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Discordant City Employment Cycles^{*}

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Abstract

This paper estimates city-level employment cycles for 58 large U.S. cities and documents the substantial cross-city variation in the timing, lengths, and frequencies of their employment contractions. It also shows how the spread of city-level contractions associated with U.S. recessions has tended to follow recession-specific geographic patterns. In addition, cities within the same state or region have tended to have similar employment cycles. We find no evidence that similarities in employment cycles are related to similarities in industry mix, although cities with more-similar high school attainment, mean establishment size, and industrial diversity have tended to have more-similar employment cycles.

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1. Introduction

National business cycles have long been characterized as a sequence of alternating periods of recession and expansion. In the United States, for example, the Business Cycle Dating Committee of the National Bureau of Economic Research (NBER) is tasked with determining official recession and expansion turning points. The determination of official business-cycle turning points is fairly opaque and untimely, and the turning points themselves are the only output from the effort. To address these shortcomings, a large literature has developed applying various statistical techniques to determine turning points and to examine underlying business cycle parameters.¹

The advantages of these statistical approaches relative to the NBER's committee approach are their replicability, transparency, and timeliness. Also, because of these advantages, statistical approaches are readily applicable to a wide variety of questions. For example, using the Markov-switching model of Hamilton (1989), the notion of distinct cyclical phases has been extended to subnational economies, revealing significant differences in the timing, length, and occurrence of state-level recessions (Owyang, Piger, and Wall, 2005). This research has also revealed that periods of national recession usually contain a spatial component in that a recession spreads across the country in a geographic pattern. The effects of the 1990-91 NBER recession, for example, were first felt in the Northeast and the Far West before spreading to interior states. The recession receded in reverse, ending relatively quickly for interior states and lasting well after the end of the official recession for coastal states.

¹ See Harding and Pagan (2008) and Chauvet and Hamilton (2006) for surveys and discussions.

This paper extends this line of research by documenting the substantial variation in the cyclical movement of city-level employment, with the aim of finding the determinants of spatial variations over the cycle. The specific question we address is whether the geographic patterns of city-level employment cycles are simply reflections of differences in city industrial compositions or whether spatial mechanisms are responsible. As cities are arguably more relevant geographic delineations of local economies than are states, our analysis should provide a more accurate picture of subnational business-cycles. As we show, city-level data also allow us to examine in greater detail the extent to which spatially similar economies have similar business-cycle experiences. This greater accuracy and detail provided by our city-level cycles will assist us in explaining the variation in subnational employment cycles and their associated geographic patterns.

In section 2 we determine the timing of the employment cycle phases for 58 large cities, which we describe relative to each other and to the national business cycle in section 3. In section 4 we estimate the relative importance of industrial and geographic factors in determining cyclical similarities between cities, and in section 5 we extend the analysis to include potential roles for human capital, channels of monetary policy, industrial diversity, and agglomeration. Section 6 concludes.

2. Estimating City Employment Cycles

For our purposes, a city is either a Metro Division or a Metropolitan Statistical Area that is not divided into Metro Divisions. We use current MSA definitions, which restricts our analysis to post-1990, and examine payroll employment for 1990.Q1-2008.Q1 for all 58 cities that had average employment above 500,000 over the period. To determine the employment-

cycle phases of these cities, we apply the Hamilton (1989) Markov-switching model to each city's payroll employment series independently. The simplest version of this model has employment cycle phases arising from the economy switching periodically between two different underlying regimes, each with its own mean growth rate.² Let μ_0 be the mean growth rate when the economy is in expansion, and let μ_1 , which is normalized to be negative, be the difference between the mean growth rates in expansion and contraction. Specify the growth rate of employment, y_t , as

$$y_t = \mu_0 + \mu_1 S_t + \varepsilon_t. \quad (1)$$

The switching in (1) is governed by the state variable, $S_t = \{0,1\}$. When S_t switches from 0 to 1, the growth rate switches from μ_0 to $\mu_0 + \mu_1$. Because $\mu_1 < 0$, S_t switches from 0 to 1 at times when the economy switches from expansion to contraction, or vice versa. Deviations from the mean growth rates are created by the stochastic disturbance, $\varepsilon_t \sim N(0, \sigma_\varepsilon^2)$.

In the Markov-switching model, the state variable, S_t , is unobserved, and arises from a first-order two-state Markov chain, so any persistence in the regime is completely summarized by the value of S_t in the previous period. More specifically, the probability process driving S_t is captured by the transition probabilities $\Pr[S_t = j | S_{t-1} = i] = p_{ij}$. We estimate the model using the multi-move Gibbs-sampling procedure for Bayesian estimation of Markov-switching models implemented by Kim and Nelson (1999).³

Simply put, the model estimates the growth rates of employment during contraction and expansion and determines for each period the probability that the economy is in contraction. To

² This follows Owyang, Piger, and Wall (2005 and 2008); Owyang, Piger, Wall, and Wheeler (2008); and Hamilton and Owyang (forthcoming). See Piger (2009) for a discussion of the basic Markov-switching model and extensions.

³ See Owyang, Piger, and Wall (2005) for a detailed description of the estimation procedure.

obtain this probability, the model compares the actual growth rate to the two regimes' growth rates while also accounting for the persistence of the series. If employment growth switches periodically between rates close to those of the two regimes, the probability of contraction will tend to be either close to zero or close to one. For present purposes we are interested only in the timing of cities' employment-cycle phases—as captured by their probabilities of contraction—and seeing the extent to which they are related to industrial composition and spatial consideration. As such, our analysis is silent on how well the cities do within each phase. Previous research has found that expansion growth rates were related to human capital and industrial structure, but that contraction growth rates were related only to the prevalence of manufacturing employment (Owyang, Piger, Wall, and Wheeler; 2008).

The model in (1) could be augmented to include additional dynamics, such as linear autoregressive dynamics, which might improve the model's fit of the data. However, this simple shifting-mean model has been shown to accurately identify the timing of NBER business cycle phases when applied to aggregate U.S. output and employment data, despite being statistically rejected in favor of more complicated models.⁴ As our goal is limited to dating business cycle regime shifts between high and low growth phases, we restrict our attention to the simple shifting-mean model to identify the dates of these shifts. More highly parameterized models could be useful if our goal were instead to determine whether the data generating process for the city-level data was linear or nonlinear, an interesting question that we do not address here.

Before applying the model to our cities, we estimate the probability of employment contraction for the United States and compare it with the official NBER recession dates. Our results are illustrated by Figure 1 in which NBER recessions are indicated by the shaded areas. As is well-known, employment growth languished long after the 1990-91 and 2001 NBER

⁴ See, e.g., Albert and Chib (1993) and Chauvet and Piger (2003).

recessions had ended, which shows up here as the probability of employment contraction remaining high beyond the ends of NBER recessions. The figure also shows a less-well-known result: U.S. employment contractions began prior to official recessions for each of the last three recessions. Specifically, the 1990-91 recession was surrounded by an employment contraction that ran from 1990.Q2 to 1992.Q2, two quarters before the official recession began until five quarters after it ended. The 2000 recession was surrounded by an employment contraction that began in 2000.Q4, two quarters prior to the recession, and ended in 2003.Q3, seven quarters after the recession had ended. Finally, the U.S. was experiencing an employment contraction two quarters prior to the start of the most recent NBER recession in 2008.Q1.

The model performs well for the cities in our sample, making the determination of contractionary periods fairly straightforward. Figure 2 shows the estimated contraction probabilities for the six largest cities in our sample. The first thing to note is the tendency for the contraction probabilities to be close to either one or zero, allowing for a clear separation of the employment series into contraction and expansion regimes. Also note the differences across cities: Although the cities' contractions tended to have occurred around the same general time periods, there were significant differences in their starting and ending dates, and, therefore, their lengths. For example, Los Angeles remained in contraction for much longer than the other four cities during the early 1990s, and Houston and Atlanta experienced the longest contractions of the early 2000s. Also notice that, by 2008.Q1, only three of the cities were in contraction, even though the national contraction had already begun. Three of these cities also exhibited some idiosyncratic switching: Los Angeles experienced a double-dip contraction during 2001-2003, Houston experienced a brief contraction in 1998-1999, and Washington's employment remained in its expansion phase throughout the early 2000s.

Figure 3 illustrates the estimated contraction probabilities for the six smallest cities in our sample. Because smaller economies tend to have noisier data, the separation into two business cycle regimes is not always as clean as for the largest cities. Even so, the model does identify several contraction episodes for each city, many of which coincide with contractions for the national economy. Idiosyncratic switches were also common: Bethesda, Hartford, Buffalo, and Rochester experienced contractions in the mid-1990s; Buffalo and Rochester experienced contractions in the mid 2000s; and Bethesda and Providence were in contraction by 2006.

Figures 2 and 3 also illustrate a number of relationships that we consider in subsequent sections. For example, even though Bethesda and Washington are in the same MSA, their employment cycles are very different.⁵ This is reminiscent of Voith (1998) and Chang and Coulson (2001), who consider whether city centers and their suburbs might have their own, but perhaps related, agglomeration processes. Notice also the similarity between the employment cycles of Buffalo and Rochester, two neighboring cities in the same state, and the different cycles of Providence and Hartford, two relatively close cities in different states.

Our results for all 58 cities are summarized in Table 1, which indicates for each quarter whether a city is in contraction or expansion.⁶ For illustrative purposes the table is shaded for periods for which U.S. employment was in contraction. The main features of Figures 2 and 3 discussed above also appear in Table 1: Although cities tended to have experienced contractions around the same times as each other, the starting and ending dates of these contractions differed a great deal; idiosyncratic contractions occurred for a number of cities during the mid 1990s and mid 2000s; and a significant number of cities were not in contraction yet by 2008.Q1. Finally, it was not uncommon for cities to completely miss the contractions felt elsewhere: five of the cities

⁵ See Wall (2012) for an analysis of the links between the employment cycles of neighboring cities.

⁶ To achieve this binary identification, we adopt the convention that a contractionary quarter is one for which the probability of contraction is greater than 0.5.

did not experience a contraction during the early 1990s, seven did not experience a contraction in the early 2000s, and Virginia Beach didn't experience a contraction during either period.

Figure 4 illustrates the differences across cities in the frequency of contraction over the period.⁷ The figure shows that city-level contraction frequencies varied a great deal around that of the U.S., which was in an employment contraction 27 percent of the time. According to our results, 12 cities were in contraction between 42 and 69 percent of the time, whereas 15 cities were in contraction less than 21 percent of the time. All five cities in Ohio and Michigan were among the high-frequency group, along with three of the eight cities in California. The low-frequency cities were more evenly distributed, although proximity to high-contraction-frequency cities was no barrier to membership in this group. For example, Indianapolis and Louisville were in contraction relatively infrequently, despite their proximity to the high-frequency cities in Ohio and Michigan.

