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Industry Concentration and Regional Housing Market Performance

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Abstract: Prior literature has analyzed determinants of housing appreciation rates at the regional level, including several studies on inter-regional differences. Generally, these previous studies have identified income, population shifts, and other demographic changes as the most important factors in explaining regional price appreciation for single-family residential properties. Existing literature has not considered the impact that regional industry concentration might have on regional housing appreciation. This study uses a Federal Housing Finance Administration price index, along with demographic and industry concentration data collected from the U.S. Census and the Bureau of Labor Statistics, to investigate whether a more or less highly concentrated industry base, as measured by a Herfindahl index, contributes to regional housing market performance. The questions of housing market impacts related to increasing concentration for a reasonably diversified metropolitan statistical area and impacts related to increasing diversification for an already-concentrated area are also examined.

1. Introduction

There is a long line of literature relating regional economic performance, variously defined, and regional industry concentration. Similarly, there is a long line of literature tying regional housing market performance to a number of those same regional economic performance measures, most notably unemployment. Conspicuously absent from the literature, however, are studies of the direct link that may exist between regional housing market performance and the level of regional industrial concentration. In fact, to the authors' knowledge, only one previous study, Coulson, Liu, and Villupuram (2013), has considered this possible relationship.

From the perspective of the individual homeowner, the possibility of a link between regional industry concentration and regional house prices is not terribly interesting or important. Models of labor mobility or regional unemployment may sometimes assume frictionless movement between cities, but that assumption is routinely and grossly violated in practice, as moving comes with significant attendant transaction costs. Thus, it is impractical to think of individual homeowners moving to take advantage of higher local housing prices (or lower non-local housing prices) due to a "better" local industry mix (or "worse" non-local mix).[1] Similarly, given the transaction costs involved in selling a house and moving even within the same metropolitan statistical area

[1] If the homeowner cannot find a job in his or her industry, and especially if the inability to do so is associated with a permanent change in the local industrial base, then moving to an MSA where the industry mix is more favorable for his or her type of employment would be a rational response, as espoused by Lilien (1982). However, this does not invalidate the point being made, since such a homeowner would not be moving simply to take advantage of house price movements related to industry concentration.

(MSA), it is unlikely that current homeowners would sell their homes to take advantage of a perceived favorable movement in local regional industry concentration. In fact, Hämäläinen and Böckerman (2004) present strong evidence that housing markets serve as an effective constraint on migration flows between regions. It is likewise impractical to think that individual homeowners would consider their contribution to regional industrial concentration when taking a new job, even if they had the necessary skills and abilities to change industries.[2] For an extensive study of the determinants of migration, both in a theoretical and empirical context, we refer the reader to Cebula (1979) and Cebula and Alexander (2006). The later discusses numerous positive and negative externalities influencing the decision to relocate.

The question is not purely academic, however. Regional planners and local government officials often are tasked with making exactly the kinds of decisions that the analysis in this current study can inform. Proof of these activities can be seen in many areas of the U.S. and across several different industries. Battles have been waged among southeastern states in very recent years to secure a variety of manufacturing facilities, from Kia and Hyundai to Boeing and Airbus. A number of cities (e.g., Austin, TX, and Charleston, SC) have poured substantial resources into upgrading local technological capabilities in the hopes of attracting additional high tech jobs. Are those jobs best for the cities that have chosen to pursue them? Obviously, the answer depends on one's definition of "best," but any justifiable definition should include consideration of the impact of pursuing one industry at the expense of another on the most expensive asset owned by the vast majority of the city's residents: housing.

This study seeks to shed light on the dilemma facing a decision-making body seeking to allocate the scarce resources available to attract new industry. The study makes two primary contributions. First, the study establishes a link between regional industry concentration and regional housing prices. Related to that point, the study highlights the importance of estimation methodology in analysis of this question. Second, the study provides some insight on the question of whether there is a dominant strategy with regard to recruiting new industry, given what the industrial base of a particular MSA already looks like. As a preview of the findings pertaining to the second question, it seems that an MSA starting with a reasonably diversified industry base does not benefit from attempts to concentrate in any particular industry. Conversely, an MSA with a relatively more concentrated industrial base as its starting point does benefit from continuing to concentrate. The remainder of the paper proceeds as follows: Section 2 provides some relevant background literature, Section 3 details the data and methodology, Section 4 discusses the results, and Section 5 concludes.

2. Literature Review

The relationship between regional economic performance and regional industry concentration has been extensively investigated, particularly when economic performance is defined as unemployment. A thorough review of this line of literature is beyond the scope of the current study, as it traces its origins at least to Tress (1938). However, the general consensus is that a diversified industrial base is beneficial to maintaining lower unemployment and to minimizing employment volatility.[3] Analyzing this question in a portfolio context, *a la* Markowitz (1952), indicates that increasing the exposure of an MSA to a very stable (with regard to employment) industry might not always be the best route to increasing overall MSA employment stability.[4]

Diversification or concentration of the industrial base has also been related to other measures of regional economic performance, such as gross state product (Sherwood-Call, 1990), per capita income (Attaran, 1986), and length of regional recessions (Kuhlmann, Decker, and Wohar, 2008). Keinath (1985), Bar-El (1985), Schoening and Sweeney (1989, 1992), and Smith (1990) attempt to broaden the study of industry concentration and regional economic performance to include non-metropolitan areas. The latter three studies also focus on the problems inherent in applying techniques designed for MSA analysis to non-metropolitan regions. Hammond and Thompson (2004) provide a more in-depth literature review

[2] It is the assumed ability to change industries that is the source of reduced unemployment in models of regions with more diversified industrial bases in a number of prior works (e.g., Neumann and Topel, 1991). Even if that assumption were true, it is still unlikely that an individual would take one job over another due to concern about his or her impact on regional industrial concentration.

