Determinants of Farm Size and Structure

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DISTINCTIVENESS IN THE DESIGN AND CHOICE OF DURABLE ASSETS UNDER RISK*

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Introduction

Last year, Douglas Young reminded this committee that the study of economies of size must be done with reference to something fixed. This, of course, economists have done routinely in production economics. The static analysis of the firm most frequently assumes some fixed resource base to which variable inputs are added to create a product. The prediction this theory produces is that all firms in perfect competition look alike.

It has been established, however, that (agricultural) firms do not look alike, either in their combination of fixed and variable inputs, or in their output mixes. One reason our theory has failed to predict this distinctiveness is because we have inadequately accounted for risk. A second reason for our poor prediction is that our models fail to characterize the firm's fixed assets with enough details to provide meaningful results.

In a world of certainty without barriers to entry, if there were a most efficient plant size, all firms would be required to migrate to that size. Then indeed all firms would look alike. But even in such a world of certainty, it may <u>not</u> be possible for firms to duplicate one another. For example, humans who are unique cannot be duplicated to provide identical management services. Moreover, even the services from a single manager are likely to change over time as age and experience alter his or her abilities to manage.

There are other reasons why it may be impossible to duplicate farm units. For example, no two farm units will find themselves equal distance from suppliers and farm product purchasers. In addition, no two tracts of land are identical. Also, all firms are likely to have begun farming at different times and experienced different prices, real interest rates, and policy cycles. The consequence of these differences will be that balance sheets will differ--altering the kinds, cost, and amount of credit firms can expect to receive from financial intermediaries. Finally, with these differences even in the most alike firms, each firm will find it has different comparative advantages resulting in distinctiveness in its choice of products.

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There are many other factors that would lead us to declare that they should be distinct. This paper focuses on two: differences in durable assets and risk. This paper points out that durables are distinct and our theory should allow for this fact. To emphasize the differences between durables, we identify important factors that lead to distinctions between durables, and then we use these differences to classify durables into one of twelve categories.

After we classify durable types, we show how the characteristics that lead us to classify durables in distinct categories produce distinct average cost curves. Finally, we show how risk and durable characteristics lead firms to choose distinct types of operations that result in distinct average cost curves. Thus we conclude there is no reason to expect farm firms to look alike even under equilibrium conditions.

Classifying Durable Assets[1]

Before proceeding with our classification, we define a durable. It is an asset capable of providing services in more than one period. Obviously, this definition depends on the length of a "period." A short enough period, for example, would result in nearly all inputs being classified as durables. On the other hand, this definition does limit what can be classified as a durable. It is that all durables must be stocks, inventories of potential service. Thus heating, lighting, pulling, growing, painting, thinking, and a host of other services are excluded from this definition of durables.

A durable's most important characteristic is its potential to supply services. We call this service potential the durable's lifetime capacity (LTC). Thus, if we wish to classify durables and distinguish between them, the focus of the classification must be on the service potential associated with each durable.

Such a focus on services might prompt the question: what alters the LTC of each durable? For example, does its principal decay/growth depend on time and use, or is it indestructible? Then we might ask, at what rate does the durable provide services? A single rate of service supply leaves the decision maker with few, if any, choices. On the other hand, if a durable provides services at multiple rates, in each period a use decision must be made.

Finally, we might ask: what are the acquisition/sale possibilities associated with the durable? Does its service potential come in divisible quantities, like seed and gasoline? Or is it available in lumpy units, like barns, bulls, combines, and cars? All of these factors will be considered as we develop our durable classification scheme.

Altering a Durable's LTC

Most durables have their service potential altered by the passage of time. This aging process may, in some cases, improve a durable's service potential as in the case of aging cheese and growing crops. In other cases, time may reduce a durable's service potential as in the case of a barn roof. Thus the study of durables must include the effect of time on the durable's LTC.

The durable's LTC may also be changed by use, a primary factor in altering a durable's LTC. A car with 100,000 miles registered on the odometer has a different LTC than the same car with 50,000 miles on the odometer. Durable use rates, then, along with time may be needed in durable analysis.

In considering how a durable's LTC may be changed through use, it will be important to distinguish between two fundamentally different durable types. One durable type, such as stored feed, fertilizer, and fuel, is consumed in the process of providing its services. In its place is a new durable. The consequence of this conversion is the absence of any disposable inventory that may require sale or disposal. Moreover, because disposal is not a concern, this type of durable (nondurable) is introduced into production functions without any distinction between it and the service it provides.

