

AN EXAMINATION OF DURKHEIM'S CONCEPTS, MATERIAL
DENSITY AND DYNAMIC DENSITY

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CHAPTER I

STATEMENT OF PROBLEM

This thesis problem is concerned with a further examination of two theoretical constructs of Emile Durkheim, variously translated as physical (or material) density and dynamic (or moral) density. These concepts are first formulated by Durkheim in his work, De la division du travail social (1893).¹ He later extends the sociological significance of them in Les Règles de la methode sociologique (1895).²

Durkheim's apparent ambiguity and inconsistency in presenting the two densities in the theory of the division of labor has been of interest to a number of writers in the field. This thesis problem, however, will not deal with Durkheim's complete theoretical formulation of the division of labor, but only with what he calls material density and dynamic density and with the interrelationships between these two concepts. An attempt will be made to clarify the meanings of material density and dynamic density and to specify to an empirical situation these components of Durkheim's theory.

¹Emile Durkheim, De la division du travail social: etude sur l'organisation des societees supereures (Paris, 1893); translated as The Division of Labor in Society by George Simpson, (New York, 1933). All citations hereafter refer to the 1964 paperback edition of Simpson's translation.

²Emile Durkheim, Les Règles de la methode sociologique (Paris, 1895); translated as The Rules of Sociological Method by Sara Solovay and John H. Mueller and edited by George Catlin, (Glencoe, Ill., 1950). All subsequent citations to The Rules . . . refer to the 1964 paperback edition of this translation.

In Durkheim's thinking, material density and dynamic density are contained within his concept of social morphology. This conceptual approach maintains Durkheim's insistence that social phenomena must be explained not in psychological terms but in social facts. The elements which constitute this human milieu are things and persons and their disposition in space, or what he terms internal environment. Social morphology, therefore, includes: (1) the study of the geographical base of peoples in its relation to social organization and (2) the study of population, its volume, density, and the way it is disposed over the soil.³

The first objective of this thesis is to propose some empirical indices or at least indicators of the two types of density based on Durkheim's writings and to check by statistical means the relative appropriateness of these indices. An index is defined as a measure or a set of measures for a selected group of units, which is used to measure indirectly a characteristic that is not directly measurable.⁴ The term indicator, as used here, refers to a tentative index.

The unit selected for the analysis is the Standard Metropolitan Statistical Area, of which the 1960 United States census includes a total of 212. The second objective is to apply statistical analysis to test whether there may be a difference as indicators of division of labor between the two types of density as implied in certain statements of Durkheim, or whether they may be essentially equivalent

³Emile Durkheim, "Sociologie et sciences sociales," (1909), cited by Harry Alpert, Emile Durkheim and His Sociology (New York, 1939), p. 51.

⁴Margaret Hagood and Daniel Price, Statistics for Sociologists (New York, 1952), p. 138.

as implied in certain other statements.

In the theory of the division of labor, Durkheim posits that in a heterogeneous and complex society individuals and groups have become differentiated with respect to function and united in an organic type of solidarity. He suggests that the division of labor through which this evolution comes about is caused by an increase in and concentration of population numbers (i.e. material density) and a consequent increase in commercial and social interaction (i.e. dynamic density).⁵ Durkheim takes particular pains to set forth the differences between the two types of density in the theory of the division of labor. There is, however, some shift of viewpoint between The Division of Labor and the subsequent Rules of Sociological Method, in which he extends the sociological significance of material density and dynamic density.

In Chapter two of The Division . . . Durkheim attempts to establish the cause for the division of labor. He states:

The division of labor develops, therefore, as there are more individuals sufficiently in contact to be able to act and react upon one another. If we agree to call this relationship and the active commerce resulting from it dynamic or moral density, we can say that the progress of the division of labor is in direct ratio to the moral or dynamic density of society.⁶

Durkheim further indicates that this relationship can only come about if the distance between individuals is diminished, and that dynamic density cannot grow unless material density grows at the same time. In the systematic treatment of the problem, Durkheim concludes that the following proposition can be formulated:

⁵Durkheim, The Division . . ., pp. 256-262.

⁶Ibid., p. 257.

. . . The division of labor varies in direct ratio with the volume and density of societies, and, if it progresses in a continuous manner in the course of social development, it is because societies become regularly denser and generally more voluminous.⁷

It is also in the chapter on the causes for division of labor that Durkheim suggests that one can usually substitute physical density for dynamic density, but that they are not inevitably correlated. In relation to material density, he states:

Since this visible and measurable symbol reflects the variation of what we have called moral density, we can substitute it for the latter in the formula we have proposed.⁸

Durkheim also suggests in the same work that this posited relationship is not always so and that there are exceptional cases where material density and dynamic density are not in accord. To clarify, he suggests that the case of England is an example in which this discrepancy exists. Here he points to the fact that the division of labor, notably the economic division of labor, is strongly pronounced, but that the autonomy of local life and regional spirit still exists (that is, material density is greater than the coalescence or interaction of units or dynamic density).⁹

⁷Ibid., pp. 262-263. Durkheim credits Comte with the original reference to this relationship. He states: "On this point, we can still rely on Comte as authority. 'I must', he said, 'now indicate the progressive condensation of our species as a last general concurrent element in regulating the effective speed of the social movement . . . we see that it is not a question here of the absolute increase of the number of individuals, but especially of their more intense concourse in a given space.' Cours. IV. p. 455."

⁸Ibid., p. 260.

⁹Ibid., p. 282.