[3] See, for example, Kort (1981), Jackson (1984), Wundt (1992), Malizia and Ke (1993), and Trendle and Shorney (2003).

[4] See, for example, Conroy (1974, 1975), Barth, Kraft, and Wiest (1975), St. Louis (1980), Brewer (1984), Brown and Pheasant (1985), Kurre and Weller (1989), Hunt and Sheesley (1994), and Siegel, Alwang, and Johnson (1994).

of this topic and include additional population characteristics in their investigation of both metropolitan and non-metropolitan regions. Based on the predictions and findings from the large literature surrounding regional industrial concentration and regional employment, employment volatility, and overall economic stability, a separate literature has developed offering strategies for regional industry recruitment.[5] However, the absence of concern in previous literature for the impact of industrial concentration on regional housing prices makes any such strategy suspect.

Broadly defined, the study of regional housing market performance could include studies of single markets for which micro-level data are available. Since that is not the level of analysis conducted in the current study, the large number of studies that fall into that category are not included in the literature review. Even with that constraint, there are numerous studies of regional housing markets utilizing regional price indices and other macro-level data to analyze inter-regional differences.[6] One of the earliest and most comprehensive examinations of inter-regional differences in housing market performance is provided by Manning (1986). Using data on a wide variety of demand and supply factors, as well as a relatively large sample of cities, Manning provides evidence that both income and non-monetary amenities are important in determining inter-regional housing demand. Supply is mainly dependent on cost-related factors. These findings are reiterated by Manning (1989) using a slightly different sample in an examination of inter-regional home price differences. Reichert (1990) conducts a similar analysis using larger regions and provides evidence that, at the level of Census divisions, regional housing markets respond very differently to various national and regional macroeconomic variables. In other words, Reichert (1990) provides evidence against the existence of a "national" housing market.

A number of other studies focus on some aspect of regional housing prices. Jud and Winkler (2002) provide evidence in support of a stock market effect on regional housing prices. Goetzmann, Peng, and Yen (2012) make the case that, prior to the severe real estate market downturn in 2006, analysis of repeat-sale housing price indices, like the Case-Shiller Index and the Federal Housing Financing Agency (FHFA) Index, would have reasonably led to increases in both supply and demand for subprime loans based on forecasted price increases. Miller and Peng (2006) find a time-varying component of the volatility of house price appreciation. Miller, Peng, and Sklarz (2011) identify housing price appreciation as a significant determinant of MSA-level gross domestic product, with differing impacts due to predictable versus unpredictable changes in housing prices. Recently, there has been some interest in the possibility of convergence in housing prices at the MSA level, as seen in Kim and Rous (2012), among several others.

The common theme within the existing literature is that no direct link is proposed between regional industrial concentration and regional housing prices. Coulson et al. (2013) proposed such a link. Using data from twelve MSAs, they investigate the relationship between the number of firms in export sectors of the Bloomberg Regional Indices and the FHFA Housing Price Index. Use of the Bloomberg Regional Indices allows for the identification of firms that are drivers of their local economies, which is particularly important in Coulson et al. (2013), as they also include earnings-per-share estimates for those firms as forward-looking indicators of housing price movements. The reliance on export sectors comes at a price, however, as this measure fails to capture employment growth (and resulting changes in concentration) among local sectors. Using location quotients greater than one as a robustness check, they find similar results, but with greatly reduced explanatory power. Finally, using a Herfindahl index as a third measure of regional industrial concentration, they find a consistently negative relationship between regional industry concentration and regional housing prices. They also conduct an attribution analysis in an attempt to pinpoint which industries contribute to housing price growth in which MSAs. The current study differs in two important respects from Coulson et al. (2013). First, a much larger sample of MSAs is utilized. Second, the estimation methodology in the current study does not require a focus solely on base or export industries.

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[5] See, for example, Katzman (1976), Miernyk (1980), Kale (1984), McHone (1984), Rasmussen, Bendick, and Ledebur (1984), and Marlin (1985).

[6] Other studies fall somewhere between these two categories through their use of U.S. Census Bureau Annual Housing Survey data, which follows a property over time regardless of owner. Since this is the kind of micro-level data not included in the current study, this group of studies is also not reviewed, despite their usage of something very akin to a house price index. See Kiel and Carson (1990), Coate and Vanderhoff (1993), or Zabel (1999) for examples.

