CHAPTER 4

RELATIONS TO ECONOMIC THEORY

The economic-theoretic foundation of marriage theory have been more deeply explored in several places (Ballonoff, 1976, Chapter 6, and Ballonoff, 1983). I review here the utility and disutility of such correspondences. A number of authors have "applied economics" to cultural theory problems by taking a specific economic model or conclusion and "fitting" this to cultural data (or, vice versa); this may be a means of proving or disproving some specific conclusion of economic theory. That, however is not the purpose of present work. Instead, I have derived a cultural theory from the natural starting point of this theory, description of cultural structures (of kinship and marriage). The present chapter compares the contructs which result from this de-novo development with constructs already in use in specific areas of economics.

The two papers noted in the paragraph above refer to economic theory of production. In a crude analogy, this appears a relevant comparison: adults produce offspring, certainly, and thus maintain their biological and cultural units. One must be extremely careful however in what conclusion is drawn from such comparisons. For example one supposedly economic argument is that if individuals maximize their (genetic) survival chances, each would simply produce as many children as possible. But the present theory predicts that cultures vary greatly in the family sizes found typically in each. This could therefore be taken as a criticism of marriage theory, since the "inference from economics" seems to make a different prediction.

This criticism is incorrect on several grounds. First, no paper, or part, of development of marriage theory makes any analogy of marriage systems to a simple maximization problem. Second, the criticism ignores that the conclusion of marriage theory that different cultures will have (as they do have) different associated family sizes, as well as other associated statistics, is a testable, and successfully tested prediction (see Ballonoff, 1973, 1976, 1982, 1982b, 1983).

But just as important, the economic theory of production never reaches any simple minded universal conclusion such as "to survive in the market place, one ought to produce as much stuff as they conceivably can". Instead, the theory attempts to predict what would be the qualitative description of a system acting by certain specific rules. Even when one of these rules is an optimization rule of some sort (which it typically is when systems are described by the mathematics of analysis on continuous spaces) the simpleminded "produce the biggest pile of anything" conclusion does not emerge.

Specifically for cultural systems we may regard marriage theory as a theory of consistency of description, that is, as a purely existential theory: "if such and such a description is correct, then such and such other properties, implied by the algebraic interpretation of the description, should be observed". This is in fact the best way to regard marriage theory: it accepts descriptions of kinship and marriage systems, translates them with certain mathematical concepts (from set theory and related topics), and then discovers that this description implies that certain statistics must be associated with that description.

Notice that the above view says <u>nothing at all</u> about any presumption of the "motives" of the members of a culture described by an ethnographer. If the quantitative values associated with inferences via marriage theory are not observed in an ethnography this would imply either that the theory is wrong, or that there is some omitted empirical detail or further elaboration needed. For example, one may observe marriage rules in an ethnography, apply the static case inference on statistics (from the form $n_s p_s = 2$) and then find that an empirical value close to p_s is observed, but that the empirical value measured on surviving family size exceeds n_s. Without knowledge of the equation on population growth associated with rules, one might then conclude that there was something wrong with the theory.

On the other hand, if one also discovers the facts as described above, and further notices in the ethnography a claim that population size was <u>declining</u>, the situation is now more subtle. Analysis such as in the appendix of chapter 3 would now apply. Additional information is needed. Has some event, perhaps a disease, recently eliminated a portion of the population? Is there a migration taking place specific to certain age groups? Has the village recently subdivided into two separate units, so that the apparent "decline" in size is an artifact of reportage, not a fully meaningful measure of cultural unit population size? And so forth. Thus, in applying the theory to any particular case, the existential view is not only useful, it is necessary to keep a clearminded view of what is meant by "theory application". Indeed, it is precisely this kind of viewpoint which leads to and has permitted development of the theory to its present form. One of the strongest claims for validity of marriage theory is precisely that it is capable of detailed refinements which may incorporate otherwise "anomalous" cases. This is how theories develop (and eventually perhaps, fail).

