MARKET INFORMATION AND PRICE REPORTING IN THE FOOD AND AGRICULTURAL SECTOR

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THE ECONOMICS OF AGRICULTURAL INFORMATION SYSTEMS

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INTRODUCTION

The 1970s have been a decade of change for American agriculture. Increased foreign agricultural trade, the termination of two decades of major government control of grain stocks, and inflation throughout every sector of the economy have resulted in significant variability and uncertainty for farmers and other agricultural decision-makers. This rising uncertainty has created new demands on the traditional information systems in the agricultural sector.

The strains placed on agricultural information systems by the fundamental changes of the past decade have led many to scrutinize closely the data base which agriculturalists often had taken for granted. Professor James T. Bonnen's work in developing an information systems paradigm provides the framework for understanding many of the changes in information systems. Application of further economic reasoning to Bonnen's information systems analytics allows for a more complete evaluation of existing systems and provides important insights into the design of new information sytems.

These concerns regarding the design and evaluation of information systems form the foundation for this paper. Initially, the rudiments of an information systems paradigm will be developed. Under this paradigm, information can be treated as an economically valuable commodity. A clear understanding of the characteristics of information is necessary to answer questions with respect to information systems design. Information characteristics, in the context of private and public uses, will be used to provide an indication of the supply of, and demand for information. Although no explicit measure of the value of information is provided, the supply and demand determinants discussed illuminate the problems in estimating the value of information. These determinants also are essential for assessing the appropriate public action concerning information provision.

Following the discussion on information supply and demand, the impacts of information on market structure and income distribution will be highlighted. These impacts provide further insights into the design of information systems. Finally, the specific case of price information is examined for a deeper understanding of information systems for this important type of market information.

AN INFORMATION SYSTEMS PARADIGM[2]

A common misunderstanding, among economists and other social scientists, is to assume that the terms "data" and "information" are interchangeable. Data are not information. The paradigm which follows clarifies the distinction between data and information and stresses the importance of considering information in a systems context.

Data Systems. Data collection is usually perceived in terms of sampling or enumerating a certain population. At a more general level, a data system is essentially an empirical attempt to represent reality as it relates to a specific population.

The infinite complexity of even small portions of reality requires some classification of various experiential phenomena into a set of categories, usually quantifiable, so that these phenomena can be easily counted or measured. Furthermore, selection of those experiential phenomena which are most relevant to the problem at hand must precede the categorization of reality. For these quantified phenomena to have logical coherence and to be adequate representations of reality, they must be related to each other and to reality in a meaningful manner. Thus, any data system has, as its basis, a concept of reality to be measured.

Although a conceptualization of reality precedes data collection, a concept itself cannot be measured directly. Instead, concepts must be operationalized or defined so that the definitions (categories or empirical variables) are as representative as possible of the selected concept. Thus, a data system is actually three distinct steps: 1) conceptualization, 2) operationalization of the concept, and 3) measurement.

The Nature of Information. An economist might view a data system as a production process which produces data but not information. Using this same analogy, the product of a data system is only an intermediate product, which requires further transformation before it is ultimately used.

Decision makers rarely use raw or even semiprocessed data directly. Some analysis or interpretation of the data is required to place them in a decision-making context. The analytical process can take many forms. At the simplest level, formatting of data is necessary in most systems to communicate the product of the data system from the data collector to the analysts and/or decision makers. Matters of data retrieval, storage, and access are all related to formatting. However, by its very nature, formatting implies a level of analysis. For complex problems, more sophisticated data analysis, such as large scale econometric modeling, is needed. But at both extremes, the nature of the system is the same.

An information system is a process which gives form and meaning to data and as such transforms data into information. With this reasoning, three major components of an information system are evident: 1) a data system, 2) the analytical capability to transform data into information, and 3) the decision maker.

Problem solving by social scientists generally begins with the consideration of a received body of theoretical concepts which are a preception of reality. The concepts are then specified as a model which can be judged against empirical evidence and conclusions drawn. Thus social theory and social statistics must share a common conceptual basis before an empirical test of any theoretical model is meaningful. Without this commonality, inductive and deductive reasoning could not be used together in problem solving.

