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SECTORAL SHOCKS AND METROPOLITAN EMPLOYMENT GROWTH

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Abstract

Horvath and Verbrugge (1996) argue that when investigating the sources of aggregate fluctuations, it is important to use the highest frequency data available. Using monthly data for the U.S. economy they show that industry-specific shocks are more important in explaining fluctuations in industrial production than are common aggregate shocks. With the exception of Coulson (1999) studies that examine the issue at the sub-national level have used low frequency, spatially aggregated data. We examine the relative importance of national disturbances versus local industry shocks for employment fluctuations using monthly data on five metropolitan statistical areas (MSAs). Input-output tables are used to quantify the strength of interindustry linkages, which are then used to help identify a structural VAR model for each MSA. Within-MSA industry shocks are found to explain considerably more of the forecast-error variance in industry employment growth (87-94 percent) than do common national shocks to productivity and monetary policy, and the manufacturing, services, and government sectors make the largest individual contributions to local employment variance. We also find that the measured importance of national shocks for employment fluctuations increases as the level of spatial aggregation increases.

The United States is made up of diverse metropolitan areas that, although linked, may respond differently to changing economic circumstances. Some metropolitan statistical areas (MSAs) may react more strongly than others to common national shocks, such as changes in monetary and fiscal policies, and technological innovations. The findings of Carlino and DeFina (1998), which showed that U.S. regions respond quite differently to unexpected changes in monetary policy, illustrate the point. Similarly, Hooker and Knetter (1997) and Davis, Loungani, and Mahidhara (1997) present evidence that changes in the regional distribution of military spending have differential regional effects.

Differences in an MSA's industrial structure may also contribute to differences in fluctuations in local economic activity. Since MSAs have different mixes of industries, they experience different shocks to output, resulting in heterogeneity in their fluctuations. For example, the Detroit MSA contains a relatively large share of the cyclically sensitive manufactured durables sector, while the share of manufactured durables in Tucson is proportionately small. The combination of differences in industrial structure and the different responses of various industries to given shocks could make some MSAs more vulnerable to certain types of shocks than other MSAs. In addition, since industries tend to concentrate spatially to take advantage of demand and supply linkages and agglomeration economies, the optimal level of activity of an industry in a given MSA depends on the aggregate level of MSA activity. Thus, when one local industry declines, the decline tends to spill over to all other local industries. The effect of local activity spillovers will differ across regions, since the degree of synergy, or links, among industries will differ across regions because of differences in industrial structure and the strength of external economies of scale. Shea (1996) finds that local spillovers account for approximately one-third of volatility in manufacturing employment at the MSA level.

Do the changing fortunes of MSAs reflect common national shocks or local sectoral shocks? While a small, but growing literature examines the relevance of sector-specific shocks for explaining aggregate (national) fluctuations, the geographical dimension of this issue has attracted much less interest. The vast majority of research at the sub-national level has used regional data to investigate the importance of sector-specific shocks in regional fluctuations.[1] Studies using data for the U.S. regions find that idiosyncratic shocks account for only 13-38 percent of regional employment variance.[2] But by using regional data, previous studies may have understated the impact of industry-specific shocks on regional activity. The law of large numbers suggests that positive shocks to one firm in an industry in a broadly defined region (such as a BEA region) will be offset by negative shocks to another firm in the industry in that region. Thus, idiosyncratic shocks will appear to be a less important source of aggregate fluctuations at the regional level. It is less likely, however, that spatial aggregation will smooth the effects of sectoral shocks at the MSA level. Thus, studies that use data at the MSA level are more likely to reflect the importance of idiosyncratic shocks to local economies than an analysis that draws inferences from studies using regional or national data.

As pointed out by Horvath and Verbrugge (1996), it is essential to use the highest frequency data available when investigating sectoral interactions; otherwise, industry-specific shocks that are rapidly transmitted (through time) to other sectors may be erroneously characterized as having a common aggregate source. Using national data, Horvath and Verbrugge

[1] There is a large and growing literature on the sources of business cycles, both within and across countries. Horvath and Verbrugge (1996) critically review studies on the significance of sector-specific shocks for national business cycles.

[2] See Clark and Shin (1998) for an extensive review of the regional studies.