More typical of durables is one in which a residual product is left over after the service extraction is completed. That is, the more usual durables are those that provide services without themselves being consumed in the process. Typical of this durable type are barns, breeding stock, and glass bottles.

For completeness, we suggest that some durables are very nearly unaffected by either time or use. We refer to this type of durable as being endurable. Land comes to mind as one often described as endurable. Land, however, may be lost or destroyed. It retains its properties only if it receives sufficient service from other durables to replenish its service capacity lost through use and time. When the analyst implicitly assumes this regeneration process, it is appropriate to label land as endurable.

A painting could also be considered an endurable durable. It provides sight services for art connoisseurs. In the process of providing these services, its service potential is not reduced or altered regardless of how many people view the painting. But imperceptibly to all but the trained observer, the painting is decaying. Time, temperature, and moisture all extract their toll. Only if they are of no interest to the research or if their effect is negligible over the time period of interest, can we classify a painting as an enduring durable. So while there may be no truly enduring durables, they represent a useful simplification in some studies.

Thus durables can be classified according to ways in which their LTC changes: by use, by time, or not at all. Many durables, however, have their capacity altered by both time and use. Thus any one durable may be included in more than one category depending on which decay method dominates.

Durables and the Services They Provide

So far we have emphasized that a durable's most important characteristic is its potential to supply services. But in this regard, there are important differences in the supply of services durables provide.

An important question to be answered about the durable's service supply is: who controls it? Is it controlled by the user? And if so, to what extent can the user control the rate of service extraction? Can the durable have more than one service rate? And if the durable is turned on, can it be turned off or reversed?

Consider the durable we call breeding stock. The services they provide are reproduction services that result in other durables we call offspring; a calf, a colt, a lamb, etc. The only control the durable owner has in this process is a breeding decision and a nutrition level. If the animal is bred, the service extraction rate begins and under most circumstances cannot be postponed, or even terminated. "On" or "off" appear to be the only alternative choices for service extraction.

When the "on" decision cannot be reversed, except at a very high cost, the durable's service flow is described as irreversible. For example, reversing the reproductive service of bred livestock is the cost of aborting the offspring or killing the animal. Other durables whose services once turned "on" cannot be reversed without incurring significant costs are clocks, body organs, and fertilized seeds. A clock has time keeping value only when it doesn't stop (unless, of course, it's a stop watch). A transplanted heart is a durable that its recipient and donor would agree would incur high reversibility costs if stopped. Finally, sprouted seeds are durables that cannot have their service flow interrupted without incurring high costs. These durables all have the characteristic in common that once they are turned on, it is very costly to turn them off.

It will often occur that single use durables have their service rate fixed. Seeds, fertilizer, fuel, and medicines, for example, are single use durables. They can only be used once, and in the process are converted to services and to durables of another form. Thus, if they are used only once, their service extraction rate is fixed.

An electric light fixture is also a durable. It is also either on or off. But the action that turns on its service flow is easily interrupted or stopped. So during any given time period, the light may turn on or off several times. This interruptibility in the service flow provided by an on and off switch makes the durable services controllable. Control allows us to extract services from the durable at varying rates depending on the need for light.

Many durables have a fixed capacity to provide services in any given period, such as the storage space in a barn. This does not, however, mean that the durable has a fixed service supply rate. The service supply rate can be controlled. A person may decide on how much hay or other durables will receive the storage services available from the barn. So the barn has a variable service supply rate, limited by total capacity.

Consider the service supply rate of some selected durables. Cars can be driven at various speeds or not at all, altering the rate at which they supply transportation services. A well (and pump) also provides transportation services. It moves water from below ground to above ground. It too can vary the rate at which these services are supplied. Finally, stored fertilizer, fuel, and seed are all durables if the time period of analysis is appropriately defined. However, once they are applied and their services turned on, the service flow level provided is fixed.

In some cases, durables may provide multiple services. Multiple use potentials also add divisibility to service extraction. A tractor can pull any number of implements increasing the divisibility of its services. It can also serve as a stationary power source to power a mill or a water pump. Or finally, if needed and no other source is available, it can provide transportation services.

Thus durables can be classified according to the reversibility of their service flows. Durables with reversible service flows are described in our classification scheme as having a "variable" service extraction rate. Durables with irreversible service flows are described in our classification scheme as having a "fixed" service extraction rate.

Acquisition Characteristics of Durables

Thus far our discussion has described how the durable's LTC, its capacity to provide services, can be altered by time and use. Then we described the service potential and the control afforded the decision maker in determining the supply of services provided by the durable. The cost of reversing service levels was a key consideration. Now we describe how the service potential of the durable can be altered through purchase.

