

AN INVESTIGATION INTO THE NATURE OF STRUCTURAL CHANGES WITHIN THE SERVICE SECTOR IN THE U.S.

Mohsen Attaran and Dennis Guseman, California State College, Bakersfield

ABSTRACT

Services are the fastest growing sector of the economy, yet relatively little study of this sector has taken place. Information about structural changes within services is needed to help formulate sound public policy regarding this area. This study investigates the changes in employment concentration for eleven service sectors over a thirteen-year period. The service sector was found to be fairly diverse but stable in employment over the period of study. Although the overall service area was stable, a great deal of change has occurred within the individual service sectors.

INTRODUCTION

Economic theory predicts that as a society advances it will proceed from an agrarian, to manufacturing, to service economy (Clark 1957, Foote 1953). The current popular business literature (Toffler 1980, Naisbitt 1982) and current employment, GNP, and personal consumption expenditure statistics would indicate that the United States has arrived at the third stage and would be considered as being economically services oriented.

The purpose of this paper is to identify interindustry (sectoral) diversification (concentration) patterns and structural changes occurring within services sectors as a whole, within given subsets of services and between subsets of services. In this investigation, entropy measure was applied to the amount of employment within services sectors of the economy for the 13-year period from 1972 to 1984. The period since 1972, was selected as the data for 3-digit SIC are consistent.

MEASURE OF DIVERSITY

Shannon's entropy function is used as a measure of diversity. Entropy as a measure of disorder, uncertainty, and homogeneity has been used to measure diverse phenomena.

The entropy measure has been invoked in empirical studies in economics as well as management, marketing, finance, and accounting (Herniter, 1973; Philippatos and Wilson, 1972, 1974; Lev, 1968, 1970).

As it is applied to the United States estimate of employment data of services, the entropy measure of diversification  $D(E_1, E_2, \dots, E_n)$  is defined as follows:

$$D(E_1, E_2, \dots, E_n) = - \sum_{i=1}^n E_i \log_2 E_i \quad (1)$$

where  $n$  = the number of service sectors (SIC's), and

$E_i$  = the proportion of total employment of the U.S. that is located in the  $i$ th service sector.

The most important properties of the above measure are:

- the maximum value of  $D$  is attained when the  $E_i$  are all equal. This is the case where all service sectors have an equal share and concentration is at a minimum.
- $D = 0$  when only one of the  $E_i = 1$  and the remaining are 0. This is an extreme case where the service activity of a region is concentrated in only one sector.

The entropy measure as it is formulated in equation (1) can be disaggregated into its between-set and within-set aspects to analyze the nature of diversity (Thiel 1972). The 45 service sectors of the U.S. ( $i = 1, 2, \dots, 45$ ) have been divided into eleven separate groups or sets:  $S_g$  ( $i \in S_g, g = 1, 2, \dots, 11$ ). (Table 1 illustrates this division.) The employment share of set  $S_g$  is then

$$E_g = \sum_{i \in S_g} E_i \quad g = 1, \dots, G$$

The entropy index of diversity within each of the  $G$  sets can be measured by:

$$D_w(E) = - \sum_{i \in S_g} E_i/E_g \log_2 E_i/E_g \quad (2)$$

Representing each set's relative share of the total trade employment by  $E_g/E_s$ , where  $E_s$  is total trade employment, the entropy measure of diversification between the  $G$  sets may then be expressed as:

$$D_b(E) = - \sum_{g=1}^G E_g/E_s \log_2 E_g/E_s \quad (3)$$

Weighting the result of Equation 2 by the relative share of each set yields:

$$D = - \sum_{g=1}^G E_g/E_s - \sum_{i \in S_g} E_i/E_g \log_2 E_i/E_g \quad (4)$$

which is the total measure or summation of diversity within the  $G$  sets.

