual observation, along with evidence from studies of agglomeration economies (Rosenthal and Strange, 2004), does suggest some rules. The automobile industry is an important part of the base of Detroit, the entertainment industry in various forms plays a similar role for Los Angeles and Las Vegas, and high technology is a fundamental economic driver of the economies of Seattle and San Jose. But there are cases which do not easily fit into a particular category of the base/local bifurcation. Is the banking sector an exporter in Detroit or does it only serve local customers? A priori reasoning does not reveal a definitive answer. Various attempts to use data to aid in this bifurcation (particularly the use of location quotients) have met with varying degrees of success (see, e.g., Brown et al., 1992). An alternative strategy is to avoid identifying sectors, per se, as being basic or local and to instead use econometric techniques to isolate the autonomous portions of employment, using location quotients, or other

[4] As discussed in the opening paragraph, expansion and contraction of these sectors can redound to the real estate market. As one example among many possible, the Eugene (OR) *Register-Guard* reports "Amid a lousy market and low prices for computer memory chips, Hynix Semiconductor plans to close its west Eugene factory and lay off 1113 employees in the next two months, company officials said Wednesday.. .Hynix's $62 million annual payroll *touched the local housing market*, and a variety of area retailers and service businesses, from hair salons to cellular phone service providers." This despite the fact that the plant represented only 0.7% of total employment in the area.

decomposition techniques borrowed from the literature on vector autoregressions (Coulson (1999), Carlino et al. (2001)).

Although the reliance on sectoral data for identifying a city's economic base is based on data availability, it has been long recognized (Tiebout, 1962) that the identification of basic employment is most accurately accomplished at the firm level. Particular firms are seen as drivers for local economies, not only because they create exogenous spending in and of themselves but also because they often act as triggers for the agglomeration of their industries in particular areas. Focus on the firm, along with the first lacuna mentioned above, suggests that the use of share prices of prominent local export-oriented firms would be an ideal causal indicator for local housing markets. Our goal is to employ such a strategy.

This identification can also be used to examine the volatility of regional house prices. To the best of our knowledge, there is very little to no examination of the effect of the concentration of industries on home prices in an MSA in the previous literature. Past studies have found a relation between the concentration of industries in an urban economy to its volatility in employment (Neumann and Topel (1991), Hammond and Thompson (2004)) but none that link such concentration to housing market volatility. There is a body of knowledge that examines the volatility of home price indices. Early attempts in the real estate literature to model volatility include Crawford and Fratantoni (2003) and Miller and Peng (2006), who utilize GARCH to model the volatility of the OFHEO home price indices. They both conclude that GARCH effects do exist for some of the OFHEO home price indices. We follow their example in linking such GARCH effects in home prices to local industry concentration.

In summary, we address two primary questions. Does expectation of the growth of an urban economic base matter for home prices? Do different industries drive economic growth and in turn real estate prices over time and what are the magnitudes for each type of industry? Does diversification of the source of labor income matter for housing prices? To address these questions, we employ both a panel data methodology and attribution analysis. The rest of the paper proceeds as follows: Section 2 discusses the data sources and the data collection procedure. Section 3 discusses the preliminary econometric procedures to check for robustness of the variables in the sample. Section 4 explains the attribution analysis approach in the literature and how it is modified to fit this study. Section 5 discusses volatility measurement and diversification of an urban economic base. Section 6 explains the estimation results while Section 7 concludes the paper.

Data

Our sample consists of 12 US Metropolitan Statistical Areas (MSA) including Atlanta, Boston, Chicago, Cleveland, Dallas, Las Vegas, Los Angeles, Miami, San Diego, San Francisco, Tacoma and Tampa. The sample period starts in 1985 and ends in 2005. We end our sample in 2005 to avoid the biases that might be caused by the severe housing bubble and the subsequent collapse of home prices. For each metropolitan area (city) we obtain the repeat sales index from the Federal Housing Finance Agency (FHFA). The change in the repeat sales index subtracted by the rate if inflation calculated from the consumer price index (CPI) for all urban consumers for all items is our measure of home price movements for these cities. The CPI data is from the Federal Reserve Bank of St. Louis' economic database. We obtain industry level employment data for each city in our sample from the Bureau of Labor Statistics. The price and return data are obtained from the Center for Research in Security Prices (CRSP). Earnings per share (EPS) realizations and one- year-ahead analysts’ forecasts of EPS are obtained from I/B/E/S (Institutional Brokers' Estimate System).

We only employ the components of the Bloomberg regional index recorded during 2005 to identify the companies that form a region's economic base. We do not use the values of the index constructed by Bloomberg LLC. Table 1 displays the count of industries associated with a particular city during the start and the end of our sample period. To identify the industry category, we use the 2-digit SIC code obtained from CRSP during the observation period. Of the MSAs that we examine, Atlanta and Las Vegas are the least diversified in terms of the number of industries at the beginning of our sample, with 2 and 3 industries respectively. Cleveland is the only city that did not witness an increase in the number of industries throughout the sample period, which could indicate stagnation in new sources of income for the city. All the other cities in our sample have experienced an influx of new industries. At the maximum, they have up to approximately four times the number of industries at the end of 2005 relative to the beginning of 1985. At the end of our sample, Las Vegas still had the lowest number of industries in its economic base portfolio.

Insert Table 1

Insert Table 1A

That the Bloomberg index does in fact provide a comprehensive barometer for the local economic base is provided in Table 1A which presents the percentage of firms that are headquartered in the MSA (as provided by Compustat[5]) that are part of the local index. As can be seen there the representation is very good, ranging from a low of 75% up to compete representation. While the index and Compustat rely on headquarter location to link firms and metropolitan areas, it is clear that headquarters are decisively important for the purposes of base sector identification (Klier (2006), Testa (2006) Davis and Henderson (2004) and especially Ono (2006)).

Table 2 reports the market value of firms with operations in a particular MSA. Atlanta and Las Vegas had the lowest number of firms in their portfolios at the beginning of our sample, in comparison to Dallas and San Francisco which had the largest number of firms during the same period with 43 and 47 corporations respectively. At the end of our sample, Las Vegas continued to have the least amount of firms along with Miami whereas Boston and San Francisco had the highest number of corporations operating in their cities with 165 and 216 respectively. In terms of market value, Atlanta and San Diego had the smallest average sized firm during the beginning and at the end of the sample. The size of an average firm is the largest in Dallas, Tampa and Tacoma at the beginning and at the end of the sample. In terms of total market value of the portfolio of firms in a particular city, Atlanta and Las Vegas had the lowest aggregate value during the beginning and the end of the sample period. In contrast, Chicago, Dallas and San Francisco had the highest total market value of the portfolio of corporations at the beginning and the end of the sample period. We will demonstrate below, using attribution analysis, that the industries that are important to the determination of housing prices are indeed those which may be plausibly thought of as basic sectors, and on that account have growth expectations that are exogenous to local economic conditions.

[5] Compustat is a Standard and Poor's database of fundamental information on active and inactive publicly held companies.

Table 3 provides a snapshot of the variables that represent the strength of the urban economic base for each MSA. We construct a stock price index for each city by obtaining the stock price for each firm in the MSA's portfolio from the Center for Research in Security Prices (CRSP). We also obtain the number of shares outstanding from the same source and use the product of the two to obtain the market value of the firm. We then calculate the market-value weighted average price of the MSA's portfolio of firms every calendar quarter, using the price and number of shares outstanding at the end of each period. We similarly construct a return index of a city by using quarterly returns of firms from CRSP and calculating the value-weighted average of returns for every calendar quarter. The general equation that represents a value-weighted index at any point in time t is as follows:

$$\text{Value-weighted index}_t = \sum \frac{w_{it}}{W_t} X_{it}$$

w_{it} represents the market value of firm i at time t, and W_t represents the total market value of all firms in a particular MSA. X_{it} represents the earnings per share (EPS), actual or expected, annual or quarterly, price and return based on the type of value-weighted index. For example, X_{it} represents the market price of firm i's equity at time t, if we are forming a value-weighted price index time-series.

Table 3 also illustrates the earnings potential for each MSA in our sample. An MSA's earnings potential is calculated by alternatively using one period ahead forecasts by analysts[6] and also realizations obtained from I/B/E/S.[7] We initially form four series for the earnings potential: two based on quarterly EPS realizations and the other two based on quarterly forecasts. For the realized EPS series, we simply calculate a market-value weighted average of the actual EPS

[6] Analyst forecasts of earnings are partly based on the earnings forecast by a firm's management.
[7] I/B/E/S is a Thomson Reuters database that provides individual analyst forecasts of company earnings, cash flows and other important financial items.

values on a quarterly or annual basis. For the quarterly earnings-potential series, we include all the quarterly EPS estimates by analysts during the current calendar quarter. The quarterly EPS estimates represent the forecast of the EPS for the next calendar quarter. We similarly calculate the annual (one- year ahead) earnings potential every quarter.

The important assumption underlying the market-value weighting for constructing these series is that the size of a firm is proportional to its exposure to a particular MSA. To ensure that we capture a firm's exposure to a particular MSA, we use as an alternative weighting variable, the labor employed by firms in an MSA, at the 2-digit SIC industry level, to come up with an alternative one year ahead forecasted series of EPS. In addition to the forecasted series, we also form a labor weighted series for realization of annual earnings. A summary of the values are reported in Table 4. The general equation that represents a labor-weighted index at any point in time t is as follows:

$$\text{Value-weighted index}_t = \sum \frac{I_{it}}{L_t} X_{it}$$

where I_{it} represents the industry employment weight of industry i at time t, and L_t represents the total employment of all industries in a particular MSA. X_{it} represents the earnings per share (EPS), actual or expected, recorded at a quarterly frequency.

Preliminary analysis and model estimation

We undertake some preliminary analysis of the data. Our first task is to examine the panel-time series properties of the prospective dependent variables for stationarity. We employ the Im et al. (2003) test for unit roots in panels. We include 4 lags and a deterministic trend in the regressions and the results are displayed in Table 5. Interestingly but not surprisingly, the OHFEO price index contains a unit root; however its differenced value (calculated as a growth rate) is stationary. Quarterly returns are also stationary. Among the earnings variables, it is interesting to note that all four of the tests reject the null of stationary, but the two annual earnings variables have much weaker prob-values.[8]

Insert Table 2

Insert Table 3

Our next step is to use regression analysis to examine the conditional correlations between the city portfolios and housing prices, as displayed in Table 6. We regress the growth rate of the OFHEO index on each of the six indicator series (individually) along with an intercept term, city fixed effects and a time trend. The growth rate is appropriate due to the results in Table 5. Moreover, the interpretation of the results in Table 6 is cleaner, since the regressand and the regressor of interest are now both flow variables. The inclusion of fixed effects is indicated by their joint significance in the regressions. Given their inclusion, whatever fit arises between the portfolio indicator and the housing price growth rate is purely due to within city variation.[9]

The results in Table 6 indicate that all of the indicators are significantly correlated with the growth rate in housing prices, with the exception of the quarterly return. The results of a fixed effects panel data estimation of the effect of the EPS indices on real home prices is displayed in Table 7. The real change in housing price is computed by subtracting CPI from the nominal change in the OFHEO index for each MSA. These nominal EPS indices were

[8] The series from San Diego had to be omitted from the test on Estimated Annual EPS index, and San Diego, Tampa and Las Vegas from the test on Estimated Quarterly EPS index, because of missing observations.

[9] The t-stat of the indicators when the city fixed effects are removed is always lower than what is displayed in Table 5.

constructed by weighting EPS realizations and projections (quarterly and annually) from the I/B/E/S database with the dollar value of labor employed by each industry. There are four indices, using realized and estimated (future) earnings per share, each on both an annual and a quarterly basis. In each case, we regress the growth rate of housing prices on the EPS measure along with a time trend. In each panel the time trend is very precisely estimated at about .1% per quarter. Although the size and significance of the EPS measure depends on which measure we use, the realized EPS variable per se doesn't have much explanatory power. The results are the same for the annual EPS realizations, which suggest that home prices react more to expectations in the earnings growth (growth in EPS) of the dominant industries in an MSA's urban economic base. In other words, house prices may already incorporate information from realized earnings. As a result, we test if the estimated earnings growth projections by financial analysts have any impact on home prices.