ECONOMIC IMPLICATIONS

In the context of an information system, information can be treated as a commodity. The paradigm outlined in the previous section implies that information only takes on the characteristics of an economically valuable commodity when used in decision-making. These characteristics provide insights for designing information systems for both public and private decision-making.

Traditionally, much of economics deals with the allocation of commodities in the economy. The ability of the market economy to allocate information efficiently and equitable is affected greatly by the inherent characteristics of this commodity. Information possesses many of the attributes of commodites classically referred to as public goods. The public good attributes of uncertainty, indivisibility and nonappropriability all are characteristic of information. Uncertainty and indivisibility are inherent in our definition of information. Information providers cannot appropriate fully the returns to information production, since it is impossible to charge for subsequent uses of the same information after it is disseminated.

The question of appropriability cannot be separated from the issue of property rights for information. Copyright and patent laws allow the returns to certain types of information to be captured by the original information provider. However, enforcement costs limit the effectiveness of these laws for most types of information. For instance, the increased accessibility of xerographic photocopiers has made the copyright laws virtually unenforceable, except for the most blatant violations. Even with these difficulties, a trade-off exists between changing the mechanisms for supplying information and changing the property rights to information to achieve a more desirable allocation of resources for information production. Changing the supply mechanism tends to be politically easier than changing property rights, and hence, the remainder of this analysis assumes a relatively constant structure of property rights for information.

In cases where data or information are sold to individuals, the incomplete appropriability characteristic often leads to a more ephemeral means of presenting information to insure that only those who originally pay the information provider receive the information. Furthermore, user fees charged for information must be maintained at a level low enough to discourage reselling.

Reselling relates to the attribute of increasing net returns in the use of information. The high fixed costs of information acquisition, relative to its subsequent transmission costs, coupled with the inherent indivisibility of information lead to increasing net returns in information use. Initial purchasers of information are able to transmit the same information to other users at a lower total cost than the original supplier. Hence, increasing returns will arise whenever the value of the information remains relatively constant for each subsequent use. The difficulties brought on by increasing returns in use are exaggerated by the incomplete appropriability attribute of information. This prevents the original supplier from charging for subsequent uses after information is disseminated. Thus, fixed acquisition costs cannot be spread over all users.

Since information only acquires value in a decision-making situation, a fundamental paradox arises when information is treated as a commodity. The exact value of information is unknown to a decision maker or purchaser until it is acquired and used. To determine precisely the information's value prior to purchase, the buyer must, in effect, obtain the information without cost. This would not cause problems, if the seller retained the property rights to the information. However, the lack of complete appropriability of information mitigates against the effective retention of property rights.

This fundamental paradox stresses the importance of credibility and reliability of sources of data and information. When forced to determine the value of information prior to its receipt, the purchaser usually estimates its value, based on previous experience with the same supplier. For statistical data, another common means to judge reliability is to examine the methodology used to collect the data. Hence, documentation of statistical procedures is especially critical in the design of operating information systems.

INFORMATION FOR PRIVATE USE

The supply of information for private decision making is affected greatly by the characteristics of information outlined in the previous section. As with other commodities, the nature of the product, i.e., the information, determines in large part the most effective means of organizing for its production. In general, three basic organizational arrangements to supply information for a given industry are possible. A specialist firm could supply information for each firm in the industry; all firms could gather information collectively, such as in a trade association; or government could provide information to all firms in the industry.

It is necessary to lay some groundwork before futher discussion of the most suitable means of providing information for private use. Social returns to information are not estimated in most instances, perhaps, because of the inherent difficulties in valuing information. However, it does seem clear that the social returns to information often exceed the sum of individuals' private returns, particularly in a decentralized economic system where information is needed to coordinate economic activity among firms. Without information, the prospects for realizing the full potential for increases in productivity from technical change in a sector would be greatly diminished.

It should also be noted that the arguments presented in this section begin with the implicit assumption that social benefits of information do exceed private benefits, i.e., positive externalities exist. From this starting point, it is easier to discuss economic considerations in evaluating different information systems. While related to questions concerning the economics of information, the following discussion is perhaps best described as dealing with the economics of information systems. This subtle distinction is necessary to maintain the generality of the results and to avoid the overwhelming difficulties associated with determining the social value of information for each existing or proposed information sytem.