3. Aggregated and Geographic Patterns of City Contractions

The city-level experiences outlined above can be reaggregated to illustrate their relationship with country-level recessions and employment contractions. In Figure 5, which tracks the number of cities in contraction over time, U.S. contractions occurred soon after the number of cities in contraction began to climb, and ended soon after the number began to fall.⁸ At no time, however, were all 58 cities in contraction. For one, as pointed out above, during each U.S. contractionary period, several cities remained in expansion throughout. For another, some cities will have already exited their contraction before other cities had entered theirs. In

⁷ The numbers underlying the figure are in the first column of Appendix 1.

⁸ One could make this figure more complicated by applying employment shares to obtain a weighted sum of city contractions, but because, as we show below, city size is unrelated to the occurrence of contractions this only changes the scale of the figure without affecting the story.

fact, it is misleading to even call U.S. contractions “national” in that large geographic components of the nation do not experience them at the same time, if at all. The U.S. contraction and expansion switches reflect a rolling weighted aggregate of the local-level switches. It is more accurate, therefore, to say that aggregate U.S. contractions occur when enough local economies have entered into contraction to make nationally aggregated data switch into its contraction phase. The shock that results in local and, eventually, aggregate contractions might be experienced nationwide, but the whole nation need not enter into contraction for an aggregate contraction to occur. Nor, as we have seen, does there need to be an aggregate contraction for local economies to switch into contraction.

As illustrated by Owyang, Piger, and Wall (2005), state contractions tend to follow geographic patterns. They show, for example, that in the period surrounding the 1990-91 NBER contraction, states on the east coast switched into contraction first, followed by states on the west coast, and the swathe of states between Texas and Montana missed out on the contraction entirely. As the state contractions ebbed during 1991, they receded back to the coastal states and lingered on for sometimes years longer. Although much of this pattern is evident in our city-level results, our data start in 1990 so we cannot see the pattern by which the early-switchers went into contraction. Even so, the official recession did not begin until 1990.Q4, yet many cities were in contraction at least two quarters earlier than this (Figure 6). A year later most, but not all cities were in contraction, and after another year had passed the contraction had receded to primarily coastal cities.

Figure 7 provides yearly snapshots of city contractions between 2000.Q3 and 2004.Q3 and illustrates a geographic pattern of contraction opposite that of Figure 6. In 2000.Q3—one quarter prior to the start of the U.S. employment contraction—10 cities far from the east and

west coasts were in contraction. One year later, the contractions had spread to most of the rest of the cities in our sample, and by two years later had begun to recede from the cities on the Atlantic coast. By 2004.Q3, 12 cities were still in contraction, most of which were the same non-coastal cities which had been in contraction in 2000.Q3. The geographic pattern of contractions during this period shared the trait with the early 1990s period that the cities that switched into contraction early also tended to switch out of contraction late. However, the directions of the geographic patterns were completely opposite: The first was an “outside-in” contraction whereas the second was an “inside-out” one.

The geographic pattern for the beginning of the third contractionary period did not resemble that for the previous two. As shown by Figure 8, in 2007.Q1, one year prior to the start of the official recession and two quarters prior to the start of the U.S. employment contraction, 17 cities were already in contraction. These cities were concentrated in California and neighboring states, Florida, and the Rust Belt. As of 2008.Q1, the contraction had spread to many of the cities in the Southeast and to more of the Rust Belt. On the other hand, the Northeast, Northwest, and Mountain regions, along with Texas, were still relatively unscathed. It is too early to make a complete city-level accounting of this contractionary period because it is still far from over as of the time we are writing. Also, additional data might change the picture even of the quarters illustrated by Figure 8.

4. Industrial or Geographic Similarity?

Thus far, we have simply been documenting the differences in city-level contractions without attempting to explain them. To take this next step, we first need a measure of the extent to which cities differ from (or are similar to) one another. The measure we use is related to the

concordance of two cities, which is the percentage of time the two cities are in the same business cycle regime (Harding and Pagan, 2002).⁹ Formally, the concordance between the employment cycles of cities i and j is:

$$C_{ij} = \frac{100}{T} \sum_{t=1}^T [S_{it}S_{jt} + (1-S_{it})(1-S_{jt})] \quad (2)$$

where S_{it} and S_{jt} are the state variables for cities i and j and T is the number of time periods. As noted in Harding and Pagan (2006), the concordance between two cities is flawed as a measure of business cycle similarity, as it can vary across pairs of cities that have independent employment cycles. Specifically, assuming that S_{it} and S_{jt} are independent, the expected concordance for cities i and j is given by:

$$E_O(C_{ij}) = 1 + 2E(S_{it})E(S_{jt}) - E(S_{it}) - E(S_{jt}), \quad (3)$$

where $E(S_{it}) = (1 - q_i) / (2 - q_i - p_i)$, $E(S_{jt}) = (1 - q_j) / (2 - q_j - p_j)$, and the O subscript indicates conditioning on the assumption that S_{it} and S_{jt} are independent. For example, consider two cities with independent employment cycles, and $p_i = p_j = 0.7$. If $q_i = q_j = 0.9$, the expected concordance equals 62.5%, but would climb to 75.5% if $q_i = q_j = 0.95$. Thus, variation in the concordance measure across city pairs may have nothing to do with variation in business cycle comovement, but may instead simply reflect variation in the transition probabilities. For this reason, we focus here on the excess concordance, defined as:

⁹ See also Harding and Pagan (2006). Camacho and Perez-Quiros (2006) discuss this approach and propose an alternative framework.

$$XC_{ij} = C_{ij} - E_o(C_{ij}) + 50. \quad (4)$$

The excess concordance will have an expected value of 50% for any pair of cities with independent business cycles. Each city's average excess concordance and its excess concordance with the U.S. employment cycle is provided in Appendix 1, while the complete set of 1653 city-pair excess concordances is provided in Appendix 2. Figure 9 gives a graphical summary of cities' employment cycles' excess concordances with the U.S. employment cycle.

Why would two cities have widely differing employment cycles? Clearly there are periodic events at the national level that result in most cities experiencing contractions at some point within a period surrounding a national recession. But, around and during these periods, cities enter and exit their own contractions at different times. If city-level switches in and out of contractions were mostly reflections of the industrial composition of cities, then concordance should be high between two cities with similar industrial structures. Likewise, if two geographically similar cities tend to have similar employment cycles, then concordance should be higher for cities within the same region, state, or metro area.

This exercise is related to a longstanding question in the macroeconomics literature about whether fluctuations in aggregate economic variables are driven by microeconomic factors such as industry-level conditions, or aggregate factors that affected all industries (Lilien, 1982; Abraham and Katz, 1986; Caballero, Engel, and Haltiwanger, 1997). The urban/regional analogue of the question splits the analysis along subnational lines, dividing fluctuations into industry, national, state, and regional factors (Clark, 1998; Carlino and Sill, 2001; Del Negro, 2002; Carlino and DeFina, 2004; Owyang, Rapach, and Wall, 2009). Kose, Otrok, and Whiteman (2003) took the question in the other direction, splitting national-level fluctuations into national, continental, and world factors.

Although related to this previous work, which considers a variety of fluctuation types, our question is substantively different because of our characterization of economic fluctuations. The Markov-switching approach characterizes employment fluctuations by the occurrence of expansion and contraction phases and phase-specific growth rates. Our interest presently is in understanding the tendencies of city pairs to be in the same employment cycle phase, regardless of the cities' growth rates within the phases.

To separate the national, regional, state, city, and industry effects, we estimate the following, which regresses business-cycle similarity, as measured by excess concordance, on measures of industrial and geographic similarity:

$$\ln(XC_{ij}) = \alpha_0 + \alpha_i + \alpha_j + \beta IS_{ij} + \omega_1 PState_{ij} + \omega_2 SState_{ij} + \rho R_{ij} + \lambda Contig_{ij} + \mu_{ij} \quad (5)$$

In (5), IS_{ij} is a measure of industrial similarity between cities i and j . Our primary measure of industrial similarity is an index that measures the average closeness of employment shares across n major sectors.¹⁰ Denoting the employment share of sector k in city i as x_{ik} ,

$$IS_{ij} = 1 - \frac{1}{n} \sum_{k=1}^n |x_{ik} - x_{jk}|. \quad (6)$$

$IS_{ij} \in (0,1]$ and equals 1 for two cities with identical employment shares for all n sectors.

Geographic similarity is measured by four dummy variables: $PState_{ij}$ equals 1 if the principal cities of i and j are in the same state, $SState_{ij}$ equals 1 if the principal city of i is in the same state as outlying counties of j , R_{ij} equals 1 if the principal cities of i and j are in the same census

¹⁰ We use annual data from the BLS for 1990-2008. The sectors are mining, logging, and construction; manufacturing; trade, transportation, and utilities; information; financial activities; professional and business services; education and health services; leisure and hospitality services; other services; and government.

region, and $Contig_{ij}$ equals 1 if cities i and j are contiguous.¹¹ Our estimation also includes city dummy variables to control for any factor that would affect a city's concordance the same across all other cities.

The results of our estimation of four versions of (5) are provided by Table 2. The first two estimations are extreme versions of the geography vs. industry question. From Model I, which assumes that geographic similarity is unrelated to concordance, we obtain a positive effect for similar industrial structures, but this result is not quite statistically significant at the 5% level ($p \approx 0.06$). From Model II, which assumes that the effect of industrial similarity is zero, we find that cities with principal cities in the same state or region tend to have more-concordant employment cycles. On the other hand, we find no statistically significant relationship for contiguity or our secondary-state dummy.

Of course, geography and industry are likely to be related in that, for a variety of reasons, cities in the same parts of the country will tend to have similar industrial structures. By including only industrial or geographic similarity, as in Models I and II, we are not controlling for this simultaneity. From our results for Model III, which does control for simultaneity, it is clear that the positive role for industrial similarity found in Model I was due mainly to that variable capturing the relationship between geographic similarity and concordance. Specifically, inclusion of industrial similarity has very little effect on our estimates of the link between geography and concordance, but inclusion of the geographic similarity dummies substantially reduces the positive coefficient on industrial similarity from Model I, and raises the p-value for this coefficient to 0.79. We conclude, therefore, that geographically similar cities tend to have

¹¹ There is a potential variable, $TertiaryState_{ij}$, for when the outlying counties of i and j are in the same state. We only have one pair for which this would equal 1 (Louisville and Cincinnati), so we do not include the variable.

similar employment cycles, but that there is no overall tendency for cities with similar industries to have similar employment cycles.