(1996) provide evidence that the measured contribution of industry-specific shocks increase noticeably as one moves from quarterly to monthly data. However, most past regional studies use data at annual or quarterly frequencies, introducing problems associated with time aggregation as well as spatial aggregation.[3]

In this paper, we study the sources of industry employment growth within each of five MSAs. The objective is to understand the relative importance of national disturbances versus local sectoral shocks in generating observed employment fluctuations in MSAs. The empirical evidence presented in this paper derives from just-identified structural vector autoregressions (SVARs), estimated for each of the five MSAs--Chicago, Los Angeles, Oklahoma City, San Francisco, and Tucson. Our estimations use monthly MSA employment data covering nine, one-digit industrial categories for the period 1951 to 1999, as well as two variables (one for monetary policy shocks, and one for aggregate productivity shocks) that capture national influences on each MSA. The findings reveal that within-MSA industry shocks explain considerably more of the forecast error variance in industry employment growth than do common national shocks. Specifically, sectoral shocks account for between 87 percent (Los Angeles MSA) and 94 percent (Tucson MSA) of the 36-month-ahead forecast error variance in employment growth. Among individual local sectors, shocks to MSA-specific government-, manufacturing-, and service-sector employment growth are the dominant sources of variation in total MSA employment.[4]

These results can be usefully compared to the large literature on the importance of sectoral versus aggregate shocks for national economic cycles. Horvath and Verbrugge (1996)

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[3] The paper by Coulson (1999) is a lone exception in that he uses MSA monthly data.

[4] Coulson (1999) finds similar evidence using data from four MSAs (Baltimore, Denver, Houston, and New York City) not used in this paper and an SVAR in which identification is motivated by shift-share analysis. Coulson's results indicate that at least two-thirds of the 36-month-ahead forecast error variance in employment growth is

use monthly data for the national economy and find that sectoral shocks account for 40-60 percent of the 24-month-ahead forecast error variance of monthly industrial production. Our lower bound estimate of the importance of sectoral shocks using MSA data (87 percent) is more than twice the lower bound estimate for these shocks using national data. And our lower bound estimate is 50 percent higher than the upper bound estimates in studies using national data. Thus, our study finds that spatial disaggregation leads to an even more significant role for sectoral shocks in accounting for aggregate MSA employment growth fluctuations than previously found in national studies.

There is considerable practical interest in knowing how the various sectors contribute to local economic growth. The results of this paper have several implications for local economic development. First, when investigating the importance of a sector for local economic growth, policymakers are well advised not to draw conclusions solely from national or regional patterns, since local shocks tend to be smoothed as the level of geographic aggregation increases. Second, it is commonly believed that employment growth in service-based economies tends to be less volatile than in manufacturing-based economies. Our results indicate a large role for manufacturing in accounting for fluctuations in aggregate MSA employment growth, but we find that the service sector plays a substantial role as well.

Literature Review

To date, a considerable amount of research has examined the extent to which sectoral shocks contribute to aggregate economic fluctuations. A majority of the studies indicate that idiosyncratic shocks play an important role in employment and output variations at the aggregate

accounted for by idiosyncratic shocks.

level [e.g., Lilien (1982), Long and Plosser (1987), Davis and Haltiwanger (1990), Romer (1991), and Horvath and Verbrugge (1996).] Studies finding a smaller measured impact of sectoral shocks include Abraham and Katz (1986) and Caballero, Engel and Haltiwanger (1994). In reviewing the literature, Horvath and Verbrugge (1996) conclude that the relative importance of sectoral versus aggregate shocks yields a distribution of results roughly centered on 40-45 percent sectoral (p.7).

Recently this line of inquiry has been applied to regional, as opposed to national, economic activity. Norrbin and Schlagenhauf (1988), Clark (1998), and Clark and Shin (1998) employ one-digit industry data to gauge how much industry-specific shocks contribute to quarterly employment variation in each of the broad U.S. regions. Bayoumi and Prasad (1997) address the same question using annual GSP data. These studies indicate that industry-specific disturbances account for between 13 percent and 38 percent of total variation in regional activity. Altonji and Ham (1990) and Prasad and Thomas (1997) explore the issue using annual data on one-digit industry employment for Canadian regions and produce estimates that range from 12 percent to 68 percent.