Market structure plays a key role in the economics of information systems. The premise is widely held, but not necessarily proven, that the fixed costs of information gathering are high relative to the variable dissemination costs. Hence, a firm could be expected to exploit these decreasing average costs by monopolizing the collection and dissemination of information for an industry. However, the incomplete appropriability of the returns to information production decreases the potential for developing monopolistic information specialist firms.

Even in cases where the premise concerning the relative fixed and variable costs of information production is untrue, other factors reduce the likelihood of the development of information specialist firms. Oliver Williamson (1975) argues that the opportunistic behavior of firms will reduce information specialization. A firm specializing in information production often could profit by selectively distorting the information it sells. Market failure would occur in the exchange between firms in an industry and the information specialist, because the information usually cannot be verified without collecting the original data again. This argument hinges on the notion that the specialist firm will be opportunistic in its behavior, which Williamson describes as seeking self-interest with guile. Thus, the opportunistic behavior of information specialist firms coupled with the fundamental paradox of information reduces the probability that firms will purchase information for private decision making from profit-seeking information specialist firms.

Recent hearings by the United States House of Representatives Small Business Committee examined the manipulation of meat prices by the *National Provisioner Dairy Market Service,* a private meat price data collection firm. The committee's staff investigator stated that the *National Provisioner Daily Market Service* reported prices even if a limited number of trades or no trades at all took place. The implied incentive in this case was to maintain sales of data to the specialist firm's customers.

As the number of transactions in the meat industry declined, it became more difficult to report prices for all types, weights, and grades of meat. Instead of admitting this, the *National Provisioner* appears to have continued reporting prices, based on a small number of transactions, to maintain customers by giving the appearance that it was doing its job. Although, unproven, these allegations are suggestive of problems arising from the reliance on specialist firms for information. (United States House of Representatives, [13, pp. 245-292]).

Information specialization is not necessarily precluded by the difficulties previously outlined. How else does one explain the existence of proprietary firms which charge users over $30,000 per year for economic information? The reliability and credibility of the information provided are essential for both the specialist firm's development and its survival. However, the need for these attributes also creates significant barriers to the entry of new information specialist firms. For example, the major large scale economic forecasting firms in the U.S. seem to have developed, in part, on the strengths of their ties to respected academic and financial institutions, which certainly enhanced the initial credibility of these firms.

The increasing economic complexity of the decisions facing most firms has also led to the development of information firms. Given the user's need for data analysis, the ability of information firms both to produce general data and information relevant to many firms and to provide analytical services to fit information needs for specific decisions creates a joint product situation. Consequently, this coupling of data services with analytical services should allow for greater specialization in information. The use of interactive computer facilities may have enabled many large economic-forecasting firms to grow by allowing individual users to change variables and assumptions. As a result, general economic forecasts can be more closely adapted to the final user's circumstances.

The public good characteristics of information imply that collective action to produce information should improve social welfare. However, these public good attributes alone do not indicate whether information production should be done by voluntarily organized, private efforts or by government intervention.

When an industry is viewed as a group of firms, Mancur Olson's theory of groups provides insights into the effects of market structure on information supply. Self-interest dictates that a group would voluntarily organize to produce a public good, as long as the individual member expects to receive benefits from the public good in excess of his or her share of costs (Olson [6]). Thus, in small groups, a public good such as information can be produced through voluntary collective action. Self-interest produces this result in the small group case because each individual receives a significant portion of the benefits from the public good. Analogously, as an industry becomes oligopolistic, market information is more likely to be produced by an industry or trade association, and government information provision is less of a necessity.

As group size increases, other incentives, such as government subsidies or selective private benefits, could be required to organize a group to produce public goods. Since an individual's consumption of a public good does not preclude its use by others, even small groups would underproduce a public good, relative to the case of a purely private good. The divergence between these two levels expands as group size increases (Olson, [6]). Hence, as an industry becomes more atomistic, government intervention might be needed to achieve a socially desirable level of information for private decisions.

INFORMATION FOR PUBLIC USE

Data collection and analysis for public sector decisions are, by definition, government activities. For public policy purposes, government provision of information is generally relied on to guarantee reliable and credible information and to protect against the strategic misrepresentation of information from private sector sources. However, government data and information are subject to abuses which detract from their effectiveness in public decisions. When utilized as performance measures for public policies, data can become politicized and lose credibility.