Insert Table 4

Insert Table 5

Insert Table 6

Insert Table 7

Table 7c and d show the fixed-effect estimates (controlled for time-trends) of the impact of estimated EPS indices on log real change in OFHEO indices. Even after controlling for time-trends, the variation in the estimated earnings growth of salient industries that comprise an MSA's economic base has a significant amount of explanatory power, both in terms of annual and quarterly urban economic growth forecasts. The R-squared for the estimations range from 0.31 to a maximum of 0.50. Our results are economically significant. The results of Table 7c can be interpreted as predicting a 0.82% growth in quarterly home prices from a 1% increase in expected quarterly growth.

One possible explanation is that the projected earnings growth of an urban economic base forecasts the demand for labor which in turn anticipates the demand for residential housing for the new laborers. The preceding results are thus consistent with the notion in the prior literature that urban economic growth influences home prices. It is also consistent with our assertion that models of house prices incorporate forward-looking expectations of urban economic activity rather than past realizations of that activity.[10]

An objection to this assertion might be that in some cases, a corporation may have high earnings due to reduced operating costs. The reduced cost could be a result of increasing worker productivity. Such a scenario would not necessarily lead to an increase in the workforce. However, MSAs that experience an increase in productivity also witness an increase in population. The agglomeration literature interprets this to be the case where productive workers

[10] An alternative explanation of our results (suggested by a referee) could run as follows: A rise in housing prices could be leveraged by homeowners into stock purchases of local companies - the so-called home country bias - manifested at the local level. Thus earnings forecasts would take into account these higher prices. The literature suggests that this effect should be tiny. First, research on cash-out refinancing suggests that only a quite small percentage of the acquired cash is used for stock purchases (Canner et al., 2002); second, the local version of the home country bias effect, while significant, only increases local presence in portfolios by a modest amount (Coval and Moskowitz, 1999). The product of these two effects should produce only a minimal impact on earnings forecasts.

are moving closer to each other. (See Glaeser et al. (201 Oa,b)). One would expect entrepreneurs and companies looking to expand operations to move to these high worker productivity areas. Glaeser et al. (2010a,b) develop various scenarios/models that help explain the causes and effects of entrepreneurship. Their models illustrate that under certain circumstances, land prices will increase due to increased demand following the arrival of entrepreneurs to a particular area.

Either way, if earnings growth is simply a result of an increase in demand with productivity staying constant, or an increase in productivity with demand staying constant for a particular firm, the long term result is an increase in jobs to that MSA from existing and/or new firms. In a way, our forward looking measure of earnings growth has the ability to forecast future agglomeration especially if the growth is a result of increased productivity of the work force in that area.

We now consider alternative explanations for a cross-sectional variation in house price growth rates which are included in Panel A of Table 8 which because of data limitations only includes observations from 1991 through 2005. Three important such explanations are total employment, population and income. The large cities and those with high incomes will tend to have high housing prices (although if high incomes are compensation for low amenities, the opposite may be true). Income data collected from Bureau of Economic Analysis, and employment data from the Bureau of Labor Statistics are included in the regression. All three have a positive coefficient, as expected, but rather low t-statistics.

One prominent demand driver that is more or less unrelated to the industrial composition of the city is retirees. This group tends to be homeowners (Haurin and Rosenthal, 2007) but is more indifferent to the industrial composition of a city than the working-age population. Using the Census of Population and the Current Population Survey, we calculate for each MSA the average percentage of the population (over the period 1991-2005) that is over 65 years of age. In this period Dallas had the lowest number of retirees as a percentage of its population at around 8% followed by Atlanta, Los Angeles, Seattle, Chicago and Las Vegas. Tampa and Miami lead the list with about 15% and 17% of its population post-retirement. The coefficient of this variable is seen to be positive, as expected, but quite small in magnitude, and not statistically significant.

Another demand driver which is outside the scope of the Bloomberg index is government. Although much of government employment is the result of local growth, employment by the federal government is often seen as an important part of the economic base. From the Bureau of Labor Statistics we construct (again for the period 1991 -2005) the percentage of the workforce that is employed by the federal government.[11] As can be seen in the table the magnitude of this variable's coefficient is large (larger than the senior percentage coefficient, at any rate) but again, its precision is sufficiently low that we cannot draw any definitive conclusion.

We also include the index of consumer confidence from The Conference Board. This is a regional measure of consumer confidence as measured by survey responses. The coefficient is positive, and relatively precisely measured. This is congruent with our overall perspective that expectations about the (local) economy play a substantive role in determining housing demand and prices. However, and importantly, neither the inclusion of this variable, nor any of the others, undermines the role of expected EPS as a primary factor in local housing markets.

Insert Table 8

---

[11] The BLS does not consistently break out state government employment. While this may be an important source of exogenous growth m some cities (like state capitals) it is likely to be in a large part locally induced.

A final adjustment to the model takes place with the inclusion of the interaction of total employment and the anticipated EPS measure. This also has a positive coefficient, and is statistically significant. This implies that the importance of expected EPS grows with the size of the local economy, which is exactly what the base multiplier theory would lead to us expect, given the existence of agglomeration effects that decrease the propensity of local economies to import. As pointed out in that literature,[12] the size of the multiplier therefore depends on the size of the city, thus the impact of the expected EPS should behave in the same way. The coefficient of the interaction term is substantive in the sense that a doubling of city employment would see an increase in the weight of expected EPS by about .02, about one-fifth of the original coefficient.

According to Glaeser and Gyourko (2005), inelastic-supply MSAs are those with higher sensitivity to home prices compared to the elastic supply MSAs, simply because constraints to new supply can increase prices in the face of fresh demand for housing. Thus we might expect the coefficient to differ across inelastic and elastic supply cities. We use Saiz (2010) to bifurcate our set of cities accordingly. The supply- inelastic MSAs are Miami, Los Angeles, San Francisco, San Diego, Chicago and Boston. Panel B from Table 8 displays the coefficients for each of the sample splits and illustrates that the sensitivity of home prices to growth in the economic base is less in those MSAs that have elastic supply compared to those that have inelastic supply. This would be expected, but remarkably even in these elastic cities the effect of expected EPS is shown to be substantive.

Glaeser and Gyourko (2005) also find that cities with declining population have inelastic housing supply. For those cities, decline in anticipated EPS is expected to have a higher negative impact on home prices since skilled workers leave the MSA leaving behind a robust supply of

[12] For a modern statement of this, see Fujita et al (1999) Chapter 3.

houses. We therefore divide our sample into two groups, one with the highest increase in population and the other with lower population increase or higher decline. Cleveland is the only MSA in our sample that has experienced a population decline. Boston experienced the smallest positive growth in population during the sample period. Las Vegas tops the list of MSAs with a doubling of its population followed by Atlanta, Dallas, Miami, Tampa and Seattle. Panel D of Table 8 displays the results of this sample split. We find that the impact of expected EPS on home prices is slightly higher in MSAs that have experienced lower population growth. But even in MSAs where the population has increased substantially due to elastic supply, expected EPS plays an important role in explaining home price movements.

As an alternative to our Bloomberg economic base barometer, we develop a competing measure of expected growth of an urban economic base by using location quotients (LQ). The location quotient is defined as

$$LQ_{it} = \frac{RE_{it}/TRE_{it}}{NE_{it}/TNE_{it}}$$

where LQ_{it} is the location quotient of industry i at time t, RE_{it} is the regional employment of industry i at time t, TRE_{it} is the total regional employment of industry i at time t, NE_{it} is the national employment of industry i at time t and TNE_{it} is the total national employment of industry i at time t.

We first obtain LQ data for all the industries in an MSA from the Bureau of Labor Statistics (BLS) for the year 2005[13] which represents the end of our sample period. For each MSA, we select industries that have a location quotient greater than one.[14] We then find companies that belong to that industry that are headquartered in the MSA using Compustat. We

[13] The year 2005 has been chosen to just select industries with $LQ > 1$. We also checked the LQs of the industries during 2002 and there were no noticeable changes.
[14] See e.g., Coulson (2006).

use the analysts' earnings forecasts of the companies and form an index by aggregating them using the labor employed by the industry. The only difference between this (LQ) method and the primary method in this study is that the LQ method only includes firms in the base industries with LQ> 1 whereas our index includes any firm in the Bloomberg regional index for the MSA. For example, the LQ method uses only the business services industry in the Atlanta MSA for the whole period, whereas the Bloomberg index would use business services, health services, electrical equipment, chemicals and industrial machinery sectors. The LQ index leaves behind a vast number of industries that Bloomberg considers as important to the economic base of an MSA.

We employ the same methodology and controls to test the power of the LQ based growth potential of an MSA to explain housing prices. The results are presented in panel F of Table 8. We find that in spite of the absence of non-base industries in the LQ based measure, it still has the ability to explain house price movements. But, the explanatory power is only half that of the Bloomberg based measure of the growth of an urban economic base. Therefore, we conclude that the companies on the Bloomberg regional index have more information about future house price movements compared to traditional measures.

Attribution analysis

Attribution analysis has been used widely in finance in the management of the stock and bond portfolios to determine the elements of a manager's strategy that is responsible for performance.[15] The technique essentially decomposes the return of a portfolio into return due to style allocation, sector allocation and stock selection. One can think of the various basic

[15] This technique was first applied by Brinson et al. (1986). Hamilton and Heinkel (1995) and Liang et_ al. (1999) have applied this methodology to the attribution of commercial real estate returns.

industries of a particular metropolitan statistical area (MSA) as a portfolio, with the return on the economic base proxied by the return on the housing market. Consequently, we decompose the housing market return of each of our MSAs using changes in the earnings growth outlook for each industry in that MSA as our explanatory variables. The coefficients reveal the magnitude of the effect of growth of a certain industry on the real change in the house price index. Specifically, we find the pattern of economic base multipliers of each industry for a particular MSA over time.

The implementation of attribution analysis involve regressing the growth rate in housing prices of an MSA on the changes in quarterly earnings per share for each industry having a presence in the MSA. The resulting coefficients are constrained to the sum to 1. The intuition for summing up to one is that all of our basic industries are accounted for e.g., the sum of the proportions that the basic industries contribute to an MSA's economic base is 100%. Individual coefficients also are constrained to be positive. The rationale for this positive constraint is to prohibit the scenario where we have to short a particular industry or certain industries. This constraint is consistent with the notion that basic industries should have a positive impact on house price movements. As a result, some of the industries that are declining in growth may not show up as significant in the attribution analysis. This is evident from some of the missing industries in the results of the attribution analysis (Table 9) when compared to the total number of industries for each MSA (Table 1). The regression along with the constraints used in an attribution analysis is as follows:

$$r_{i,t} = [b_{i,1}x_{1,t} + b_{i,2}x_{2,t} + b_{i,3}x_{3,t} + \cdots + b_{i,N}x_{N,t}] + \varepsilon_{1,t} \qquad \text{for } t = 1,2,\ldots,T$$

$$s.t.\, b_{i,n} > 0 \qquad for\ n = 1,2 \ldots N\ \ and$$

$$b_{i,1} + b_{i,2} + \cdots + b_{i,N} = 1$$

In the above analysis, $r_{i,t}$ represents the growth rate of the OFHEO home price index for MSA i at time t, x_{jt} represents the average projected EPS for a 2-digit SIC industry j at time t and b_{ij} is the estimate of the attribution of industry j to MSA i. The b_{ij}s are constrained to be positive and they sum to one for each i.

The analysis uses a rolling estimation window of 3 years for most MSAs. More specifically, in each quarter we obtain the attribution coefficients by regressing the MSA return for that quarter and 3 prior years on the growth rate in earnings.[16] We then move to the next quarter and perform the same regression (look back 3 years), to obtain the time-series of attribution coefficients. The results are robust to using windows of 4 and 5 years. We settled with a 3 year window for most MSAs and for those such as Chicago, we employ a larger window to maintain the degrees of freedom.