As already indicated, by using annual or quarterly data as well as broad regional aggregates, these studies may have underestimated the impact of industry-specific shocks. One exception is the paper by Coulson (1999). He estimates a structural vector autoregression (SVAR) using monthly data on one-digit industry employment for four MSAs in order to measure the relative contributions of aggregate and structural shocks to employment growth. Coulson (1999) clearly shows a substantially larger role for sectoral shocks compared to previous studies that used quarterly or annual regional data. According to the variance decompositions presented in Table 3 in Coulson's article, idiosyncratic shocks account for 67-97 percent of 36-month-ahead forecast error variance in employment growth in the four MSAs he studied. He also finds that at the local level, manufacturing-, service-, and public-sector shocks account for a substantial portion of employment growth variation.

Empirical Framework

As with Coulson's (1999) effort, our study presents empirical evidence based on SVAR models of monthly one-digit industry employment at the MSA level. At the same time, our study differs from Coulson's analysis in four significant ways. First, our study provides evidence on several relevant issues not explored by Coulson, including the extent to which spatial and temporal aggregation affects the measured contribution of sectoral shocks to total employment variation, and the degree to which an MSA's interindustry dynamics magnify or dampen sectoral shocks.

Second, we employ an alternative strategy for identifying structural shocks in the estimated models. Coulson (1999) developed a novel and intuitive strategy, motivated by shift-share analysis. Essentially, for a specific MSA, his procedure restricts an industry's employment growth to reacting identically to employment shocks in each of the other industries. A strength of his approach is that each sector can be affected by all other sectors, although with an identical magnitude. A drawback is that these, and other, restrictions leave the model highly over-identified.[5] The present study, by contrast, adopts a variant of an identification procedure discussed in Horvath and Verbrugge (1996), one based on the strength of interindustry linkages. The method is employed so as to leave each of the SVARs exactly identified.

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[5]Coulson's (1999) approach results in 70 or more overidentifying restrictions, which are rejected.

The third difference concerns the selection of MSAs for study. Coulson (1999) examined sectoral employment growth in the Baltimore, Denver, Houston, and New York City MSAs. Our study analyzes sectoral employment data from the Chicago, Los Angeles, Oklahoma City, San Francisco, and Tucson MSAs. The selection of these five MSAs is motivated both by their long sample periods and by a desire to provide evidence that complements Coulson's.[6]

Finally, the empirical analysis explicitly incorporates measures of common, or national, economic shocks. Coulson's formulation has no independent aggregate shocks (the effects of aggregate shocks are captured by including the eight one-digit national industries in the SVARs for each MSA).

The model. We study the dynamic behavior of 9 x 1 covariance-stationary vectors, $X_{m,t}$:

$$X_{m,t} = (\Delta e_{m,1t}, \Delta e_{m,2t}, ..., \Delta e_{m,7t}, TBILL_t, PROD_t)', \quad (1)$$

where: t indexes months; m indexes MSAs; and Δe is the monthly log difference in employment; the numbers 1 through *7* refer to seven one-digit industries within the selected MSA. Two variables are included to capture national economic shocks: *TBILL* is the monthly change in the three-month T-bill rate, and *PROD* is the monthly growth rate of aggregate productivity. As in Horvath and Verbrugge's (1996) study, aggregate productivity is measured as national industrial production divided by total hours worked nationally.

[6] With the exception of the Chicago MSA, the data cover the period 1951:1 to 1999:8; for Chicago, the data begin 1952:1. In Coulson's (1999) study, the sample periods for Baltimore and New York City are roughly the same as ours, while the starting date for Denver and Houston is January 1970.

The vector AR representation of $X_{m,t}$ describes the system's dynamics subsequent to a shock and is expressed as:

$$(2) \qquad AX_{m,t} = B(L)X_{m,t-1} + \varepsilon_{m,t}$$

where A is a 9 x 9 matrix of coefficients describing the contemporaneous correlations among the variables; $B(L)$ is a 9 x 9 matrix of polynomials in the lag operator, L; and

