Chapter 11

A STRUCTURAL APPROACH TO MARKETS

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STRUCTURAL ANALYSIS focuses upon the patterns of relationships among social actors. This emphasis rests on the often unspoken postulate that these patterns—independent of the content of the ties—are themselves central to individual action. Moreover, structural analysis posits that the constraints associated with positions in a network of relationships are frequently more important in determining individual action than either the information or attitudes people hold (Berkowitz 1982, 8).

Structural context is represented by patterns of ties of varying content, and the analyst's interest is in how individual behavior serves to reproduce the structural context (Burt1982). The discovery of "self-reproducing" structural contexts has occupied structural analysts in such diverse areas as kinship systems (White 1963), organizational structures (Kanter 1977), world systems (Snyder and Kick 1979; Love 1982; Breiger 1981), and abstract social structures (Lorrain and White 1971). In this endeavor structures are "explained" when their self-reproducing properties—and therefore their continued existence—are analytically understood.[1]

This approach contrasts sharply with information-oriented approaches, which explain the existence and/or continuation of a particular structure by showing how it is more "efficient" (in terms of a set of defined goals) than any available alternative (Williamson 1975). Only efficient structures are likely to be empirically observed, because inefficient structures would perish through natural selection or be made more efficient through the "maximizing" efforts of interested individuals. Structural approaches, on the other hand, identify a self-perpetuating system of structural constraints, without stepping within the kind of information framework needed to assess efficiency.

Structural analysis is often criticized because it excludes maximization and efficiency considerations, and hence lacks a solid basis for explaining how individual actors choose among the alternatives available to them. Though

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some notable efforts have been made to include maximizing considerations (Boorman 1975; Winship 1978; Burt 1982), we will argue that to do so risks violating a basic thematic of structural analysis: *structures exist and reproduce themselves in part because the information needed to pursue maximization and efficiency* is not available. In other words, an individual frequently does not know in advance which option will produce, for example, the highest profits or the lowest costs. In these circumstances, *the only tangible guidance available to the actor is that which can be inferred from the patterns and outcomes which emerge from relations among actors.* That is, the individual makes his or her choice by observing the fate of others who have faced similar, but by no means identical choices. Maximization, if relevant, is defined only within the limited *social* framework of existing outcomes. Other alternatives may not appear or may be left unexplored simply because no useful evidence about them can be generated. Individuals rely on existing outcomes for guidance, and in doing so generate new outcomes to rely on. *Reproducibility,* rather than efficiency, *is the main issue.*

In this chapter, we present a recent model of production markets (see White 1981a, 1981b, 1987; Leifer 1985) that adopts the orientation of structural analysis. It shows how manufacturers of a particular product decide on the volume of their production and the prices they charge in a setting where they have a distinct reputation (i.e. their product is perceived and treated by their potential customers as being different from that of the competition in the market).

The vexing problem manufacturers must resolve is how they "fit into" the market, or, more to the point, how their customers would have them fit in. The producer would, of course, like to know how consumers would respond to volume and price changes, as well as how other producers would respond to such changes.

However, the requisite "demand curves" are almost never available and game-theoretic efforts to second-guess competitors' reactions must rely on implausible assumptions. In the real world businesses cannot know how consumers or competitors will respond to a particular change in volume or price. Our proposed structural model pulls the producer out of the mythical information setting in which everything is known and has the individual entrepreneur seeking guidance purely on the basis of the *observed* outcomes for all the producers in his or her market in the prior production period. The various outcomes are treated as a menu of fates (i.e. roles, or niches), to select from in the coming period. Producers "maximize" within this very limited social framework. They assess future possibilities by observing competitors' past pricing volume strategies, and find their place among the competitors by assessing these possibilities against their own production costs. The parallel action of competitors will influence each producer's fate that is observed in the next production period.

Our concern here is with the circumstances in which a viable market is produced, one where the summation of producers' choices serves to reproduce the role structure from the previous production period, and it is then used in a subsequent period with the same effect. When these circumstances materialize, the producers become locked into a self-fulfilling framework in which their unique fate (role) is perpetuated from period to period.

We begin our exposition with a speculative discussion of how Tony's frozen pizza operation uses its experience (and that of its competitors) to make choices about pricing and volume of production—and, hence, total revenues. We then sketch the formal model that underlies the speculation, moving from the interests of Tony to an interest in the conditions under which markets can function and reproduce themselves. Finally, we shift to the comparative issue, developing a topology of markets to show how inequality of revenue outcomes results from different cost and valuation contexts. We conclude with a discussion contrasting our structural approach with the information approaches found in the economic and business literature.