In The Rules . . . he again stresses a close association between the two densities and implies that one can stand for the other. Re-emphasizing this point, Durkheim states:

The principal task of the sociologist ought to be . . . to discover the different aspects of this milieu, which can exert some influence on the course of social phenomena. Until the present, we have found two series of facts which have eminently fulfilled this condition; these are: (1) the number of the social units or, as we have also called it, the size of society; and (2) the degree of concentration of the group, or what we have termed the dynamic density. By this last expression must not be understood the purely physical concentration of the aggregate, which can have no effect if the individuals, or rather the group of individuals, remain separated by social distance.¹⁰

The relation between material density and dynamic density still apparently troubles him, for later in The Rules . . . he repeats the idea in the form of an apology for confusing the two and implies again that substituting one for the other is entirely legitimate for measuring the economic division of labor. He states:

. . . we would lay ourselves open to serious error if we always judged the social concentration of a society by the degree of its physical concentration. Roads, railroads, etc. can serve for commerce better than for fusion of population of which they are only a very imperfect index.¹¹

The discrepancy resulting from Durkheim's presentation of material density and dynamic density indicates not only the basis, but the need for clarification of these concepts. This thesis is limited to such a clarification and does not attempt to deal with the causal connection of these concepts with the theory of division of labor.

¹⁰Durkheim, The Rules . . . , p. 114.

¹¹Ibid., p. 115.

CHAPTER II

A REVIEW OF DURKHEIMIAN COMMENTARY ON MATERIAL DENSITY AND DYNAMIC DENSITY

Among the commentaries of Durkheim's work, several criticisms of his apparent emphasis on the central significance of population are noted. Benoit-Smullyan's analysis of Durkheim's approach to the division of labor suggests strong biological overtones. According to Benoit-Smullyan, Durkheim disposes of psychologistic and individualistic explanations for the division of labor but submits his own morphological approach (that is, material density and dynamic density). Accordingly, the increase in population numbers intensifies competition and hence specialization in order for individuals to survive. Benoit-Smullyan implies that Durkheim rests his "entire explanation upon the factor of an assumed increase in population" and, thus, assumes that this is a biologicistic explanation rather than a social one.¹

With a caustic criticism of the sociologicistic school, Pitirim Sorokin arrives at the same conclusion. He assumes that Durkheim's explanation for the division of labor is dependent on procreation and multiplication of population. Sorokin indicates that Durkheim's

¹Emile Benoit-Smullyan, "The Sociologism of Emile Durkheim and his School," An Introduction to the History of Sociology, ed. Harry Elmer Barnes (Chicago, 1948), p. 508.

answer is, therefore, dependent on the biological factor, increase in population, and nothing more. In other words, only material density is causally significant.²

By examining Harry Alpert's treatment of the problem it becomes evident that Durkheim's writings can be interpreted in a number of various ways. Alpert, in attempting to establish the causality in Durkheim's theory of the division of labor, suggests that moral density (or dynamic density) may be restated in a less equivocal expression by calling it "the degree of social interaction."³ Alpert then attempts to delineate the factors contained in this expression and to establish a causal relationship by indicating that the cause of the division of labor is the actual increase in the degree of social interaction.⁴ According to Alpert, this is a preliminary and tentative statement of causal connection based on the empirical data adduced by Durkheim in The Division Alpert criticizes Durkheim, however, for confusing material density and dynamic density, the primary focus of this objection being Durkheim's later reference to the proposition: "The division of labor varies in direct ratio with the volume and density of societies" ⁵ In his opinion, the words are Durkheim's but the spirit is not. Alpert concludes that if this statement is accepted at face value, Durkheim's explanation of the division of labor is contrary to his own

²Pitirim Sorokin, Contemporary Sociological Theories (New York and London, 1928), p. 480.

³Alpert, p. 90.

⁴Ibid.

⁵Ibid.; also supra, Chap. I, p. 3.

methodological principle of social facts being explained socially. Alpert concludes, "It is no wonder, then, that his book has been qualified as Malthusian."⁶ One does not know whether this difference in meaning is a result of semantics or whether it simply arises from difficulty in trying to establish a causal level of analysis.

In a seminal article by Leo Schnore, to which this thesis is greatly indebted, Schnore maintains that the confusion between material density and dynamic density is a point widely misunderstood and misinterpreted.⁷ Schnore views dynamic density as the significant factor and suggests that dynamic density may be better understood if treated as an intervening variable between material density and the division of labor. (See Table I.)

TABLE I
SCHNORE'S REFORMULATION OF DURKHEIM'S PROBLEM

Independent Variable	Intervening Variable	Dependent Variable
material density	dynamic density	division of labor
or	or	or
size of population; population concentration	commercial interaction; social interaction	specialization; differentiation

In addition he proposes that Durkheim rejects any single-factor explanation. According to Schnore, Durkheim does not assume the

⁶ Alpert, p. 91.

⁷ Leo Schnore, "Social Morphology and Human Ecology," American Journal of Sociology, LXII, (1957-1958) pp. 624-625.

Spencerian position that population growth is the determining cause for the division of labor. Instead, Schnore maintains that Durkheim clearly indicates that differentiation will accompany growth only if interaction increases concomitantly. This intensification of interaction is viewed as a result of technological changes that facilitate contact, exchange and communication.⁸ Schnore, moreover, attempts to show that those factors and concepts with which Durkheim was working are clearly sociological. He suggests that the concepts material density and dynamic density both refer to interaction and thus can not be referred to as intrinsically biological constructs.⁹

Following the lines of Schnore, Robert Bierstedt attempts to show that the two types of density are markedly different. Bierstedt indicates that Durkheim's material density is simple population density and the degree of population dispersion and concentration in a given society. He points out, as does Durkheim, that concentration of population brings about increased interaction among people and new ways of transportation and communication which serve to decrease the segmentation of society.¹⁰ According to Bierstedt, this is a density

⁸Ibid. Moreover, Schnore asserts that most Durkheimian critics do not give credit to the fact that "changes in effective population size need not depend upon natural increase or decrease." Schnore suggests two organizational (social) changes that can also be responsible for change in population size: (1) "fission" whereby a whole segment of community moves off to establish a new community or colony and (2) "fusion" or growth by merger which is seen as the opposite form of the splitting-off process. Also, see The Division . . ., p. 258.