Data are rarely politicized by manipulating the numbers, *per se.* More subtle methods are normally used, such as timing the release of data to suit the announcement of policy proposals, changing data formats to coordinate technical interpretations with policy pronouncements, or the failure to change existing data concepts to fit reality when these changes would result in new data which reflect unfavorably on the current political leadership. Private uses also lead to politicized data. Private sector interests can politicize public data, if utilized in critical private decision. For example, political pressures arising from the use of the Consumer Price Index in collective bargaining have prevented timely improvements in the reliability of this data series.

Although problems do arise in using government provided data for public sector decisions, the alternative is often much worse. Government reliance on privately supplied information for public decisions generally creates a more troublesome set of problems. The potential for strategic misrepresentation exists whenever data provided by private firms is used for public policy decisions. Perhaps the most cogent examples of these difficulties are in the energy field, where oil industry data on reserves and other variables provide the basis for many public policy decisions (Miller, [5]).

INFORMATION DEMAND

Many difficulties arise in estimating the demand for information, as a result of its inherent characteristics. Since the value of information depends on its use in decision-making situations, the demand for information reflects its value in the decision processes of private and public users. The value of information is not known with certainty until it is used. Consequently, firms that are risk adverse generally would demand less than a socially optimal amount of information, due to the uncertainty of their returns, *a priori,* to investments in data and information.

Industrialization leads to specialization of production processes which requires increased amounts of information for firm and market coordination. Thus, *certeris paribus,* specialization would increase the returns to the firm from information investments. An individual firm's demand for information is affected by its ability to reap the benefits from information investments. In concentrated industries, the returns to investments in information for private decisions can be captured by the small number of firms in the industry. At the opposite end of the spectrum, where there are many firms in an industry, private sector investment in information production for private uses likely would approach zero, since only minuscule returns could be captured by any single firm. However, in this case, the public returns to information in the form of improved market coordination probably would surpass the private returns. On this market structure continuum, demand for public use information would decline as industries become less atomistic and then increase as information is utilized to monitor monopolistic industries, especially where antitrust regulation of monopolies is regarded as a socially desirable goal.

INFORMATIONAL IMPACTS ON MARKET STRUCTURE

In the previous sections some of the effects of market structure on information supply and demand were presented. There is a subtler causal relationship which runs in the opposite direction, i.e., the impacts of information on economic structure. Firm size and industrial structure are affected by the economic characteristics of information. The inherent risks in information production for a given firm are such that insurance coverage by outside sources cannot be obtained to offset those risks. Self-insurance, in the form of diversification, becomes the major means available to the firm to counteract the risks in information investments. Consequently, for a firm to undertake data collection and analysis on its own accord, it must be of sufficient size to internalize the risk of losses in information gathering. Thus, information production is more prevalent among large firms, and large firm size generally is related to industrial concentration.

Industrial organization is also affected by the characteristic of increasing returns in the use of information. As Roy Radner [7, p. 457] notes: "The acquisition of information often involves a 'set-up cost,' i.e., the resources needed to obtain the information may be independent of the scale of the production process in which the information is used." This can lead to "informational economics of scale," which are self-reinforcing in that a larger scale operation justifies more information acquisition while more information warrants an even greater scale of operation [15]. Theoretically, economies in information acquisition create an incentive for firm size to increase to the point of monopoly, as long as information is obtained in an optimal manner. Although Radner and Wilson relate their arguments to horizontal firm structure, Williamson [14] clearly indicates that the same argument applies to vertical integration as well. Thus, the economic characteristics of information can alter the vertical structure of a sector by creating incentives for vertical integration simply to reduce uncertainty.

INFORMATION AND INCOME DISTRIBUTION

Equity of income distribution is an important consideration in most public investment decisions. Distributional factors also influence the design and assessment of information systems. As Lester Thurow [12] argues, changes in the distribution of income are caused by factors which are themselves distributions. Hence, explanations of income distribution must focus on the distribution of these causal factors. The distribution of information can be viewed as a major causal factor which influences the distribution of income.