Tony's Dilemma

Tony produces and distributes frozen pizzas at the national level. Every three months he evaluates the market performance of his frozen pizzas and makes a decision about his volume (y) of production and his suggested retail price[2] for the coming quarter—and hence his projected revenue (W).[3] Tony uses his knowledge of the frozen pizza market to make this decision.

The market for Tony is populated by other frozen pizza producers that Tony knows by name and reputation. A brand name is attached to the frozen pizzas of each producer, and these give the producers distinct public images. Totino's and Jeno's, for example, are high-volume, inexpensive party pizzas. Stouffer's, on the other hand, sports a "French crust" (home-based in Ohio) and finds its way into more intimate gatherings at a higher price and a much lower volume. Celeste implants itself in the middle range, a favorite in middle-class families where neither parent has much time to cook.

These reputations are quite stable and, combined with the distinctive reputation of his own pizza, create a powerful constraint on Tony's choices. At least for the next three months, Tony assumes these reputations are not likely to change. Even in the long run, however, Tony is very uncertain about what would happen if he tried to induce a change in the reputation of his frozen pizza and therefore change his niche; and he is equally uncertain about how he would go about doing this. Tony perceives himself as locked in a structure of distinct "niches" over which he has little control.

The reputation of each frozen pizza brand can be represented in two dimensions: volume and revenue. Market shares are quite stable. The lower "quality" frozen pizzas command a large proportion of the market, while higher "quality" pizzas account for a small percentage. These reputational price differences are sharp and stable. Stouffer's costs more than Totino's, and this difference is an acknowledged feature of the "market" Tony has come to know. Tony accepts the fact that consumers are willing to pay different prices for different brands of frozen pizzas, without needing to understand the dynamics of consumer behavior. In textbook terms, Tony is operating in a "differentiated" market.

Quality differentiation poses a formidable problem for Tony's production and pricing decisions. Tony cannot take "price" as a given, since there is no single price in the market, but a unique price for each brand of goods. He could, of course, simply reuse the price he received in the prior period, but this has some potential drawbacks. First, in doing so he may be ignoring significant changes in the conditions of his market, and this could result in major problems. Second, Tony would be evading the basic question (which he might reflect on, but a researcher would insist on) of why he occupies the particular niche that he occupies. That is, a good businessperson should seek to change niches, if it is possible and profitable to do so. Finally, Tony could not safely assume his current price would be accepted if he changed his production volume (explained below).

Hence, his own production figures for the previous quarter offer Tony only a little guidance concerning the possibilities he faces. Outside of simply repeating his past period decision for both price and volume, no obvious guidelines for action appear present. The uniqueness of Tony's niche and the niches of other frozen pizza producers makes it unclear how Tony can use his own past, or the pasts of others, for guidance for the future.

Fortunately, Tony's knowledge of the "market" goes beyond the mere description of each producer's "niche" and his own production figures. *Tony knows how the niches are tied together.* There is a particular order to them. In Tony's market, low "quality" (that is, price) is tied to high production volumes (though in other markets, like disposable diapers, it may be the opposite). This he takes as a basic fact of the market he is in. This fact is crucial in his production volume and pricing decisions. If Tony successfully increased his market share, his public reputation would undergo a change also. He would become a mass market pizza maker and, in this market, the perceived quality of his product would decline. Thus Tony cannot make his volume decision independent from his price decision. The two are interrelated, as they are both tied to a distinct set of reputations, or niches, that are sustainable in this particular market.

This arrangement—or menu—is not secret; every pizza maker, market analyst, and noncasual observer of the business knows it well. The menu simply consists of the basic prices, sales volume, and—hence—revenues of frozen pizza producers in the prior production period. These figures are published

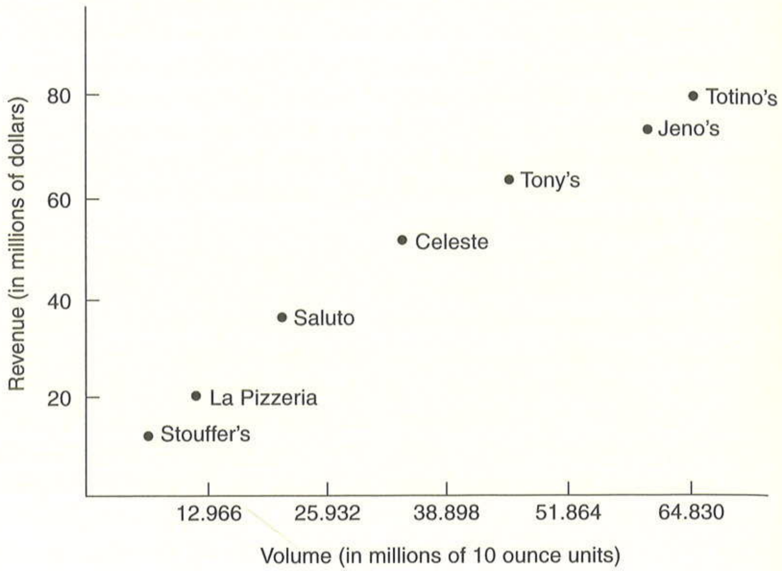

FIGURE 11.1 A menu of fares. The (annual) volume, revenue outcomes for seven frozen pizza producers. The menu defines the possibilities awaiting the producers in the next production period.