Model IV is a more-general specification that removes the restriction that the importance of regional similarity is the same across regions. Specifically, Model IV includes four regional-similarity dummies, one for each Census region. It shows that cities in the Midwest region tend to have more-similar employment cycles, but that there is no such relationship for cities in the Northeast, South or West. In addition, Model IV yields a much stronger estimate of the relationship for the Midwest, more than five times the average effect documented in Model III. Note also that Model IV is preferred statistically to Models I – III in that the restrictions needed to obtain those models from IV are easily rejected by likelihood-ratio tests (p -value < 0.001).

We return below to discussing the implications of Model IV, but before doing so we need to check whether our results are sensitive to the way we have measured industrial similarity. We can think of two reasons why our industry similarity index might mask important differences in industrial structure and suppress the importance of industry in explaining concordance. First, the level of aggregation, which is limited by data availability, might be too blunt to capture differences that matter. In particular, our index does not distinguish between the durable and nondurable goods sectors, which might be problematic because the durable goods sector should be more sensitive to monetary policy, for example. Second, perhaps our index, which averages across all sectors, is masking the importance of a subset of sectors. Table 3 summarizes the results we obtain under measures of industrial similarity that ameliorate both of these concerns. Separate data for durable and nondurable sectors are unavailable for three of our cities, so the results in Table 3 are for 55 cities only.

Model IVa simply confirms that we obtain the same general results with our 55 cities as for Model IV with the full sample. Model IVb constructs the industrial similarity index with separate data for durables and nondurables, obtaining almost identical results to Model IVa. Model IVc dispenses with the similarity index and uses measures of similarity for sectors whose sensitivity to the employment cycle should differ from the average: manufacturing and mining, logging, and construction tend to be more sensitive than average, whereas the government sector tends to be less sensitive than average.¹² Nonetheless, we do not find that similarity in any of these sectors is related to concordance. Finally, Model IVd differs from Model IVc in that it looks at durable-goods similarity rather than manufacturing similarity. Again, this has no effect on our results.

To summarize the importance of geographic factors in explaining the pattern of city contractions, the expected excess concordances from Model IV are provided in Table 4. For example, the employment cycles of two cities in different regions and states have an expected excess concordance of 64.2%, as obtained from the intercept term. If the two cities are in the same state in the South, West or Northeast, where regional similarity does not matter, the expected excess concordance rises to 72%. If they are in the same state in the Midwest, where regional similarities matter, the expected excess concordance rises further to 77.9%. So, depending on where the cities are located, geographic similarity can have up to a 13.7 percentage point difference on their expected excess concordance.

Our city dummies can be as important in determining concordance as the geographic factors, as summarized by Table 5, which provides the estimated city effects from Model IV and converts them into percentage points. To prevent perfect collinearity, the city dummies were

¹² For each industry the similarity between cities i and j is $1 - |x_{ik} - x_{jk}|$.

restricted to sum to 0, so each shows the difference relative to the average. A positive city effect indicates that, controlling for industrial and geographic similarity, the city tended to display higher excess concordance with others than the average city. The city effect for Phoenix means that their excess concordances with others was nearly 9 percentage point higher, whereas the city effect for Riverside reduced their excess concordances with others by 12 percentage points. The geographic pattern of the city effects is shown by Figure 10. Because the regional effects have been taken out by the four regional dummies, cities with the highest and lowest city effects are scattered across the country. There seems to be some commonality within some states, however, most notably Florida.

These city effects can capture many things, including some that are not necessarily city specific. For example, they might be capturing state-specific effects if the relationship between concordance and being in the same state differs across states. Our state dummy does not distinguish between states, so any state-specific effect that differs from average will be captured by the city effects. The city dummies can also capture how a city's concordance with all other cities differs because of the city's very particular industrial structure. For example, a reasonable explanation for the large negative city effects for Detroit, Warren, San Diego, and Virginia Beach is that they have very specific industries that set them apart: automobile manufacturing in the cases of Detroit and Warren, and large military bases in the cases of San Diego and Virginia Beach. So, although these industries are important in explaining the employment cycles of their particular cities, they are not prevalent enough across cities to explain the geographic patterns depicted above.

5. Geography vs. Other Similarities

Our results above indicate that cities within the same state and perhaps the same region tend to have similar employment cycles. These results are driven either by the existence of spatial propagation whereby switches in and out of contractions spread via some underlying spatial links between cities, or cities in the same state or region tend to share certain characteristics that we have not controlled for. In this section we examine whether any of four sets of variables capturing similarities in human capital, monetary-policy channels, industrial diversity, and agglomeration are related to concordance.¹³ Further, if they are related, we can compare their inclusion in the estimation on our estimates of geographic factors to see if they are driving our findings. The results of this exercise are provided in Table 6.

For the first set of results—Model V—we add three measures of human capital similarity to Model IV: a racial similarity index constructed along the lines of the industrial similarity index, and two measures of educational similarity (high school and bachelor’s degree attainment) constructed along the lines of the single-industry similarity measures used above.¹⁴ We know from previous research that cities’ performance in either phase of the employment cycle is related to human capital as measured by education and race (Owyang, Piger, Wall, and Wheeler, 2008), and that the employment effects of recessions differ by race and education level (Hoynes, 2000; Engemann and Wall, 2010). Our question here is a bit different from this: Do similarities between cities in their racial composition and educational attainment make them more likely to be in the same phase of the employment cycle? Figures 11 and 12, which plot employment by

¹³ The data for these variables are from the Census Bureau’s *State and Metropolitan Area Data Book: 2006*, which included online updates as of February 9, 2009. This source typically provides data for one year because of changes in the composition of cities over time.

¹⁴ We use four racial categories: white, black, Asian or Pacific Islander, and Native American. High school attainment is the share of the population over 25 years of age who have a high school diploma and have no additional education. Bachelor’s degree attainment is the share of the same group with at least a bachelor’s degree. All variables are for 2006.

race and educational attainment over our sample period, illustrate why one might think this to be so.

Note the period surrounding the aggregate employment contraction of the early 2000s (Figure 11): Black employment started falling in 1999, prior to the start of the aggregate contraction, whereas white employment peaked in 2001, after the aggregate contraction had begun. This suggests that cities with relatively similar racial compositions might have had relatively similar employment cycles, although the less-clear pattern around other turning points suggests otherwise. The differences between levels of educational attainment in the employment effects of contractions are more stark than those between races (Figure 12): The drop in employment for those with at least a bachelors degree is almost imperceptible whereas steep and early drops and late recoveries are the norm for those with only a high school diploma.¹⁵ All else constant, cities with a labor force that has relatively many with only a high school diploma should, therefore, have a significantly different employment cycle from those with relatively many with at least a bachelors degree. As summarized by Table 6, when we add our human capital variables to Model IV, only the similarity in high school attainment is positive and statistically significant: Two cities with similar levels of high school attainment tend to have more-concordant employment cycles.

Previous research has found that the effects of monetary policy differ across states and regions (Carlino and DeFina, 1998 and 1999), so it is possible that the city-level differences in employment cycles are driven in part by varying responses to monetary policy shocks. To capture differences in the magnitudes of various channels of monetary policy, Model VI adds three variables to Model V. The money channel, whereby monetary policy has larger effects on

¹⁵ Note that these are the only education and racial categories available at a quarterly frequency and that the data on educational attainment begin in 1992.

manufacturing than other industries, is already captured by our industry-similarity variable. To capture the broad credit channel, through which large firms are better able to absorb monetary policy shocks because of lower information and transactions costs, we have included the similarity in mean establishment size. Through the narrow credit channel small banks are thought to be more limited than large banks in finding alternative funding under tight monetary policy, so we have included two bank-size measures. The first, average bank size—deposits per bank—represents this channel directly, and the second, banks per establishments, represents the availability of banking options for firms within a city. As shown in Table 6, we find evidence that the broad money channel is related to city business-cycle similarity in that the sign on the similarity of mean establishment size is positive and statistically significant.

The final two models, VII and VIII, examine whether employment cycle similarities can be attributed to similarities in industrial diversity and agglomeration, respectively. Simon (1988) found that a more industrially diversified city will have less frictional employment because its labor force will be more able to adjust to any negative shock. In our context, this might mean that two cities that are similarly diversified should have similar employment cycles because they could adjust more quickly during a contraction. Model VII demonstrates that the similarity of industrial diversity is positively related to concordance, and this effect is statistically significant at the 5% level. Finally, to test whether similarly agglomerated cities tend to have similar employment cycles, we estimated Model VIII, which adds similarity of city density and city size to Model VI. Neither variable is close to being statistically significant.

Models VII and VIII include each of the statistically significant variables from all specifications we have considered, with Model VII preferred to Model VIII based on a likelihood ratio test. The same geographic variables that were significant in Model IV are still significant in

Model VII, with only minor changes in their magnitudes. From Model VII we conclude that employment-cycle similarity is related to similarity in geography, industrial diversity, high school attainment, and mean establishment size.

To see the extent to which these similarities matter, Table 7 calculates the expected concordances under the various combinations of these similarities. The first column of results, which is analogous to Table 4, assumes that two cities have the sample-average similarities in high school attainment, mean establishment size, and industrial diversity but can differ geographically. Note first that for two such cities in different regions and states, the expected excess concordance is 63.8. If the two cities were in the same state in the South, West or Northeast, they should have an excess concordance of 71.2. If they are in different Midwestern states their expected excess concordance is 68.5, while if they are in the same Midwestern state, their expected excess concordance rises to 76.5.

The second through fourth columns of results assume, respectively, that the two cities have the same levels of high school attainment, establishment size and industrial diversity. Having the same level of each of these attributes adds, by itself, between 0.6 to 1.0 percentage points to the expected excess concordances in the first column of results. The final column assumes that the cities have the same level of each of these attributes, and results in concordances that are 2.3 to 2.8 percentage points larger than those in the first column of results. Thus, our addition of human capital, monetary policy, and industrial diversity variables contributes something, but not a whole lot, to our explanation of city concordances. In contrast, geographic similarity is still explaining large chunks of the differences in concordance.

The large effect of geographic similarity on city-level business cycle comovement is striking. It is possible that this effect is proxying for some city-level characteristics that we have

not considered here. Alternatively, the geographic similarity is picking up a spatial propagation mechanism by which turns in the employment cycle are spread from city to city. One likely such mechanism is the intensity of trade relationships, which is known to be strongly related to the distance between U.S. trading regions, as well as display a home-state bias.¹⁶

6. Summary and Conclusions

We estimated city-level employment cycles for 58 large U.S. cities and documented the substantial cross-city variation in the timing, lengths, and frequencies of their employment contractions. We also showed how the spread of city-level contractions associated with U.S. recessions has tended to follow recession-specific geographic patterns. Cities within the same state or region have tended to have similar employment cycles, but cities with similar industrial mixes did not. Additionally, cities with more-similar high school attainment, mean establishment size, and industrial diversity have tended to have more-similar employment cycles. According to our statistically preferred model, geographic similarity can raise the percentage of time that two cities are in the same business cycle phase by as much as 13.2 percentage points. For any degree of geographic similarity, having identical high school attainment, mean establishment size and industrial diversity will raise the percentage of time two cities are in the same business cycle phase by as much as 2.8 percentage points.