The distinction between data and information, as outlined earlier in the information systems paradigm, has significant implications for income distribution. An equal distribution of data in society would have a very different impact on income than an equal distribution of information, due to the disparity in analytical capabilities among data users. Differences in analytical capabilities seem similar to the differences in education and training, which Thurow [12] has shown is related to the distribution of income. Insofar as

education improves an individual's data analysis capabilities, the distribution of education and, hence, information would impact on the distribution of income.

Although the availability of information is often expected to reduce income inequality, differences in the ability to use or act on information can actually exaggerate income differences. In the case of concentrated buyers and dispersed sellers, new information tends to place the buyers at an advantage. In addition to the superior analytical capability usually found in large, concentrated firms, these firms have a greater capacity to use new information and take counteraction. For example, price fixing agreements among buyers can be maintained more readily through the publication of market prices. As long as large firms advantageously use their superior information in market transactions with smaller firms or individuals, the resulting income distribution will favor the larger, more concentrated firms.

Because of the great disparities in analytical capabilities between large and small firms, many individuals feel that the rich get richer and the poor get poorer when the government supplies data. Farmers often insist that they are hurt by USDA data, because the firms buying agricultural commodities or selling farm inputs use the resulting information to the detriment of farmers who must transact business with these firms. The implication is that these firms can often perform more sophisticated analyses on the USDA data than can farmers. An initial reaction to this difficulty, and a solution advocated by some individuals, is to stop all public provision of market data.

This Luddite view of the problem and its solution is likely to widen further the income inequities between large and small firms. If the government does not provide the data, the largest firms will probably produce proprietary data to meet their needs. Hence, termination of government data collection will only broaden the disparity in income between the largest and smallest trading partners.

Despite the availability of government data, many of the largest firms produce their own data on market conditions and, thus, only use government data as a source of validation. For instance, observers for Continental Grain Company monitor production in most of the major grain-producing areas of the world. The USDA uses agricultural attaches for similar purposes and publishes information on production in foreign countries, based on these observations. The grain company would clearly be in a more advantageous position, relative to the farmer if the USDA stopped publishing data on foreign grain production. In addition to their inherent advantage in analytical capability the grain company would be the only party with data. The degree of industrial concentration, and the income distribution that would follow, would be even more extreme than the prevailing situation.

The more reasonable conclusion to be drawn after examining the problems of unequal information in trades is that the government should do a more thoughtful job in managing its investments in data collection and analysis. Accounting for income distributional consequences and the effects of market structure on data design could help insure that new data investments would

tend to ameliorate the inequities among large and small firms in trades. However, the government must make this a conscious goal in order to have an impact.

PRICE INFORMATION

Conventional economic wisdom dictates that prices are the most efficient method to allocate resources and to transmit market information in an economy. The price system removes the need for individuals trading in a market to be made aware of the details of changing market conditions. Price changes simply encapsulate these details. However, prices, *per se,* are superfluous for resource allocation when free information concerning all other factors affecting supply and demand is available. The limits on an individual's comprehension of information create the need for a means to economize on the transmission of market information. Prices provide this means of economizing.

Although prices reflect all essential market information whenever this information is perfect or costless, uncertainty reduces the informational content of prices. Random or stochastic elements affecting supply or demand variables can result in prices which do not transmit the information required for optimal resource allocation (Grossman and Stiglitz [4]). Thus, as uncertainty increases, prices will reflect a smaller amount of the relevant information.

Costly information results in a nominal amount of market power for firms of all sizes, leading to noncompetitive price levels and often to significant price dispersion as well (Salop, [10]). Consequently, as the informational content of prices is reduced due to uncertainty, firms with information or market power would obtain more favorable prices. In this light, market power can be viewed as another stochastic element reducing the informational content of prices. Thus, in situations where buyers obtain market power relative to sellers, both market prices and the informational content of these prices would decline.

Government data and information provision tends to increase the informational content of agricultural prices. By reducing information costs to users, government information on yields, stocks, export sales, etc. enhances the informational content of agricultural prices. One only needs to observe future market prices on the day following the release of USDA statistics to see the impact of this government information.