The above analysis differs from the traditional way that attribution analysis is done. The usual method (for example, Liang et. al., 1999) is to run a constrained regression with the preceding constraints using the entire time-series. Using a rolling window, however, provides us with a good insight into the changing nature of an MSA's economic base. For example, while house prices in San Diego (see Fig. If) tended to co-move with the engineering and management services industry until the end of 2001, within the past 6 years the chemicals and allied products industry and electronic components (high tech) retail have been the dominant industries.

The attribution coefficients obtained using this analysis are forced to sum to unity, irrespective of the number of industries. A concern could therefore be that if an industry or industries is misidentified as basic when it is not, the model might still force a positive

[16] Our attribution analysis attempts to explain house price movements strictly according to this industrial composition. As such we are implicitly assigning the role of consumer confidence (and other drivers) to be the result of changes in that composition.

attribution coefficient on that sector. Our maintained assumption is that the Bloomberg regional indices accurately represent the composition of important firms in an urban economic base. As a result, two MSAs may have the same industry type, but are comprised of different corporations.

Insert Table 9

To further examine the impact of the estimated industrial growth of an MSA on home prices, we conduct an attribution analysis of OFHEO home price appreciation using the estimated growth rates of the various industries that comprise the economic base of each respective MSA. Tacoma and Dallas are excluded from our analysis due to the unavailability of the OFHEO house price index for the earlier years. For the other 10 cities included in our sample, the results of the attribution analysis are presented in Fig. 1 and Table 9. Fig. 1 displays the results of the dynamic attribution analysis. The number of lags used in the rolling window of the dynamic attribution analysis depends upon the number of 2-digit SIC industries. If an MSA has a higher number of industries, a higher number of lags is necessary to implement the rolling regressions. The results of the attribution analysis presented in Table 9 and Fig. 1 for each city are as follows:

Atlanta (45 quarters): Four industries - chemicals, industrial machinery, electrical equipment and instruments and related industries appear to account for 94% of Atlanta's growth in the home prices with electrical equipment as the earliest generator of job growth, during the mid-1990s. Industrial machinery then became the primary driver of employment growth during the late 1990s, followed by instruments and related industries. Over the last 2 years of our sample, the chemical industry has been the dominant force underlying housing growth.

Insert Figure 1A

Boston (38 quarters): fabricated metal, instruments, durable wholesale trade and most notably depository institutions appear to be the primary drivers of Boston's economic base. These industries have appeared to account for about 78% of growth in Boston's home prices. In earlier times, wholesale trade was the primary driver of jobs in Boston probably due to its proximity to a harbor which would facilitate exports, followed by the Instruments industry. However, depository institutions have dominated Boston's growth in the last 5 years of our sample.

Insert Figure 1B

Chicago (8 quarters[17]): Like Boston, depository institutions have been a key component of the growth in Chicago's house price. Together with educational services, and to a lesser extent food and kindred products, these industries account for about 51% of the growth in the home prices.

Insert Figure 1C

Tampa (34 quarters): About 75% of Tampa's house price appreciation is attributable to health services and durable wholesale trade. Both industries have been consistent creators of jobs over time.

Insert Figure 1D

San Francisco (41 quarters): Like Boston and Chicago, the growth in San Francisco's housing prices appears to have been driven by 2 industries: depository institutions, and security,

[17] Due to the large number of industries and the unavailability of EPS due to the lack of analyst following for certain industries.

commodity brokers and services. About 66% of growth in the home prices are associated with these two industries.

Insert Figure 1E

San Diego (33 quarters): About 75% of growth in the home prices is attributable to the anticipated growth in earnings of three industries: chemicals and allied products, electrical and electronic equipment and engineering and management services with the electrical and electronic equipment industry as the earliest creator of job growth. Engineering and management services then became the next generator of growth. Over the last 4 years of our sample, chemicals and allied products have been the dominant driver of growth.

Insert Figure 1F

Miami (35 quarters): The forecasted earnings growth of three industries, lumber and wood products, durable wholesale trade and automotive repair, and services and parking, appear to account for the majority (87%) of Miami's housing appreciation. All three industries have continued to play a dominant role in the MSA's growth. To explain in more detail, what automotive repair, services and parking industry would entail, a deeper analysis using a 4-digit SIC code was conducted. We found that it is essentially the truck rental and leasing industry.

Insert Figure 1G

Los Angeles (20 quarters): The economic base of Los Angeles has been primarily driven by 2 industries: heavy construction contractors and transportation equipment which have contributed about 80% of growth in the home prices. Heavy construction contractors has been the primary growth engine. Recently (2004-2005) the transportation equipment industry has also become a driver of growth.

Insert Figure 1H

Las Vegas (48 quarters): Surprisingly, the potential earnings growth in the amusement and hotel industries accounts for only a small portion (7%) of Las Vegas' housing price appreciation. Instead, approximately 90% of the growth in housing prices correspond to the anticipated earnings growth in insurance and miscellaneous manufacturing over time. This is because while the former is a big employer, its contribution to economic growth over this particular time period is muted; it employed a more or less constant proportion of the local labor force.

Insert Figure 1I

Cleveland (57 quarters): The depository institutions industry has played a dominant role in the movement of home prices in the Cleveland MSA. Together with instruments and related products, these two industries have contributed about 75% of the growth in home prices. Industrial machinery and equipment manufacturing contribute an additional 5% towards house price appreciation.

Insert Figure 1J

In summary, for the MSAs which we examine, the earnings growth corresponding to two to four key industries in a given economic base appear to be the primary drivers of the growth rate in an MSA's house prices. More importantly the industries that we highlight are indeed largely basic industries. Local-serving sectors, while occasionally showing up in the lists in the Table, almost never show up as large economic forces in the attribution analysis. This is quite congruent with the economic base theory. Housing prices are typically associated with only a couple of basic industries. However, these basic industries do not necessarily remain a constant dominant force over time, due to their cyclical nature. As our findings indicate, home prices for some MSAs such as Boston are driven by a new set of industries over time while other MSAs like Chicago have had a relative stationary set of basic industries, whose earnings potential have accounted for the majority of that MSA's house price appreciation.

Volatility in housing prices

An examination of the impact of the urban economic base on home prices would not be complete if it just examines the relation on only the first dimension. Therefore, in addition to studying the impact of employment of an urban economic base on housing prices; we also study the relationship between the source of employment and volatility in housing prices. The Herfindahl index is the usual measure of concentration, measured as equation (4) below:

$$HI_t = \sum_{i=1}^{n} \left[\frac{LI_{i,t}}{\sum_{i=1}^{n} LI_{i,t}}\right]^2$$

HI_t is the Herfindahl index of an MSA at time t, $LI_{i,t}$ is the labor income for industry i, for month t and n is the total number of industries in an MSA.

Dynamic volatility is modeled as a GARCH (1, 1) process. The following system of equations is solved to obtain the volatility time-series:

$R_{it} - \alpha + \theta \sum_{i=1}^{n} R_{itj} + \varepsilon_t$

$\sigma_t^2 = \omega + \alpha\varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2.$

R_{it} is the continuously compounded return on an OFHEO monthly home price index of an MSA i at month t. Past literature ((See Miller and Peng (2006)) has documented persistence in home price index returns and therefore we use lagged index returns as the dependent variable in the first equation to account for any persistence in return. The optimal number of lags is determined using the Akaike Information Criterion (AIC). The minimum number of lags used was three and the maximum number of lags was nine months. The highest number of lags was applied to the Miami and Las Vegas MSAs. θ is a vector of coefficients of the lagged returns. σ_t is the volatility at time t. The estimated volatility is a function of the squared residual from the return equation (ARCH term) and lagged volatility (GARCH term).

The Herfindahl index for the MSAs is presented in Fig. 2. Except for Las Vegas, all MSAs have seen their concentration of the source of labor income increase over the two decades. This is in spite of the fact that the number of industries used in the calculation of the index has increased over the two decades, except for Cleveland. This implies that the main drivers of the urban economy have been unchanged.

Several studies have related the effects of a diversified employment base to lower unemployment. We have shown thus far that the expected employment growth of an industry drives the demand for homes and hence their prices. However, industrial growth goes through cycles as is evident in the attribution analysis. The main industry that drives labor demand has been changing over time in most MSAs. Neumann and Topel (1991) argue that equilibrium differences in unemployment are driven by the difference in the covariance structure of their industrial sector's labor demand. In another related study, Hammond and Thompson (2004) find that increased industrial specialization or reduced diversification increases employment volatility. Therefore our hypothesis on the volatility of housing prices is that concentration of the source of labor income increases volatility due to the cyclical nature of the industry that drives the economic base (Fig. 3).

The results of the panel data estimation of the impact of employment concentration on volatility in housing prices are presented in Table 10. We employ fixed-effects estimation to control for unobserved variables. An F-test on the absence of MSA fixed effects was rejected at the 99% confidence level. When we estimate the effect of Herfindahl index based on MSA fixed effects only we do not find any relationship between employment concentration and home price volatility. We also perform an F-test for the absence of time fixed effects, but it is rejected at the 99% confidence level. Therefore, we also perform an F-test for the absence of the combined time and MSA fixed effect, which is also rejected at the 99% confidence level. As a result, we have three estimations based on MSA fixed effect, time fixed effect and time and MSA combined fixed effect as represented by Panels A, B and C respectively. All the estimations involving time fixed effects indicate that the Herfindahl index and house price volatility are positively related.

Based on the above results, one can conclude that the diversified labor demand in an MSA is more desirable for stable home prices. We argue that the positive relationship between employment concentration and home price volatility has implications for urban policymakers, city managers and academics. Future studies on housing demand should not only take into account the growth of the industrial base, but also its diversity since it has an impact on house prices. For city managers and urban policymakers, the impact of an industry they tend to attract could lead to either a smooth or rough road ahead for housing prices depending on how it changes the diversity of the industrial base.

Insert Figure 2

Insert Figure 3

Conclusion

This study confirms the evidence of a large body of work that supports the hypothesis that home prices are driven by idiosyncratic economic variables. A distinguishing feature of our study is that we create and employ new forward looking industrial growth indices that measure the urban economic strength of an MSA that appear to do a better job relative to similar contemporaneous measures of economic activity. We further partition the urban economic growth into various industries and track the attribution of the growth in various industries to that of housing prices over time which yields interesting results. There are mature cities like Cleveland that have had the same industry as its growth driver for the last 15 years. In contrast, there are cities like San Diego where new industries are born almost every 5 years which exert new influences on the entire housing market. All the above results are consistent with two hypotheses: 1. Home prices are driven by local economic growth variables; and 2. From an investment perspective, home prices do follow anticipated growth prospects of an urban economy. Another distinguishing feature of our study is our analysis of the impact of the diversification of an urban economic base on house price volatility. We find that a well-diversified source of labor income in an economic base helps reduce volatility in housing prices. This has implications for urban policymakers in terms of preparing their infrastructure to attract low growth-variance industries or ones that would make the industrial base more diversified. Also, studies involving demand models of housing prices should take into account diversification of employment base as a factor.

Table 1. Industrial composition of an MSA's economic base. The number of industries associated with each MSA's urban economic base is calculated using the 2-digit SIC codes from Center for Research in Security Prices (CRSP). The list of corporations in each city is obtained from the Bloomberg regional indices for 2005.1985 and 2005 are the first and last years of the sample.

MSA	Year	Number of industries (2-digit SIC)
Atlanta	1985	2
Atlanta	2005	9
Boston	1985	16
Boston	2005	31
Chicago	1985	20
Chicago	2005	36
Cleveland	1985	20
Cleveland	2005	20
Dallas	1985	25
Dallas	2005	33
Las Vegas	1985	3
Las Vegas	2005	5
Los Angeles	1985	25
Los Angeles	2005	41
Miami	1985	4
Miami	2005	10
San Diego	1985	6
San Diego	2005	22
San Francisco	1985	15
San Francisco	2005	30
Tacoma	1985	8
Tacoma	2005	13
Tampa	1985	7
Tampa	2005	18

Table 1A. Effectiveness of Bloomberg regional indices (BRC) as a proxy for the regional economic base. The firms in the Bloomberg regional indices for the year 2005 were matched with the headquarters data from Compustat and the percentage of firms that were headquartered in the MSA. The percentage of headquartered firms in an MSA represented by Bloomberg regional indices is calculated as the ratio of the number of firms that are in the Bloomberg regional index to the number of firms that are headquartered m the MSA (as per Compustat).