¹⁶ See, for example, Wolf (2000), Hillberry and Hummels (2003, 2008).

Appendix 1. Summary Statistics

	Contraction Frequency	Mean Excess Concordance	Excess Concordance with U.S.
Atlanta-Sandy Springs-Marietta, GA	0.361	71.7	78.7
Austin-Round Rock, TX	0.167	62.5	77.7
Baltimore-Towson, MD	0.292	67.8	75.9
Bethesda-Gaithersburg-Frederick, MD	0.514	68.9	76.0
Boston-Quincy, MA	0.278	67.2	75.1
Buffalo-Niagara Falls, NY	0.389	68.7	84.3
Charlotte-Gastonia-Concord, NC-SC	0.278	70.1	64.6
Chicago-Naperville-Joliet, IL	0.264	68.3	77.6
Cincinnati-Middletown, OH-KY-IN	0.681	61.7	77.9
Cleveland-Elyria-Mentor, OH	0.569	67.5	87.7
Columbus, OH	0.444	66.5	81.0
Dallas-Plano-Irving, TX	0.208	68.5	72.3
Denver-Aurora, CO	0.153	62.6	73.8
Detroit-Livonia-Dearborn, MI	0.681	61.4	76.5
Edison, NJ	0.083	54.9	79.4
Fort Lauderdale-Pompano Beach-Deerfield Beach, FL	0.278	62.7	64.6
Fort Worth-Arlington, TX	0.264	69.4	85.1
Hartford-West Hartford-East Hartford, CT	0.472	61.6	61.8
Houston-Sugar Land-Baytown, TX	0.333	68.9	62.1
Indianapolis-Carmel, IN	0.194	66.7	57.0
Jacksonville, FL	0.333	71.5	68.2
Kansas City, MO-KS	0.347	65.8	70.1
Las Vegas-Paradise, NV	0.306	70.3	73.0
Los Angeles-Long Beach-Glendale, CA	0.347	67.6	69.3
Louisville-Jefferson County, KY-IN	0.194	63.5	83.9
Memphis, TN-MS-AR	0.528	69.1	80.5
Miami-Miami Beach-Kendall, FL	0.236	68.6	78.3
Milwaukee-Waukesha-West Allis, WI	0.236	70.3	62.1
Minneapolis-St. Paul-Bloomington, MN-WI	0.403	71.0	59.2
Nashville-Davidson--Murfreesboro, TN	0.194	64.5	76.0
Nassau-Suffolk, NY	0.139	55.3	66.3
Newark-Union, NJ-PA	0.181	57.4	61.9
New Orleans-Metairie-Kenner, LA	0.472	61.4	75.6
New York-White Plains-Wayne, NY-NJ	0.292	67.9	68.0
Oakland-Fremont-Hayward, CA	0.597	62.7	79.7
Oklahoma City, OK	0.139	64.2	65.6
Orlando-Kissimmee, FL	0.264	70.6	74.6
Philadelphia, PA	0.306	69.0	57.2
Phoenix-Mesa-Scottsdale, AZ	0.417	73.2	80.3
Pittsburgh, PA	0.292	68.2	81.6
Portland-Vancouver-Beaverton, OR-WA	0.194	68.2	78.8
Providence-New Bedford-Fall River, RI-MA	0.194	61.7	71.3
Richmond, VA	0.236	68.9	70.1
Riverside-San Bernardino-Ontario, CA	0.264	54.2	64.2
Rochester, NY	0.375	67.4	68.0
Sacramento-Arden-Arcade-Roseville, CA	0.236	54.4	74.8
St. Louis, MO-IL	0.264	69.0	65.4
Salt Lake City, UT	0.167	62.4	77.0
San Antonio, TX	0.319	64.9	81.6
San Diego-Carlsbad-San Marcos, CA	0.667	59.7	88.6
San Francisco-San Mateo-Redwood City, CA	0.458	63.4	71.2
San Jose-Sunnyvale-Santa Clara, CA	0.208	70.9	71.0
Santa Ana-Anaheim-Irvine, CA	0.347	63.4	71.9
Seattle-Bellevue-Everett, WA	0.181	66.9	80.2
Tampa-St. Petersburg-Clearwater, FL	0.347	70.8	71.4
Virginia Beach-Norfolk-Newport News, VA-NC	0.028	57.3	71.8
Warren-Troy-Farmington Hills, MI	0.486	62.5	77.1
Washington-Arlington-Alexandria, DC-VA-MD-WV	0.125	56.5	77.3
Cross-City Average	0.285	65.4	73.3
United States	0.276		

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Figure 1.

Employment-Contraction Probability for the United States
Shaded Areas are NBER Recessions

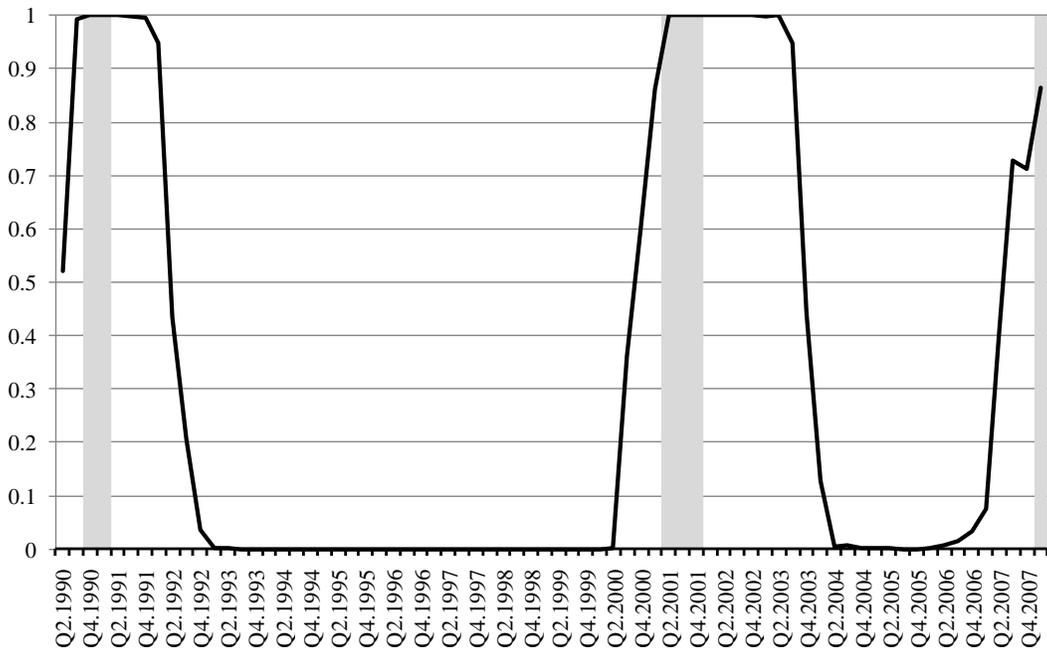


Figure 2. Employment-Contraction Probabilities for the Six Largest Cities
 Shaded Areas are U.S. Employment Contractions

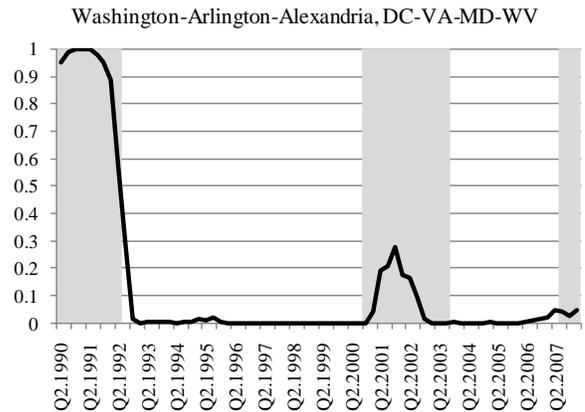
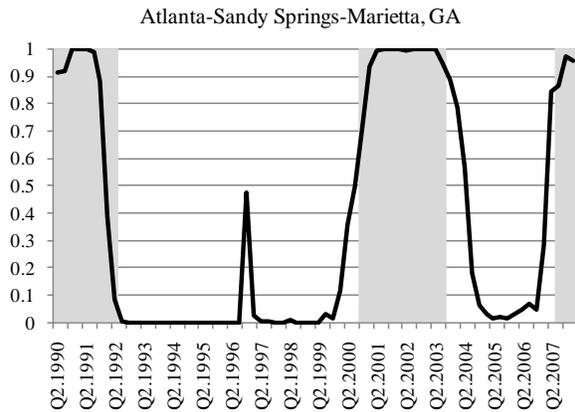
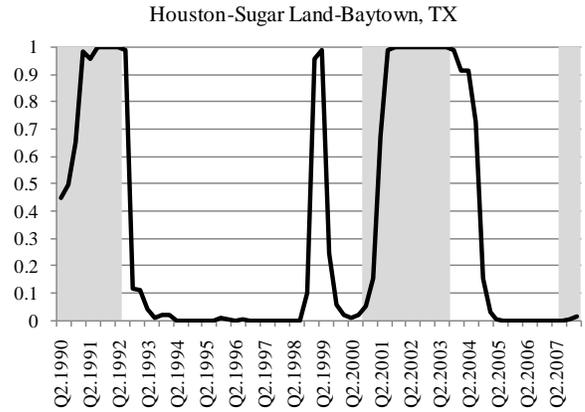
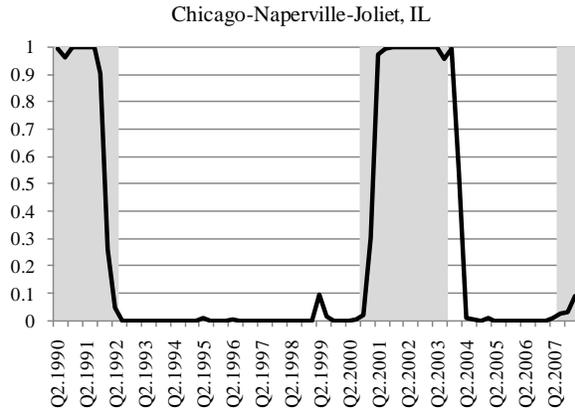
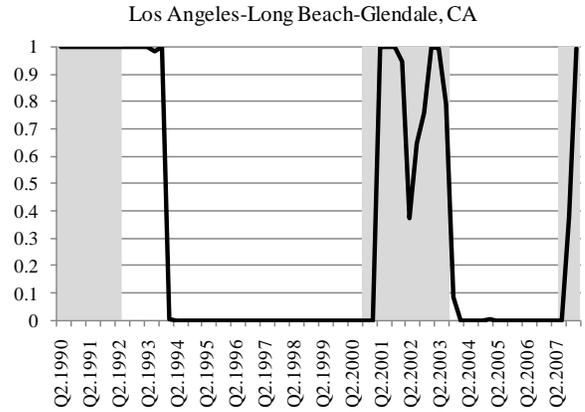
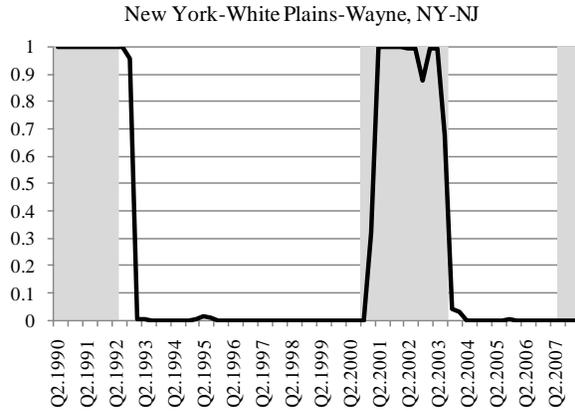