$\varepsilon_{i,t} = \left[\varepsilon_{1,t}, \varepsilon_{2,t}, \cdots, \varepsilon_{9,t}\right]'$ is a 9 x 1 vector of structural disturbances, or primitive shocks, for each variable. Thus, each of the system's variables can be influenced by its own, idiosyncratic shocks and by shocks to all other variables. The matrices A and $B(L)$ determine how shocks to each variable are transmitted through the system, both contemporaneously (the A matrix) and in subsequent periods (the $B(L)$ matrix). To see this more explicitly, rewrite (2) as a reduced-form system:

$$(3) \qquad X_{m,t} = C(L)X_{m,t-1} + u_{m,t}$$

where $C(L) = A^{-1}B(L)$ is an infinite-order lag polynomial, and $\mu_{i,t} = A^{-1}\varepsilon_{i,t}$ describes the relationship between the model's reduced-form residuals and the model's structural residuals.

Estimation procedure and identification restrictions. The elements of $B(L)$ and A are estimated using Bernanke's (1986) two-step procedure. In the first step, OLS estimates of the reduced-form errors $\mu_{i,t} = A^{-1}\varepsilon_{i,t}$ are obtained for the dynamic simultaneous equation model (3). Sufficient restrictions are then placed on the variance-covariance matrix of structural errors and on the matrix of contemporaneous correlations, A, to achieve identification. Given estimates of A, estimates of $B(L)$ are derived from the relationship, $C(L) = A^{-1}B(L)$, where $C(L)$ comes from the estimated reduced-form (3). Estimates of A also allow estimates of the structural errors, ε_t, as implied by the relationship, $\mu_{i,t} = A^{-1}\varepsilon_{i,t}$.

Structural VAR models of the type used in this paper generally employ restrictions on the structural cross-equation variances, on the matrix of contemporaneous interactions (A), and on the matrix of long-run multipliers $\left[C(1)\right]$. The well-known rank condition requires N^2 restrictions to just-identify an $N-$equation system. After imposing nine $\left(N\right)$ normalizations, which are implemented by restricting the own structural variances to unity, another $N\left(N-1\right)$ restrictions are imposed to just-identify the model. Following usual SVAR practice, $N\left(N-1\right)/2$ additional restrictions are imposed by requiring zero covariances across the structural shocks. The remaining $N\left(N-1\right)/2$, or 36, restrictions impose values of zero on certain elements of the A matrix.

Eight restrictions are imposed by assuming that aggregate productivity shocks are unaffected contemporaneously by shocks to any other system variable. Another seven zero restrictions are obtained by assuming that the change in the three-month T-bill rate is unaffected contemporaneously by shocks to each industry's employment growth. Doing so is reasonable given the relatively small amount of employment in each sector within an MSA, compared to the national total. The remaining 21 restrictions are selected using a variant of an approach developed by Horvath and Verbrugge (1996).

Their methodology essentially rank-orders industry pairs by the magnitudes of the pairs' input-output coefficients. The relative sizes of the coefficients are assumed to measure the relative strengths of the connections between the industries' outputs. They then set a cut-off value for the coefficients, with all industry pairs having a coefficient value below the cut-off assigned a zero contemporaneous correlation. The cut-off value must be chosen arbitrarily and, in the Horvath and Verbrugge (1996) analysis, produced an overidentified model. The present study achieves a just-identified system by comparing the two direct input coefficients for each industry pair. The combination with the smaller coefficient is then assigned a zero contemporaneous correlation.

The procedure can be illustrated with reference to Table 1, which displays the 1996 one-digit industry-level direct requirements table, obtained by aggregating the published two-digit data from the national input-output table across the relevant sub-industry categories. Consider the industry pair manufacturing/construction. The two direct requirement coefficients are 0.3035 for manufacturing to construction, and 0.0067 for construction to manufacturing. For this case, our analysis assumes that construction has no contemporaneous effect on manufacturing, while manufacturing is permitted to affect construction contemporaneously. The procedure works well in that it allows zero restrictions to be imposed for relatively small direct requirement coefficients. Eleven of the coefficients that were zeroed out are less than 0.01, while 19 of the necessary 21 are less than 0.05. The highest coefficient value to be zeroed out is 0.07.