MSA	Percentage of Compustat headquartered firms that are represented by Bloomberg
Atlanta	79%
Boston	86%
Chicago	80%
Cleveland	85%
Dallas	89%
Las Vegas	100%
Los Angeles	79%
Miami	100%
San Diego	93%
San Francisco	95%
Tacoma (Seattle)	75%
Tampa	80%

Table 2. Size of an MSA's urban economic base portfolio. The list of corporations in each city is obtained from the Bloomberg regional indices for 2005. Market value for each firm is the product of price per share and the number of shares outstanding. Data for both are obtained from the Center for Research in Security Prices. Average market value is the average market value of firms m a particular city. Total market value represents the sum of equity market values of the corporations that have exposure to a particular urban economic base.

MSA	Year	Number of firms	Average market value (m $millions)	Minimum size (in $millions)	Maximum size (in $millions)	Total market value (in $millions)
Atlanta	1985	3	60	19	82	180
Atlanta	2005	16	532	13	3536	8510
Boston	1985	32	167	2	926	5347
Boston	2005	165	1783	5	35630	294131
Chicago	1985	43	1261	12	6992	54216
Chicago	2005	122	5472	56	70114	667558
Cleveland	1985	36	1268	8	21122	45661
Cleveland	2005	51	4065	25	46094	207317
Dallas	1985	43	1822	6	42282	78338
Dallas	2005	80	7990	10	332887	639210
Las Vegas	1985	4	180	50	385	720
Las Vegas	2005	12	4561	99	15216	54728
Los Angeles	1985	41	416	1	5356	17043
Los Angeles	2005	143	2209	4	78422	315945
Miami	1985	4	377	9	1332	1507
Miami	2005	15	4914	57	36477	73716
San Diego	1985	10	97	11	496	970
San Diego	2005	77	1372	5	61289	105661
San Francisco	1985	47	906	15	13385	42590
San Francisco	2005	216	5868	6	139796	1267575
Tacoma	1985	9	1619	31	6808	14571
Tacoma	2005	17	25251	130	285932	429262
Tampa	1985	7	1674	11	9053	11721
Tampa	2005	22	6837	22	98547	150418

Table 3. Urban economic base indices for various MSA's (market-value weighted). Market value for each firm is the product of price per share and the number of shares outstanding. Data for both are obtained from the Center for Research in Security Prices. Price is the end of the quarter market value weighted average price of the portfolio of firms that have exposure to a particular city. The firms in an MSA's portfolio are obtained from the Bloomberg regional indices. Qtly. return represents the market value-weighted average quarterly returns of firms in a particular city. EPS-Qtly, actual and EPS-Ann, actual represents the market-value weighted average of realized quarterly earnings per share of firms in a city's portfolio. EPS-Qtly, actual and EPS-Ann, forecast represents the market-value weighted average of forecasted quarterly and annual earnings per share of firms respectively, in a city's portfolio. Actual Earnings per share and EPS forecasts are obtained from I/B/E/S. EPS values presented are in dollars.

MSA	Year	Qtr	Price	Qtly. return	EPS-Qtly, actual	EPS-Ann, actual	EPS-Qtly, forecast	EPS-Ann, forecast
Atlanta	1988	1	4.61	-0.15	0.00	0.02	0.01	0.02
Atlanta	2005	4	29.14	0.04	0.30	1.06	0.37	1.36
Boston	1985	1	29.69	0.21	0.19	0.41	0.07	0.30
Boston	2005	4	37.62	0.06	0.46	1.67	0.41	1.60
Chicago	1985	1	47.77	0.21	0.16	0.43	0.09	0.36
Chicago	2005	4	51.39	0.02	0.63	2.32	0.66	2.39
Cleveland	1985	1	55.78	0.18	1.22	3.96	1.12	4.45
Cleveland	2005	4	51.02	-0.01	0.63	2.44	0.59	2.05
Dallas	1985	1	52.30	0.11	0.25	1.20	0.30	1.31
Dallas	2005	4	51.14	-0.04	1.16	3.83	1.17	3.97
Las Vegas	1985	1	25.34	0.08	0.66	1.05	0.00	1.28
Las Vegas	2005	4	46.85	0.07	0.46	1.95	0.44	2.27
Los Angeles	1985	1	32.75	0.12	0.02	1.03	0.36	1.48
Los Angeles	2005	4	57.05	0.03	1.00	3.10	0.85	3.26
Miami	1985	1	31.03	0.21	0.45	1.64	0.46	1.70
Miami	2005	4	44.35	0.08	0.57	2.83	0.41	2.88
San Diego	1985	1	20.75	0.31	0.03	0.28	0.10	0.46
San Diego	2005	4	40.60	0.00	0.44	1.32	0.37	1.43
San-Francisco	1985	1	32.84	0.16	-0.01	-0.10	0.01	0.09
San Francisco	2005	4	58.16	0.05	0.58	2.02	0.75	2.39
Tacoma	1985	1	43.10	0.18	0.25	0.83	0.25	0.82
Tacoma	2005	4	37.46	0.04	0.43	1.81	0.43	1.87
Tampa	1985	1	91.73	0.24	0.31	1.10	0.34	1.19
Tampa	2005	4	32.97	-0.01	0.61	2.35	0.60	2.43

Table 4. Urban economic base indices for various MSA's (industry-employment weighted). The firms in a city's portfolio are obtained from the Bloomberg regional indices. EPS, actual, annual and EPS, forecast, annual represent the industry-employment weighted average of the actual and forecasted earnings per share of firms respectively, in an MSA's portfolio. Earnings per share realizations and forecasts are obtained from I/B/E/S. The industry level employment data has been obtained from the Bureau of Labor Statistics web site (http:// www.bls.gov/sae/home.htm).

MSA	Year	Qtr.	EPS, actual, annual	EPS, forecast, annual
Atlanta	1990	1	-0.08	0.01
Atlanta	2005	4	-0.04	0.25
Boston	1990	1	0.13	0.13
Boston	2005	4	0.17	0.28
Chicago	1990	1	0.13	0.19
Chicago	2005	4	0.37	0.56
Cleveland	1990	1	0.20	0.34
Cleveland	2005	4	0.03	0.49
Dallas	1990	1	0.34	0.15
Dallas	2005	4	0.28	0.44
Las Vegas	1990	1	1.05	0.03
Las Vegas	2005	4	0.64	0.51
Los Angeles	1990	1	-0.48	0.15
Los Angeles	2005	4	0.46	0.56
Miami	1990	1	0.07	0.09
Miami	2005	4	0.09	0.36
San Diego	1990	1	0.04	-0.05
San Diego	2005	4	0.18	0.42
San Francisco	1990	1	0.07	0.10
San Francisco	2005	4	0.16	0.33
Tacoma	1990	1	0.50	0.21
Tacoma	2005	4	0.95	0.52
Tampa	1990	1	-0.07	0.07
Tampa	2005	4	0.46	0.42

Table 5. IPS tests for panel stationarity. The 1 % critical value for the test statistic in this case is — 1.810, therefore all of the series reject the null except for the OHFEO index. Test regressions include four lags and a time trend.

Variable	IPS test levels	IPS test differences
OHFEO index	3.244	-4.555
Price index (of firms)	-3.145	-9.348
Quarterly return index (of firms)	-8.122	-9.072
Actual EPS index quarterly (value-weighted)	-5.069	-8.999
Actual EPS index annual (value-weighted)	-2.391	-8.983
Estimated EPS index quarterly (value-weighted)	-4.314	-9.267
Estimated EPS index annual (value-weighted)	-2.348	-9.242

Table 6. Preliminary regression analysis. The table contains coefficients and t-ratios of the row variable in a regression of the OFHEO index of residential housing prices. The regressions always include a time trend and metropolitan fixed effects.

Variable	Coefficients	t-Ratio
Price index (of firms)	0.0002	-2.98
Quarterly return index (of firms)	-0.0003	-0.31
Actual EPS index quarterly (value-weighted)	0.0024	4.90
Actual EPS index annual (value-weighted)	0.0070	5.44
Estimated EPS index quarterly (value-weighted)	0.0023	4.36
Estimated EPS index annual (value-weighted)	0.0007	5.80

Table 7. Fixed-effects regression analysis of OFHEO index on labor-weighted EPS indices.

Variable	Coefficient	Std. err	t-Stat	p-Value
a. Realized EPS (quarterly):				
Real (deflated) value of EPS qtly.	0.599	0.45	1.34	0.18
Time	0.001b	0.00	17.54	0.00
Constant	— 0.013b	0.00	-10.53	0.00
Fixed effect	Within	Between	Overall	
R-square	0.34	0.33	0.32	
b. Realized EPS (annual):				
Real (deflated) value of EPS ann.	0.195	0.14	1.43	0.15
Time	0.001b	0.00	17.05	0.00
Constant	— 0.013b	0.00	-10.36	0.00
Fixed effect	Within	Between	Overall	
R-square	0.34	0.33	0.32	
c. *Estimated EPS (quarterly):*				
Real (deflated) value of EPS qtly.	0.824d	0.42	1.95	0.05
Time	0.001b	0.00	17.81	0.00
Constant	— 0.013b	0.00	-10.68	0.00
Fixed effect	Within	Between	Overall	
R-square	0.34	0.50	0.32	
d. Estimated EPS (annual):				
Real (deflated) value of EPS qtly.	0.340b	0.12	2.76	0.01
Time	0.001b	0.00	17.48	0.00
Constant	— 0.014b	0.00	-10.74	0.00
Fixed effect	Within	Between	Overall	
R-square	0.35	0.40	0.31	

[a] 95% Significance. [b] 99% Significance.

Table 8. the estimated EPS (annual) and control for employment, total population, consumer confidence, income, the percentage of retirees living m an MSA and the ratio of government employees to the total number of employees in the MSA. We limit our sample period to 1990-2005 due to the unavailability of retirement and government employment data from 1985-1989.

Panel A (1990-2005):	All MSAs
Intercept	0.005470 (0.28)
EPS estimate	0.111547*** (4.39)
Log (total employment)	0.001186 (1.40)
EPS* log (total employment)	0.032746*** (4.09)
Log (population)	0.003254 (0.80)
CC	0.000499** (2.05)
Log (income)	0.083594 (0.85)
% of population above 65 years of age	0.001246 (1.29)
% of Gov. employment	0.014534 (1.33)

Panel B: We divide the sample of MSAs into two groups: one with higher supply elasticity and the other with lower supply elasticity. Then, for each group, we regress the deflated returns m home prices of the MSAs on the estimated EPS (annual) and control for employment, total population, consumer confidence, income, the percentage of retirees living m an MSA and the ratio of government employees to the total number of employees m the MSA. We limit our sample period to 1990-2005 due to the unavailability of retirement and government employment data from 1985-1989.

	In-elastic (supply) MSAs	Elastic (supply) MSAs
Intercept	0.102482**	-0.04008***
	(2.35)	(-2.50)
EPS estimate	0.092703***	0.009113**
	(3.11)	(1.96)
Log (total employment)	0.003695	0.001244
	(0.99)	(0.41)
EPS* log (total employment)	0.018521***	0.004287**
	(4.03)	(2.12)
Log (population)	0.001473	0.000021

	(1.16)	(0.80)
CC	0.000397	0.000500***
	(1.45)	(4.32)
Log (income)	0.049632	0.098337
	(0.36)	(1.47)
% of population above 65 years of age	0.001549	0.001246
	(1.30)	(1.29)
% of gov. employment	0.012659	0.013356
	(1.22)	(1.16)

Panel C: We test if the difference between the impact of future earnings on inelastic supply MSAs is statistically different from the elastic supply MSAs

EPS estimate coefficients	0.08359***
(Inelastic minus elastic)	(2.63)

Panel D. We divide the sample of MSAs into two groups: one with higher rate of increase m population and the other with lower population growth. Then, for each group, we regress the deflated returns in home prices of the MSAs on the estimated EPS (annual) and control for employment, consumer confidence, income, the percentage of retirees living in an MSA and the ratio of government employees to the total number of employees m the MSA. We limit our sample period to 1990-2005 due to the unavailability of retirement and government employment data from 1985-1989.