⁹Ibid., p. 265.

¹⁰This is also a point stressed by Schnore. It would appear that Durkheim considered "the extended lines of transmission and communication" as a component of material density, but this relationship is not clear in Durkheim's writings. See The Division . . ., pp. 259-260.

of a different kind which Durkheim terms moral density and sometimes uses synonymously with social volume. As Bierstedt views Durkheim's explanation, societies become more voluminous as they advance, and there is a subsequent increase in division of labor. Bierstedt further clarifies the problem by stressing that the increasing density not only permits an increase in division of labor, but actually necessitates it.¹¹

In concluding this review of commentary on Durkheim's writing, reference should be made to an earlier analysis of Durkheim's theory of the division of labor by Robert K. Merton, who views certain parts as biological but also emphasizes the socially significant components. He attempts to point out that Durkheim did not abandon his sociological approach. Merton says that Durkheim finds the determining cause of the division of labor to be the increase and heightened density of population which is labeled as a biological factor. He maintains that it is only in so far as this demographic change is associated with increased social interaction (e.g., competition) that this change will occur. He states, "It is thus this social factor--'the dynamic density' as he terms it--which Durkheim finds actually determinent."¹² Merton is inclined to view the heightened interaction and exchange as the sociologically significant factor and suggests that the oversimplified analysis which attributes increased division

¹¹Robert Bierstedt, Emile Durkheim, ed. Edgar Johnson (New York, 1966), p. 103.

¹²Robert K. Merton, "Durkheim's Division of Labor in Society," American Journal of Sociology, XL, (1934), pp. 325-326.

of labor solely to demographic or biological explanations should be reexamined.¹³

A review of the commentary concerning the relationship between material density and dynamic density indicates not only a number of different interpretations, but also a certain amount of confusion. It is the purpose of this thesis to examine the relationship between material density and dynamic density.

¹³Ibid. In addition, a recent and interesting position concerning the causal priority of the concepts material density, dynamic density and the division of labor has been taken by Che-Fu Lee (unpublished report given in seminar, Oklahoma State University by Che-Fu Lee, Durkheim's Causal Priority in Explanation, February, 1967). Lee reverses Schnore's position and suggests that material density is the manifest expression of dynamic density. He uses mathematical reasoning and suggests that this position is valid if Durkheim's position on social facts is valid.

CHAPTER III

METHODOLOGY

The methodology employed in this thesis is based on the two objectives of the problem: (1) to establish empirical indices based on Durkheim's writings of the two types of density and to check, by statistical means, the relative appropriateness of the indices; and (2) to test whether there is or is not a difference between material density and dynamic density as indicators of division of labor. The concept of division of labor is used only in its relationship to material density and dynamic density.

It should be noted that in Durkheim's description of the two types of density and their relationship to the division of labor, size is an integral part. Durkheim is referring to this relationship when he suggests that moral density cannot grow unless material density grows at the same time. He states, "It is useless to try to find out which has determined the other; they are inseparable."¹

Because of Durkheim's stress on the interdependence of size and the other theoretical concepts to be dealt with here, any attempt to measure independent relationships among the latter must control for the former. This logic is reinforced by a set of exploratory correlations of the tentative indices with size held constant. The results of these correlations indicate that although the factor of size

¹Durkheim, The Division, p. 258.

affects the numerical value of the correlation coefficients, the indices are differentiated and can serve to measure the theoretical concepts.² Even though these indices appear to be at least semi-independent, size must still be controlled. This is accomplished by utilizing partial correlation analyses.

Selection of Unit of Analysis

Standard Metropolitan Statistical Areas in the United States are the units of analysis. It can be inferred from Durkheim's writings that the reference of density is to the city.³ The S.M.S.A. is preferable to other urban units for which data are separately available because it represents a functional social and economic community not defined by arbitrary political lines of demarcation. According to the census definition of the S.M.S.A., ". . . it is necessary to consider as a unit, the entire population in and around a city, the activities of which form an integrated economic and social system."⁴ Another consideration in the selection of the S.M.S.A. is that the total 212 listed by the Bureau of Census range in size from 73,000 to 10,000,000 and represent a sufficient variation to test the hypotheses. Because of inadequate data, three S.M.S.A.'s will be omitted.⁵ The revised total of 209 is used

²See Appendix A.

³Durkheim, The Division . . . , p. 258; Durkheim, The Rules . . . , p. 116.

⁴United States Bureau of the Census, Census of the Population, United States Summary, General Social and Economic Characteristics, 1960, P.X.

⁵Incomplete data is found for three S.M.S.A.'s located in Connecticut: Meriden, New London--Groton--Norwich, and Norwalk. U. S. Bureau of the Census, Statistical Abstracts, County and City Data Book, 1962.

instead of a sample not only because it provides sufficient variation in size, but also because it offers a large enough number to increase confidence in statistical measurements.