Figure 3. Employment-Contraction Probabilities for the Six Smallest Cities
 Shaded Areas are U.S. Employment Contractions

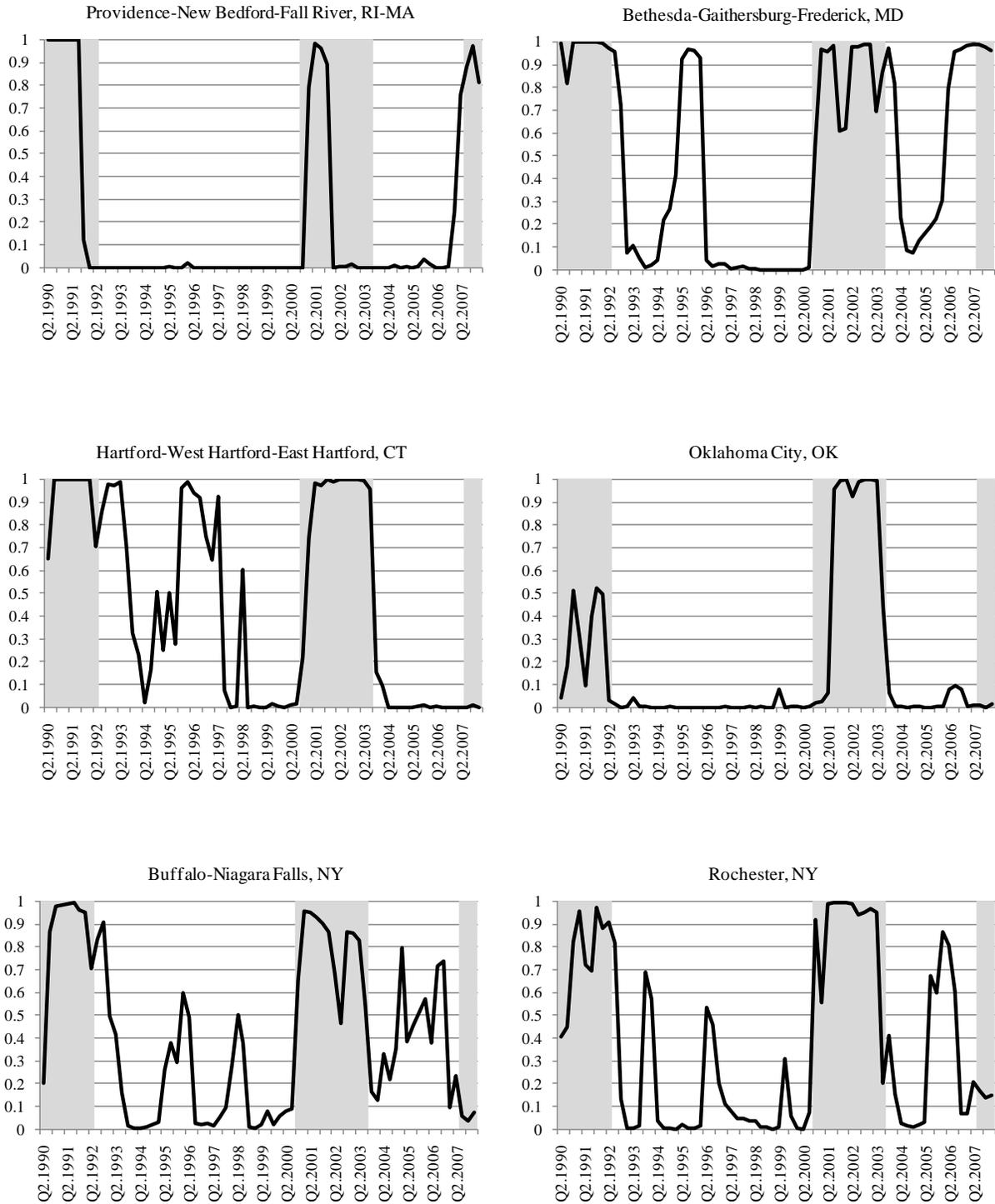


Figure 4.

Frequency of Recession Across Cities, 1990-2008
(Percentage of Time in Contraction)

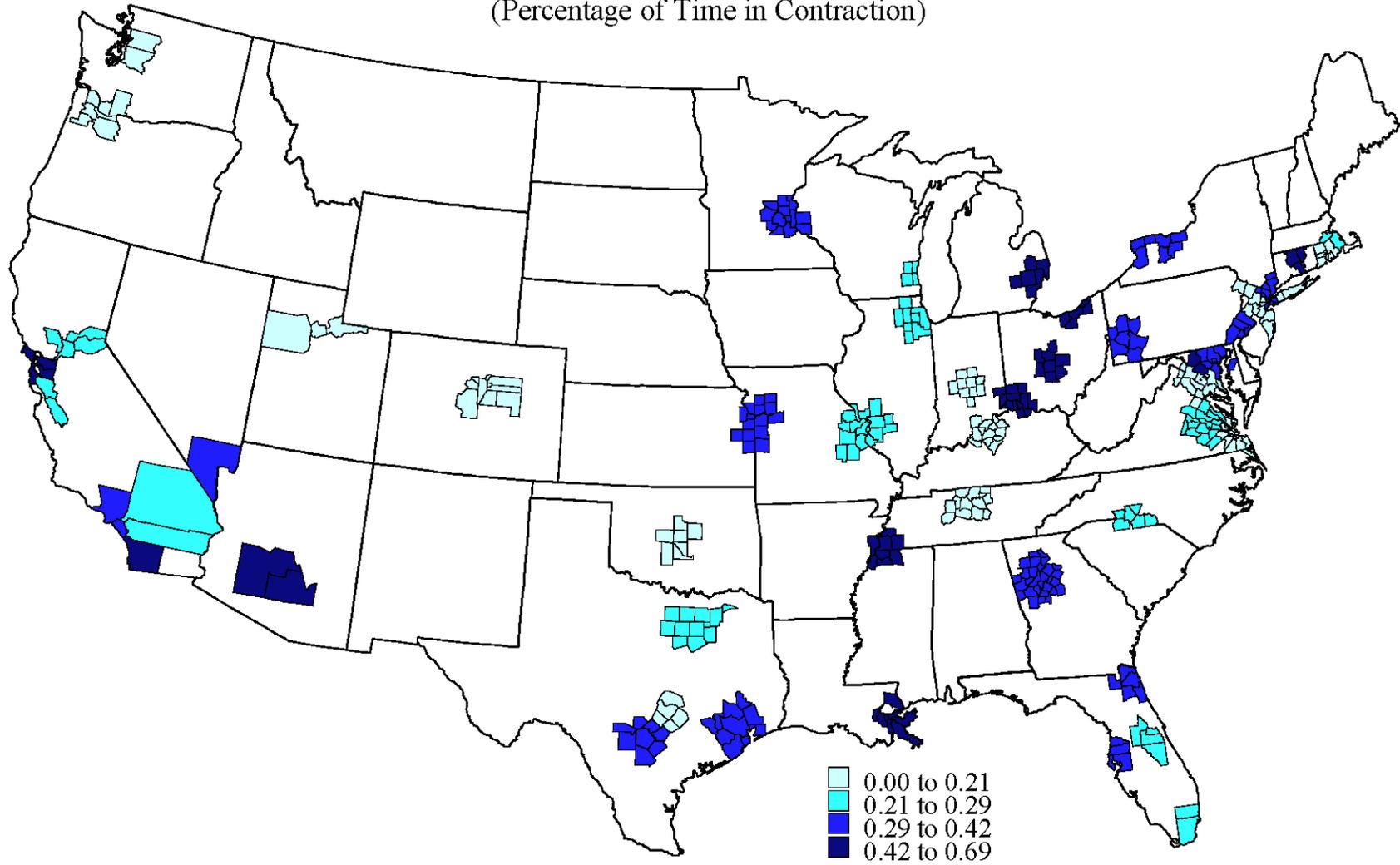


Figure 5.

Number of Cities in Contraction
Light Gray Areas Indicate U.S. Employment Contractions
Dark Gray Areas Indicate NBER Recessions