Data and Estimation Results

Data. The analysis employs monthly Bureau of Labor Statistics industry employment series for seven one-digit industries in each of five MSAs: construction; manufacturing; transportation, communications, and public utilities (TPU); wholesale and retail trade (Trade); finance, insurance, and real estate (FIRE); services; and government. One-digit industries are studied because a higher level of detail would increase the dimensionality to the point where estimation becomes infeasible.[7] Moreover, disclosure requirements limit the availability of MSA data even at the two-digit level of detail. The MSAs are Chicago, Los Angeles, Oklahoma City, San Francisco, and Tucson. These MSAs are chosen because monthly data are available over a long period of time, namely, early 1950s to October 1999 (see ft. 4). The maintained assumption is that the data are difference stationary with no co-integrating relationships among them. The Schwarz information criterion indicates that 12 is the optimal lag length for the SVAR system.

Before presenting the results from the VAR analysis, we need to show that the industrial structures of our five MSAs do, in fact, differ. Table 2 shows the share of total MSA employment accounted for by each one-digit industrial sector. The table shows that industry mix does differ across the five MSAs. For example, manufacturing accounts for 27 percent of total employment in the Chicago and Los Angeles MSAs but only 11 percent of Tucson's total employment. Government is responsible for 23 to 24 percent of total employment in Oklahoma City and Tucson, but only 12 percent of Chicago's total employment. Mining is relatively more important in Oklahoma City and Tucson, than in the other MSAs. There is less variation, however, in services' share of total employment across the five MSAs. Services' share of total MSA employment runs from a low of 18 percent in Oklahoma City to between 21 and 22 percent in the other MSAs.

Cumulative impulse responses. Charts 1 through 5 contain the cumulative impulse response functions for total MSA employment resulting from a one-standard-deviation positive shock to each of the variables in the system. The aggregate MSA response is an employment-

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[7] Other potential MSA-level economic variables, in particular personal income, are not studied because they are not available on a monthly basis.

weighted average of the MSA's industry responses. Each chart contains nine response functions indicating the dynamic path of total MSA employment after a one-standard-deviation shock to each industry variable and to the two national variables. The middle solid line represents the point estimate, while the two outer lines demarcate a 90 percent confidence interval.[8] Each graph also contains a dashed benchmark line that is explained below.

The results suggest several points. First, shocks to employment growth in most industries tend to have statistically significant and lasting effects on total employment growth within each of the MSAs studied. Second, certain consistencies emerge regarding the responses. In general, total MSA employment growth responds relatively strongly to shocks to manufacturing, construction, trade, and services, in terms of both magnitude and duration. Alternatively, employment responses to national shocks tend to be more much more muted, with productivity shocks having the smaller impact. In several instances, the responses to national shocks are not significantly different from zero. These findings are consistent with an explanation of aggregate MSA employment growth that emphasizes sectoral shocks over aggregate U.S. shocks.

Third, shocks to a variety of industry/MSA employment growth pairs tend to be magnified significantly through the systems' dynamics, although it is difficult to generalize. To reveal magnification effects, a dashed benchmark line is placed on each graph in charts 1 through 5. For the industry shocks, the benchmark is a constant equal to the standard deviation of that industry's employment growth shock times that industry's employment weight in the MSA. This

[8] Confidence intervals were developed using a variant of the simulation technique described in Runkle (1987). Essentially, the estimated reduced-form system was hit with mean zero random shocks, with variances coinciding with the estimated variance/co-variance matrix. The system was then simulated to generate a new set of observations, and the reduced form was re-estimated. Impulse responses were then computed using the new reduced-form errors and the A^{-1} matrix obtained from the Bernanke decomposition. This series of steps was then repeated 500 times. The confidence bands consist of the 5 percent and 95 percent fractiles of the simulated

product equals the initial impulse response of an MSA's employment in the absence of any system interaction (i.e., in the absence of industry interactions, a one-standard-deviation shock to an industry initially increases MSA employment by the shock times the industry's employment weight). Many of the industries deviate significantly from the benchmark for some period of time. In some cases, such as for both manufacturing and construction in Chicago, Oklahoma City, and Tucson, the magnifications of the initial responses are considerable.

The benchmarks for T-bill and aggregate productivity shocks must be created in a different manner because there is no direct proportional relationship between these shocks and MSA employment growth as there is between industry and MSA employment growth. For these national shocks, the benchmarks indicate the cumulative impulse response to the relevant shock, based on the orthogonal reduced-form variance/co-variance matrix that allows no contemporaneous interindustry effects. A comparison of the benchmark responses to the structural responses indicates whether the structural contemporaneous correlations magnify or diminish the initial responses. The estimates reveal that T-bill rate shocks are never magnified. Productivity growth shocks are magnified in both the Los Angeles and San Francisco MSAs, although the effects are transitory, lasting no more than 18 months.