3. Data and Methodology

3.1. Data

The data for the study are readily obtained from a variety of publicly-available sources. The MSA-level per capita income data come from the Bureau of Economic Analysis, as do the data on number of one-unit building permits issued annually in each sample MSA. The MSA-level annual unemployment rates come from the Bureau of Labor Statistics, while the annual population data come from the U.S. Census Bureau. The mortgage rates utilized are the Federal Home Loan Bank regional average annual rates available from the Federal Home Loan Mortgage Corporation. The regulatory constraint variable is an index value created and first used by Gyourko, Saiz, and Summers (2008). The index value is formed from data collected via the Wharton Residential Land Use Regulation Survey, which gathered data on the restrictiveness of several aspects of the permitting, zoning, and entitlement process for a large number of MSAs. The index is constructed such that a larger number indicates a more restrictive regulatory environment regarding residential development. The geographic constraint variable was created and first used by Saiz (2010). It captures the percentage of undevelopable land within a 50 km radius of the centroid of the central city in an MSA.

The housing price index utilized is from the Federal Housing Finance Agency (FHFA), which is the successor index (and organization) to the index produced for many years by the Office of Federal Housing Enterprise Oversight (OFHEO). The index is available quarterly at the MSA level for a large number of metropolitan statistical areas. However, in order to help ensure availability of the other data used in modeling, only the index values for the 100 largest MSAs identified by FHFA are utilized. Even with that constraint, a number of MSAs are lost due to a lack of data availability. When MSA definitions change over the sample period, every effort is made to ensure substantial similarity between old and new definitions. In several cases for the building permit data, this was not possible. Thus, the final sample consists of 83 MSAs, which are listed in Table A1 in the Appendix.

The remaining data needed is the industry concentration data. This is obtained from the U.S. Census Bureau. This data is only available annually, and it is only available in consecutive years from 1997 through 2011. Beginning in 1998, the then-new North American Industrial Classification System (NAICS) was adopted to replace Standard Industrial Codes (SIC) for reporting of such data. While mapping between SIC and NAICS is certainly feasible, doing so for the addition of only one year to the beginning of the sample period did not seem warranted. Thus, the sample period is 1998 through 2011, and the observation frequency is annual. Since annual data are utilized, seasonal adjustment of the data is less important than it would otherwise be with higher frequency data. Therefore, when presented a choice between seasonally-adjusted or not seasonally-adjusted data, the not seasonally-adjusted is chosen in each case. Given that not all of the data series are available as seasonally-adjusted series, this choice has the added benefit of avoiding the use of different seasonal adjustment techniques or criteria across data series.

There are four variables of potential interest that could be used to calculate a measure of industry concentration: number of firms, number of establishments, annual employment, and annual payroll. Unfortunately, in order to avoid disclosing private information about individual firms, there are many instances where annual employment and annual payroll are not reported at even the supersector (e.g., agriculture) level. Thus, the only two of these four potentially interesting variables that are consistently available are number of firms and number of establishments. Since number of establishments simply counts multiple locations of a firm individually, number of firms seems to be the more reasonable choice in measuring industry concentration. Thus, the Herfindahl (1950) indices, also sometimes called Hirschman (1945) or Herfindahl-Hirschman indices (HHI), used are based on number of firms in each NAICS supersector for each MSA. Variable names and definitions are provided in Table 1. Table 2 gives some descriptive statistics about the sample.

Table 1. Variable Names and Definitions

Variable Name	Description
HPI %CH	Percent change from one year to the next in the FHFA housing price index level for an MSA
Conc %CH	Percent change from one year to the next in concentration across industries within an MSA measured by a Herfindahl Index at the NAICS supersector level
Unemp %CH	Percent change from one year to the next in MSA unemployment
Pop %CH	Percent change from one year to the next in MSA population
PCI %CH	Percent change from one year to the next in MSA per capita income
Permit %CH	Percent change from one year to the next in number of single-unit building permits issued by an MSA
Mortgage Rate	Federal Home Loan Mortgage Corporation regional average annual interest rates
Mortgage Rate %CH	Percent change from one year to the next in the Federal Home Loan Mortgage Corporation regional average annual interest rates
Sand State	Takes the value one if the MSA is located in one of the "sand" states (i.e. Florida, Arizona, California, Nevada)
Geo Constraint	the percentage of undevelopable land in the subject MSA from Saiz (2010)
Reg Constraint	the Wharton Residential Land Use Regulation Index value for the subject MSA from Gyourko, Saiz, and Summers (2008)
NAICS11 %CH	Percent change from one year to the next in MSA "market share" of NAICS supersector 11 (agriculture, forestry, fishing, and hunting)
NAICS21 %CH	Percent change from one year to the next in MSA "market share" of NAICS supersector 21 (mining, quarrying, and oil and gas extraction)
NAICS22 %CH	Percent change from one year to the next in MSA "market share" of NAICS supersector 22 (utilities)
NAICS23 %CH	Percent change from one year to the next in MSA "market share" of NAICS supersector 23 (construction)
NAICS31-33 %CH	Percent change from one year to the next in MSA "market share" of NAICS supersector 31-33 (manufacturing)
NAICS42 %CH	Percent change from one year to the next in MSA "market share" of NAICS supersector 42 (wholesale trade)
NAICS44-45 %CH	Percent change from one year to the next in MSA "market share" of NAICS supersector 44-45 (retail trade)
NAICS48-49 %CH	Percent change from one year to the next in MSA "market share" of NAICS supersector 48-49 (transportation and warehousing)
NAICS51 %CH	Percent change from one year to the next in MSA "market share" of NAICS supersector 51 (information)
NAICS52 %CH	Percent change from one year to the next in MSA "market share" of NAICS supersector 52 (finance and insurance)
NAICS53 %CH	Percent change from one year to the next in MSA "market share" of NAICS supersector 53 (real estate and rental and leasing)
NAICS54 %CH	Percent change from one year to the next in MSA "market share" of NAICS supersector 54 (professional, scientific, and technical services)
NAICS55 %CH	Percent change from one year to the next in MSA "market share" of NAICS supersector 55 (management of companies and enterprises)
NAICS56 %CH	Percent change from one year to the next in MSA "market share" of NAICS supersector 56 (administrative and support and waste management and remediation services)
NAICS61 %CH	Percent change from one year to the next in MSA "market share" of NAICS supersector 61 (educational services)
NAICS62 %CH	Percent change from one year to the next in MSA "market share" of NAICS supersector 62 (health care and social assistance)
NAICS71 %CH	Percent change from one year to the next in MSA "market share" of NAICS supersector 71 (arts, entertainment, and recreation)
NAICS72 %CH	Percent change from one year to the next in MSA "market share" of NAICS supersector 72 (accommodation and food services)
NAICS81 %CH	Percent change from one year to the next in MSA "market share" of NAICS supersector 81 (other services except public administration)
NAICS99 %CH	Percent change from one year to the next in MSA "market share" of NAICS supersector 99 (industries not classified)