routinely in trade publications and business indexes, and reflected locally in retail prices and shelf space allocations. The menu that Tony observes is provided in figure 11.1. The orderliness of this menu is found in the fact that each production volume is associated with a unique revenue (i.e. price), insofar as the producer's outcomes fall on an "orderly" (though not usually linear) curve.

The menu of producer outcomes is the only tangible evidence for the possible niches that are sustainable within the frozen pizza market. To step outside this tangible menu would involve considerations of reputation formation, consumer psychology, and producer reactions that hold few prospects for sure-footed guidance for Tony. Tony uses the observed fates of other frozen pizza producers as his "opportunity set," because his knowledge of the market goes no further.

The rest is simple. Tony has a good idea of his (variable) production costs over a range of volumes. He assesses these costs against the assumed revenue opportunities in the market, and selects the production volume and appropriate asked revenue (price) that maximizes his return (profits). This can be done with a graph and ruler, as illustrated in figure 11.2. In a stable market, with each producer operating like Tony, the individual maximizing decisions lead each producer to choose the same niche as the previous period. The producer therefore reproduces the same opportunity set (menu of possibili-

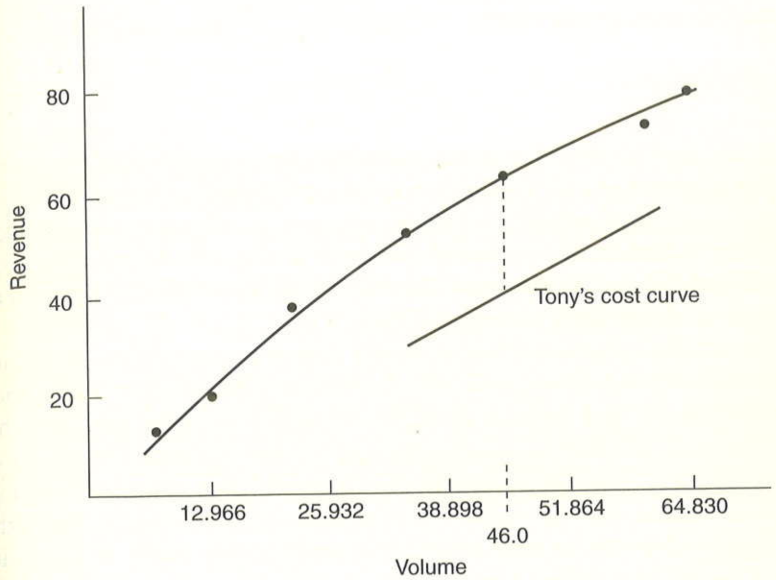

FIGURE 11.2 Tony's optimization problem. Tony assesses his production costs against the volume, revenue opportunities defined by actual outcomes of frozen pizza producers in the prior production period. Tony chooses the production volume, and associated price, which optimizes the difference between revenue and cost (i.e. profit).

ties). This is then used for guidance in the next period, yet this does not arise through mechanically repeating past (y, W) actions; *each enterprise assesses its situation in each cycle and reaffirms that its niche in a structure of niches is where it is best suited.* The frozen pizza producers' belief in the market is self-fulfilling, but it is a useful and reasonable belief, since without it they would lack any tangible guidance in choosing a production-pricing strategy.

The market is a simple affair for Tony, which he can use with no mathematical effort. From Tony's point of view, the reliance on tangible price and volume data—not just his own, but also his competitors—is reassuring. The ease of using these data enhances their appeal, particularly in comparisons to the largely fictional (difficult to utilize) curves of the econometrician. Tony has little incentive to abandon his particular view of the market as long as it seems to work for him—that is, as long as he is making money.

Exploring the conditions under which markets work, in the sense of market behavior reproducing market structure, requires going beyond Tony's simple point of view. The analytic underpinnings of Tony's market must be developed, so we can understand how distinct roles are sustained and orderliness is reproduced. We do this in the next section (for a more thorough treatment, see White 1981a or Leifer 1985).