Selection of Indices

Two indices have been initially chosen for each of the theoretical components of Durkheim's theory of the division of labor. (See Table II.) In the preliminary selection of indices for material density,

TABLE II
REPRESENTATION OF THE COMPONENT CONCEPTS OF DURKHEIM'S
THEORY OF THE DIVISION OF LABOR AND THE
TENTATIVE SELECTED INDICES

C O N C E P T S		
<u>MATERIAL DENSITY</u>	<u>DYNAMIC DENSITY</u>	<u>DIVISION OF LABOR</u>
Size of population numbers per unit	Extent of social and commercial contact per unit	Degree of differentiation and specialization per unit
Extent of transportation and communication per unit		

T E N T A T I V E I N D I C E S		
Population numbers per S.M.S.A.	Volume of wholesale sales per S.M.S.A.	Number of males employed as professionals, technical, and kindred workers per S.M.S.A.
Number of workers employed in transportation and communication per S.M.S.A.	Volume of demand bank deposits per S.M.S.A.	Number of males employed as craftsmen, foremen and kindred workers per S.M.S.A.

the writer relies primarily on Durkheim's statements concerning the

concentration of population, especially in cities, and the development of more rapid and more numerous means of transportation and communication. He states:

As for physical density--if it is understood thereby not only the number of inhabitants per unit area, but the development of communication and transmission--it progresses ordinarily, at the same rate as the dynamic density and in general can serve to measure it.⁶

According to Durkheim, these factors of increased material density, by suppressing or diminishing the gaps separating social segments, "increase the dynamic density of society."⁷

It is the opinion of this writer that population size and concentration as stated in Durkheim's writings are combined, referring to the progressive condensation of societies, that is, the concentration of not only population numbers but of commercial-social units as well. In a more technical sense, such combinations of size and concentration are found in the formation of urban conglomerates connected to regional hinterlands and to each other by lines of transportation and communication. Although the transportation lines referred to at the time of Durkheim's writings were primarily roads, the number of workers employed in transportation and communication will be used here. This index is justified on the premise that it offers a cross-section of all the current means of transportation and communication.⁸

⁶Durkheim, The Rules . . . , p. 114.

⁷Durkheim, The Division . . . , p. 258.

⁸An alternative measure for transportation and communication (the volume of air passenger service for each S.M.S.A.) was given some consideration, but according to the Office of the Federal Aviation Agency, complete data for all S.M.S.A.'s have not yet been collected. The census category of the number employed in transportation and communication includes the following subgroups: (1) transportation, railroads and railway express service, trucking service and warehousing; (2) communication, telephone and telegraph, wire, radio and television. County and City Data Book.

Two indices for material density are, therefore, to be considered: (1) to represent the size of the society, population numbers in the Standard Metropolitan Statistical Areas, and (2) to represent the lines of transportation and communication, the number of workers employed in transportation and communication in the Standard Metropolitan Statistical Area.⁹

On first glance, it appears that an adequate index for dynamic density is a measure of those individuals employed in commercial occupations and in social interactional occupations. (In his definition Durkheim indicates that dynamic density is the function of the number of individuals who are having social as well as commercial relations, that is, those that not only compete but live a common life.) Upon a closer examination of Durkheim's writings, however, it can be inferred that he is more concerned with the reduction of segmentation or the increasing interdependence and interrelation of people than with the amount of social interaction per se. He states:

Social life can be affected only by the number of individuals who participate effectively in it. That is why the dynamic density of a people is best expressed by the degree of fusion of the social segments.¹⁰

Durkheim further clarifies this position concerning the fusion of social segments. He says that social life, rather than existing in a multitude of small, spatially separated units, is generalized or extended. In his words, "Social relations . . . consequently become more numerous since they extend on all sides, beyond their

⁹ Ibid., see item (1), pp. 432, 440, 444, and item (42), pp. 442, 434, and 450.

¹⁰ Durkheim, The Rules . . ., p. 114.

original limits."¹¹ Here Durkheim is suggesting that dynamic density refers to the increased scale of social contact, and until this scale of contact develops to a high degree, the social segments, rather than being functionally interrelated, will remain essentially distinct and alike.

The indices selected for dynamic density, therefore, relate most closely to Durkheim's emphasis upon the diminishing gaps which separate social segments and the fusion or centralization of commercial control. In respect to the latter idea, Durkheim suggests that there is a regional commercial aspect found in such contact. He states:

But it happens that a region, heretofore, independent of this centre, is bound to it through means of communication which partially overcome the distance. At the same time, one of the barriers which hemmed it in is lowered, or at least recedes. The market is extended, there are now more needs to satisfy.¹²

The work on regions by human ecologists and geographers suggests possible indices for dynamic density. In R. D. McKenzie's early study, he suggests that city regionalism is the product of contact and division of labor, with particular emphasis on the function of distribution, banking, and transportation. N. S. B. Gras, the economic historian, indicates the importance of regional commercial contact in defining the rise of the metropolitan center, placing particular emphasis on the function of banking. Donald J. Bogue uses the earlier theories of McKenzie and Gras as the basis for statistical analysis of the structure of the metropolitan community, stressing the functional interdependence of the hinterland and the concept of

¹¹Durkheim, The Division . . . , p. 260.