Table 2. Descriptive Statistics.

Variable	Mean	Std Dev	Minimum	Maximum
HPI Level	180.34	48.00	80.88	405.15
HPI %Ch	0.0328	0.0869	-0.3680	0.3846
Unemp	5.8	2.5	1.6	17.3
Unemp %Ch	7.5	22.6	-42.7	134.4
Lag-Unemp	5.5	2.3	1.6	17.3
Lag-Unemp %Ch	8.6	23.0	-42.7	134.4
Population (Pop)	2191048	2681261	413387	19059358
Pop %CH	0.0123	0.0133	-0.2541	0.0629
Lag-Pop	2179654	2673248	413387	18897109
Lag-Pop %CH	0.0123	0.0136	-0.2541	0.0629
Per-Capita Income (PCI)	36191.53	7995.52	17277	79099
PCI %CH	0.0356	0.0338	-0.1124	0.3210
Lag-PCI	35668.66	7774.79	17277	78824
Lag-PCI %CH	0.0345	0.0346	-0.1124	0.3210
Permit	8156.75	9398.53	204	61558
Permit %CH	-0.0443	0.2092	-0.7208	0.9488
Lag-Permit	8569.12	9602.76	204	61558
Lag-Permit %CH	-0.0435	0.2139	-0.7208	0.9488
Mortgage Rate	6.172	0.978	4.395	8.080
Mortgage Rate %CH	-0.0344	0.0771	-0.1697	0.0964
Sand State	0.2289	0.4203	0	1
Concentration	0.0927	0.0037	0.0835	0.1177
Lag-Concentration	0.0926	0.0037	0.0835	0.1169
Concentration %CH	0.0010	0.0093	-0.0527	0.0579
Lag-Concentration %CH	0.0011	0.0096	-0.0527	0.0579
Geo Constraint	25.64	21.41	1.04	79.64
Reg Constraint	0.0940	0.6858	-1.24	1.89
Full Sample Size				1162

3.2. Methodology

Other than computing percent changes in the variables for each sample year, the data do not require substantial manipulation. The only exception is the formation of a Herfindahl index for each MSA based on the number of firms in each NAICS industry delineation. The Herfindahl Index for each MSA is computed as:

$$HHI_j = \sum_{i=1}^{N} S_{i,j}^2 \tag{1}$$

where N equals the total number of industry groupings by NAICS code and $S_{i,j}$ equals the number of firms in industry i in MSA j divided by the total number of firms in MSA j. The industry delineations are provided in Table 1.

With all independent variables now in hand, standard ordinary least squares (OLS) and two-stage least squares (2SLS) regression techniques are employed in analyzing the relationship between regional industry concentration and regional housing market performance. The first set of models estimated make use of OLS regression to ascertain whether there is, in fact, a relationship to be explored. The first model reported in Table 3 uses only contemporaneous observations of the independent variables identified in prior literature as potentially important in the determination of housing price index performance. Specifically, the equation estimated is:

$$\begin{aligned} HPI\ \%CH_t = \alpha_t &+ \beta_1 Conc\ \%CH_t \\ &+ \beta_2 Unemp\ \%CH_t \\ &+ \beta_3 Pop\ \%CH_t \\ &+ \beta_4 PCI\ \%CH_t \\ &+ \beta_5 Permit\ \%CH_t \\ &+ \beta_6 Mortgage\ Rate_t \\ &+ \beta_7 Sand\ State_t \\ &+ \beta_8 Geo\ Constraint_t \\ &+ \beta_9 Reg\ Constraint_t \\ &+ \epsilon_t \end{aligned} \tag{2}$$