One may still wonder, however, what kind of thinking is "inherently" (whether or not by design of the theorist) imputed to cultural members by marriage theory in particular. Another means of interpreting marriage theory is to claim that culture bearers attempt to maintain their culture, and/or act in systematic ways to modify it. While one must be extremely careful in ascribing such "motives" to peoples, particularly if the ethnographer of some group did not make such a specific claim, this kind of economic vocabulary is useful in interpreting certain features of marriage theory. For example, for a structurally numbered system acting on population sizes near their minimum bounds, the theory predicts not only the average family sizes but also the actual total group sizes. (For lineage systems per Ballonoff

1982 and 1983, the theory is always capable of making statements related to group size).

More detailed development of structural numbered theory at its minimum bounds (Ballonoff, 1976 pages 83 to 106) can be illustrated by a kind of "production theory" model (as was done in Ballonoff, 1976 pages 117 to 120).

The production theory model that roughly interprets structural numbers involves a diagram rather like a production isoquant. An isoquant is a curve which shows all combinations of productive inputs which produce the same quantity of output. Figure 1 shows a typical isoquant, for combinations of inputs 1 and 2 to produce a specific level of output 0_a. For example, if the output is berries, and the inputs land planted in berry bushes and labor to tend the berries, then we may get the same total output of berries with perhaps two acres and one worker, as with one acre and two workers, due to ability to avoid weeds, prune bushes, harvest when precisely ripe, etc. 0_a shows all the combinations of labor plus land which would produce the specific total amount of output 0_a with the assumed technology. Figure 2 shows the typically considered case where to produce more in total, that is to produce output 0_b rather than 0_a, it requires more of both inputs. Thus curve 0_b is drawn above curve 0_a (I ignore questions of the precise shape of the curves, relating to technical questions of production technologies).

Now consider the case where a small system is acting according to a rule with structural number s. Associated with this s is a smallest number of reproducing lineages L_s and a smallest number of ascribed reproducing females F_s. We could assume there is one female ascribed as the reproducer of each lineage, so that $F_s = L_s$. This would be a system where the lineage consists of just the "family" of offspring ascribed to that female, which is the case to which structural number theory applies. If we now consider the "product produced" to be maintenance of a culture with structural number s associated with its marriage rule, and "productive inputs" of "reproductively ascribed females", and "numbers of family groups", then we can draw the picture shown as figure 3.

Figure 3 shows a curve (not yet interpreted) containing the point where $F_s = L_s$. Note that the collection of all such points for all s would fall on the dotted line at 45°. If we consider the structural number of a culture as a measure of the quantity of something maintained (e.g., as for example a measure of the complexity of the marriage rule, which in fact it is) then one may first notice that for two structural numbers, s_a and s_b and $s_b > s_b$ that the curves drawn through them would have the same general properties as the curves 0_a and 0_b with the curve associated with the higher level of production being to the upper right of the curve associated with a lower level of production.