Forecast error variance decompositions of MSA employment. Table 3 contains the forecast error variance decompositions of total MSA employment by contributing sector for horizons of one month, 12 months and 36 months. The results for each horizon lead to virtually identical qualitative conclusions and differ in magnitude by relatively small amounts. A noticeable aspect of the findings is the importance of shocks to government, manufacturing, and

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responses. Runkle's (1987) approach is basically the same except that it continually reshuffles and uses the original errors, rather than randomly drawing shocks from a distribution for use in each iteration, as was done in this paper.

services for overall MSA employment growth in four of the five MSAs. Manufacturing accounts for more than 30 percent of total employment growth variance in Chicago and Los Angeles and at least 17 percent in Oklahoma City, San Francisco, and Tucson.

Shocks to the service sector are also important, accounting for a double-digit share of total variance in four of the MSAs: Oklahoma City (24.3 percent), San Francisco (20.9 percent), Los Angeles (18.9 percent), and Chicago (13.0 percent). Shocks to the government sector are also important, accounting for a double-digit share of total variance in four of the MSAs: Tucson (32.3 percent), Chicago (16.3 percent), Oklahoma City (14.9 percent), and San Francisco (10.4 percent). Shocks to the trade sector account for a double-digit share of total variance in three MSAs: Oklahoma City (14.0 percent), San Francisco (10.3 percent), and Tucson (10.8 percent). Shocks to other industries generally account for relatively small proportions of total employment variance in the MSAs, the exceptions being construction and transportation, communication and public utilities in San Francisco (14.6 percent and 11.6 percent, respectively) and construction in Tucson (16.8 percent).

National shocks to an MSA's employment growth typically play a considerably smaller role than shocks to sectors within the MSA. The largest combined effect of the national shocks is 13 percent in Los Angeles; the smallest is 6.3 percent in Tucson. In three of the five MSAs (Chicago, Oklahoma City, and Tucson), national shocks explain less than 10 percent of the overall variance. Thus, impacts from national shocks appear to be minor. Table 3 also shows that the five MSAs in this study responded differently to T-bill rate shocks and to aggregate productivity shocks.[9]

Our results are broadly consistent with those of Coulson (1999), despite the different MSAs, time periods, and identifying restrictions employed. Coulson also found that much of the variance in an area's total employment growth is accounted for by employment growth variance in manufacturing, services, and government. He also found the variance in construction employment growth was important in Denver and Houston, as was the case for San Francisco and Tucson in the present study.

The impact of idiosyncratic and national shocks at the industry level. The previous results indicate that the vast majority of total employment growth variation in each MSA comes from industry employment shocks. It is possible, however, that although national shocks contribute a relatively minor amount of variance to total employment growth, these shocks might have a substantial impact on the variance of employment growth in particular industries.

To explore the issue, Table 4 presents an alternative view (by MSA and by sector) of the variance decompositions for the 36-month forecast horizon. The table contains two columns for each MSA. The first, titled "Own," reports the proportion of an industry's forecast error variance accounted for by its own shocks. The second column, titled "National," shows for each industry the combined fraction of forecast error variance contributed by the two aggregate shocks. The remaining proportion of an industry's forecast error variance (not shown) represents the fraction accounted for by all other local sectors.

The table entries show that the majority of each industry's 36-month forecast error

[9] The finding that MSAs responded differently to T-bill shocks supports the similar findings of Carlino and DeFina (1998) for the BEA regions.

variance is accounted for by its own shocks. The fractions due to own-sector shocks range from a low of 58.5 percent for trade in San Francisco to a high of 85.3 percent for FIRE in Chicago. National shocks generally contribute less than 10 percent of a given sector's employment variance. An exception is manufacturing in Chicago, Los Angeles, and San Francisco, where the combined national shock accounts for at least 11 percent of the 36-month-ahead forecast error variance. Once again, the measured impacts of national shocks on MSA employment growth are small.