where all variables are as defined in Table 1. The second model reported in Table 3 also makes use of OLS regression, but in addition to the variables given in Equation (2), the second model in Table 3 includes one-year lags of *Conc %CH*, *Unemp %CH*, *Pop %CH*, *PCI %CH*, and *Permit %CH* (i.e., $Conc\ \%CH_{t-1}$, $Unemp\ \%CH_{t-1}$, $Pop\ \%CH_{t-1}$, $PCI\ \%CH_{t-1}$, and $Permit\ \%CH_{t-1}$). Beracha and Skiba (2011) identify five significant quarterly lags in the FHFA housing price index. Since the data used in the current study are annual data, the best solution to controlling for five quarterly lags seems to be the inclusion of a single annual lag. As will be further discussed in the Results section, the lag of industry concentration is not significant, which is also true for the contemporaneous measures of unemployment, population, and income when estimated in the presence of their one-year lags. Thus, these variables are dropped from the reduced form models estimated throughout the rest of the analysis.

The remaining models reported in Tables 4 – 6 make use of 2SLS regression to account for the potential endogeneity between one-unit building permits issued in an MSA and the performance of that MSA's housing market. The contemporaneous percentage change in single unit building permits issued is instrumented using $Unemp\ \%CH_t$, $Pop\ \%CH_t$, $NAICS23\ \%CH_t$, $Mortgage\ Rate\ \%CH_t$, and *Reg Constraint*. Since the one-year lag of percentage change in single unit building permits is also included in the reduced form of the model, it must also be treated as endogenous. As would be expected, it is instrumented using $Unemp\ \%CH_{t-1}$, $Pop\ \%CH_{t-1}$, $NAICS23\ \%CH_{t-1}$, $Mortgage\ Rate\ \%CH_{t-1}$, and *Reg Constraint*. In other words,

$$\begin{aligned} Permit\ \%CH_t = \alpha_t &+ \beta_1 Unemp\ \%CH_t \\ &+ \beta_2 Pop\ \%CH_t \\ &+ \beta_3 NAICS\ \%CH_t \\ &+ \beta_4 Mortgage\ Rate\ \%CH_t \\ &+ \beta_5 Reg\ Constraint_t + \epsilon_t \end{aligned} \tag{3}$$

and

$$\begin{aligned} Permit\ \%CH_{t-1} = \alpha_t &+ \beta_1 Unemp\ \%CH_{t-1} \\ &+ \beta_2 Pop\ \%CH_{t-1} \\ &+ \beta_3 NAICS\ \%CH_{t-1} \\ &+ \beta_4 Mortgage\ Rate\ \%CH_{t-1} \\ &+ \beta_5 Reg\ Constraint_{t-1} \\ &+ \epsilon_{t-1} \end{aligned} \tag{4}$$

where all variables are again as defined in Table 1.

After this first-stage regression is estimated, and the predicted values for $Permit\ \%CH_t$ and $Permit\ \%CH_{t-1}$ are obtained, the second-stage regression of the base model with one-year lags can commence. The model takes the form:

$$\begin{aligned} HPI\ \%CH_t = \alpha_t &+ \beta_1 Conc\ \%CH_{t-1} \\ &+ \beta_2 Unemp\ \%CH_{t-1} \\ &+ \beta_3 Pop\ \%CH_{t-1} \\ &+ \beta_4 PCI\ \%CH_{t-1} \\ &+ \beta_5 Permit\ \%CH_t \\ &+ \beta_6 Permit\ \%CH_{t-1} \\ &+ \beta_7 Mortgage\ Rate_t \\ &+ \beta_8 Sand\ State_t \\ &+ \beta_9 Geo\ Constraint_t \\ &+ \beta_{10} Reg\ Constraint_t \\ &+ \epsilon_t \end{aligned} \tag{5}$$

where all variables are as defined in Table 1. The results from this base model are reported on the left-hand side of Tables 4 – 6. On the right-hand side of Tables 4 – 6, the MSA-level Herfindahl indices of industrial concentration are replaced with the actual percentage allocations to each industry segment and Equation (5) is re-estimated.[7]

4. Results

4.1. OLS Results

Table 3 represents a pooled OLS regression on the percent change in the FHFA housing price index by a vector of parameters including measures of industry concentration, demography, and geographic location, as well as physical, governmental, and financial

[7] It is worth noting that this study does not include controls for MSA fixed effects as is often done in multi-city studies of housing price indices. Coate and Vanderhoff (1993) and Jud and Winkler (2002) point out that MSA fixed effects controls are included in large part to capture geographic and regulatory growth constraints across MSAs. Since cleaner controls (i.e., *Geo Constraint* and *Reg Constraint*) are now available, this study forgoes the additional restrictions imposed by the inclusion of MSA fixed effects.

housing-specific factors. This initial model is used to illustrate the importance of these various factors on house price levels across the entire sample. The reported results are divided between an analysis using only contemporaneous observations of the independent variables and an analysis using single year lags for the time-dependent parameters. The contemporaneous model shows statistical significance at the 1% level for numerous parameters, including the parameter of interest (the measure of percent change in concentration ratio). One parameter of note that is not statistically significant in the contemporaneous-only model is percent change in unemployment. The general model fit is considered good and representative of the findings of prior studies, with an adjusted R^2 of 41.4%.