Reproducing Structures

The Producer

Tony, and each of the other pizza manufacturers, uses the data of observed volume (y), revenue (W) outcomes from the prior production period to construct a schedule of possibilities for the next period. We refer to this schedule as a $W(y)$ schedule. It is a shared construct among all the producers; they are a closed "clique" in the sense that they know each other's outcomes and use them to define their own possibilities.[4]

Each producer, however, has his or her own cost curve. These differences in the cost of production mean that the various pizza makers will come to different volume and revenue decisions. Tony, for example, calculates how much it would cost him to manufacture the number of pizzas that a competitor produces ($C(y)$). He compares his cost with their revenues (assuming that if he entered their niche, he would be forced [or allowed] to charge their price) and computes his total anticipated profit *in that niche*. If some niche other than his own offers a greater return, he must consider a change. The desirability of particular niches will be different for producers with manufacturing costs different from Tony's.

In mathematical form, the volume decision is resolved by solving the maximization problem below:

$$\max_{y} W(y) - C_i(y), \quad (11.1)$$

where $C_i(y)$ = producer i's total production cost for volume y and $W(y)$ = total revenues for volume y ($W(y)$ is not unique to producer i, but rather is a menu shared by all producers). Equation 11.1 is a mathematical representation of the process illustrated in figure 11.2.

We will approximate the cost curves of the different producers as a family of similar and simple shapes. First, all producers experience the same economies of scale where c is a shape parameter that taps economies ($c < 1$) or diseconomies ($c > 1$) of scale, and q is a scale parameter. To account for differences in the scale of costs, we introduce a cost index g_i that is unique for each producer i.[5] The cost curves are given the following form:

$$\text{Costs}_i = C_i = qy^c g_i^d, \quad (11.2)$$

where d allows the range of cost differentiation fixed by the cost indices (g_i) to be stretched or shrunk, and can be positive or negative.[6] The need for this stretching or shrinking of cost differences between producers will become apparent when we show how cost differences have to be related to consumer valuation differences for a stable market to be possible.

Maximizing profits (equation 11.1) is assured when the well-known marginal condition is met:

$$\frac{dW}{dy} = \frac{dC}{dy} \quad (11.3)$$

(in words, when the slope of the cost curve equals the slope of the revenue curve, marginal cost equals marginal revenue; this can be seen in figure 11.2.) along with the second-order condition (ensuring a maximum as opposed to a minimum):

$$\frac{d^2W}{dy^2} < \frac{d^2C}{dy^2}. \quad (11.4)$$

In addition, producers require positive profits to produce. These conditions provide a complete specification of the producer's behavior.[7] In the real world, each manufacturer can (without fancy mathematics) approximate the profit-maximizing solution for his or her cost curve and pursue that niche.

The Consumer

There is another side to markets, the consumer side. There is always some mystery associated with consumer behavior in differentiated markets, because consumers are so often willing to pay substantially higher prices for a product whose superiority cannot be "objectively" established. The producer never looks directly inside the mysterious consumer.[8] Yet consumer behavior in aggregate plays a fundamental role in shaping producer outcomes.

A desirable feature of our model is that producers never have to look past the outcomes of other producers to see the consumer side. The role of the aggregate consumer can be represented as follows. The consumer, for whatever reason, values the different goods (brands) differently, that is, is willing to pay a higher price for some brands than others. As a group, consumers also value different quantities of each good differentially, for example, they may be willing to pay only 50 percent more for two pizzas than for one. This aggregate taste can be expressed mathematically as a collective value consumers receive from the goods of producer i:

$$\text{Value}_i = S_i = ry^a h_i^b. \quad (11.5)$$

Here r is a scale parameter; the exponent a relates quantity (y) to value; h_i is a unique "value" index for the good of producer i; and b is a parameter that determines the spread for these indices across producers (it can only be positive, due to the convention of assigning a higher value index to producers whose products are perceived as more valuable).[9]

The consumer makes comparisons across products, and insists that value received bears some relation to dollars given out for each product. If one producer's total offering has less value for the consumer than another's, then the consumer will insist on paying less for the total output. A product which successfully occupies a niche in a differentiated market must sell for a price appropriate to its (perceived) quality; it must confer the same "value per dollar" as other products. Hence in a stable market, the same ratio (θ) of value per dollar holds across all goods, or

$$\theta = \frac{S_i}{W_i} = \frac{S_j}{W_j} \quad (11.6)$$

for all goods of producers i, j.

The stage is set now for showing how the differences in costs and differences in valuations provide the materials for building a stable market. Tony's cost position vis-à-vis the other producers and the valuation his pizzas receive vis-à-vis other frozen pizzas will "voluntaristically" restrain the niches he can occupy in the market. These positions are set in the g and h indices, respectively.