TABLE 1  
Classification of Service

Sector	Sector Name	No. of Industries in Group
S <sub>1</sub>	Transportation	8
S <sub>2</sub>	Communication	2
S <sub>3</sub>	Utilities	4
S <sub>4</sub>	Banking and Financial	4
S <sub>5</sub>	Insurance	3
S <sub>6</sub>	Real Estate	3
S <sub>7</sub>	Personal Services	3
S <sub>8</sub>	Business Services	8
S <sub>9</sub>	Medical and Health Care	4
S <sub>10</sub>	Education	2
S <sub>11</sub>	Entertainment	4
	Total	45

The total entropy measure of economic diversity for the wholesale and retail trade can be obtained by summing Equations 3 and 4:

$$D(E) = - \sum_{g=1}^G E_g/E_s \log_2 E_g/E_s + \sum_{g=1}^G E_g/E_s \left( - \sum_{i \in S_g} E_i/E_g \log_2 E_i/E_g \right) \quad (5)$$

This disaggregation of entropy into its between-set and within-set aspects, where  $G = 11$  is carried out and the results are presented in the following sections.

#### RESULTS

Using equation (1), the diversity indices of service employment were calculated for the U.S. for the thirteen-year period from 1972 to 1984, and the results are presented in Table 2. Calculation of the entropy measure is based on employment data from 45 service sectors (3-digit SIC). The value  $E_i$ , which measures the  $i$ th service sector's relative share of employment for a given year, is calculated from the BLS series, Employment and Earnings, States and Areas. Since there are 45 sectors, the maximum value of  $D = \log_2 45 = 5.49$ . The diversification values would then range from 0 to 5.49, with a diversification value of 5.49 denoting the greatest diversification (lowest concentration) among the forty-five services sectors of the country. Looking at Table 2, we see that total entropy remain almost constant. There is no evidence of any trend revealed by the total entropy indices of services employment.

The between-set entropy measure which results from applying equation (3) is also presented in Table 2. The between-set measure merely identifies the extent to which the United States' services employment is distributed equally between the eleven services sets. There is a trend towards greater between-set concentration over the thirteen-year period ( $t = 15.49$ , signi-

ficant beyond .001). This indicates an increase in size disparity between these eleven sets of firms.

The within-set entropy measures for the eleven groups of services produced from applying equation (2) is presented in Table 2. The within-set measure represents the application of the entropy measure to eleven groups of services treated independently. There is evidence in Table 2 of a trend toward increasing concentration within the transportation set, utilities, real estates, business services, education, and entertainment. However, Table 2 shows a trend toward increasing diversification within the services set of communication, banking, insurance, personal services, health care, and education.

We have seen that the maximum value of entropy equal 5.49. for the years 1972 and 1984 we calculated actual entropy as a percent of maximum entropy. This provides a better understanding of what has been happening to relative concentration (diversification). These results are given in Table 3. In interpreting Table 3, it must be kept in mind that when actual entropy as a percent of total entropy falls, relative concentration rises. Table 3 reveals not much change in the total entropy over the period 1972-1984. With regard to the between-set diversification, there has been a 1.93% decline.

This indicates that during the period of the study, there has been an increase in size disparity between these eleven groups of services. Among the eleven groups, communication and health care show a change of more than 2.5%. Utilities show a change of less than .05%. The rest of the groups show a change of between 1.0 to 2%.

The weighted within-set entropy measures of the eleven groups reflect each group's contribution to the degree of economic diversification within the total services. There was evidence of a trend toward decreasing contribution of transportation group, utilities, insurance, real estate, personal services, education, and entertainment. However, there was a trend toward increasing contribution of banking and financial group, business services, and medical and health care sector to the degree of economic diversification within the total services sectors.<sup>2</sup> There was no trend revealed by the weighted-within entropy of the communication set ( $t = .32$ , not significant). In applying equation (4), the weighted within-set measures for the two groups were summed to yield the total weighted within-set entropy measure. There was evidence of a trend toward increasing diversification

<sup>1</sup> The t-test of the slopes indicate a statistically significant relationship beyond the .01 level.

<sup>2</sup> The t-test of the slopes indicated a statistically significant relationship beyond the .01 level.

TABLE 2

A DISAGGREGATED ENTROPY MEASURE OF EMPLOYMENT DIVERSITY, U.S. SERVICES, 1972-1984  
(MATRIX OF DIVERSITY WITHIN EACH SECTOR)