The results from the second model presented in Table 3 incorporate the one-year lag of the time-dependent parameters per Beracha and Skiba (2011). The results from this second estimation tend to support these earlier findings, as all lagged explanatory variables, except lagged percent change in concentration ratio, take on statistical significance at the 1% level. As in the case of the contemporaneous model, fit is relatively strong at 49.2% (adjusted R^2). In interpreting the economic significance of the various parameters, changes in the FHFA house price index are primarily driven by changes in industry concentration, population, income, and construction activity.

Table 3. Baseline Models of Returns on FHFA Housing Price Index.

Contemporaneous Only			With One-Year Lags	
Constant	-0.120***		Constant	-0.049***
Conc %CH	1.153***		*Conc %CH*	0.487*
Unemp %CH	-0.000		*Conc %CH Lag*	-0.208
Pop %CH	1.030***		*Unemp %CH*	-0.000
PCI %CH	0.417***		*Unemp %CH Lag*	-0.000***
Permit %CH	0.190***		*Pop %CH*	-0.010
Mortgage Rate	0.021***		*Pop %CH Lag*	1.085***
Sand State	-0.013**		*PCI %CH*	0.052
Geo Constraint	0.000***		*PCI %CH Lag*	0.354***
Reg Constraint	0.010***		*Permit %CH*	0.194***
			Permit %CH Lag	0.110***
			Mortgage Rate	0.011***
			Sand State	-0.013**
			Geo Constraint	0.000***
			Reg Constraint	0.011***
R^2	41.9%		R^2	50.0%
Adjusted R^2	41.4%		Adjusted R^2	49.2%
F	78.6***		F	64.0***
N	989		N	911

Note: Dependent variable is percent return on the FHFA home price index in both models.
***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

4.2. IV Results using Two-stage Least Squares

As illustrated in Table 3, building permit activity is a primary driver of housing price changes. However, building permit activity should properly be treated as endogenously determined, as house price changes also drive changes in permitting activity. Since building permits are endogenously determined, a set of instruments as discussed in Section 3.2 is devised to derive the best unbiased estimator for changes in single unit housing permits. Tables 4 - 6 are the resulting parametric measures of determinants for changes in the house price index.

Table 4 uses this pooled two-stage least squares methodology to report full sample estimates. As noted above, the results on the left-hand side of the table include the consolidated measure of MSA-level industry concentration (i.e., the Herfindahl index), while the results on the right-hand side of the table disaggregate industry concentration into independent industry segments. The results for the Herfindahl index essentially follow the pooled results as provided in Table 3. However, with the treatment of percent change in building permits as endogenously determined, the primary parameter of interest, change in industry concentration, is not statistically significant at conventional levels. The remaining parameters show significance at the 1% and 5% levels, again with economically significant results for change in population, income, permitting activity, and both financial and geographic measures. For example, a 1% increase in population is shown to correlate with a 1% increase in housing price. The second part of the analysis disaggregates the consolidated concentration measure into the 20 component industry classifications identified in Table 1. Several of these individual concentration measures showed statistical significance at the 1%, 5%, and 10% level. Of note, the measures for change in manufacturing (*NAICS31-33 %CH*) and wholesale trade (*NAICS42 %CH*) both show negative and significant results at the 1% level. By contrast, the measures for changes in finance, insurance, and real estate (*NAICS52 %CH* and *NAICS53 %CH*) are positive and significant at the 1% level.

Table 4. Two-Stage Least Squares Estimation of FHFA Housing Price Index Returns.

Overall Concentration Measure			Individual Concentrations	
Constant	-0.035**		Constant	-0.026
Conc %CH	0.236		*NAICS11 %CH*	-0.032**
Unemp %CH Lag	-0.000**		*NAICS21 %CH*	0.009
Pop %CH Lag	1.068***		*NAICS22 %CH*	-0.013
PCI %CH Lag	0.379***		*NAICS23 %CH*	0.162
Permit %CH	0.238***		*NAICS31-33 %CH*	-0.462***
Permit %CH Lag	0.144***		*NAICS42 %CH*	-0.378***
Mortgage Rate	0.010***		*NAICS44-45 %CH*	-0.061
Sand State	-0.013**		*NAICS48-49 %CH*	-0.122
Geo Constraint	0.000***		*NAICS51 %CH*	-0.078
Reg Constraint	0.012***		*NAICS52 %CH*	0.524***
			NAICS53 %CH	0.492***
			NAICS54 %CH	0.025
			NAICS55 %CH	-0.115***
			NAICS56 %CH	-0.189*
			NAICS61 %CH	0.006
			NAICS62 %CH	-0.313**
			NAICS71 %CH	0.041
			NAICS72 %CH	-0.195
			NAICS81 %CH	-0.343**
			NAICS99 %CH	0.018***
			Unemp %CH Lag	-0.001***
			Pop %CH Lag	0.884***
			PCI %CH Lag	0.352***
			Permit %CH	0.241***
			Permit %CH Lag	-0.073*
			Mortgage Rate	0.007**
			Sand State	-0.017***
			Geo Constraint	0.000***
			Reg Constraint	0.008***
R^2	47.9%		R^2	60.5%
Adjusted R^2	47.3%		Adjusted R^2	59.2%
F	88.9***		F	53.4***
N	911		N	911

Note: Dependent variable is percent return on the FHFA home price index in both models.
***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

In order to further study the impact of concentration on house price changes, the sample is divided between MSAs that begin with a less concentrated industry base and MSAs that begin with a more concentrated industry base. The results are reported in Tables 5 and 6, respectively. Using the same methodology and reporting scheme as in Table 4, the results in Tables 5 and 6 offer a more revealing glimpse into the interplay of regional industrial concentration and regional housing markets. When viewing the results from the less concentrated MSAs in Table 5, the overall concentration measure (Herfindahl index) is again insignificant at conventional levels, as was the case for the full sample results reported in Table 4. The disaggregated industry concentration measures are also quite similar to the Table 4 results, with a change in manufacturing concentration having a negative and significant impact on house price changes, while changes in finance, insurance, and real estate concentration show positive and significant impacts on changes in the house price index.