	Low population growth MSAs	High population growth MSAs
Intercept	0.098724***	0.061846***
	(2.11)	(3.34)
EPS estimate	0.090038***	0.008937**
	(3.35)	(2.06)
Log (total employment)	0.003000	0.000649
	(0.92)	(0.53)
EPS* log (total employment)	0.016999***	0.005634***
	(3.78)	(2.52)
CC	0.000405	0.000615

	(1.49)	(3.82)
Log (income)	0.038527	0.083421
	(0.57)	(1.33)
% of population above 65 years of age	0.001643	0.001451
	(1.30)	(1.18)
% of gov. employment	0.012887	0.013174
	(1.27)	(1.40)

Panel E: We test if the difference between the impact of future earnings on high population growth MSAs is statistically different from the low population growth MSAs.

EPS estimate coefficients	0.08110***
(Low population growth minus high population growth)	(2.80)

Panel F: EPS index based on companies in industries with LQ> 1 in an MSA

We regress the deflated returns on home prices of the MSAs on the estimated EPS (annual) and control for employment, total population, consumer confidence, income, the percentage of retirees living in an MSA and the ratio of government employees to the total number of employees in the MSA. The estimated EPS variable is weighted based on companies that are headquartered m that MSA that have an industry LQ greater than 1. We limit our sample period to 1990-2005 due to the unavailability of retirement and government employment data from 1985-1989.

	All MSAs
Intercept	0.009342
	(0.56)
EPS estimate	0.057928***
	(2.54)
Log (total employment)	0.001277
	(1.22)
EPS* log (total employment)	0.010385**
	(2.11)
Log (population)	0.004296
	(1.08)
CC	0.000516**
	(2.18)
Log (income)	0.089143
	(1.03)
% of population above 65 years of age	0.001181
	(1.35)
% of gov. employment	0.014007
	(1.20)

Panel G: We test if the difference between the impact of Bloomberg estimated EPS earnings index is statistically different from the LQ estimated EPS earnings index.

EPS estimate Coefficients	0.05362***
(Low population growth minus high population growth)	(3.18)

t-Statistics m parentheses.
* p<0.05.
** p<0.01.
******* *p OOOI.*

Table 9. Attribution of real estate returns by industry.

Industry (4-digit SIC)	Mean attribution	t-Stat	p-Value	No. of qtrs.
a. Atlanta:				
Chemicals	16.85%	3.66	0.00	45
Industrial machinery	14.65%	5.29	0.00	
Electrical equipment	28.74%	5.17	0.00	
Instruments and related	34.01%	6.15	0.00	
Business services	3.44%	5.75	0.00	
Health services	2.31%	3.55	0.00	
b. Boston:				
Heavy construction	1.35%	4.82	0.00	38
Printing & publishing	1.26%	2.44	0.02	
Chemicals	2.37%	5.88	0.00	
Leather	1.86%	4.29	0.00	
Fabricated metal	11.81%	7.02	0.00	
Industrial machinery	0.67%	5.16	0.00	
Electrical	1.04%	5.93	0.00	
Instruments	11.87%	6.56	0.00	
Electric, gas & sanitary	0.36%	3.39	0.00	
Wholesale trade-durable	21.45%	5.69	0.00	
Miscellaneous retail	0.03%	1.56	0.13	
depository institutions	33.06%	6.03	0.00	
Security, commodity brokers & services	5.44%	10.57	0.00	
Personal Services	4.62%	4.04	0.00	
Business services	1.47%	5.59	0.00	
Engineering and management services	1.35%	5.54	0.00	
c. *Chicago:*				
Nonmetallic Minerals, except fuels	2.20%	11.34	0.00	8
Food and Kindred Products	11.59%	7.65	0.00	
Apparel and Other Textile Products	1.01%	3.55	0.01	
Printing and Publishing	3.32%	2.19	0.07	
Chemicals and Allied Products	1.45%	8.02	0.00	
Rubber and miscellaneous plastics products	1.25%	10.11	0.00	
Fabricated metal products	1.48%	6.68	0.00	
Industrial machinery and equipment	5.75%	3.81	0.01	
Electrical and electronic equipment	0.13%	1.11	0.30	

Transportation equipment	1.41%	6.80	0.00	
Instruments and related products	2.88%	8.94	0.00	
Miscellaneous manufacturing industries	0.58%	3.02	0.02	
Communications	1.32%	10.26	0.00	
Electric, gas, and sanitary services	0.20%	1.05	0.33	
Wholesale trade - durable goods	1.71%	7.36	0.00	
Wholesale trade - nondurable goods	0.00%	1.00	0.35	
Eating and drinking places	1.90%	4.40	0.00	
Miscellaneous retail	8.99%	5.41	0.00	
Depository institutions	28.55%	6.43	0.00	
Insurance earners	0.67%	2.95	0.02	
Real estate	1.64%	11.11	0.00	
Holding and other investment offices	3.56%	5.24	0.00	
Business services	0.98%	2.75	0.03	
Motion pictures	1.08%	5.97	0.00	
Health services	3.41%	5.42	0.00	
Educational services	10.72%	11.78	0.00	
Engineering and management services	2.22%	3.17	0.02	
d. Tampa:				
Apparel	6.12%	3.98	0.00	34
Printing & publishing	0.31%	3.56	0.00	
Electrical	6.28%	3.51	0.00	
Misc. manufacturing	1.08%	3.90	0.00	
Wholesale trade-durables	17.10%	7.97	0.00	
Security, commodity brokers and services	7.52%	4.58	0.00	
Business services	2.76%	3.05	0.00	
Health services	58.83%	12.56	0.00	
e. San Francisco:				
Heavy construction contractors	1.11%	8.36	0.00	41
Chemicals	1.86%	2.98	0.00	
Primary metals	1.90%	8.96	0.00	
Industrial machinery	0.71%	4.89	0.00	
Electrical equipment	3.24%	4.59	0.00	
Instruments	2.62%	5.94	0.00	
Electrical, gas and sanitary services.	3.21%	5.89	0.00	
Food stores	2.04%	3.63	0.00	
Automotive and gas stations	1.03%	5.78	0.00	
Apparel stores	0.28%	3.17	0.00	

Furniture stores	1.11%	8.10	0.00	
Miscellaneous retail	1.00%	6.49	0.00	
Depository institutions	44.12%	16.79	0.00	
Security, commodity brokers and services	22.50%	12.47	0.00	
Holding and other investment offices	2.55%	4.06	0.00	
Business services	8.53%	8.60	0.00	
Engineering and management services	2.20%	7.62	0.00	

/. San Diego:

Chemicals and allied products	35.79%	5.58	0.00	33
Industrial machinery and equipment	6.34%	5.11	0.00	
Electrical and electronic equipment	24.92%	4.40	0.00	
Instruments and related products	8.95%	4.18	0.00	
Miscellaneous retail	8.47%	2.81	0.01	
Hotels and other lodging places	0.38%	2.79	0.01	
Engineering and management services	15.15%	3.96	0.00	

g. Miami:

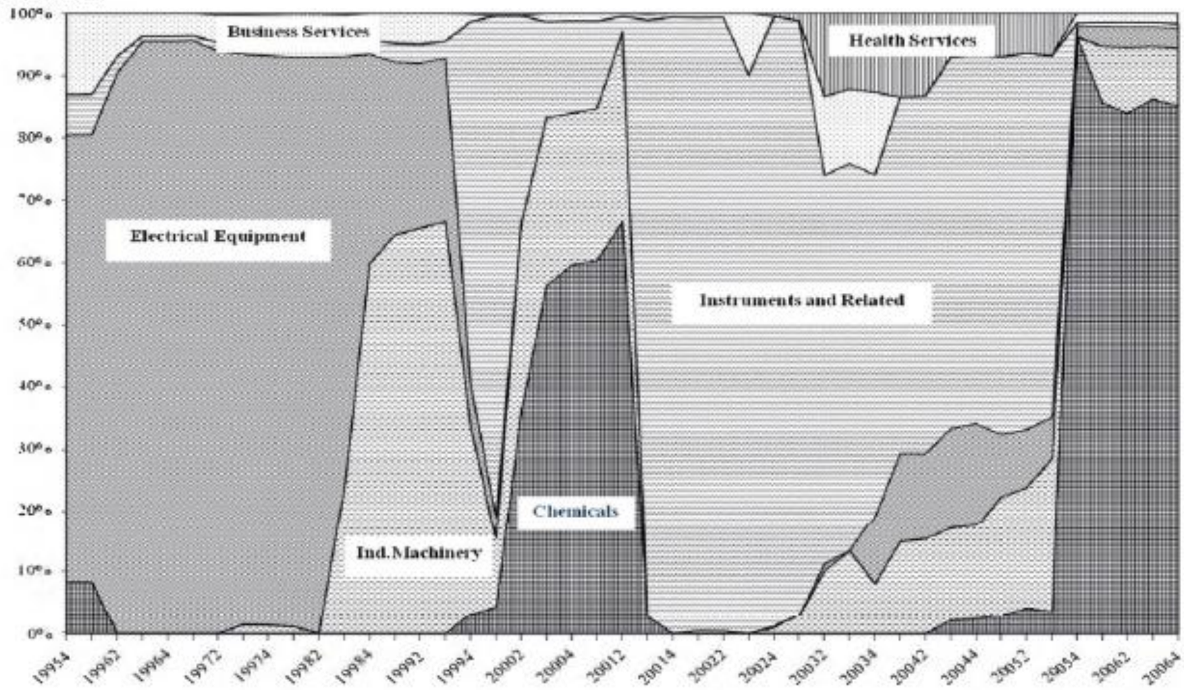
Heavy construction contractors	6.26%	3.93	0.00	35
Lumber and wood products	14.87%	7.19	0.00	
Chemicals and allied products	1.04%	3.06	0.00	
Wholesale trade - durable goods	46.44%	16.74	0.00	
Business services	5.90%	4.73	0.00	
Automotive repair, services, and parking	25.48%	8.25	0.00	

h. Los Angeles:

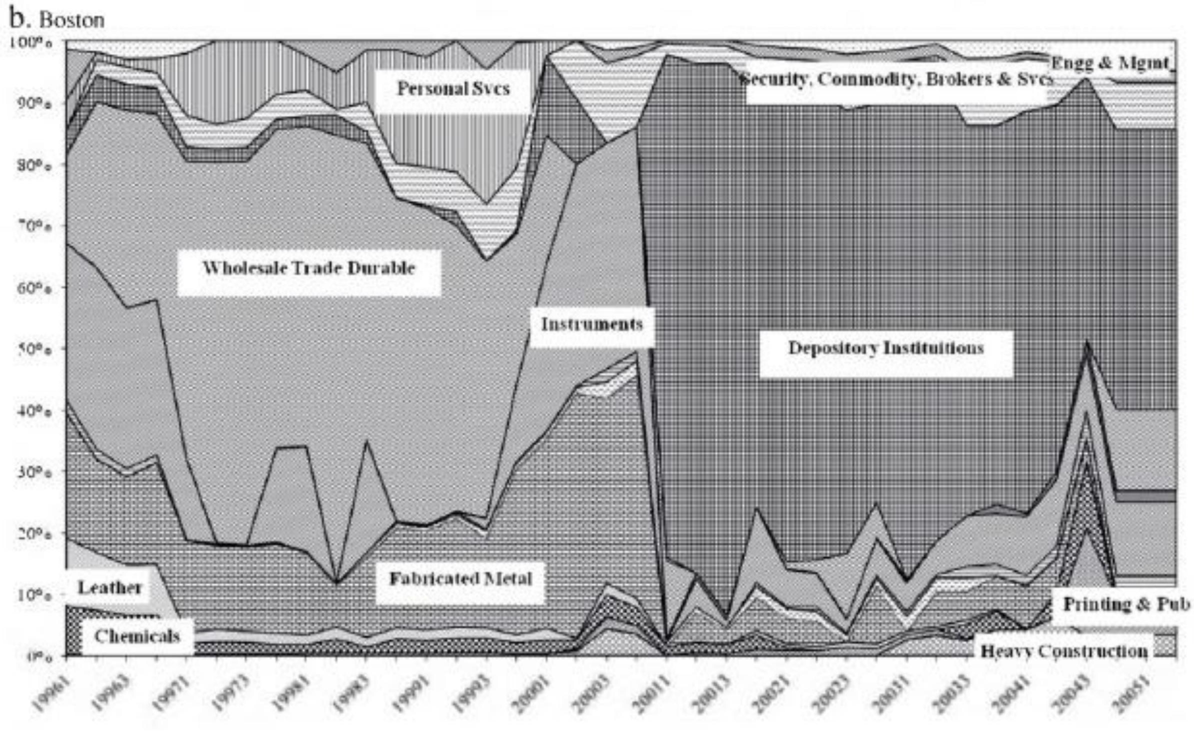
Oil and gas extraction	0.90%	8.04	0.00	20
General building contractors	1.45%	4.53	0.00	
Heavy construction contractors	72.40%	24.69	0.00	
Chemicals and allied products	1.39%	10.79	0.00	
Fabricated metal products	0.61%	4.01	0.00	
Transportation equipment	5.79%	2.53	0.02	
Miscellaneous manufacturing industries	0.59%	2.31	0.03	
Electric, gas, and sanitary services	2.75%	4.37	0.00	
Wholesale trade - durable goods	0.75%	6.65	0.00	
Food stores	0.89%	2.12	0.05	
Insurance earners	1.34%	9.96	0.00	
Insurance agents, brokers, and	0.25%	1.29	0.21	