The impact of regional aggregation. As was discussed earlier, the model of MSA employment growth suggests that increasing the level of regional aggregation (e.g., using regions rather than MSAs, or the nation rather than regions) should reduce the measured impact of industry shocks. The result is consistent with the law of large numbers. Evidence on this issue is provided by estimating two additional SVARs – one using industry data aggregated across the five MSAs studied in this paper and another using national industry data. I every other respect the aggregated empirical models are identical to the individual MSA models (i.e., same identifying restrictions, etc.).

Table 5 displays the combined fraction of the forecast error variance accounted for by the two national shocks at the 12-month, 24-month, and 36-six month horizons. There are seven entries for each forecast horizon--one each for the five disaggregated MSAs, one for the aggregated MSAs, and one for the nation. As predicted, the measured importance of national shocks grows as the level of aggregation increases. By the 36th month, the 16.7 percent contributed by national shocks to employment growth variance for the five-MSA aggregate exceeds the national contribution to each of the individual MSA's variance and is noticeably above the employment-weighted average contribution to the individual MSAs. The 41.1 percent contributed by national shocks to the national employment growth variance, in turn, is more than two-and-a-half times the share at the aggregated MSA level. Thus, the importance of industry-specific shocks decrease as the level of geographic aggregation increases.

Summary and Conclusion

This paper has presented evidence on the sources of variation in employment growth for seven one-digit industries in five different MSAs. Using just-identified structural VAR models, we find that within-MSA industry shocks explain considerably more of the forecast error variance in industry employment than do common national shocks. Consistent with the findings presented in Coulson (1999), the results show that the vast majority of industry employment growth variation arises from MSA-specific government-, manufacturing-, and service-sector employment shocks.

The results can also be usefully compared with results in the large literature on the importance of sectoral versus aggregate shocks for national economic cycles. In reviewing the literature, Horvath and Verbrugge (1996) conclude that the relative importance of sectoral versus aggregate shocks yields a distribution of results roughly centered on 40-45 percent sectoral (p.7). Horvath and Verbrugge's (1996) own analysis, using monthly data, indicates an even larger role for sectoral shocks—they account for 40-60 percent of the 24-month-ahead forecast error variance of monthly industrial production. Our study finds that spatial disaggregation leads to an even more significant role for sectoral shocks in accounting for employment growth fluctuations. We find that national shocks account for only between 6.3 percent and 13 percent of the forecast error variances of MSA employment growth.

Our results are potentially of interest to local policymakers. It is commonly believed that employment fluctuates more in local economies with a high share of manufacturing jobs, while local economies with a high share of service jobs tend to be relatively stable. Our findings bear out the first part of this belief: manufacturing is found to be the single most important source of employment fluctuations in Chicago and Los Angeles, the second most important source of variation in Oklahoma City and San Francisco, and the third most important source in Tucson. The second part is not so clear: the service sector was the single most important source of employment fluctuations in Oklahoma City and San Francisco, while it is the second most important in Los Angeles. Thus, local economies with a relatively large share of jobs in the service sector are not as immune to fluctuations in its overall employment as typically believed.

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Table 1*:* 1996 Input-Output Direct Requirements Matrix
(Standardized by total input amounts per unit of output)

Input *Output*	Const.	Mfg.	TPU	Trade	FIRE	Services	Govt.
Construction	0.0009	0.0067	0.0355	0.0073	0.0311	0.0084	0.0210
Manufacturing	0.3035	0.3590	0.0626	0.0466	0.0089	0.1016	0.0150
Trans., Communications, and Public Utilities	0.0258	0.0458	0.1595	0.0418	0.0220	0.0357	0.0177
Trade	0.0840	0.0624	0.0162	0.0213	0.0022	0.0211	0.0024
FIRE	0.0166	0.0170	0.0312	0.0652	0.1514	0.0703	0.0060
Services	0.0964	0.0592	0.1083	0.1252	0.0725	0.1449	0.0094
Government	0.0010	0.0012	0.0025	0.0065	0.0100	0.0068	0.0015

Table 2: Industry Mix and Location Quotients by MSA

Industry Mix

(Share of total MSA employment accounted for by each sector)