Table 5. Two Stage Least Squares Estimation of the FHFA Housing Price Index for Metropolitan Statistical Areas Already Relatively Less Concentrated Across Industries.

Overall Concentration Measure			Individual Concentrations	
Constant	-0.020		Constant	-0.052**
Conc %CH	-0.566		*NAICS11 %CH*	-0.038*
Unemp %CH Lag	-0.001**		*NAICS21 %CH*	-0.019
Pop %CH Lag	1.295***		*NAICS22 %CH*	0.002
PCI %CH Lag	0.264*		*NAICS23 %CH*	-0.046
Permit %CH	0.283***		*NAICS31-33 %CH*	-0.674***
Permit %CH Lag	0.126***		*NAICS42 %CH*	-0.313
Mortgage Rate	0.008**		*NAICS44-45 %CH*	0.009
Sand State	-0.013		*NAICS48-49 %CH*	-0.122
Geo Constraint	0.001***		*NAICS51 %CH*	-0.043*
Reg Constraint	0.013***		*NAICS52 %CH*	0.373***
			NAICS53 %CH	0.580***
			NAICS54 %CH	-0.231
			NAICS55 %CH	-0.157**
			NAICS56 %CH	-0.069
			NAICS61 %CH	0.043
			NAICS62 %CH	-0.329
			NAICS71 %CH	0.143
			NAICS72 %CH	0.031
			NAICS81 %CH	-0.294
			NAICS99 %CH	0.005
			Unemp %CH Lag	-0.001***
			Pop %CH Lag	1.088***
			PCI %CH Lag	0.202
			Permit %CH	0.221***
			Permit %CH Lag	-0.010
			Mortgage Rate	0.010***
			Sand State	-0.013
			Geo Constraint	0.000
			Reg Constraint	0.011**
R^2	48.6%		R^2	63.5%
Adjusted R^2	47.5%		Adjusted R^2	61.2%
F	86.7***		F	47.0***
N	482		N	482

Note: Dependent variable is percent return on the FHFA home price index in both models.
***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table 6. Two Stage Least Squares Estimation of the FHFA Housing Price Index for Metropolitan Statistical Areas Already Relatively More Concentrated Across Industries.

Overall Concentration Measure			Individual Concentrations	
Constant	-0.054**		Constant	0.011
Conc %CH	1.310**		*NAICS11 %CH*	-0.025
Unemp %CH Lag	-0.000		*NAICS21 %CH*	0.015
Pop %CH Lag	0.980***		*NAICS22 %CH*	-0.034
PCI %CH Lag	0.406***		*NAICS23 %CH*	0.354*
Permit %CH	0.168***		*NAICS31-33 %CH*	-0.232
Permit %CH Lag	0.186***		*NAICS42 %CH*	-0.698***
Mortgage Rate	0.012***		*NAICS44-45 %CH*	-0.040
Sand State	-0.015		*NAICS48-49 %CH*	-0.105
Geo Constraint	0.000*		*NAICS51 %CH*	-0.019
Reg Constraint	0.010**		*NAICS52 %CH*	0.761***
			NAICS53 %CH	0.534***
			NAICS54 %CH	0.093
			NAICS55 %CH	-0.048
			NAICS56 %CH	-0.312**
			NAICS61 %CH	-0.019
			NAICS62 %CH	-0.464**
			NAICS71 %CH	-0.020
			NAICS72 %CH	-0.397**
			NAICS81 %CH	-0.273
			NAICS99 %CH	0.034***
			Unemp %CH Lag	-0.001***
			Pop %CH Lag	0.849***
			PCI %CH Lag	0.489***
			Permit %CH	0.254***
			Permit %CH Lag	-0.180***
			Mortgage Rate	0.001
			Sand State	-0.021**
			Geo Constraint	0.000*
			Reg Constraint	0.004
R^2	49.2%		R^2	55.7%
Adjusted R^2	48.0%		Adjusted R^2	52.5%
F	84.6***		F	65.0***
N	429		N	429

Note: Dependent variable is percent return on the FHFA home price index in both models.
***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table 6, which reports results from the subsample of MSAs that begin with a more concentrated industry base, provides a singularly different result than found in previous models. The model that includes the Herfindahl index as an overall concentration measure shows a positive and significant (at the 5% level) result for changes in industry concentration (*Conc %CH*). The concluding result is that, when measuring concentration by a Herfindahl index, an increase in industry concentration in an MSA that is already more highly concentrated leads to an economically significant increase in house prices as measured by the FHFA index. As in previous models, the disaggregation of the concentration measure by industries within the MSA leads to similar results, with some additional industry segments showing statistical significance not previously observed in prior results. The coefficients on the remaining independent variables are generally consistent across the full sample and subsample estimations, with the exception of *Unemp %CH* in the less concentrated MSA subsample and *Sand State* in both subsamples. These variables move from negative and significant in the full sample results to statistically insignificant in the referenced subsample results.