Price data collection by an individual firm depends on its expected returns from searching for a better price. Firms would search for a higher selling (or lower buying) price until the marginal costs of search equal the marginal returns. Search costs are simply the data gathering costs, which should be relatively constant regardless of firm size. The expected returns to a price search are determined by the amount of price dispersion and the number of units of a commodity the firm is selling or buying. Since each unit is generally sold (or bought) at the same price, the total returns to search are affected by the volume of sales. As a result, firm size and, hence, market structure determine the incentives for a firm to collect price data. Government price

data provision seems less essential as markets become more concentrated and firm size increases, since it is in a firm's self-interest to collect price data for its own use.

Some people argue that government price data provision is never required, since both large and small firms will collect enough price data to satisfy their own demand by equating marginal search costs to their marginal returns. However, this argument ignores the fundamental paradox of information, which implies that the returns to search will be uncertain until after the price data are obtained. Consequently, risk adverse firms will underinvest in price information gathering, relative to a socially desirable amount. An even more significant rebuttal to arguments against government price data collection is the reduction in price dispersion which occurs, all else equal, as the amount of search in a market increases. (Stigler [1]). Hence, in concentrated markets, price dispersion should decline, since larger firms will undertake search on their own. In atomistic markets of similar size but with smaller firms, the total amount of search is likely to be lower and price dispersion greater.

Dispersion in selling prices can affect the distribution of producers' gross income. Government price reporting in atomistic markets can be justified to reduce price dispersion and improve the resulting income distribution, as long as firms with relatively small gross sales do not consistently receive the higher prices whenever price dispersion occurs.

Price information also affects market structure directly. As the informational content of prices is reduced, firms will tend to substitute internal organization, such as vertical integration or contracting, for market mediated exchange, in order to gain more knowledge of market conditions (Williamson, [14]). As Arrow [1] indicates, this is especially true when production lags and information leads occur. For example, these circumstances occur when a processor must set its production before purchasing inputs, and when the firm which supplies the inputs knows its approximate production level in advance. In this case, the processor's incentive to vertically integrate is *not* to insure advance quantities of raw materials but instead to obtain information about its market price (Arrow [1]). Thus, the lack of sufficient price data could lead to vertical integration.

CONCLUSIONS

In summary, knowledge of two critical economic relationships, market structure and income distribution, are essential for understanding the design of agricultural information systems. The rationale for government data collection and analysis for atomistic or competitive industries, such as agriculture, evolves from the nature of the economic structure in the industry, as well as the impact of information on income distribution. The importance of publicly supplied information for private sector decisions in agriculture has been manifested in the tremendous increase in agricultural productivity over the past 50 years. Society as a whole has reaped the benefits of these public investments in agricultural information in the form of lower food costs and an abundance of excess farm labor and other resources for non-agricultural

production. These improvements in resource allocation from public information on atomistic industries, when compared to more concentrated industries, provide an important rationale for government spending on information systems.

Although government agricultural information systems were designed, for the most part, to overcome the impacts of uncertainty on resource allocation in the sector, the side effects of these information systems on income redistribution furnish another significant justification for public investments in information. The market structure of agriculture, at times, has mitigated against greater income equality. Concentrated buyers in the sector have undoubtedly used their superior analytical capability and capacity to use public information to their benefit in trading with dispersed sellers. However, the alternative of less public information would only worsen the income inequality in the favor of large firms.

In many instances, the distribution of income in agriculture has become less divergent, as a result of public action to equalize information among agricultural traders. The land-grant college system and Extension education programs, in all likelihood, have reduced the disparity in analytical capability of farmers, relative to the concentrated buyers of agricultural commodities. Government regulation of futures markets also has improved the farmer's capacity to use information.

The logical basis for public reporting of agricultural prices follows from the more general arguments already summarized, as well as from more specific reasoning unique to price information. Increased price data collection and analysis can reduce price dispersion and, hence, reduce income inequality, especially where large firms possess more information than the smaller firms in an industry. By lessening incentives for horizontal integration and reducing barriers to entry of new firms, publicly available price information can ameliorate industrial concentration and its deleterious impact on consumers. Price data can be utilized by outside investors for decisions regarding potential entry into an industry. The availability of price data also tends to expand the market area for a given firm, which could lessen concentration in a geographic area. As long as those providing data remain objective price reporters, published price data can also provide a routine means for resolving disputes among individuals. Finally, the need for price information to manage government price support programs provides another rationale for public price data collection and analysis, especially in agriculture.

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FOOTNOTES

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[2] Adapted in part from Bonnen (1977).