Tying the Sides Together

We have now given mathematical expression to both the cost and value elements in differentiated markets. In order for an equilibrium $W(y)$ schedule consistent with these elements to exist, the ordering of producers on costs must be the same as the ordering of their goods on value, though these orderings can be stretched and shrunk or even reversed. This means that either (1) the producer whose product commands the highest value has the highest costs, the second highest value has second highest costs, etc., or (2) the producer who commands the highest value has the lowest costs, the second highest has the second lowest, etc.

We call this constraint the *coherence condition*, as the constraint is that the two orderings must cohere. Without this coherence the behavior of the producer and consumer sides could not be tied together in a reproducible market, as we will show below. The fact that the elusive "value" to the consumer must be related to production costs is somewhat reassuring. We see this as a reasonable hypothesis about real-world economics: *a sustainable market cannot be built among a set of products whose valuations are unrelated to their costs.*

Mathematically, we proceed as follows. The abstract property that lies at the basis of both cost and value differentiation can be called quality: Let n_i be the quality index for producer i. The coherence condition insures that

$$n_i = g_i = h_i \quad (11.7)$$

for all i

So let g and h be vectors of indices. The producers insist that (from equations 11.2 and 11.3)

$$\frac{dC}{dy} = cqy^{c-1}\, g^d = \frac{dW}{dy} \quad (11.8)$$

i.e. maximum profit. The consumer insists that

$$S = \theta W = ry^a h^b \Rightarrow h = (\theta W / ry^a)^{1/b}$$

$$\frac{dW}{dy} = \frac{cqy^{c-1}(\theta W)_{d/b}}{r^{d/b} y^{ad/b}} = cqy^{((bc-ad)/b)-1}(\theta W / r)^{d/b} \quad (11.9)$$

i.e. competitive value per dollar. Only a market where equations 11.8 and 11.9 hold will satisfy both producers and the consumer. The coherence condition implies that the solution for h in equation 11.9 can be substituted for g in equation 11.8, producing an equation where the abstract quality index disappears. By rearranging the terms in this equation and integrating, a solution can be obtained for W (revenue) in terms of y (volume). The $W(y)$ equation is

$$w = ((cq(b-d) / (bc-ad))\, (\theta / r)^{d/b} y^{(bc-ad)/b} + K)^{b/(b-d)} \quad (11.10)$$

or $W = (Py^e + K)^f$ with the appropriate substitution for P, e, and f. Given the context of differentiated costs and valuations (equations 11.2 and 11.5, with 11.7) that characterizes a particular market, the ratio θ, and the historically determined constant of integration K, observed producer outcomes should fall on the $W(y)$ schedule of equation 11.10. Producers, of course, "see" only the discrete outcomes, and not the $W(y)$ equation.

The crucial interdependence between volume and quality sensed by producers like Tony can be derived by solving the following problem:

$$\frac{d(profits)}{dy} = \frac{dW}{dy} - \frac{dC}{dy} = f(Py^e + K)^{f-1} Pey^{e-1} - cqy^{c-1} n^d = 0$$

to obtain (with substitution for P, e, and f):

$$n^{b-d} = (cq\theta(b-d) / (r(bc-ad))y^{c-a} + K(\theta / r)^{(b-d)/b / ya(b-d)/b}). \quad (11.11)$$

Given the range of quality indices and contextual parameters, this equation yields the optimal production volumes for producers in a market. (Note that these volumes cannot be obtained through a closed form solution unless K happens to equal zero.)

Interpretation

The alert reader might suppose that equations 11.10 and 11.11 would relieve a producer like Tony from the task of observing outcomes of other producers. This is not the case, however. The quality index "n" will be meaningless to Tony since he is aware of only his own costs, so equation 11.11 cannot be used to find his optimal volume. The W (y) equation (11.10) looks more promising, since "n" does not appear in it. Even assuming Tony knows the cost and value parameters in equations 11.2 and 11.5, however, he could not obtain an analytical solution for his (y, W) decision (with equation 11.3) because there are two indeterminacies K and θ, which require observational data to obtain. These indeterminacies imply that the schedule of niches that emerges in any given market will not be uniquely determined by the cost and value context (equations 11.2 and 11.5). A range of schedules is possible that all "work" in the sense of both satisfying the producer and consumer sides and being reproduced through the behavior of these sides. Tony, or researchers, cannot predict the exact shape or scale of a schedule in a specific market. *No amount of analytical finesse can relieve Tony of his social interdependence on other producers in defining his "opportunity set," or relieve the researcher of a dependence on data.*