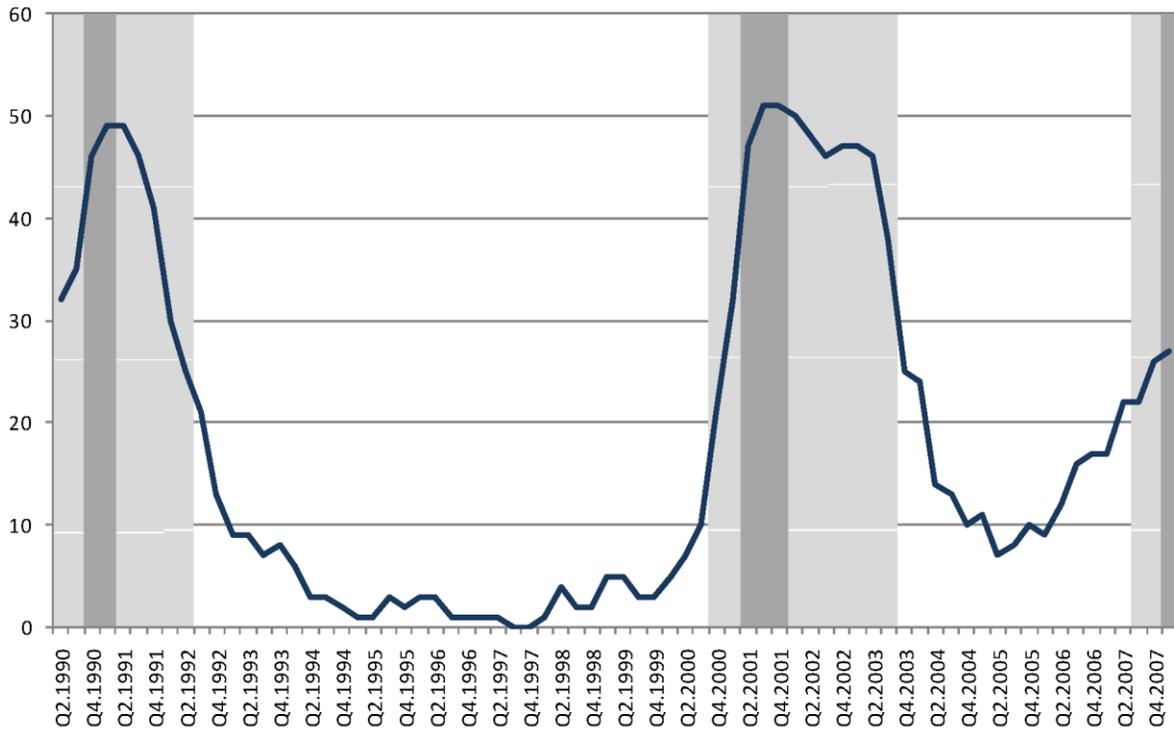
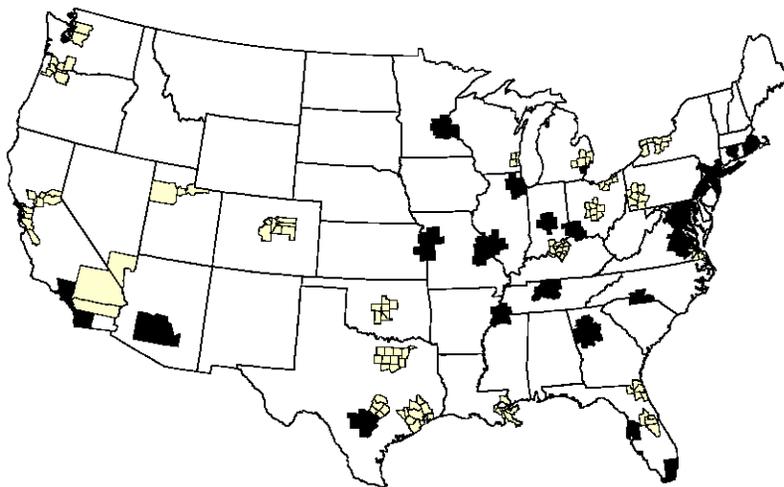
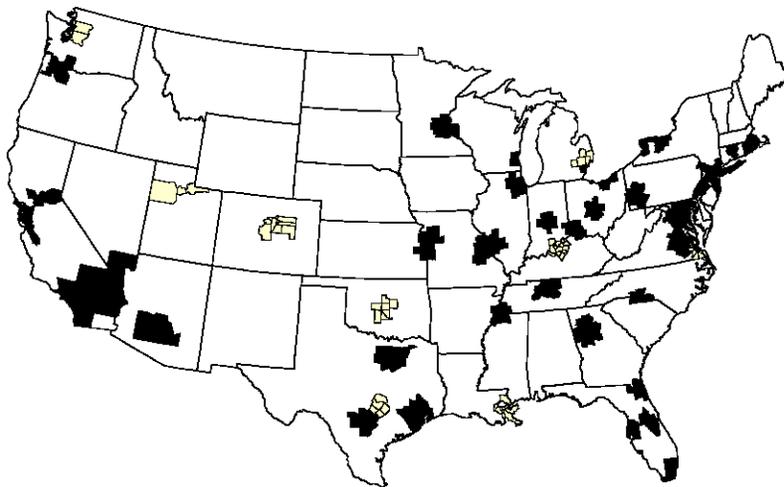