In some cases, a durable's LTC may be increased through the purchase of repairs. Other times, the most efficient means of increasing LTC is to purchase a new and sometimes a differently designed durable. These decisions require careful attention to acquisition characteristics of durables; characteristics which will enable us to complete our durable classification scheme.

We now describe durables as either lumpy or divisible in acquisition. This classification, however, requires some careful description. What is it that we acquire? This we already agreed was the LTC or the inventory of potential services. But the form of the inventory is of interest. To increase the inventory of gasoline services, we simply buy more gasoline. There is no economy of scale in the purchase of gasoline except perhaps in the transaction cost: one gallon of gasoline provides one-half the amount of services available from two gallons of gasoline. Another way to describe this relationship would be to say that the LTC of gasoline is linearly related to the amount of gasoline purchased.

When the LTC of the durable is linearly related to the stock of the durable, we call the durable "divisible in acquisition." Examples of this type of durable include fertilizer, seeds, gasoline, feed, bonds of the same company, stocks of the same company, paint, and most animals used in commercial production.

Another kind of durable, one we call lumpy in acquisition, exhibits economies of size in acquisition. Consider a fence around one square mile. This would require four miles of fence. Now consider a fence around four square miles. This would require eight miles of fence. Doubling the fence quadruples the area enclosed. Thus, the area enclosed (a service potential) is not linearly related to miles of fence. This is an example of economy of scale.

Another example of the same phenomenon is the supply of horsepower. One tractor design may be preferred for small amounts of horsepower. But the ideal way to supply twice as much horsepower is not to purchase two tractors of the same size and use them pulling in tandem-like engines on a train. Instead, the ideal way to supply twice as much horsepower is to design a different tractor with the capacity of supplying the necessary power. This is because there is economy of scale. For one thing, a redesigned tractor only requires one driver as opposed to two drivers needed to extract horsepower from two smaller tractors.

Durables may also be considered to be "lumpy" in acquisition if they are unique in some important characteristics. Earlier we described livestock used in commercial production as divisible in acquisition. There are, however, animals that can be considered exceptions. These are the animals that possess some unique design characteristic. For example, Secretariat, the race horse, possessed a unique phenotype and genotype that simply cannot be replaced or duplicated. Thus, Secretariat and the acquisition of highly selected breeding stock, in general, are likely to be lumpy in acquisition.

Thus, durables that achieve economies of scale in the acquisition of LTC must be redesigned for each required level of LTC. There will be no one optimal design. The optimal design will depend on the level of services required from the durable. So we classify this type of durable as lumpy in acquisition. This is because the optimal way to increase its LTC is not simply to increase the quantity of the existing durable. It requires a change in design.

Twelve Types of Durables

Thus durables can be classified according to their acquisition characteristics. Those durables in which there existed economies of scale provided by design changes were called lumpy in acquisition. Those durables exhibiting no economy of scale in design were divisible.

In our discussion so far, we have distinguished durables by the manner in which their LTC was altered. With this process, durables' LTC was altered by time or use, or was maintained. When a durable's LTC is altered by both time and use, the more significant of the two is used for the classification. We also classified the service supplied by the durable as being either fixed (irreversible) or variable (reversible). Finally, we classified the acquisition characteristic of durables as either being lumpy or divisible. This final characterization depended on whether or not a design change was warranted to alter the supply of services. These distinct durable characteristics result in 12 durable types. The table below summarizes the twelve different durable types resulting from our classification scheme.

Table 1.

A Classification of Durable Assets According to Acquisition, Use, and Changes in Lifetime Capacity (LTC) of the Durable to Provide Services

	Acquisition Characteristics		Use Characteristics		How LTC Is Changed		
	Lumpy	Divisible	Fixed	Variable	Time (Fixed)	Use (Variable)	Enduring
1.	x		x		x		
2.	x		x			x	
3.	x		x				x
4.	x			x	x		
5.	x			x		x	
6.	x			x			x
7.		x	x		x		
8.		x	x			x	
9.		x	x				x
10.		x		x	x		
11.		x		x		x	
12.		x		x			x

To help identify the different classes, we construct Table 2. This table lists the 12 durable types and gives an example of each. We remind the reader, however, that both the identification and classification of durables is arbitrary depending on its use and the period of use.

Table 2.