service				
Holding and other investment offices	2.05%	2.85	0.01	
Hotels, rooming houses, camps, and other lodging places	1.59%	8.49	0.00	
Business services	1.01%	4.09	0.00	
Motion pictures	1.65%	15.61	0.00	
Amusement and recreational services	0.82%	4.70	0.00	
Health services	1.21%	11.57	0.00	
Engineering and management services	2.56%	4.12	0.00	
i. *Las Vegas:*				
Miscellaneous manufacturing industry	28.76%	5.92	0.00	48
Electric, gas, and sanitary services	1.01%	6.17	0.00	
Insurance earners	62.79%	13.23	0.00	
Hotels, rooming houses, camps, and other lodging places	2.42%	3.29	0.00	
Amusement and recreational services	5.01%	6.73	0.00	
j. *Cleveland:*				
Metal mining	0.50%	7.16	0.00	57
Printing and publishing	0.41%	5.96	0.00	
Chemicals and allied products	1.17%	3.86	0.00	
Rubber and miscellaneous plastics products	2.27%	5.34	0.00	
Primary metal industries	2.84%	3.32	0.00	
Fabricated metal products	3.27%	9.24	0.00	
Industrial machinery and equipment	5.10%	6.48	0.00	
Electrical and electronic equipment	0.38%	5.81	0.00	
Transportation equipment	0.89%	5.50	0.00	
Instruments and related products	14.92%	9.00	0.00	
Building materials, hardware, garden supplies	0.26%	3.34	0.00	
Depository institutions	60.65%	32.34	0.00	
Insurance earners	7.33%	4.77	0.00	