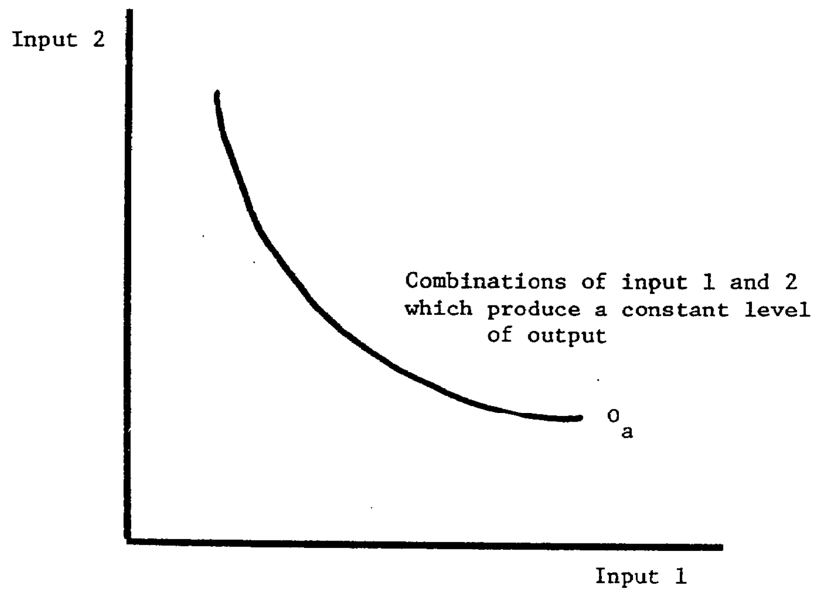

FIGURE 1

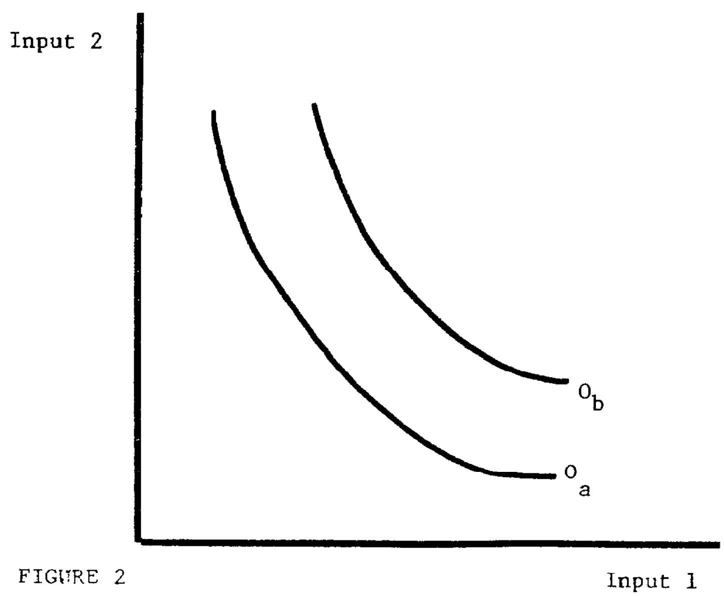

FIGURE 2

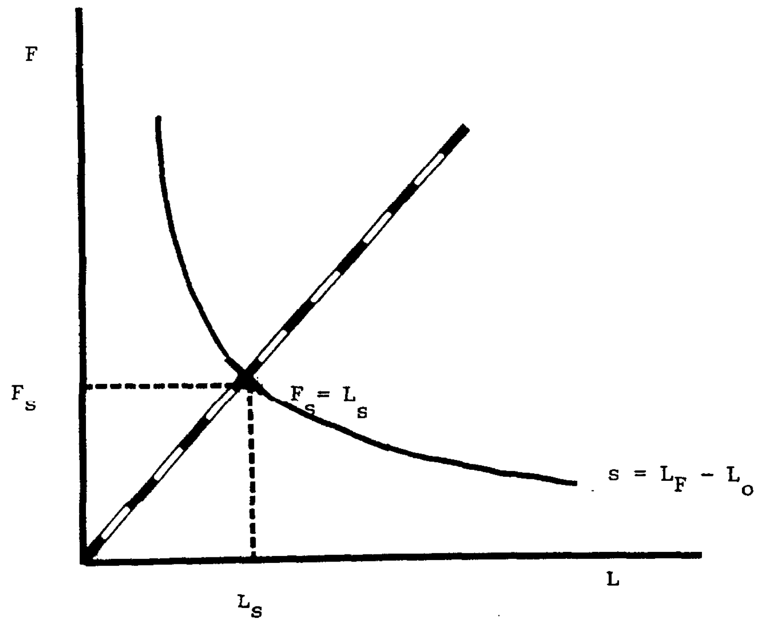

FIGURE 3

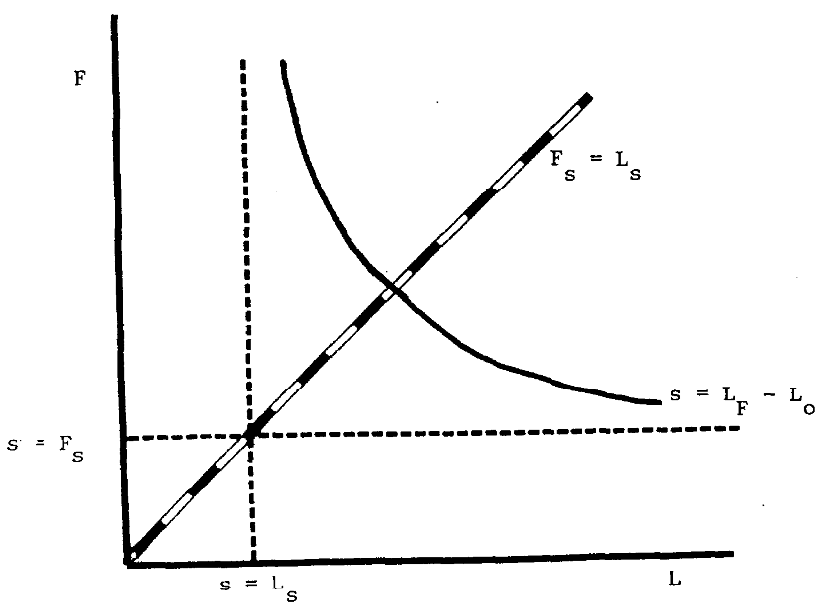

FIGURE 4

To maintain a culture with L units, each ascribed unit L must have ascribed within it at least one female F who may in turn reproduce the culture. This is implied by the construction of the minimal structure, if not otherwise obvious as something about which to formulate some mathematics. Consider a population of size N, maintaining rule with structural number s. Clearly all of the following must be true: $s \leq N$, $s \leq L_s$, $s \leq F_s$ and $N \geq L_s$, $N \geq F_s$. Further, it may occur that there are some families that have no female offspring. Denote the number of such families as L_o. Then clearly, $s \leq L_s - L_o$.

Consider the birth of a female. According to the underlying Stirling Number statistic, we don't know, biologically, to which family this will occur. Simplifying from the model of chapter 3, the probability that the birth will occur to any given family may be considered as $1/L_s$ and therefore that it will not occur to any given family as $(L_s - 1)/L_s$. The probability that in F_s such births, none will occur to a given family is $\left((L_s - 1)/L_s\right)^{F_s}$. The number of such families may be estimated by the quantity $L_s\left((L_s - 1)/L_s\right)^{F_s}$ and thus the expression $s \leq L_s - L_o$ becomes

$$s \leq L_s - L_s \left(\frac{L_s - 1}{L_s}\right)^{F_s} \qquad (1)$$

If this expression is set as an equality and graphed, it produces a graph like that of figure 4. The curve for $s = L_s - L_o$ graphs as the minimum bound of a region. Any system with statistics to the right of this curve could maintain structural number s. Any system which falls below the line $s = F_s$ or to the left of the line $s = L_s$ would violate the minimal structure condition and no longer be capable of reproducing a structure described with structural number s. Systems falling between the curved line and the minimal structure conditions would (almost) certainly fail, as their probability of reproduction of the minimal conditions violates $s = L_s - L_o$. Statistics based on $F_s = L_s$ are those studied by my previously published tables based on the Stirling Number of the Second Kind, for structural numbered systems.

Thus, the minimal envelope survival condition $s = L_s - L_o$ plays a role strongly resembling the role of a production function in economic theory. We could imagine a surface, resembling figure 2, showing the interrelationships of various structural numbers and population sizes, and can compare properties of these curves and isoquants. For example, structural numbers are discrete values ... i.e., integers. Thus, there is always a gap between curves. The space between curves may be thought of as representing systems using more than one rule, not all of which have the same structural number, so that the entire space on the (L, F) plane is filled, as it must be in production theory.