Figure 6. Early 1990s Contractions
Cities in Contraction are in Black

1990.Q2



1991.Q2



1992.Q2

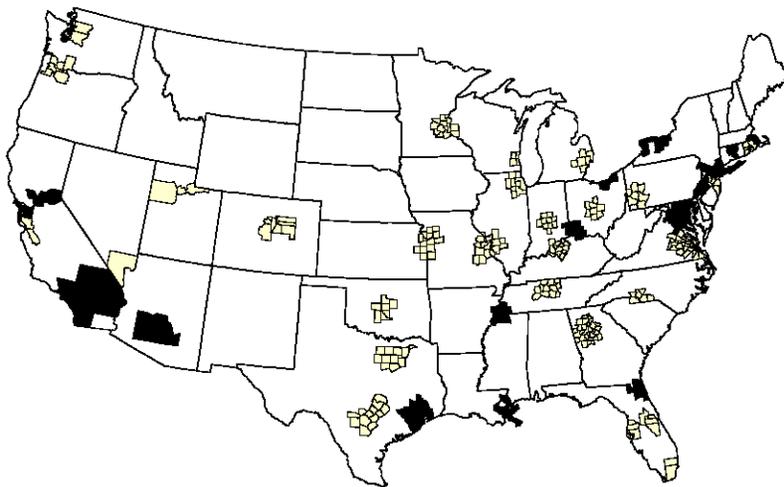


Figure 7. Early 2000s Contractions
Cities in Contraction are in Black



Figure 8. Late 2000s Contractions
Cities in Contraction are in Black

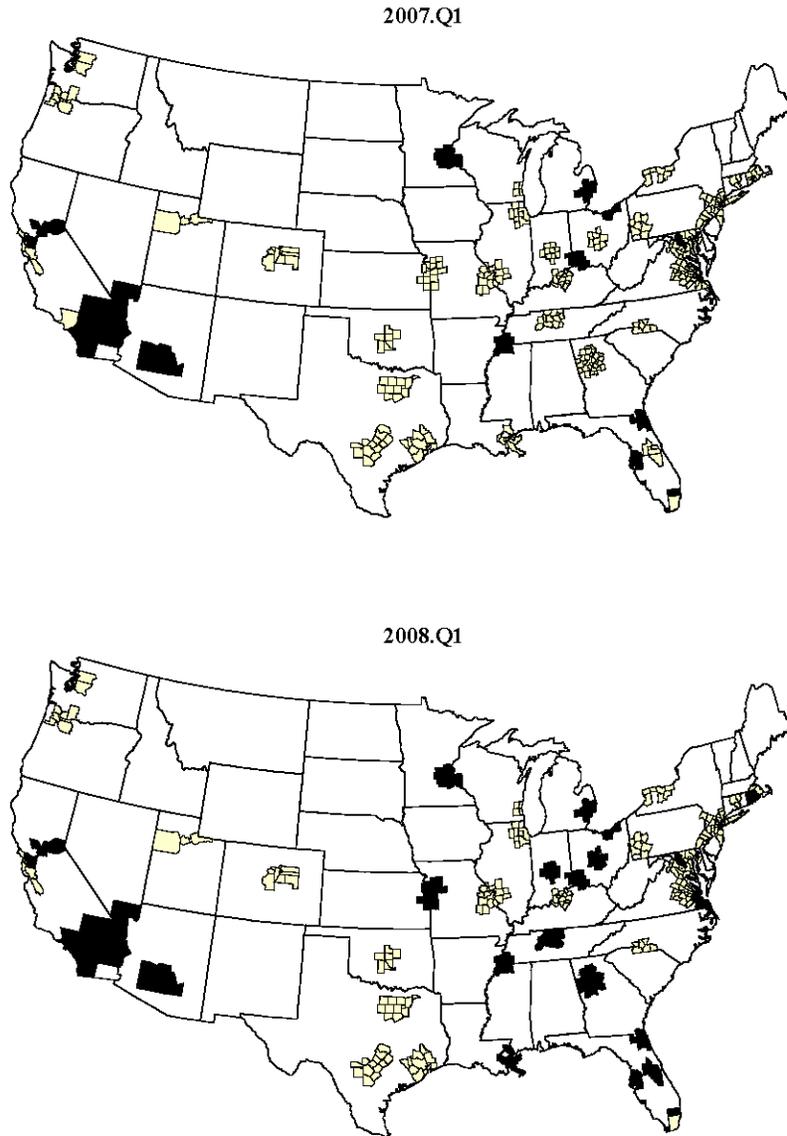


Figure 9. Excess Concordance with the United States

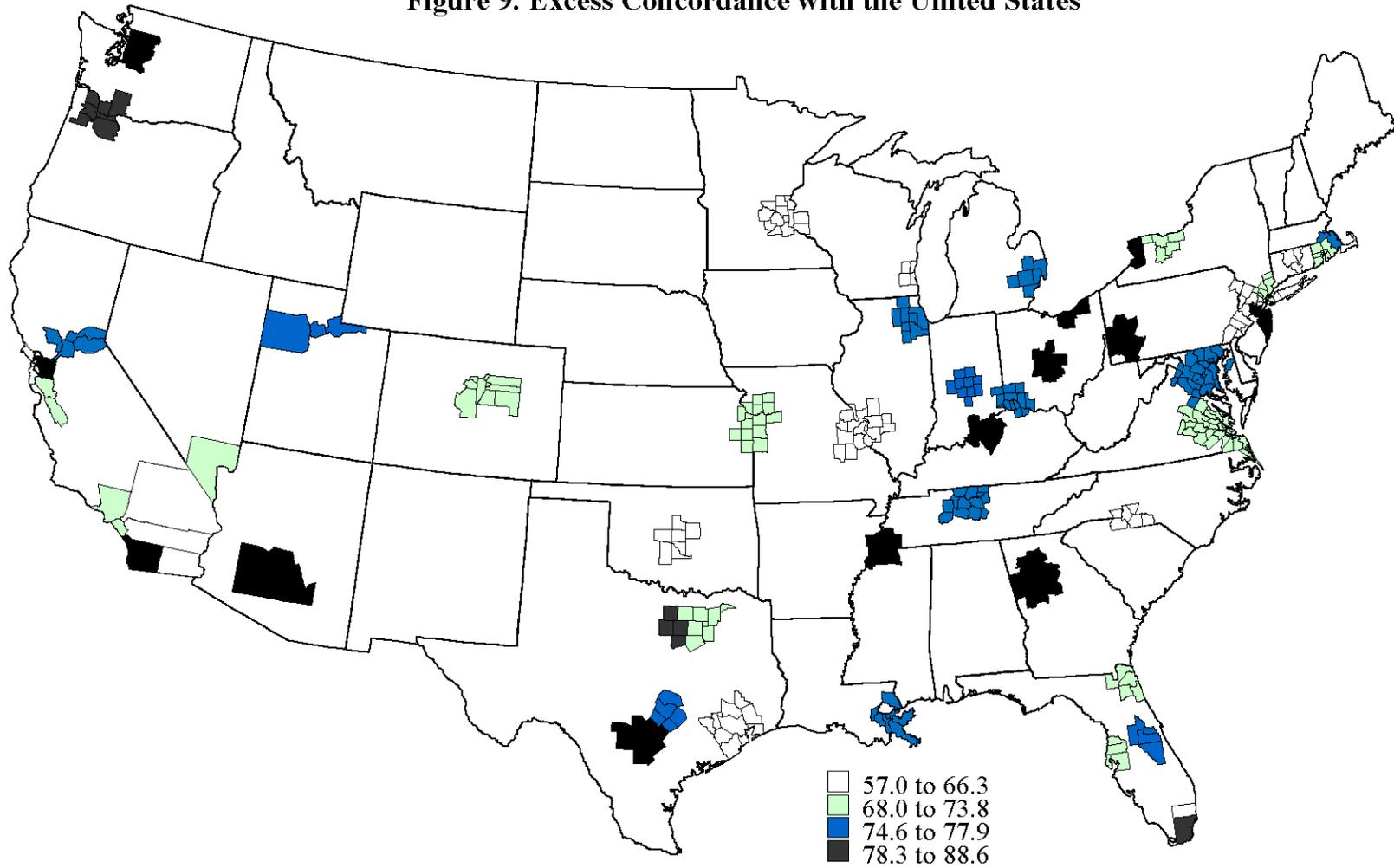


Figure 10. City Effects in Percentage Points

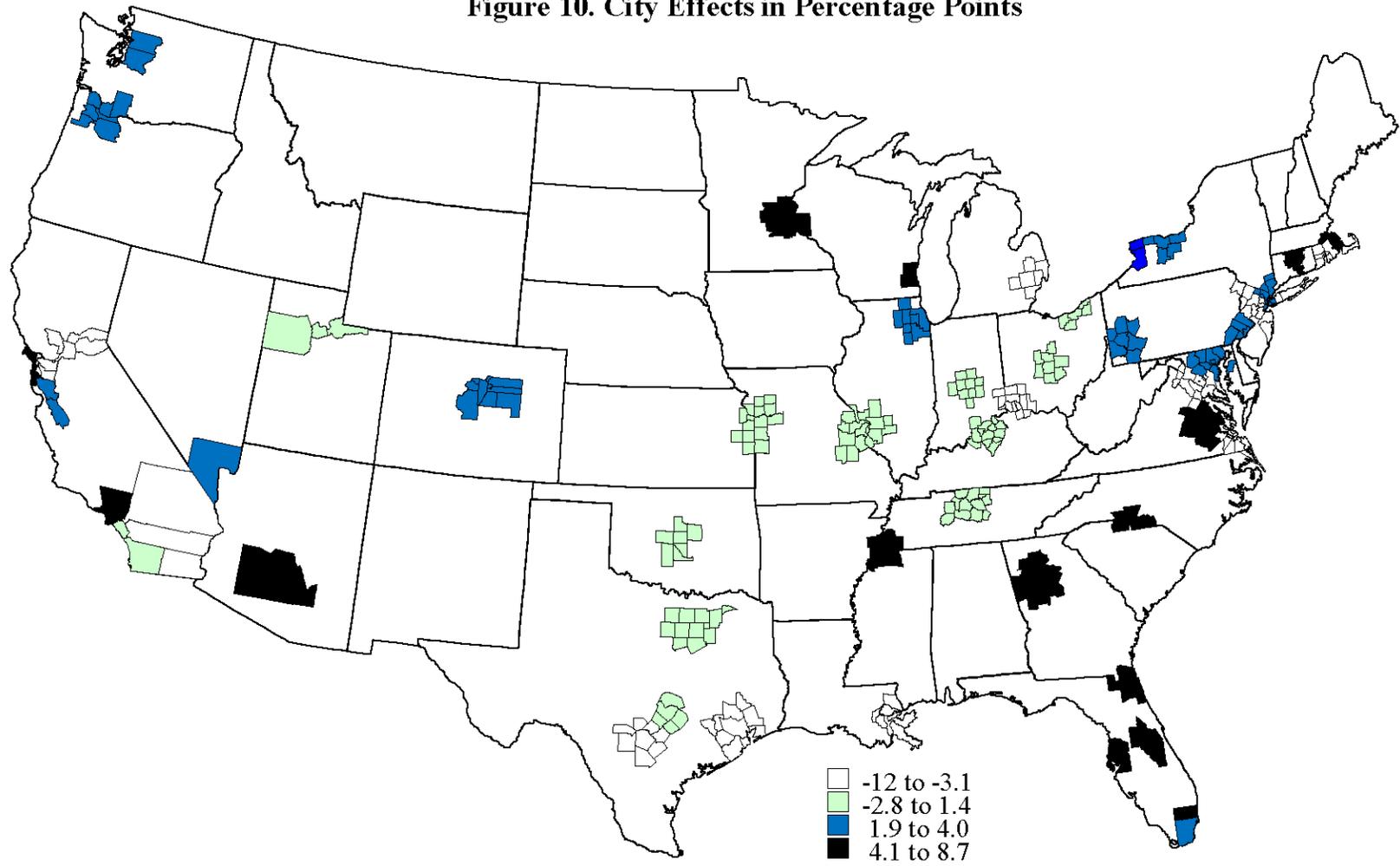


Figure 11. Employment by Race
 Shaded Areas Indicate U.S. Employment Contractions

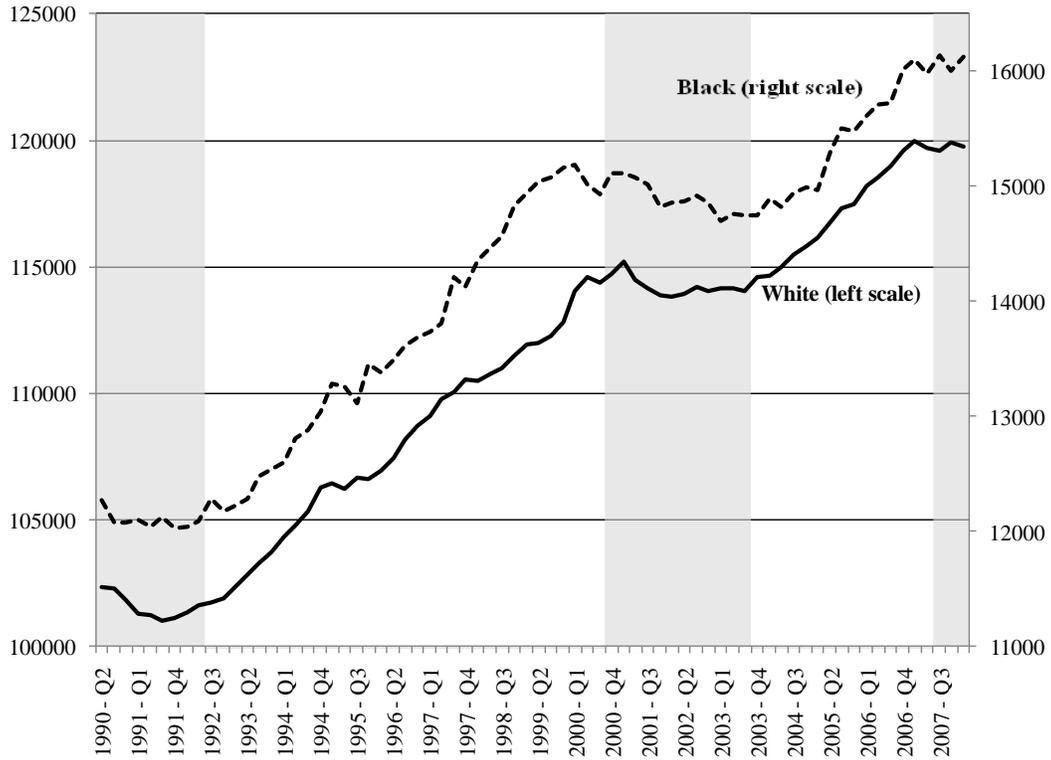


Figure 12. Employment by Educational Attainment
 Shaded Areas Indicate U.S. Employment Contractions

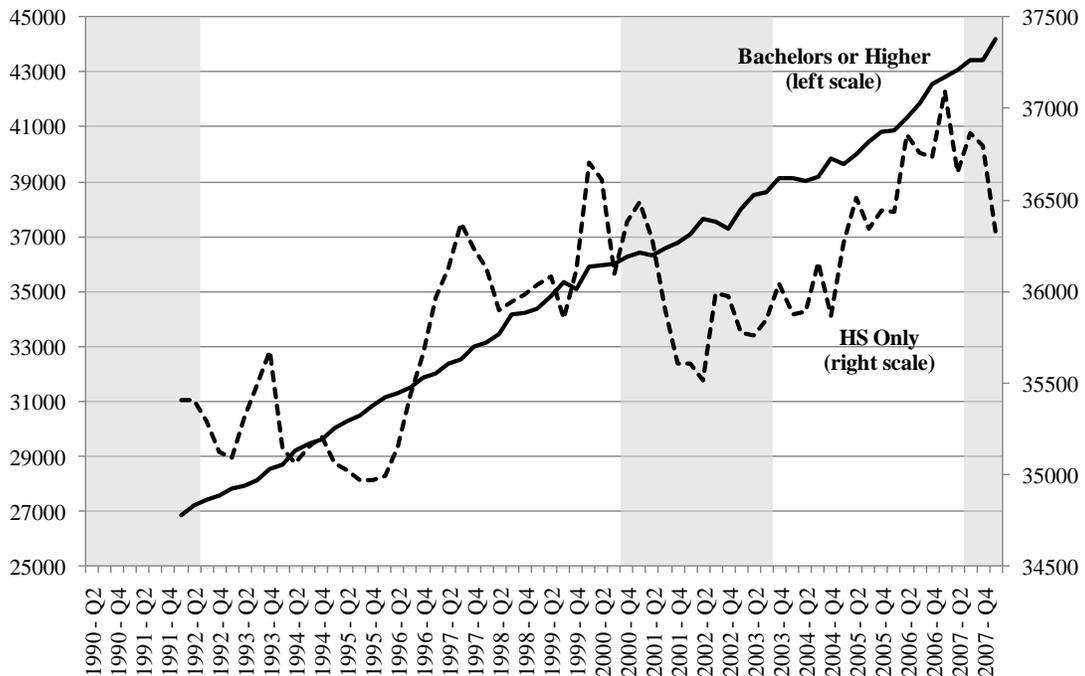


Table 2. Industrial vs. Geographic Similarity

	I	II	III	IV
Industrial Similarity Index	0.9325 (0.4997)		0.1283 (0.4910)	-0.0211 (0.4842)
Same Principal State		0.1146* (0.0217)	0.1144* (0.0217)	0.1150* (0.0208)
Same Secondary State		-0.0072 (0.0277)	-0.0076 (0.0277)	-0.0169 (0.0283)
Same Region		0.0152* (0.0065)	0.0149* (0.0065)	
Both in Northeast				0.0271 (0.0190)
Both in South				-0.0126 (0.0099)
Both in Midwest				0.0789* (0.0192)
Both in West				0.0115 (0.0166)
Contiguous		0.0403 (0.0304)	0.0400 (0.0305)	0.0434 (0.0303)
Constant	4.1942* (0.0138)	4.1602* (0.0029)	4.1637* (0.0137)	4.1616* (0.0135)

The dependent variable is the log of the excess concordance between the two cities, all five models include city dummies, and all independent variables except for dummies are in logs. Statistical significance at the 5 percent level is indicated by “*”. Standard errors are White-corrected.