Year	Total Entropy	Between-Set Entropy	Within Set Entropy										
			Transp.	Commun.	Utilit.	Banking Finan.	Insur.	Real Estate	Personal Services	Business Services	Health	Educat.	Entert.
1972	4.8764	3.2772	2.1735	.5571	1.7347	1.4031	1.3530	1.4606	1.2865	2.7912	1.5161	.8409	1.4409
1973	4.8761	3.2647	2.1625	.5525	1.7337	1.3938	1.3634	1.4621	1.3072	2.7817	1.5492	.8427	1.4297
1974	4.8642	3.2498	2.1623	.5571	1.7300	1.3545	1.3773	1.4328	1.3327	2.7711	1.5658	.8430	1.4281
1975	4.8481	3.2337	2.1825	.5785	1.7364	1.3435	1.3929	1.4138	1.3513	2.7784	1.5763	.8222	1.4167
1976	4.8424	3.2216	2.1524	.5935	1.7347	1.3500	1.4037	1.4072	1.3536	2.7785	1.5883	.8005	1.4208
1977	4.8434	3.2134	2.1246	.6074	1.7297	1.3589	1.4087	1.4042	1.3536	2.7707	1.5953	.8058	1.4327
1978	4.8463	3.2101	2.0984	.6232	1.7266	1.3645	1.4139	1.4072	1.3592	2.7659	1.5989	.8095	1.4434
1979	4.8623	3.2113	2.0874	.6159	1.7279	1.3737	1.4115	1.4394	1.3513	2.7481	1.6208	.8343	1.4198
1980	4.8574	3.2036	2.1172	.6248	1.7166	1.3729	1.4147	1.4354	1.3561	2.7453	1.6205	.8662	1.3799
1981	4.8474	3.1919	2.1152	.6390	1.7155	1.3924	1.4119	1.4198	1.3616	2.7413	1.6151	.8724	1.3728
1982	4.8373	3.1815	2.1176	.6565	1.7100	1.3894	1.4099	1.4023	1.3647	2.7588	1.6209	.8853	1.3658
1983	4.8472	3.1711	2.0907	.6992	1.7010	1.4318	1.4161	1.4072	1.3656	2.7536	1.6406	.8872	1.3665
1984	4.8716	3.1710	2.0711	.7127	1.7090	1.4697	1.4298	1.4152	1.3577	2.7273	1.6647	.8944	1.3482

TABLE 3

## MATRIX OF ACTUAL WITHIN-SET ENTROPY AS PERCENT OF MAXIMUM ENTROPY

Year	Total Entropy	Between-Set Entropy	Within Set Entropy										
			Transp.	Commun.	Utilit.	Banking Finan.	Insur.	Real Estate	Personal Services	Business Services	Health	Educat.	Entert.
1972	88.79	59.67	39.58	10.14	31.59	25.55	24.64	26.60	23.43	50.83	27.61	15.31	26.23
1984	88.71	57.74	37.71	12.98	31.12	26.76	26.04	25.77	24.72	49.66	30.31	16.29	24.55

revealed by the total weighted within-set entropy measure.

When the ratios of actual weighted within-set entropy as percent of maximum entropy were calculated, the total weighted within-set measure showed a change of 1.85%. Among the eleven groups, business service showed the highest change (increase of 2.66% to the degree of diversification within services) followed by transportation (decrease of 1.85%) and health (increase of 1.74%). There was not much change in weighted within-set entropy for any of the rest of the eleven groups.

## CONCLUSIONS

This study has shown that from a macro perspective the service sector has remained fairly stable over the period of study. However, several points need to be made. First, the service sector is relatively diverse in terms of employment, achieving approximately 89% of total possible entropy. Thus, in terms of employment, services seem to be fairly equally distributed in size. yet, this study also showed a shift towards an increased disparity in size for the service sector.

A second point to be made from the study is that even in light of a stable situation for overall

services, this is not true for the individual groups of services. This overall stability is due to the fact that some service sectors are becoming more concentrated while other services are becoming more diverse. Those services becoming more concentrated, i.e. a trend for some firms to hire a disproportionate number of employees, are transportation, entertainment, business services, real estate, and utilities. Communications, medical and health care services, personal services, banks and financial services, insurance, and education are becoming more diverse, i.e. more of an equality in terms of the employment of the various companies. The transportation, business services, and the medical and health care services are the sectors accounting for the largest percent of change. Many changes are occurring within the transportation and health care sectors due to deregulation. Business services and health care have also experienced changes due to a more aggressive application of marketing practices which may account for these results.

This study has shown that entropy measures can be applied as a means of monitoring economic activity within the service sector. Given the growing role of services within the economy it is important to monitor structural changes within this sector to develop sound public policy.

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