	CHICAGO	LOS ANGELES	OKLAHOMA CITY	SAN FRANCISCO	TUCSON	US
Government	**0.116**	**0.132**	**0.244**	**0.187**	**0.232**	**0.153**
Mining	**0.002**	**0.004**	**0.034**	**0.002**	**0.033**	**0.009**
Construction	**0.040**	**0.039**	**0.051**	**0.050**	**0.079**	**0.046**
Manufacturing	**0.272**	**0.267**	**0.123**	**0.151**	**0.112**	**0.223**
TPU	**0.069**	**0.059**	**0.062**	**0.093**	**0.061**	**0.057**
Trade	**0.226**	**0.224**	**0.244**	**0.225**	**0.224**	**0.281**
FIRE	**0.068**	**0.058**	**0.060**	**0.80**	**0.043**	**0.050**
Services	**0.207**	**0.217**	**0.181**	**0.213**	**0.217**	**0.180**

Table 3: Industry Contribution to MSA Forecast Error Variance
(Fraction of total MSA error variance at indicated horizon)

Source of Variance	Chicago			Los Angeles			Oklahoma City			San Francisco			Tucson		
	1 month	12 month	36 month	1 month	12 month	36 month	1 month	12 month	36 month	1 month	12 month	36 month	1 month	12 month	36 month
Government	0.189	0.180	0.163	0.081	0.056	0.056	0.172	0.150	0.149	0.103	0.105	0.104	0.398	0.336	0.323
Construction	0.050	0.059	0.073	0.071	0.070	0.079	0.045	0.058	0.065	0.174	0.146	0.146	0.146	0.171	0.168
Manufacturing	0.377	0.360	0.326	0.332	0.377	0.345	0.244	0.216	0.210	0.203	0.188	0.184	0.184	0.178	0.173
Trans., Comm., and Utilities	0.075	0.069	0.075	0.049	0.055	0.059	0.066	0.074	0.076	0.120	0.117	0.116	0.059	0.062	0.063
Trade	0.101	0.084	0.079	0.096	0.076	0.083	0.143	0.140	0.140	0.094	0.104	0.103	0.110	0.112	0.108
FIRE	0.016	0.036	0.064	0.026	0.054	0.059	0.038	0.048	0.048	0.016	0.022	0.026	0.014	0.024	0.024
Services	0.183	0.138	0.130	0.295	0.211	0.189	0.286	0.249	0.243	0.232	0.214	0.209	0.083	0.078	0.079
3-month T-bill	0.010	0.065	0.079	0.006	0.047	0.066	0	0.025	0.026	0.011	0.038	0.043	0.005	0.015	0.019
Productivity Growth	0	0.010	0.011	0.043	0.054	0.064	0.006	0.040	0.043	0.048	0.067	0.068	0.003	0.025	0.044

Table 4: Sources of Sectoral Forecast Error Variance
(Fraction of variance at the 36-month horizon)

Source / Sector	Chicago		Los Angeles		Oklahoma City		San Francisco		Tucson	
	Own	National	Own	National	Own	National	Own	National	Own	National
Government	0.752	0.064	0.764	0.069	0.669	0.080	0.758	0.075	0.814	0.036
Construction	0.756	0.078	0.774	0.062	0.728	0.063	0.784	0.052	0.777	0.066
Manufacturing	0.654	0.112	0.669	0.146	0.812	0.081	0.711	0.134	0.785	0.052
Trans., Comm., and Utilities	0.724	0.067	0.775	0.046	0.819	0.022	0.823	0.040	0.838	0.032
Trade	0.622	0.069	0.599	0.070	0.650	0.046	0.585	0.112	0.724	0.068
FIRE	0.853	0.028	0.701	0.091	0.747	0.050	0.739	0.038	0.748	0.054
Services	0.773	0.043	0.761	0.079	0.769	0.079	0.787	0.067	0.790	0.047

Table 5: National Shock Contribution to Forecast Error Variance
(Fraction of total employment error variance at indicated horizon)

Forecast Horizon	Chicago	Los Angeles	Oklahoma City	San Francisco	Tucson	Five-MSA Aggregate	Nation
12 months	0.075	0.101	0.065	0.105	0.039	0.137	0.446
24 months	0.091	0.127	0.068	0.108	0.063	0.168	0.412
36 months	0.090	0.130	0.069	0.111	0.063	0.167	0.411