¹²Ibid., p. 268.

metropolitan dominance. Following the lines of these earlier writers, Rupert B. Vance and Sara Smith Sutker rely heavily upon the reciprocal influences of the metropolitan center and the regional hinterland in selecting indices for the metropolitan function. Among the indices of interdependence suggested in the above writings are: wholesale sales, business service receipts, number of branch offices, retail sales, bank clearings, and value added by manufacturing. Further suggestions can be gained from Otis Dudley Duncan, et. al., in Metropolis and Region, a later work emphasizing in particular wholesale sales and bank demand deposits as indicators to be used in examining the interrelationship between metropolis and region.¹³

Of the above indicators, two are found to be particularly relevant to Durkheim's writing. In relation to Durkheim's emphasis on the fusion of social segments and on the regional complex, the following will be used to represent dynamic density: (1) volume of wholesale sales per S.M.S.A., because it has been shown to be the simplest adequate measure of a city's regional commercial influence, and (2) volume of demand bank deposits per S.M.S.A., because it is thought to represent a more generalized measure of social and economic interaction.¹⁴

¹³R. D. McKenzie, The Metropolitan Community (New York, 1933), pp. 113, 164; N.S.B. Gras, An Introduction to Economic History (New York, 1922), p. 204; Donald J. Bogue, The Structure of Metropolitan Dominance (Ann Arbor, 1949), p. 18; Rupert B. Vance and Sara Smith Sutker, "Metropolitan Dominance and Integration," The Urban South, ed. Rupert B. Vance and N. J. Demerath (Chapel Hill, 1954), pp. 112-113; Otis Dudley Duncan, et. al., Metropolis and Region (Baltimore, 1960), pp. 9, 31; see also Robert E. Dickinson, City, Region and Regionalism (Oxford, 1947), Chap. 6.

¹⁴Gras., p. 204.

In relation to Durkheim's writings on division of labor, two specific indicators seem to be appropriate. As defined by the Bureau of the Census, these are: (1) the number of males employed as professionals, technical, and kindred workers per Standard Metropolitan Statistical Area, and (2) the number of males employed as craftsmen, foremen, and kindred workers per Standard Metropolitan Statistical Area.

By division of labor, Durkheim means not only the differentiation of function, that is diversity, but also a high degree of specialization of function. This point is made clear as Durkheim indicates that even if one compares the diverse branches of the same function rather than the widely separated functions, work will still become more specialized. With the extension of the commercial market, some individuals will be able to maintain themselves only by concentrating their efforts upon a part of the total function that they formerly performed, that is, the creation of new specialties.¹⁵

Durkheim's apparent emphasis on occupational differentiation and occupational specialization is the basis for the selection of the indices to represent division of labor. He states:

. . . if professional groups extend their functions over an entire territory instead of remaining restricted, as formerly, to the limits of a city, their professional activity will be very different from what it was formerly.¹⁶

Durkheim suggests that in a city different occupations can coexist without destroying one another. Since they perform different services

¹⁵Durkheim, The Division . . . , p. 270.

¹⁶Durkheim, The Rules . . . , p. 116.

and pursue different objectives, they can perform them in a parallel manner.¹⁷ In keeping with this concept tentative indices should therefore be selected from categories which include the most highly specialized jobs.¹⁸ The research design requires only one index for division of labor. Because of Durkheim's emphasis on differentiation as well as specialization, the correlations between the two indices suggested above and an index of occupational differentiation (total number of detailed occupational categories per S.M.S.A.) are examined. The index having the highest correlation with the latter index is used as a measure of division of labor.

Selection of Statistical Methods

Among statistical methods suitable for this problem is the Spearman rank coefficient of correlation designated as ρ ; however, since at least the interval level of measurement has been attained, a parametric statistic is indicated. The Pearsonian product moment correlation, designated as r is, therefore, the statistical method to be applied in analysis.

Comparison of the various correlation coefficients can be adequately accomplished through the application of the Hotelling t test:

¹⁷Durkheim, The Division . . . , p. 267.

¹⁸Otis D. Duncan, and Albert J. Reiss, Social Characteristics of Urban and Rural Communities, 1950 (New York, 1956), pp. 92-102. See also, Leslie Kish, "Differentiation in Metropolitan Areas," American Sociological Review, 1958, pp. 388-398.

$$t_{d_r} = (r_{12} - r_{13}) \sqrt{\frac{(N - 3) (1 + r_{23})}{2(1 - r_{23}^2 - r_{12}^2 - r_{13}^2 + 2r_{23}r_{12}r_{13})}}$$

This test can be used with particular relevance to the data and methods employed in this problem, because it compares the correlations of two separate variables (X_1 and X_2) with the same third variable (X_3)¹⁹. An added advantage of the test is that when using large N , \bar{z} is interchangeable with \underline{t} for hypothesis testing purposes. Since there will be no inference made to a wider population, meeting the assumptions of normality and randomness does not seem necessary.

Steps in Analysis

The first step in analysis is dependent upon the first objective, selecting the most adequate indices of Durkheim's theoretical concepts from the alternative indices tentatively selected from Durkheim's writings. The index for division of labor is used as a benchmark in this procedure. Selection of an index for division of labor is, then, an intermediary step not included in the objectives; therefore, it will be considered first. Both of the initially selected indicators of division of labor represent occupational categories with a high degree of specialization of function. (See Table II.) The argument for the appropriateness of a particular index for division of labor is strengthened, however, if its relationship to both occupational specialization and occupational differentiation can be established.

A simple technique is employed to determine which of the preliminary indices for division of labor is more closely related to

¹⁹J. P. Guilford, Fundamental Statistics in Psychology and Education (New York, 1965), p. 108.

occupational specialization and differentiation. Relying on Durkheim's emphasis that occupational differentiation refers to the diversity of types of occupation, a representation of differentiation can be approximated by calculating for each S.M.S.A. the number of the possible 494 detailed occupational categories in which at least one worker is enumerated.²⁰

In a sample, stratified by size and otherwise random, of 101 S.M.S.A.'s, Spearman's rank correlation coefficient is employed to measure the degree of association between occupational differentiation as defined above and the two tentatively selected indices. The most adequate indicator for division of labor is the index which shows a higher correlation with occupational differentiation.