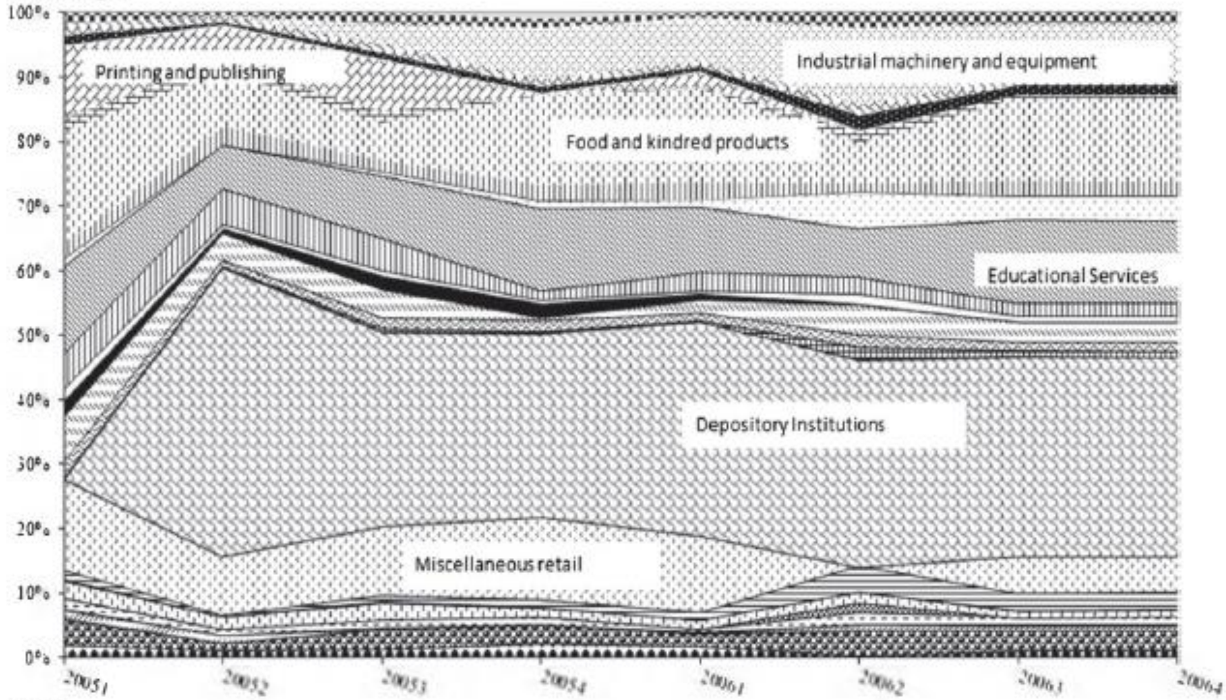
a. Atlanta



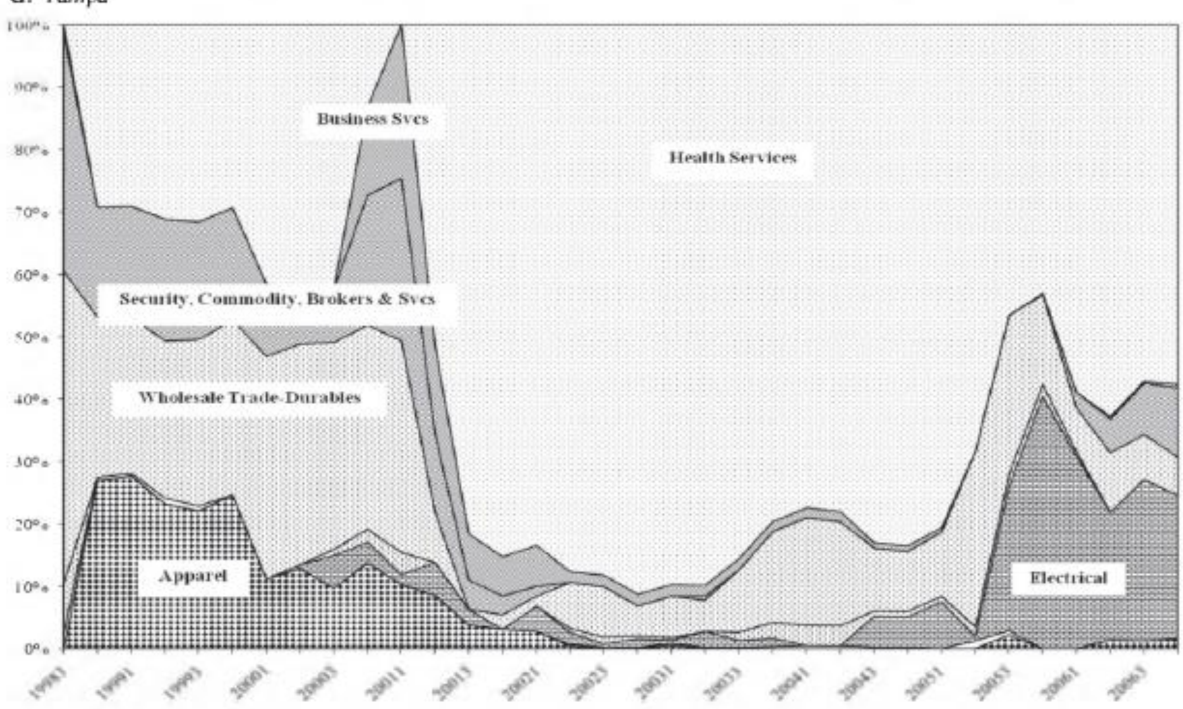
b. Boston



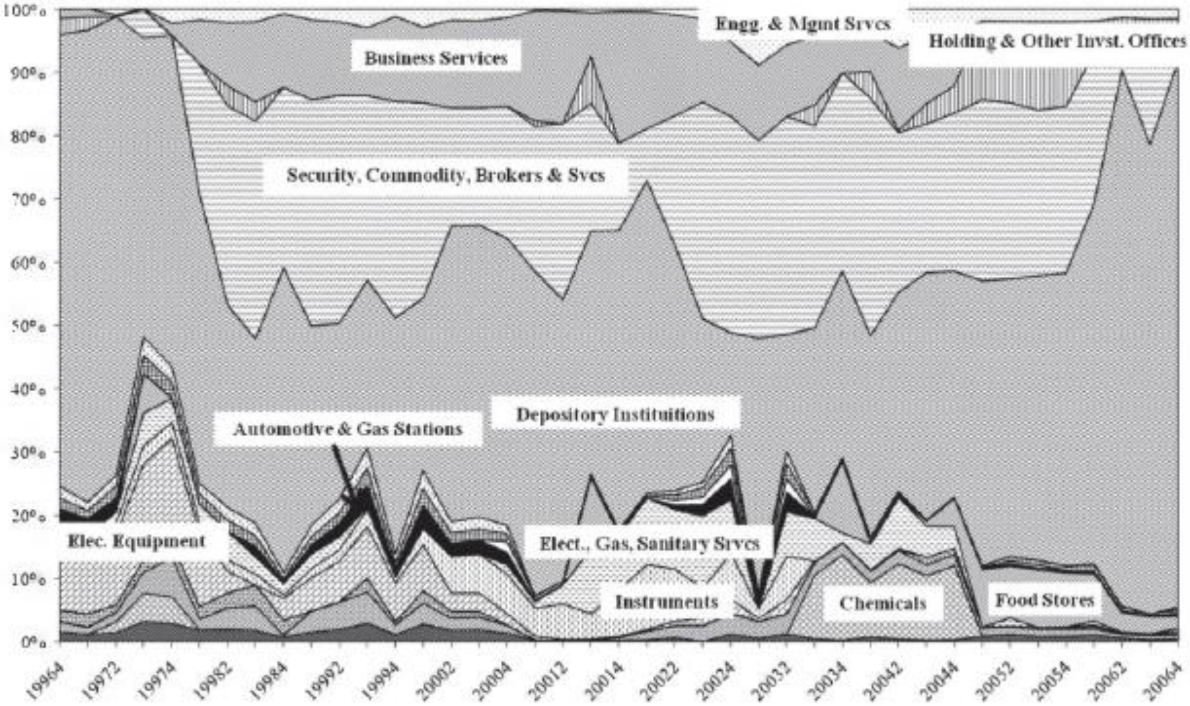
c. Chicago



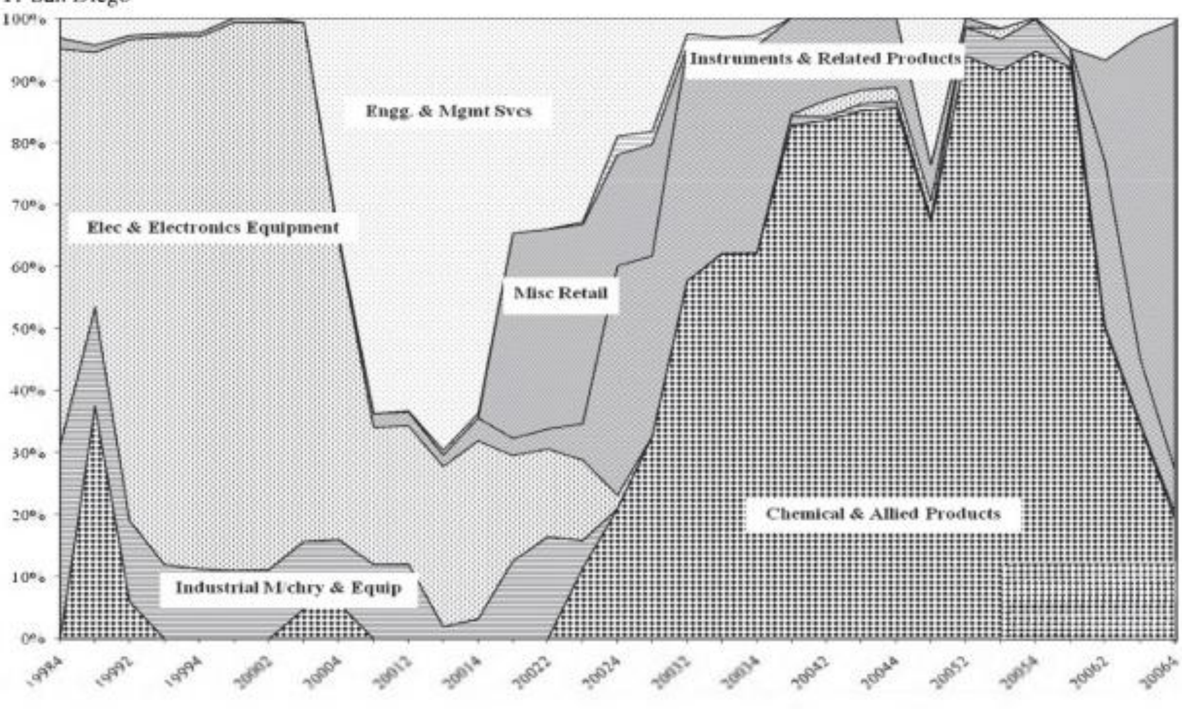
d. Tampa



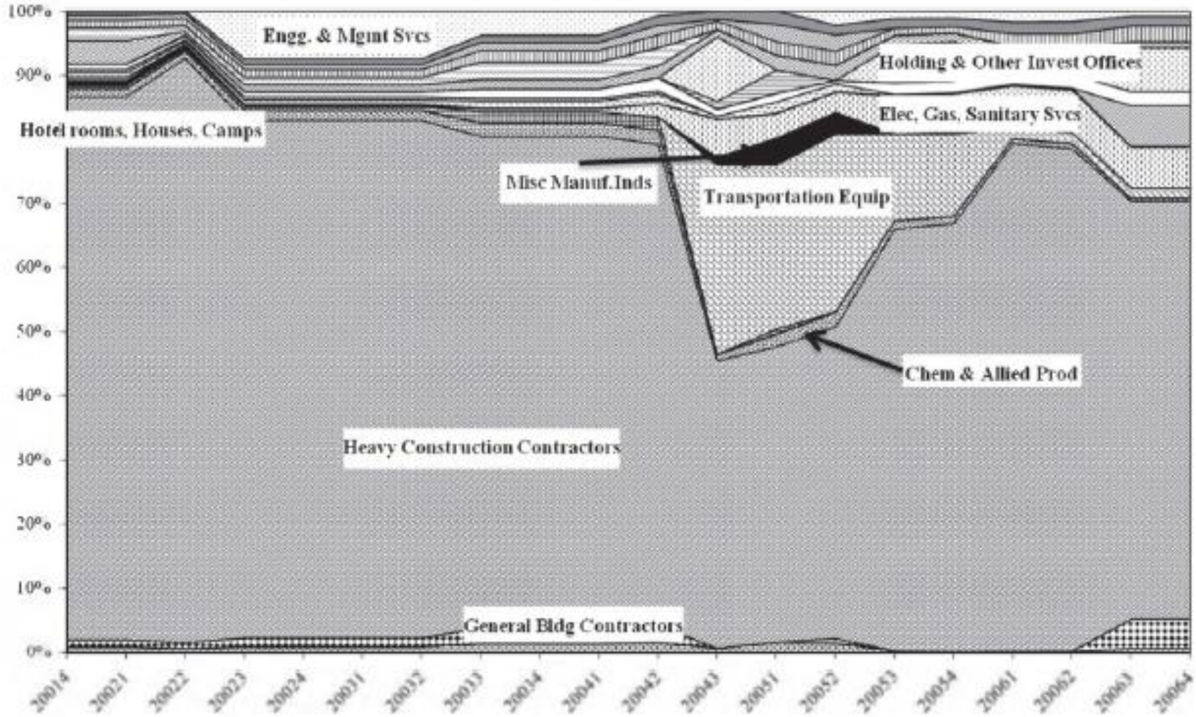
e. San Francisco



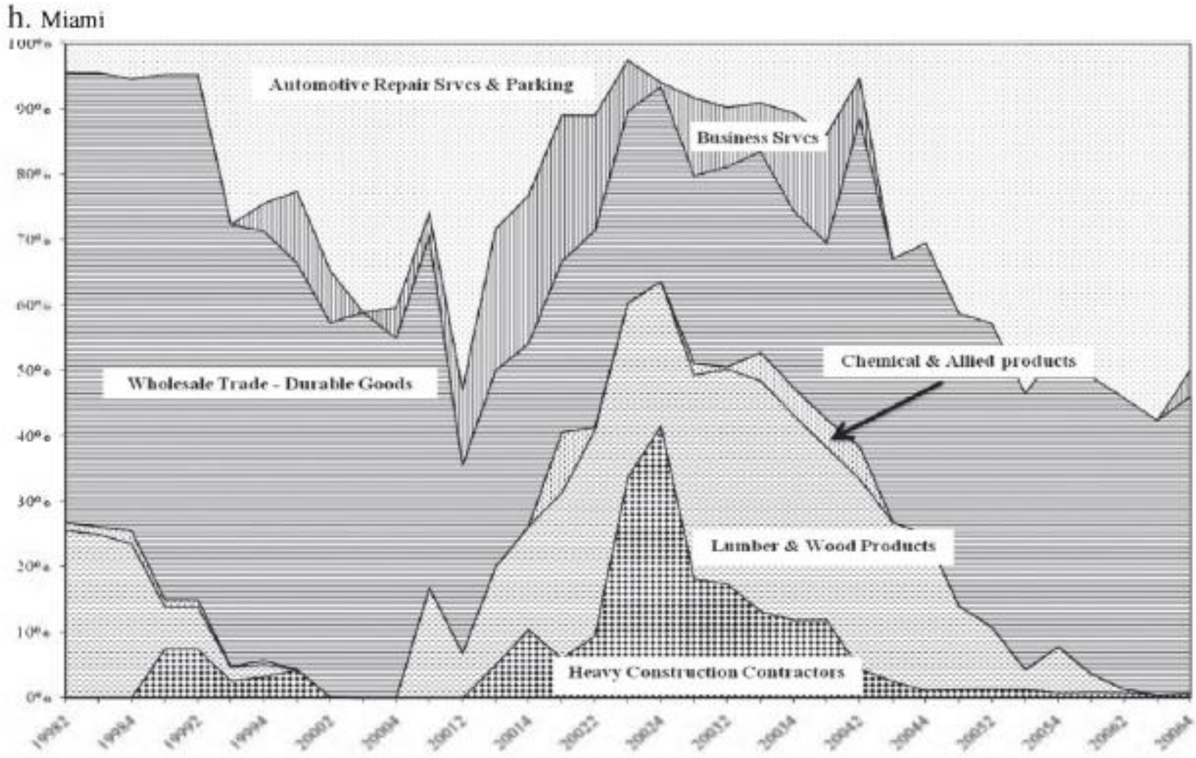
f. San Diego



g. Los Angeles



h. Miami



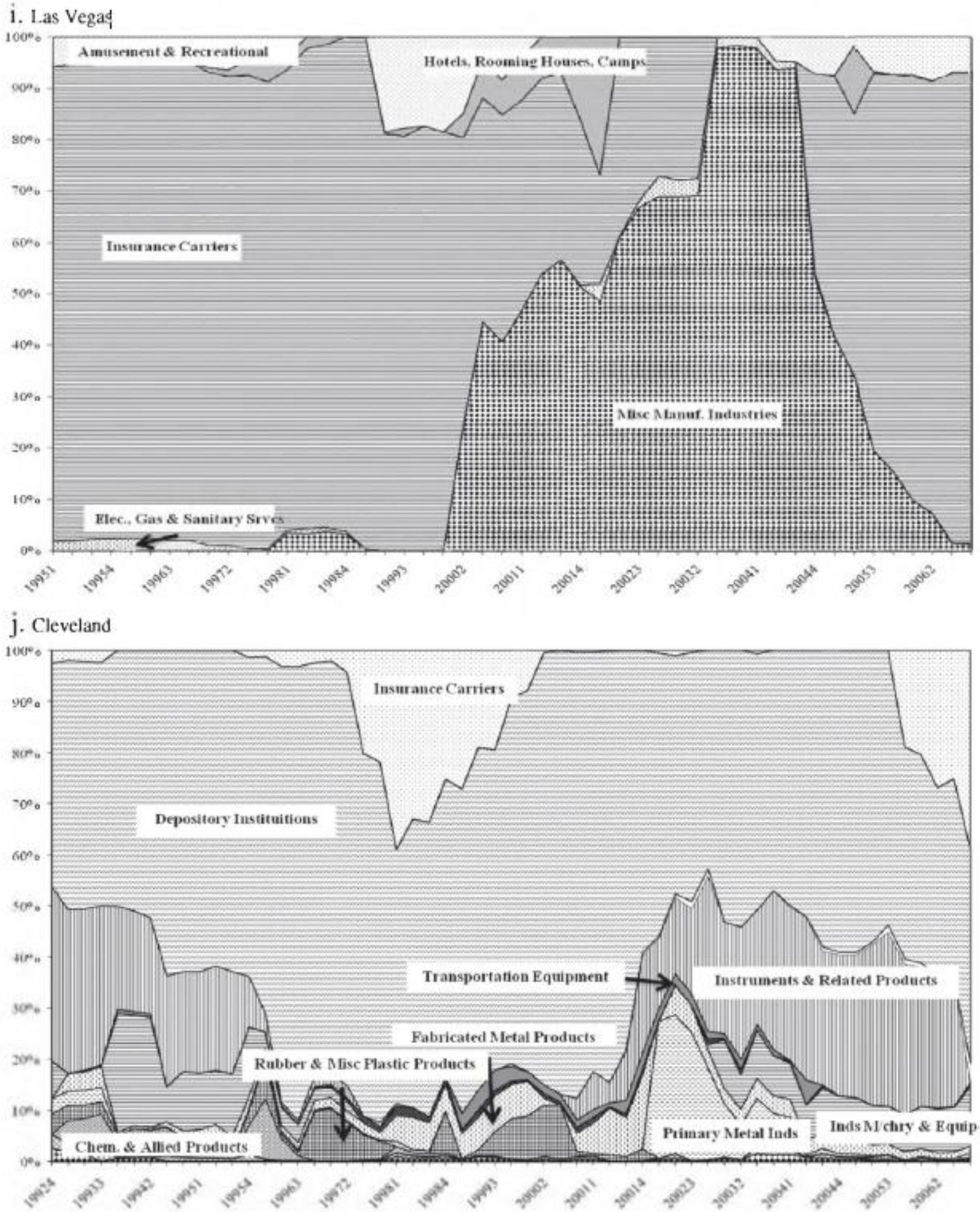


Figure 1. Attribution analysis.