5. Conclusions and Directions for Future Research

Two primary conclusions can be reached from the foregoing analyses. First, MSAs beginning with a less concentrated industrial base (or alternatively, beginning with a more diversified industrial base), do not measurably benefit by increasing industry concentration. Second, MSAs beginning with a more highly concentrated industrial base (or a less diverse industrial base), may benefit from increasing concentration in industries to which they already have substantial exposure. These results relate specifically to benefits measured as changes in a widely used house price index and do not account for potential drawbacks to a strategy of increasing industrial concentration, such as increased regional economic instability. The marriage of the two constraints is necessary for the creation of a broader industry recruitment strategy.

Given that this is only the second study to address any aspect of the relationship between regional industrial concentration and regional housing market performance, there is substantial room in the literature for additional work beyond that mentioned above. Given the literature relating MSA size and regional industrial concentration (e.g. Rodgers, 1957; Clemente and Sturgis, 1971; Bahl, Firestine, and Phares, 1971; Marshall, 1975) and that the sample used in this study was comprised of the largest MSAs in the U.S., it would also be of interest to investigate whether this result continues to hold once smaller MSAs are included in the sample. Intuition suggests that the finding should be more pronounced in that case, but additional research is required. Finally, given the recent national housing bubble and its bursting, it would be of interest to investigate the interaction of industrial concentration and the bubble period. In short, there are numerous unanswered questions regarding this area of research that should provide for interesting and important work in the future.

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Appendix

Table A1. Sample Metropolitan Statistical Areas.

Akron, OH	Louisville/Jefferson County, KY-IN
Albany-Schenectady-Troy, NY	Memphis, TN-MS-AR
Albuquerque, NM	Miami-Miami Beach-Kendall, FL
Allentown-Bethlehem-Easton, PA-NJ	Milwaukee-Waukesha-West Allis, WI
Atlanta-Sandy Springs-Roswell, GA	Minneapolis-St. Paul-Bloomington, MN-WI
Austin-Round Rock, TX	Nashville-Davidson-Murfreesboro-Franklin, TN
Bakersfield, CA	New Haven-Milford, CT
Baltimore-Columbia-Towson, MD	New Orleans-Metairie, LA
Baton Rouge, LA	New York-Jersey City-White Plains, NY-NJ
Birmingham-Hoover, AL	Oklahoma City, OK
Boise City, ID	Omaha-Council Bluffs, NE-IA
Boston, MA	Orlando-Kissimmee-Sanford, FL
Bridgeport-Stamford-Norwalk, CT	Oxnard-Thousand Oaks-Ventura, CA
Buffalo-Cheektowaga-Niagara Falls, NY	Philadelphia, PA
Cape Coral-Fort Myers, FL	Phoenix-Mesa-Scottsdale, AZ
Charleston-North Charleston, SC	Pittsburgh, PA
Charlotte-Concord-Gastonia, NC-SC	Portland-Vancouver-Hillsboro, OR-WA
Chicago-Naperville-Arlington Heights, IL	Providence-Warwick, RI-MA
Cincinnati, OH-KY-IN	Raleigh, NC
Cleveland-Elyria, OH	Richmond, VA
Colorado Springs, CO	Riverside-San Bernardino-Ontario, CA
Columbia, SC	Rochester, NY
Columbus, OH	Sacramento--Roseville--Arden-Arcade, CA
Dallas-Plano-Irving, TX	St. Louis, MO-IL
Dayton, OH	Salt Lake City, UT
Denver-Aurora-Lakewood, CO	San Antonio-New Braunfels, TX
Detroit-Dearborn-Livonia, MI	San Diego-Carlsbad, CA
El Paso, TX	San Francisco-Redwood City-South San Francisco, CA
Fresno, CA	San Jose-Sunnyvale-Santa Clara, CA
Grand Rapids-Wyoming, MI	Sarasota-Bradenton-North Port, FL
Greensboro-High Point, NC	Seattle-Bellevue-Everett, WA
Greenville-Anderson-Mauldin, SC	Stockton-Lodi, CA
Hartford-West Hartford-East Hartford, CT	Syracuse, NY
Honolulu ('Urban Honolulu'), HI	Tampa-St. Petersburg-Clearwater, FL
Houston-The Woodlands-Sugar Land, TX	Tucson, AZ
Indianapolis-Carmel-Anderson, IN	Tulsa, OK
Jacksonville, FL	Virginia Beach-Norfolk-Newport News, VA-NC
Kansas City, MO-KS	Washington-Arlington-Alexandria, DC-VA-MD-WV
Knoxville, TN	Wichita, KS
Las Vegas-Henderson-Paradise, NV	Winston-Salem, NC
Little Rock-North Little Rock-Conway, AR	Worcester, MA-CT
Los Angeles-Long Beach-Glendale, CA	