Examples of 12 Classes of Durables Depending on Their Being Lumpy (L) or Divisible (D) in Acquisition, Fixed (F) or Variable (V) in the Rate at Which Services Are Extracted, and Whether Time (T) or Use (U) Changes Their Capacity to Provide Services or If They Are Enduring (E)

Durable Type		Service	Examples
1.	LFT		Clocks, paint on buildings
2.	LFU		Ozone layer, minuteman missles
3.	LFE		Artificial hearts, legal doc.
4.	LVT		Computers, fences
5.	LVU		T.V., irrigation equipment
6.	LVE		A national park, lake
7.	DFT		Wine, forests, growing crops
8.	DFU		Matches, seeds, fertilizer, gas
9.	DFE		Land used for corn prod., secure stocks and bonds
10.	DVT		Roads, telephones
11.	DVU		Bedding straw, nails, clothing hooks
12.	DVE		Diamonds and precious metals

Miscellaneous Problems Encountered When Classifying Durables

The major problem encountered when attempting to classify durables is the following. Durables may have more than one use; and different uses may result in the durable being classified differently. Land is an example of this difficulty.

Land used to grow crops is a durable divisible in acquisition and considered indestructible in most studies. Land devoted to growing crops has a high reversibility cost so we consider its supply of services fixed. But land used for recreation or for roads has its services supplied determined by visitors to the recreation site or by the number of travelers using the road. Finally, some studies of land consider erosion as the problem which takes land out of the enduring class and puts it in the time or use decay class. The point is that the unique classification of the durable often depends on its application when it is a durable capable of providing many different services.

A related durable classification problem is that many durables change form or location or both. In the process, they become different types of durables. For example, paint in cans is a durable divisible in acquisition. Moreover, since it can be applied a drop at a time, it is also variable in use. In this case, variable in use means that at any time the decision maker may stop the extraction of services by closing the lid on the paint can and refusing to paint any more. On the other hand, paint applied to the exterior of a building is different than paint in the can. Now the acquisition of applied paint is lumpy, not divisible. In addition, it is nearly impossible or at least very costly to stop the service flow from the applied paint. Thus, we now classify the paint on a surface as lumpy in acquisition with a fixed service extraction rate, and a decay determined by time.

A similar story to the paint in cans versus paint on the exterior of a building can be told in other settings. For example, seeds stored in sacks in a storage shed are not the same durable as planted seeds. Nor is stored fertilizer the same durable as applied durables. The list could, of course, continue.

Another classification problem is that durable decay often depends on durable use. An unused car wears out by time. Cars driven frequently wear out through use and time. Thus our decay categories simply list extremes--with most durables wearing out through time and use.

The other problem encountered in the classification of durables is that our definition is not capable of excluding anything that lasts for more than one period and supplies a service. Laws, wills, riparian rights, and right of ways would all be durables under our classification. These, however, more appropriately come under the heading of institutions. To quote A.A. Schmid:

> . . . institutions are sets of ordered relationships among people that define their rights, their exposure to the rights of others, their privileges, and their responsibilities. (p. 6)

Having proposed a classification scheme to organize our understanding of durables, we now turn to an evaluation of the use of durables as topics for research in the literature of agricultural economists.

Durable Asset Types and Average Cost Curves

We have identified 12 different types of durables. What we deduce next is that differences in durable characteristics result in different costs of extracting services. Thus the average cost curve of firms, even ones that produce the same product, may be quite distinct if they use different durables.

Average cost curves for durables divisible in acquisition most likely meet the requirements of our perfectly competitive models in which all firms look alike. For durables whose service capacity is linearly related to quantity of durables acquired, has irreversible service flows, and whose capacity is altered through use alone (durable type 8), the average cost of extracting services is a constant (Figure 1). On the other hand, for durables whose service capacity is divisible in acquisition, has reversible service flows, but whose capacity is altered by time alone (durable type 10), the average cost curve decreases with the level of services extracted (Figure 2). And for durables whose capacity is altered by use and time, the average cost curve may be "U" shaped (Figure 3). Of course, each of the other durables may produce still different shaped cost curves.

Risk and the Choice of Durables

To say that different durables are associated with different average cost curves does not alone explain why firms may be distinct. The complete explanation requires we introduce uncertainty. Indeed, with certainty and differences in durables, firms in an industry should look alike (assuming it were possible to duplicate firms) in a world of certainty because once an output level is established, the cost minimizing plant would be preferred. But once uncertainty enters, and not one but a set of service levels required of the durable, it becomes less clear which of a family of durables is preferred.

To illustrate this latter point, consider the two average cost curves graphed in Figure 4. Durable 1 has a lower average cost of providing services between service level extraction rates BC. Consequently, durable 1 is to be preferred as long as the service extraction rate is between those levels. Outside of those levels of production, however, durable 2 is preferred.