Thus, the parallel of marriage theory and production theory is not completely without merit, but both the value and the limits of this must be understood.

Construction of the theory of minimal structures, and of the equation just described, does not depend upon an analogy to some portion of economic theory. While it is possibly useful to describe the marriage theory relationship in economic terms, the only "motivation" type language needed was no more than that "people maintain their culture". All of the analytical results follow from technical consequences of interpreting this in a mathematical expression, through construction of minimal structures.

There has been however, one place where a direct use was made of a result from economic theory; more particularly, from the theory of finance. This was in the development in Ballonoff (1982) of empirical prediction equations for the growth resulting from mixes of or changes in the marriage rule (between systems with different structural numbers or lineage organizations). This parallels the suggestion made above that production theory conditions can only be met if combinations of structural numbers are permitted in the theory. The analogy used in Ballonoff (1982) considered a culture as a corporate group, which may invest either its own or other capital for a return. The analogy of cultural units to corporate groups is well known in the literature of social anthropology, while the notion that a culture "invests" in its own survival by reproduction of offspring, is but a reinterpretation of the above discussion.

Economic theory has also been frequently used as a "model" for population growth. The analogy of population size to growth of capital is commonly used. This analogy is however not the same analogy as that applied in development of the historic growth equations of marriage theory. I discussed this point in some depth in Ballonoff (1983), but essentially the argument is as follows: the simple "economic growth of capital" model assumed a growth rate analogous to interest paid on or dividends declared on equity. This, however, is not the only way in which corporations may increase capital.

Thus one should expect that assuming a growth form which sets the population size in time t equal to an exponential growth function of the size in some previous time, would be at best simple, and likely wrong. In marriage theory, I have instead constructed the "growth" equations. These do predict point valued measures of growth that would be observed consistent with observation of other measurements on the same culture at the same time. But they are not values which would be put into a growth equation to predict future population sizes. Instead, one must first forecast the future mixes of marriage rules. From these, by use of the equations of marriage theory, one predicts growth as well as other measures, that may be observed at the future date for which the particular mix of marriage rules is also forecast. If one knew the particular path of marriage rule mix into a future period, one could then also predict the future path of growth rates of that same period.

Of course, this would also work for historic periods where, in fact, the time path of marriage rules is knowable. If one knows the time path $\{u(t)\}$ of the mix of rules, then a sequence $\{(p(t), r(t))\}$ can be computed from equations of chapter 3. By an argument in Ballonoff (1982), these r(t) however, are not predictions of empirical growth; in a corporate comparison, they are more like the "internal rate of return" based on which internal (to the corporate entity) investments are made. The resulting "total growth of equity" more resembles the empirical growth that will be observed.

Denoting predicted empirical growth by R(t), then from Ballonoff (1982: page 105)

$$R(t) = \frac{2p(t)\, r(t)}{(p(t)^2 + 2r(t))} \tag{2}$$

approximately. This equation was successfully applied in that paper to compute the time path of European population growth from 1000 A.D. to the present, from knowledge only of the social history. That is, from knowledge of the time path of $\{v(t)\}$ over certain rules, $\{(p(t), r(t))\}$ was computed and $\{R(t)\}$ inferred over that same path. This was compared to the documented actual history and produced a fit.

The relationships of marriage theory therefore permit a theory of history; or more precisely of the relationship of social history to social demography. [They also permit predictions of results on evolutionary time scales, noted in the next chapter]. It can be seen that marriage theory is not merely predictive of "point in time" joint occurrences of statistics associated with existence of a rule (e.g., "the demography of the rule"), but also of time-dependent sequences of such sets, in which the time parameter has as its unit value a "generation interval". Any theory which claims a generation as its basic unit of time, also implies an historic time scale is its effective range.

An internally coherent predictive cultural theory exists, has clear ties to several substantive fields, and simultaneously is not the same theory predicted or claimed by "general systems" authors. In particular, while there are close relationships to concepts from economics, marriage theory and its "demographic" implications are not simple developments from or applications of economics.