The indeterminacies fit neatly with, and strengthen the case for, our portrait of real-world market behavior. In an ongoing market for frozen pizzas (or other products), there are established, discernible niches—for example, a cheap, quick, doughy product may occupy the bottom end of the spectrum, just below the less inexpensive, slightly more time-consuming, very cheesy entry. While it is possible to conceive of an infinity of new products (say a cheaper cheesy pizza), it is impossible to calculate their impact on the current niche structure. It is far simpler to estimate the consequences of invading (or remaining in) an existing niche. That is, producers correctly (from a mathematical *and* practical perspective) rely on the current structure as a frame for decision making, basing future choices on data derived from the current circumstances of themselves and their competitors.

This raises a new substantive and analytic issue. If both Tony and the researcher must look at producer outcomes for guidance and parameter estimates, how should this schedule be interpreted? Only a discrete set of outcomes is observed, yet it represents a continuous W (y) schedule. What is the meaning of such a schedule, above and beyond the discrete producer outcomes it is based upon?

To illustrate this issue mathematically, we note that parameter K in equation 11.10 can take on nonzero values. If the continuous W (y) schedule had a reality independent from the discrete producer outcomes, one would be led to the implausible conclusion that producing nothing ($y = 0$) might yield positive revenue. We are therefore tempted to limit the range of the continuous W (y) schedule to the close vicinity of the actual producer outcomes.

Yet even within a limited range the interpretation of a continuous schedule is not unambiguous. The equation for this schedule (equation 11.10) has parameters b and d, θ and K, and possibly r and q, which depend upon a specific set of producers (ns) for their values. A different set of producers

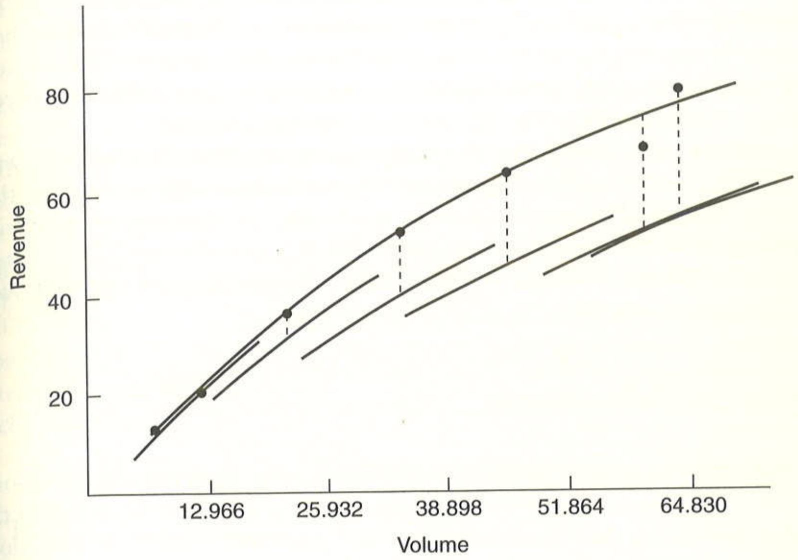

FIGURE 11.3 A self-reproducing market. Each producer uses the shared menu of fares (market outcomes) to select a volume and associated price for the next production period. In a self-reproducing market, their selections will reproduce the menu of fates they used for guidance. That is, they will reselect the niche they occupied in the prior period.

(and thus quality index range) would yield different values for b and d, as well as the other parameters above. Therefore, though producers could assume that any point on the continuous W (y) schedule represents a viable niche, this assumption stands in tension with the dependence of the W (y) schedule on a specific set of producers.

Producers assume they could be anywhere on the W (y) schedule while simultaneously realizing that the schedule itself is built from their own uniqueness. The only situation where these dual beliefs do not stand in contradiction is when the W (y) schedule leads them to reselect their prior niche, and hence reproduce the schedule. We believe that this is a key to understanding the real-world conservatism of producers: they have little tangible motivation to step outside of their niche in a reproducible market.

Tony produces in a market that continually reproduces itself through the actions of Tony and the other producers, and the mysterious consumer. The production has a structural context, which both guides it and is reproduced by it. To illustrate this reproduction process, figure 11.3 shows some partially simulated data from the frozen pizza market. Each producer is producing at an optimum volume, and therefore chooses to remain in the same niche after each production period. The volumes and revenues suggested by this context serve to reproduce the context (assuming reacceptance by the consumer). The reproduced context can then serve for guidance in the next production period, and so on. Tony is locked into this reproducible structure by his self-fulfilling behavior. He has little incentive to step outside this structure into a setting of *ex ante* information and expectations.