The next step is to evaluate the tentatively selected indices using relevant data for each of the 209 Standard Metropolitan Statistical Areas. As a check, partial correlations are calculated to examine the relationship among the indices by partialing out the index of population size and the index for division of labor.

To fulfill the first objective, the initial correlations between the index for division of labor and each of the alternative indices of material density and of dynamic density are compared. (See Tables IV and V.) The Hotelling t test is then applied to determine if there is a significant difference between the alternative indices for each concept of density; the one which indicates a higher degree of association with the index for division of labor is chosen to

²⁰The United States Bureau of the Census, U. S. Census of the Population, 1960, Vol. I., Characteristics of the Population, PC (1) C, General and Social and Economic Characteristics, States Reports, Vol. 1-50, see Occupational Group and Class of Worker of Employed Persons by Sex for S.M.S.A., 1960.

represent its respective concept.

The more representative indices for material density and dynamic density are now applied to the second objective of this problem, that of determining whether there is a difference between the two densities, an hypothesis which may now be restated in the following form:

- Ha: Dynamic density and material density as measured by selected indices are statistically different indicators of division of labor.
- Ho: As measured by selected indices, there is no difference between dynamic density and material density as indicators of division of labor.

The Hotelling \underline{t} test is used to test Ho, the null hypothesis, that is, whether the correlation coefficient of material density and division of labor represents a significant difference in correlation as compared to the correlation coefficient of dynamic density and division of labor. There is no direction indicated in the alternative hypothesis (Ha), hence, a two-tailed test is called for with the .05 level of significance. Interchanging \bar{z} with \underline{t} , the \underline{t} required to reject the null hypothesis is 1.96 (N = 209). (See Table VI.)

CHAPTER IV

ANALYSIS AND RESULTS

Final Selection of Indices

The variables employed in the preliminary selection of an index for division of labor are as follows:

Y_1 = number of males employed as professional, technical, and kindred workers per S.M.S.A.

Y_2 = number of males employed as craftsmen, foremen, and kindred workers per S.M.S.A.

Y_3 = number of detailed occupational categories in which workers are employed.

The Spearman rank correlation coefficient rho is used to measure the degree of association between Y_1 correlated with Y_3 and Y_2 correlated with Y_3 to determine which of the two variables, Y_1 and Y_2 , is the better indicator of occupational differentiation as well as of occupational specialization. When Spearman's rho is used to compare the association between Y_1 and Y_3 with that between Y_2 and Y_3 , the results are as follows:

Y_1 and Y_3	(N = 101)	rho = .728
Y_2 and Y_3	(N = 101)	rho = .732
Y_1 and Y_2	(N = 101)	rho = .691 ¹

¹It should be noted that rho is closely equivalent to the Pearsonian r numerically. With large samples it is possible to treat an obtained rho as an approximation of r.

By examining these results it is apparent that there is little difference in the degree of association between Y_1 and Y_3 (.728) and Y_2 and Y_3 (.732). It is also noted that there is a substantial degree of association between Y_1 and Y_2 (.691). It appears, therefore, that either index designated as Y_1 and Y_2 can be used to represent the index of division of labor.

Since only one index is required as a criterion in the research design, Y_1 (number of male professional, technical, and kindred workers per S.M.S.A.) is selected because this category includes more diversified representation of the most highly specialized occupations. In the absence of any statistically indicated superiority for either index, selection of one on such grounds may be permitted.

Initial correlation among the tentative indices for material density and dynamic density and the selected index for division of labor is found in Table III. The selection of the index for material

TABLE III

INITIAL CORRELATION OF TENTATIVE INDICES USING
THE PEARSONIAN PRODUCT MOMENT CORRELATION

	X_1	X_2	X_3	X_4	Y_1
X_1	1.00	.981	.938	.831	.958
X_2		1.00	.972	.866	.965
X_3			1.00	.893	.958
X_4				1.00	.864
Y_1					1.00

X_1 to represent material density, population numbers per S.M.S.A.

TABLE III (Continued)

X_2	to represent material density, number of workers employed in transportation and communication per S.M.S.A.
X_3	to represent dynamic density, volume of wholesale sales per S.M.S.A.
X_4	to represent dynamic density, volume of demand bank deposits per S.M.S.A.
Y_1	to represent division of labor, number of male professional, technical, and kindred workers per S.M.S.A.

density is accomplished by comparing the correlations of the two preliminary indices, X_1 and X_2 , with the selected index for division of labor, Y_1 , and applying the Hotelling t test. (See Table IV,)

TABLE IV

SELECTION OF INDEX FOR MATERIAL DENSITY
BY APPLICATION OF HOTELLING t TEST

INITIAL CORRELATION	NULL HYPOTHESIS	HOTELLING t
$r(X_1 \text{ and } Y_1) = 0.958$	$H_0: r(X_2 \text{ and } Y_1) =$	* $t =$ less than 1.0
$r(X_2 \text{ and } Y_1) = 0.965$	$r(X_1 \text{ and } Y_1)$	

*Cannot be rejected at .05 level.

The hypothesis is that the true difference in correlation is zero. Adopting a one-tailed test at the .05 level, the null hypothesis cannot be rejected. Although either index can be employed, the number of workers employed in transportation and communication per S.M.S.A. (X_2) is selected as the index to represent material density. The selection of this index rather than population numbers (X_1) is based on Durkheim's emphasis on the means for extending social contact

rather than the pure physical concentration found in size of unit.