Table 3. Robustness Across Measures of Industrial Similarity

	IVa	IVb	IVc	IVd
Industrial Similarity	0.0546 (0.5319)			
Industrial Similarity (durables and nondurables)		0.0077 (0.5483)		
Mining, Logging, and Construction Similarity			0.0572 (0.0970)	0.0542 (0.0953)
Government Similarity			0.3300 (0.2091)	0.3187 (0.2095)
Manufacturing Similarity			-0.1412 (0.0906)	
Durables Similarity				-0.1494 (0.1232)
Same Principal State	0.1198* (0.0238)	0.1198* (0.0239)	0.1178* (0.0231)	0.1171* (0.0230)
Same Secondary State	-0.0175 (0.0296)	-0.0174 (0.0296)	-0.0179 (0.0297)	-0.0174 (0.0297)
Both in Northeast	0.0205 (0.0194)	0.0208 (0.0194)	0.0200 (0.0194)	0.0198 (0.0194)
Both in South	-0.0061 (0.0103)	-0.0061 (0.0103)	-0.0046 (0.0102)	-0.0041 (0.0103)
Both in Midwest	0.0793* (0.0194)	0.0795* (0.0194)	0.0803* (0.0195)	0.0801* (0.0195)
Both in West	0.0094 (0.0167)	0.0095 (0.0167)	0.0100 (0.0167)	0.0101 (0.0166)
Contiguous	0.0587 (0.0334)	0.0587 (0.0335)	0.0575 (0.0336)	0.0591 (0.0336)
Constant	4.1630* (0.0148)	4.1617* (0.0159)	4.1695* (0.0106)	4.1697* (0.0109)

The dependent variable is the log of the excess concordance between the two cities, all five models include city dummies, and all independent variables except for dummies are in logs. Statistical significance at the 5 percent level is indicated by “*”. Standard errors are White-corrected. Because of data availability, Austin, TX; Bethesda, MD; and Fort Lauderdale, FL are not included in this data set.

Table 4. Expected Excess Concordances from Model IV

Two cities in:	Expected Excess Concordance
1) different regions and states	64.2
2) the same state in the South, West, or Northeast	72.0
3) different Midwestern states	69.4
4) the same Midwestern state	77.9

Table 5. Estimated City Effects from Model IV

City	City Effect (est. coeff.)	Standard Error	City Effect (% points)
Phoenix-Mesa-Scottsdale AZ	0.1265	0.0099*	8.7
Atl-Sndy Sprgs-Martta GA	0.1106	0.0095*	7.5
Jacksonville FL	0.1018	0.0074*	6.9
Tampa-St Pete-Clearwater FL	0.0904	0.0095*	6.1
Charlotte-Gastonia-Concord NC-SC	0.0863	0.0116*	5.8
Orlando FL	0.0861	0.0093*	5.8
Las Vegas-Paradise NV	0.0830	0.0223*	5.6
Minneapolis-St Paul-Blmngtn MN-WI	0.0807	0.0109*	5.4
San Jose-Sunnyvale-Santa Clara, CA	0.0756	0.0120*	5.0
Milwkee-Wksha-W Allis WI	0.0705	0.0117*	4.7
Memphis TN-AR-MS	0.0689	0.0149*	4.6
Fort Worth-Arlington, TX	0.0677	0.0093*	4.5
Bthsd-Frdck-Gthrsbrg MD	0.0674	0.0105*	4.5
Richmond VA	0.0652	0.0079*	4.3
Houston-Baytown-Sugar Land, TX	0.0622	0.0109*	4.1
Philadelphia, PA	0.0602	0.0092*	4.0
Dilas-Plno-Irvng TX	0.0568	0.0101*	3.8
Miami-Miami Bch-Kendall, FL	0.0558	0.0097*	3.7
Pittsburgh PA	0.0558	0.0130*	3.7
Buffalo-Niagara Falls NY	0.0542	0.0079*	3.6
St Louis MO-IL	0.0504	0.0108*	3.3
Baltimore-Towson MD	0.0503	0.0096*	3.3
Portlnd-Vanc-Bvrtn OR-WA	0.0502	0.0127*	3.3
Chicgo-Nprvll-Jliet IL	0.0411	0.0101*	2.7
NY-Wayne-White Plains, NY-NJ	0.0385	0.0096*	2.5
Rochester NY	0.0332	0.0089*	2.2
Boston-Cambridge-Quincy, MA	0.0330	0.0101*	2.2
Seattle-Bellevue-Everett, WA	0.0298	0.0138*	1.9
LA-Long Bch-Glndale, CA	0.0286	0.0113*	1.9
Cleveland-Elyria-Mentor OH	0.0209	0.0153	1.4
Indianapolis IN	0.0196	0.0101	1.3
Columbus OH	0.0078	0.0150	0.5
Nashville-Davidsn-Murfreesbro TN	0.0015	0.0121	0.1
Oklahoma City OK	-0.0026	0.0108	-0.2
Kansas City MO-KS	-0.0029	0.0141	-0.2
San Antonio TX	-0.0058	0.0160	-0.4
Louisville KY-IN	-0.0189	0.0162	-1.2
Ft Ldrdle-Pmpno Bch-Drfld Bch FL	-0.0338	0.0145*	-2.1
Snta Ana-Anahm-Irvine, CA	-0.0394	0.0154*	-2.5
Denver-Aurora, CO	-0.0403	0.0147*	-2.5
San Francsc-San Mateo-Redwd Cty, CA	-0.0406	0.0126*	-2.6
Salt Lake City UT	-0.0424	0.0141*	-2.7
Austin-Round Rock TX	-0.0440	0.0148*	-2.8
New Orlns-Metaire-Kennr LA	-0.0487	0.0118*	-3.1
Providence-Fall River-Warwick, RI-MA	-0.0510	0.0139*	-3.2
Oaklnd-Fremnt-Haywrdr, CA	-0.0541	0.0177*	-3.4
Hrtfrd-W Hrtfrd-E Hrtfrd, CT	-0.0556	0.0230*	-3.5
Warren-Frmngtn Hills-Troy, MI	-0.0596	0.0174*	-3.7
Cincinnati-Middletn OH-KY-IN	-0.0733	0.0186*	-4.5
Dtroit-Lvnia-Drbrn MI	-0.0740	0.0161*	-4.6
San Diego-Carlsbd-San Marcos CA	-0.1066	0.0198*	-6.5
Virginia Beach-Norfolk-Nwprt Nws VA-NC	-0.1215	0.0181*	-7.3
Newark-Union, NJ-PA	-0.1270	0.0174*	-7.7
Wash-Arlington-Alexandria, DC-VA-MD	-0.1381	0.0202*	-8.3
Nassau-Suffolk, NY	-0.1709	0.0189*	-10.1
Edison, NJ	-0.1731	0.0162*	-10.2
Sacramento-Arden-Arcade-Roseville, CA	-0.1997	0.0240*	-11.6
Riverside-S Bernardno-Ontario CA	-0.2068	0.0239*	-12.0

Statistical significance at the 5 percent level is indicated by “*”.

Table 6. More Covariates of Concordance

	V	VI	VII	VIII
Industrial Similarity	-0.1205 (0.4940)	-0.1859 (0.4961)	-0.3429 (0.5041)	-0.3691 (0.5048)
Industrial Diversity			1.9211* (0.9622)	1.9200* (0.9631)
Same Principal State	0.1111* (0.0207)	0.1100* (0.0210)	0.1107* (0.0210)	0.1111* (0.0211)
Same Secondary State	-0.0197 (0.0291)	-0.0193 (0.0290)	-0.0185 (0.0292)	-0.0184 (0.0293)
Both in Northeast	0.0295 (0.0190)	0.0309 (0.0185)	0.0322 (0.0185)	0.0316 (0.0184)
Both in South	-0.0108 (0.0100)	-0.0093 (0.0100)	-0.0086 (0.0100)	-0.0087 (0.0100)
Both in Midwest	0.0748* (0.0191)	0.0702* (0.0192)	0.0711* (0.0193)	0.07149* (0.0193)
Both in West	0.0077 (0.0171)	0.0066 (0.0182)	0.0071 (0.0182)	0.0070 (0.0182)
Contiguous	0.0412 (0.0309)	0.0402 (0.0310)	0.0400 (0.0310)	0.0397 (0.0309)
Racial Similarity	0.1006 (0.0930)	0.0924 (0.0920)	0.0786 (0.0917)	0.0770 (0.0920)
High School Attainment	0.2225* (0.0695)	0.2099* (0.0697)	0.2092* (0.0697)	0.2036* (0.0718)
Bachelor's Attainment	-0.1127 (0.0744)	-0.1035 (0.0743)	-0.0979 (0.0745)	-0.0971 (0.0753)
Average Bank Size		0.9892 (0.7097)	0.9834 (0.7083)	0.9448 (0.7092)
Banks per Establishments		-0.8560 (1.8931)	-0.7183 (1.8934)	-0.6983 (1.8944)
Mean Establishment Size		1.2081* (0.5557)	1.1633* (0.5584)	1.1544* (0.5605)
City-Density				0.0289 (0.0646)
City-Size				-1.9033 (14.3430)
Constant	4.1727* (0.0150)	4.1862* (0.0162)	4.1917* (0.0161)	4.1921* (0.0170)

The dependent variable is the log of the excess concordance between the two cities, all five models include city dummies, and all independent variables except for dummies are in logs. Statistical significance at the 5 percent level is indicated by “*”. Standard errors are White-corrected.

Table 7. Expected Concordances from Model VII

Two cities in:	Different HS Attainment, Establishment Size, and Industrial Diversity	Same HS Attainment	Same Establishment Size	Same Industrial Diversity	Same HS Attainment, Establishment Size, and Industrial Diversity
1) different regions and states	63.8	64.7	64.5	64.4	66.1
2) the same state in the South, West, or Northeast	71.2	72.2	72.1	72.0	73.9
3) different Midwestern states	68.5	69.4	69.3	69.2	71.0
4) the same Midwestern state	76.5	77.5	77.4	77.3	79.3