A possible new entrant into the market, however, must be concerned with the viability of the untested positions. A continuous schedule implies that any position is viable, yet the schedule itself may have little meaning outside of the set of distinct producers around which it is constituted. To address the issue of *potential* niches, we must look at constraints on aggregate volume and revenue flows.

Aggregating Differentiation

We must treat aggregate demand in a different way from traditional theory, because we accept qualitative distinctions among the various entries in the market. However, the frozen pizza industry (and other similar sectors) does constitute a market in the sense that entries or exits that affect aggregate flows will affect existing producers in the market. It makes sense, therefore, to ignore the uniqueness of each producer's goods, and to speak of an aggregate demand, even if this total demand depends very much on the specific products offered. If, for example, the cheap, quick, doughy pizza were pulled from the market and replaced by an equally cheap and quick cheesy entry, the aggregate demand might change upward or downward. Therefore, we can speak of aggregate demand, but we must be sensitive to its dependence on the particular schedule of products offered.

The aggregate mechanism is expressed in a satiation parameter, γ, which operates on aggregate value in the following way:

$$\text{Total value} = V = (\Sigma_i S\ (y(n_i),\ n_i))^{\gamma}.\ (11.12)$$

Hence a γ of less than 1 means the sum of value obtained from separate goods is discounted. This discounting, however, will affect the ratio of value per dollar (θ) through a complex feedback path (see White 1981a). To illustrate the connection between θ and γ, assume that the market is operating at a level where the total value to the consumer is equal to the total revenue flow ($W = \Sigma_i\ S\ (y\ (n_i))$). The θ_0 associated with this special case is derived in the following manner:

$$V = (\Sigma_i S\ (y(n_i),\ n_i))^{\gamma}. = (\theta \Sigma_i W(y(n_i)))^{\gamma} = \theta^{\gamma} W^{\gamma} = W$$
$$\Rightarrow \text{breakeven theta} = \theta_O = W^{(1-\gamma)/\gamma}\ (11.13)$$

Thus while γ is not found in the *W* (*y*) schedule (equation 11.10), its influence operates through θ and hence can affect the scale of flows in a market.

Entry and exit will be very noticeable events in such markets involving named producers and significant shifts in the market schedule faced by all producers. The ultimate shape of the market is contingent not only on a specific set of unique producers, but also on the aggregate flows they generate. The continuous *W* (*y*) schedule that links discrete producers, mathematically given in equation 11.10, is a fragile construct that has a clear interpretation only when it functions so as to reproduce itself across periods. Should the producer be guided to shift niches, or a new producer contemplate entering the market, their acceptance would be dependent upon factors only vaguely understood.[10]

One strength of our model is that it gives considerable leverage over such possible changes. The tools outlined here allow predictions of the consequences of a change in costs or valuations as well as the effects of entry, exit or niche changes. These predictions are illustrated and discussed in Leifer 1985.

A Topology of Reproducible Structures

Our model can also be used to explore the variety of possible reproducible market structures. Markets can vary widely in the degree to which producers are *spread out* in their costs of production (*d*) or in the value of their goods to consumers (*b*). They can also vary in the consequences of *shifting* their volumes on production costs (*c*) or value to consumers (*a*). Variation on these spread and shift dimensions corresponds to considerable variation in market operation.

There is, therefore, no single type of market, but instead a whole topology of market contexts. Some cost and valuation contexts will not sustain a reproducible market. For example, in some contexts, the perceived comparative value of the products, combined with the cost structures associated with them, lead to an "unraveling" of the *W* (*y*) schedule by encouraging producers to seek a corner solution. In these circumstances, we expect that markets do not appear. Conversely, our model predicts reproducible markets where none were thought possible in economic theory, for example in circumstances where it would cost less to produce more—a situation common in real markets. Among reproducible markets, variations will be found in the inequality of outcome (volumes, revenues, profits) between producers, and on basic aspects of market functioning.

In an earlier paper, White (1981a) maps out the cost and valuation contexts that can sustain reproducible markets. Here we focus on a portion of these contexts—those in which it costs more to make higher-quality goods—and explore the possible range of inequalities among producers. Though the analytic results we offer are dependent upon a number of simplifying assumptions and specific functional forms, they provide an intriguing glimpse into the variety of reproducible market structures one should expect to find in comparative studies of markets.