The selection of the index for dynamic density is accomplished by comparing the correlations of the two preliminary indices, X_3 and X_4 , with the selected index for division of labor, Y_1 , and applying the Hotelling t test. (See Table V.)

TABLE V
SELECTION OF INDEX FOR DYNAMIC DENSITY
BY APPLICATION OF HOTELLING t TEST

INITIAL CORRELATION	NULL HYPOTHESIS	HOTELLING t
$r(X_3 \text{ and } Y_1)$ 0.958	$H_0: r(X_3 \text{ and } Y_1) =$	* t 8.39
$r(X_4 \text{ and } Y_1)$ 0.886	$r(X_4 \text{ and } Y_1)$	

*Reject at .05 level.

The hypothesis is that the true difference in correlation is zero. Adopting a one-tailed test at the .05 level, the null hypothesis is rejected. Based on these findings, decision is made to select X_3 , the volume of wholesale sales per S.M.S.A., as the index for dynamic density. In examining the difference found between $r(X_3 \text{ and } Y_1)$ and $r(X_4 \text{ and } Y_1)$, it is reasoned that the volume of wholesale sales is the better index of dynamic density because it is more directly tied to the extension of social interactional scale and the fusion of social segments. It appears that the volume of bank deposits, therefore, is a more indirect measure of the contact and interdependence of people. Thus, the three indices selected in fulfilling the first objective of this thesis are: (1) to represent division of labor, Y_1 , number of male professional, technical, and kindred workers per S.M.S.A.; (2) to represent material density, X_2 , number of workers

employed in transportation and communication per S.M.S.A.; and (3) to represent dynamic density, X_3 , volume of wholesale sales per S.M.S.A.

The second objective of the thesis is to determine whether there is a difference between material density and dynamic density as indicators of division of labor when represented by the indices selected here. In order to carry out this objective, the same procedure applied to the selection of indices is employed. (See Table VI.)

TABLE VI
COMPARISON OF MATERIAL DENSITY AND DYNAMIC DENSITY
BY APPLICATION OF HOTELLING t TEST

INITIAL CORRELATION	NULL HYPOTHESIS	HOTELLING t
$r(X_2 \text{ and } Y_1) = 0.965$	$H_0: r(X_2 \text{ and } Y_1) \neq$	* $t =$ less
$r(X_3 \text{ and } Y_1) = 0.958$	$r(X_3 \text{ and } Y_1)$	than
		1.0

*Cannot be rejected at .05 level.

The hypothesis is that the true difference between the correlations $r(X_2 \text{ and } Y_1)$ and $r(X_3 \text{ and } Y_1)$ is zero. Adopting a two-tailed test at the .05 level, the null hypothesis cannot be rejected. Hence, it appears that either material density or dynamic density will stand to measure division of labor as implied in Durkheim's theory of the division of labor.

Partial Correlation

Partial correlation analyses are employed here to examine the interrelationships among indices when X_1 (material density, represented

by population size) is partialled out and also when Y_1 (division of labor, represented by number of professional, technical, and kindred workers) is partialled out. Analysis is purely descriptive and is based on comparison of the relative strength of the partial correlations and the reductions which come through partialing. (See Tables VII and VIII.)

TABLE VII

CORRELATIONS OF TENTATIVE INDICES
PARTIALING OUT SIZE (X_1)

	X_2	X_3	X_4	Y_1
X_2	1.00	.776	.454	.474
X_3		1.00	.591	.600
X_4			1.00	.425
Y_1				1.00

TABLE VIII

CORRELATIONS OF TENTATIVE INDICES PARTIALING
OUT DIVISION OF LABOR (Y_1)

	X_1	X_2	X_3	X_4
X_1	1.00	.771	.256	.020
X_2		1.00	.648	.240
X_3			1.00	.451
X_4				1.00

When the factor of population size (X_1) is partialled out, several significant relationships become apparent. In examining the correlations between X_3 (dynamic density, represented by volume of wholesale

sales) and the other selected indices, X_3 , appears to consistently show the strongest degree of independence. The correlation of X_3 and X_2 (material density, represented by number of workers in transportation and communication) appears to be the strongest correlation (.776) showing the least amount of reduction. The correlation of X_3 and Y_1 (division of labor) also seems to be relatively strong (.600).

A primary objective of this problem is to compare X_3 and X_2 as indicators of Y_1 . Such a comparison shows that the relationship between X_3 and Y_1 is stronger than the relationship between X_2 and Y_1 . X_3 , therefore, seems to be the more adequate indicator of Y_1 . The relationship between X_2 and Y_1 appears to be partly a function of size and partly due to the relatedness of X_2 and X_3 .

When considering the second set of partial correlations, the correlation between X_1 and X_2 shows the least amount of reduction and the greatest association independent of Y_1 (.771). Again, the correlation of X_3 with X_2 seems to be relatively strong (.648); however, the correlation of X_1 and X_3 appears to be weak (.256). These findings substantiate those of the first partial correlation analysis in that X_1 appears to have a greater association with X_2 , and X_3 is more closely related to Y_1 .

In general, the findings seem to support Durkheim's emphasis on the functional interrelatedness of the various concepts of the theory of the division of labor. The findings indicated when employing the Hotelling \underline{t} test show that X_2 and X_3 are reasonably equivalent indicators of division of labor. The partial correlation analyses generally reinforce these findings to the extent that when considering the relative strength of association between X_2 and X_3 , it appears that

these indices are related, although not equivalent, indicators of division of labor; that is, there is a functional relatedness among X_3 , X_2 and Y_1 with X_3 apparently being the more adequate index for Y_1 .