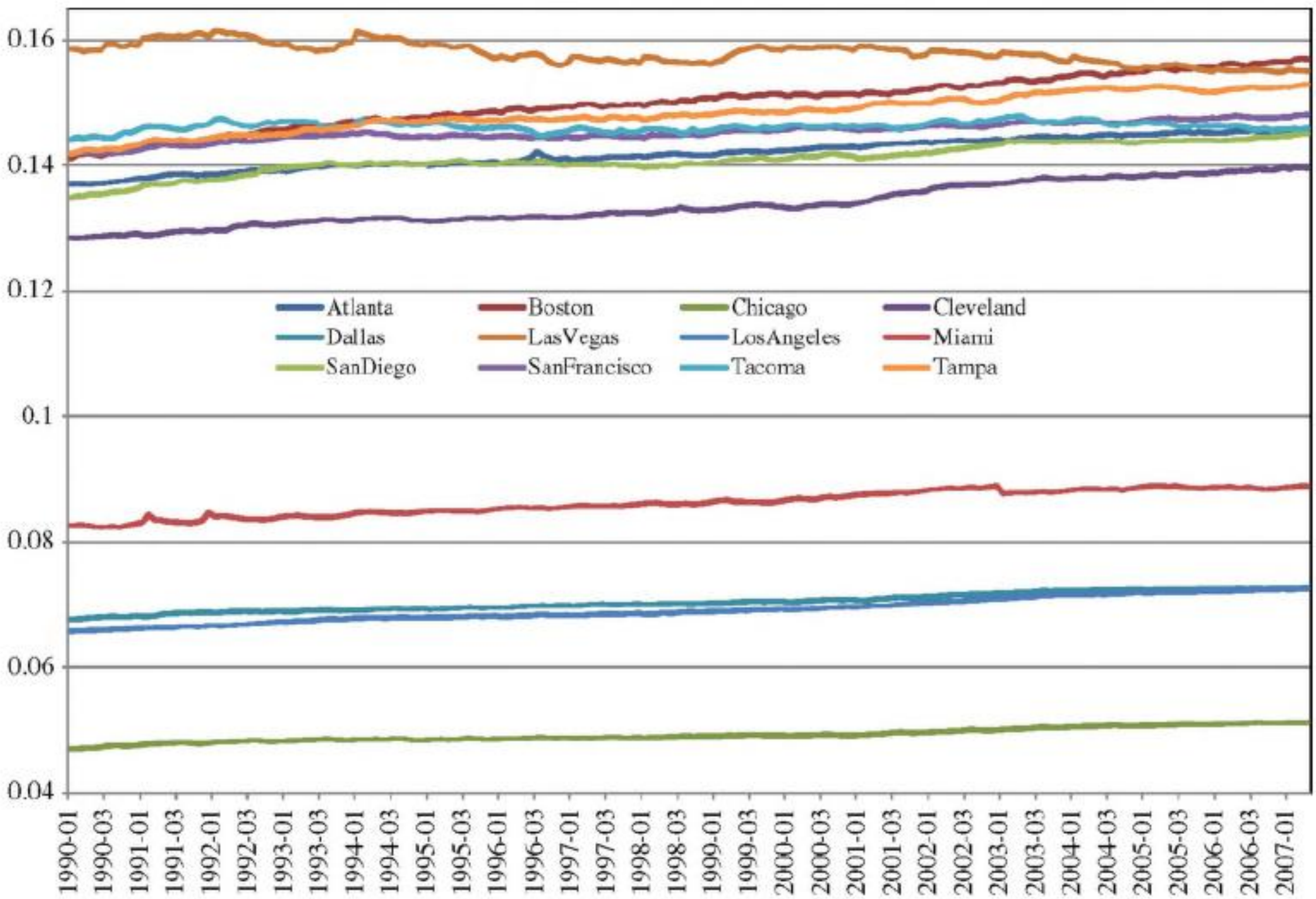


Figure 2. Herfindahl index of MSAs

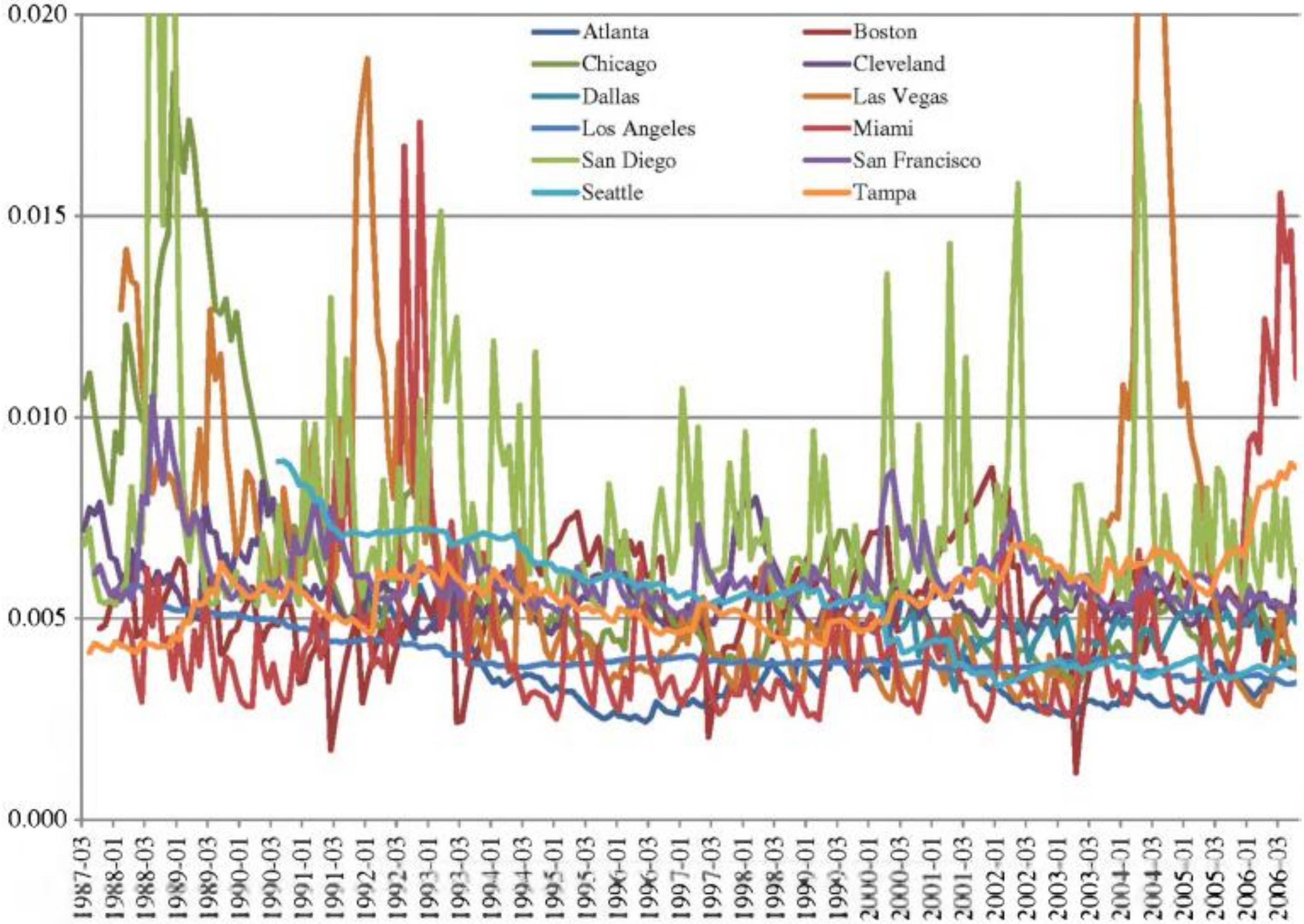


Figure 3. GARCH (1, 1) volatility of housing indices.

References

Abraham, J., Hendershott, P., 1996. Bubbles in metropolitan housing markets. *J. Hous. Res. 7*, 191-207.

Brinson, G.P., Hood, L.R., Beebower, G.L., 1986. Determinants of portfolio performance. *Financ. Anal. J. 42* (4), 39-44.

Brown, S.J., Coulson, N.E., Engle, R.F., 1992. On the determination of regional base and regional base multipliers. *Reg. Sd. Urban Econ. 22*, 619-635.

Canner, Glenn, Dynan, Karen, Passmore, Wayne, December 2002. Mortgage refinancing in 2001 and early 2002. *Fed. Reserv. Bull*. 469-481.

Capozza, D.R., Hendershott, P.H., Mack, C., Mayer, C.J., 2002. *Determinants of real house price dynamics*. NBER Working Paper.

Carlino, Gerald, Defina, Robert, Sill, Keith, 2001. Sectoral shocks and metropolitan employment growth. *J. Urban Econ. 50*, 396-417.

Coulson, N. Edward, 1999. Sectoral sources of metropolitan growth. *Reg. Sei. Urban Econ. 27*, 723-743.

Coulson, N. Edward, 2006. Urban employment fluctuations. In: Arnott, R., McMillen, D. (Eds.), *A Companion to Urban Economics*. Blackwell Publishing, Malden, MA, pp. 460-478.

Coval, Joshua D., Moskowitz, Tobias J., 1999. Home bias at home: local equity preference in domestic portfolios. *J. Financ. 54* (6), 2045-2073.

Crawford, Gordon W., Fratantoni, Michael C., 2003. Assessing the forecasting performance of regime-switching, ARIMA and GARCH models of house prices. *Real Estate Econ. 31* (2), 223-243.

Davis, J., Henderson, J.V., 2004. *Headquarters' Location Decisions.* CES working paper no 04-02. US Bureau of the Census, Center for Economic Studies, Washington DC.

Fujita, M., Krugman, P., Venables, A., 1999. The Spatial Economy. MIT Press, Cambridge.

Gallin, Joshua, 2006. The long-run relationship between house prices and income: evidence from local housing markets. *Real Estate Econ. 34* (3), 417-438.

Glaeser, Edward L., Gyourko, Joseph, 2005. Urban decline and durable housing. *J. PoliL Econ. 113* (2), 345-375.

Glaeser, Edward L, Matthew, G., Resseger, 2010a. The complementary between cities and skills. *J. Reg. Sa. 50* (1), 221-244.

Glaeser, Edward L., Rosenthal, Stuart S., Strange, William C., 2010b. Urban economics and entrepreneurship. *J. Urban Econ. 67* (1), 1-14.

Hamilton, S.W., Heinkel, R.L, 1995. Sources of "Value-Added" in Canadian Real Estate Management. *Real Estate Finance 12*, 57-70.

Hammond, George W., Thompson, Enc, 2004. Employment risk in the U S. metropolitan and nonmetropolitan regions: the influence of industrial specialization and population characteristics. *J. Reg. Sei. 44* (3), 517-542.

Haurin, D., Rosenthal, S., 2007. The influence of household formation on homeownership across time and race. *Real Estate Econ. 35*, 411-450.

Hoyt, Weimer, 1939. *Principles of Urban Real estate*. Ronald Press Co.

Hwang, Min, Quigley, John M., 2006. Economic fundamentals m local housing markets: evidence from US metropolitan regions. *J. Reg. Sa. 46* (3), 425-463.

Im, Kyung So, Peseran, Hashem, Shin, Yongcheol, 2003. Testing for unit roots in heterogeneous panels. *J. Econ. 115,* 53-74.

Jud, Donald G., Winkler, Daniel T., 2002. The dynamics of metropolitan housing prices. *J. Real Estate Res. 23*, 29-45.

Klier, Thomas H., 2006. Where the headquarters are: location patterns of large public companies, 1990-2000. *Econ. Dev. Q. 20* (2), 117-128.

Liang, Youguo, Hess, Robert, Bradford, David, McIntosh, Willard, 1999. Return attribution for commercial real estate investment management *J. Real Estate Portfol. Manage. 5* (1), 23-30.

Malpezzi, S., 1999. A simple error-correction model of house prices. *J. Hous. Econ. 8,* 27-62.

Miller, N., Peng, L., 2006. Exploring metropolitan housing price volatility. *J. Real Estate Financ. Econ. 33,* 5-18.

Neumann, George R.,Topel, Robert H., 1991. Employment risk, diversification and unemployment *Q.J. Econ. 106* (4), 1341-1365.

Ono, Yukako, 2006. What do census data tell us about headquarters locations. *Econ. Dev. Q. 20* (2), 129-141.

Rosenthal, Stuart S., Strange, William C., 2004. Evidence on the nature and sources of agglomeration economies. *Handb. Reg. Urban Econ. 4,* 2119-2171.

Saiz, Albert, 2010. The geographic determinants of housing supply. *Q.J. Econ. 125* (3), 1253-1296.

Testa, William A., 2006. Headquarters research and implications for local development *Econ. Dev. Q. 20* (2), 111-116.

Tiebout, C., 1962. *The Community Economic Base Study* Supplementary Paper 16.