For present purposes, the topology of reproducible market structures can be represented in two dimensions. The first dimension concerns spreads or, more precisely, a ratio of spreads. This ratio (*b/d*) compares the spread of goods in value to consumers with their spread on costs of production. If the spreads are equal (*b/d* = 1) this means, for example, that if one product costs twice as much to produce as another, consumers perceive it as twice as valuable. A ratio of greater than 1 (*b/d* > 1) means that goods are more differentiated on value to consumers than they are on the manufacturing costs for producers, and a ratio of less than 1 implies the reverse.

In the frozen pizza market, the ratio is greater than 1, since valuation differences are large relative to cost differences. Using a number of guesses in the absence of reliable data, and methods developed elsewhere (Leifer 1985), we have placed the *b/d* ratio for the frozen pizza market around 2.5. (For example, Stouffer's pizza may cost 1.2 times as much as Jeno's to produce, while conferring 1.5 times the value.)

The second dimension concerns shifts. It too turns out to be a ratio. This ratio (*a/c*) compares the consequences of shifting production volumes on value to consumers and costs to producers. Stated simply, if overall production were doubled, it might increase production costs by 75 percent (considering economies of scale). If consumer values increased by 90 percent for the doubled output, however, then our ratio is greater than one (*a/c* > 1). If an increase in production volume increases the dollar value to consumers as much as it increases dollar costs to producers, then our ratio (*a/c*) is 1.

We have placed the ratio for the frozen pizza market around 1.89 with c = 0.9 (unit costs would decrease slightly with an increase in production volume) and a = 1.7 (value to consumers would increase sharply with an increase in producer volumes).

These two dimensions—the spread ratio (*b/d*) and the shift ratio (*a/c*)—define the axes of a topology of market structures. We will focus only on regions that can sustain viable markets in the upper right quadrant. This quadrant is shown in figure 11.4. The frozen pizza market is a solitary point in this quadrant. One can imagine, or discover through comparative efforts, a multitude of diverse markets in different regions of the quadrant. Each market would have its own inequalities and sensitivities, as we will now map out.

We limit our attention to the prime regions for stable markets. These correspond to the "Stable" areas in figure 11.4. In the market region "Unravels" there is a tendency for producers to select corner solutions in their production decisions, and hence "unravel" the volume-revenue schedule as all producers move toward the same "corner." In the market region "Explodes" there is a potential (in certain parameter configurations) for explosive

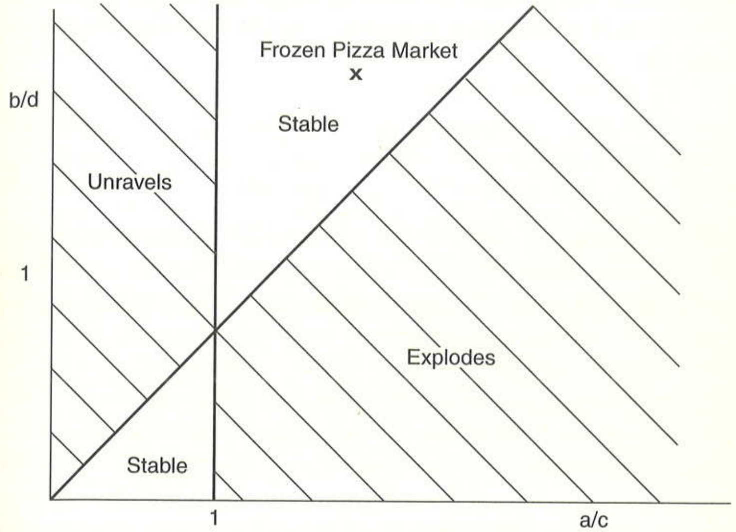

FIGURE 11.4 A topology of market contents. The parameters associated with cost and value contexts define a two-dimensional topology of market contexts. The dimensions are the ratios of spreads on value over spreads on cost between goods, and volume shift consequences on value over volume shift consequences on costs.

growth[11] because companies are monetarily rewarded for increased production. In either instance, though relative niches can be found, there is no stability in the niches sought across production periods. Each company migrates at each decisional juncture. For a more detailed explanation of stable and unstable regions, see White 1981a.

Within the stable market region—where firms are constrained to maintain their niches—it turns out that inequality in market (revenue) share depends primarily on the ratio which we call g.

$$g = \frac{(b/c)-1}{(a/c)-1}$$

In the shaded region, g is constant across lines passing through (1,1), though it is not defined on (1,1) as here the denominator of g is zero. As will become evident, (1,1) is a highly peculiar point in the topology of reproducible markets. It is the point where the spreads and shifts are the same for the producer and consumer sides.

To mathematically explore inequality as a function of g, some simplifying assumptions are necessary. We assume that K (see equation 11.10) is zero, and that producers are spread uniformly across the entire range of n (see equations 11.2, 11.5, and 11.7). With these assumptions, an equation for