CHAPTER V

SUMMARY AND CONCLUSIONS

This thesis problem is aimed at an empirical examination of Durkheim's concepts, material density and dynamic density. It contains two objectives: (1) to establish empirical indices of the two concepts of density based on Durkheim's writings and to check by statistical means the relative appropriateness of these indices, and (2) to test whether there is difference or equivalence as indicators of division of labor between material density and dynamic density as represented by the selected indices.

The Standard Metropolitan Statistical Area is used as the unit of analysis. Data on indices for the concepts are taken from the 1960 United States Census. The Pearsonian r is utilized as the statistical means of analysis; and comparison of the correlations of the indices is made by application of the Hotelling t test. Partial correlation analyses are employed to investigate the interrelationship among the indices tentatively selected.

First, Y_1 (number of professional, technical and kindred workers per S.M.S.A.) is selected as a criterion index to represent division of labor. Second, in comparing the indices of material density and of dynamic density with the index for division of labor, X_2 (number of workers in transportation and communication per S.M.S.A.) is selected as the index to represent material density, and X_3 (volume

of wholesale sales per S.M.S.A.) is selected to represent dynamic density. A test of the null hypothesis that there is no difference as indicators of division of labor between dynamic density and material density as measured by selected indices indicates that the hypothesis cannot be rejected. The conclusion is that, as Durkheim suggests, material density and dynamic density appear to be equivalent indicators of division of labor.

This relationship is altered somewhat upon examination of the findings utilizing partial correlation analyses. On the basis of the analysis partialing out size, it is noted that because of the difference in strength of correspondence between the index representing material density (X_2) correlated with that representing division of labor (Y_1) and the index selected for dynamic density (X_3) correlated with that for division of labor (Y_1), X_2 and X_3 might be considered more as related indices of division of labor than equivalent ones.

In addition, it appears as though dynamic density is the factor of central significance in explaining the relationship between material density, dynamic density and division of labor. This suggestion is based primarily on its relative independence of size. Although the general confounding effect from size is apparent after size (X_1) is partialled out, the index for dynamic density shows the least amount of reduction in its association with the indices for material density and division of labor, emphasizing its relative independence of size.

When division of labor is partialled out, the index for dynamic density (X_3) shows a strong reduction in its association with the

index for size, whereas the index for material density (X_2) appears to be more closely related to size. The index for dynamic density, therefore, seems to be more closely related to division of labor; moreover, in both sets of partial correlation analyses, dynamic density maintains a strong correlation with material density. Dynamic density, therefore, seems to be the centrally significant index. Because the index for dynamic density maintains a strong association with both the index for material density and the one for division of labor, an interrelatedness among the three concepts is suggested.

By and large, what is accomplished in this thesis problem is to reaffirm the functional relatedness of the concepts material density and dynamic density as originally posited by Durkheim. There is some implication that dynamic density is the more centrally significant factor.

In a point well-taken, Che-Fu Lee proposes that, to Durkheim, functional relatedness refers to correspondence which may be empirically demonstrated, but causality must be sought in the higher order proposition of the social fact.¹ If one is to accept Durkheim's methodological principle that social phenomena must be explained by social phenomena, then the writer must conclude that much of the commentary on Durkheim's theory of the division of labor has been misinterpreted. Explanation of social facts must be sought in the social fact, the dynamic density, which, according to Durkheim, is seen as the manifestation of material density. This point is clarified in noting that dynamic density, to Durkheim refers not to the physical concentration of the aggregate, but

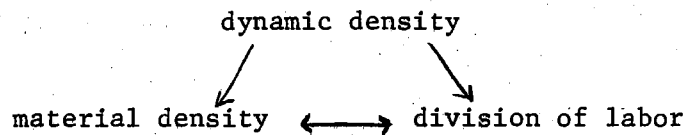
¹
Che-Fu Lee, p. 4.

to the social concentration of which, he states: ". . . the size is only the auxiliary and, generally speaking the consequence."²

Rather than the confused and often suggested representation that:

material density → dynamic density → division of labor

it may well be more appropriate to represent the theory of the division of labor as:



The analysis employed in considering the objectives of this problem is by no means exhaustive. The conclusions made are tentative. Future research might be directed toward exploration of the connections between Durkheim's concepts of material density and dynamic density and certain concepts of present-day human ecology.

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APPENDIX A

EXPLORATORY CORRELATIONS OF TENTATIVE PER CAPITA AND PROPORTIONATE INDICES UTILIZING THE PEARSONIAN PRODUCT MOMENT CORRELATION*

	X ₁	X ₂	X ₃	X ₄	X ₅	X ₆	X ₇	X ₈
X ₁	1.00	.623	.998	.319	.012	.346	.173	-.014
X ₂		1.00	.631	.331	-.116	.267	.113	-.034
X ₃			1.00	.320	.011	.355	.192	-.013
X ₄				1.00	-.132	.380	.216	.001
X ₅					1.00	.262	.131	.107
X ₆						1.00	.398	.122
X ₇							1.00	.047
X ₈								1.00

X₁ population numbers per S.M.S.A.

X₂ population density per square mile per S.M.S.A.

X₃ total number of workers employed per S.M.S.A.

X₄ proportion of sales workers per S.M.S.A.

X₅ proportion of clerical workers per S.M.S.A.

X₆ per capita volume of wholesale sales per S.M.S.A.

X₇ per capita volume of demand bank deposits per S.M.S.A.

X₈ proportion of transportation and communication workers employed per S.M.S.A.

*These tentative indices are examined on an exploratory basis in the selection of appropriate indices to be used in later analysis.

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