Now consider the two durables, durable 3 and durable 4, described in Figure 5. If the single service extraction rate were A, we would be indifferent between durables 3 and 4. And if the service extraction rates required were A-ΔA or A+ΔA, with equal likelihood we would also be indifferent between the two durables. Thus it is possible to be indifferent between different durables even under certainty.

Firm and Industry Equilibrium Levels Under Risk

One of the most widely used models in risk is the portfolio model. Popularized in the finance literature by Markowitz and extensively applied in agricultural economics (Robison and Brake), it characterizes a particular class of durables: those divisible in acquisition and indestructible (durable type 9). For this class of durables, however, the average cost curve is a constant. As a result, separation properties associated with this model arrive at the conclusion that all firms hold identical combinations of risky assets although the relative amounts of risky and safe assets may be different between firms.

What is shown next is that for a different durable type, a combination of durable types 10 and 11, not only will the firms invest different amounts in risky and safe assets, but will purchase different durables and produce at different levels.

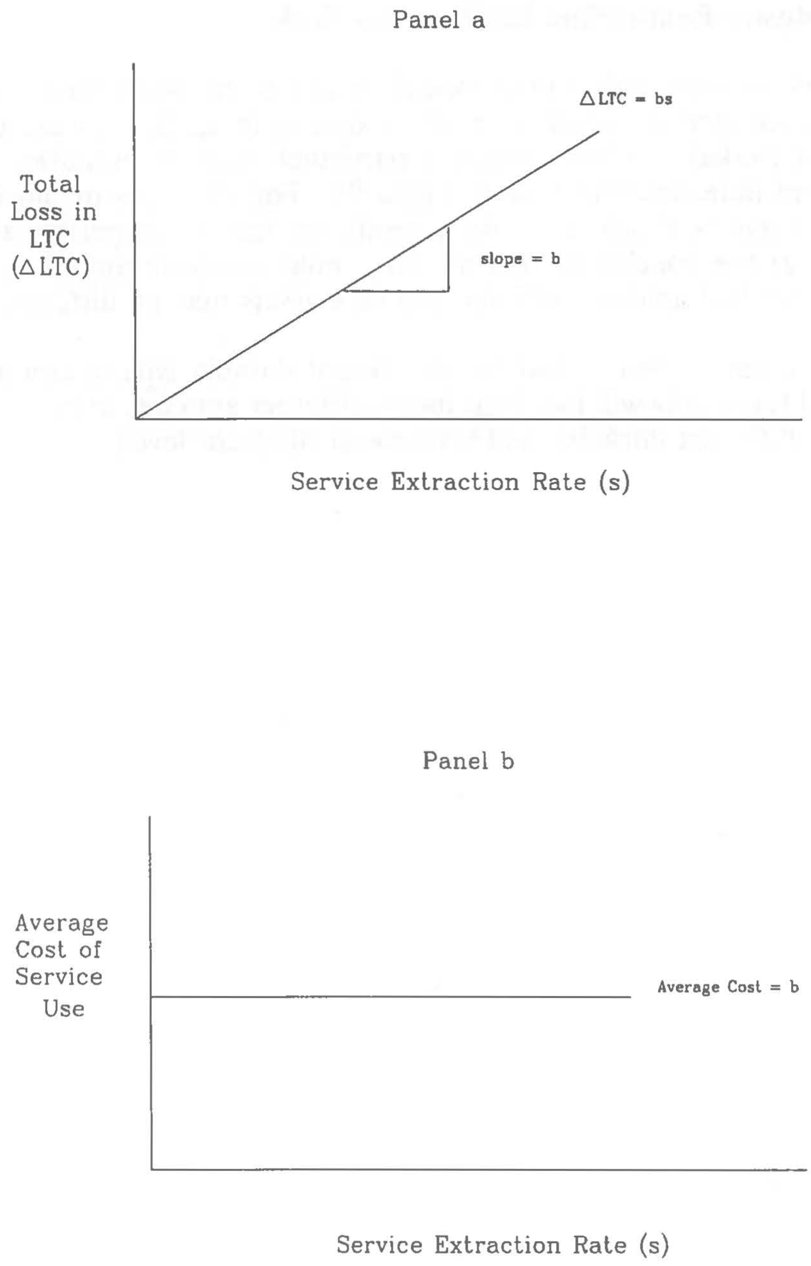

Figure 1.

The Total and Average Cost of Services From Durable Type 11, Divisible in Acquisition, Variable Use Rate, and Decay Through Use

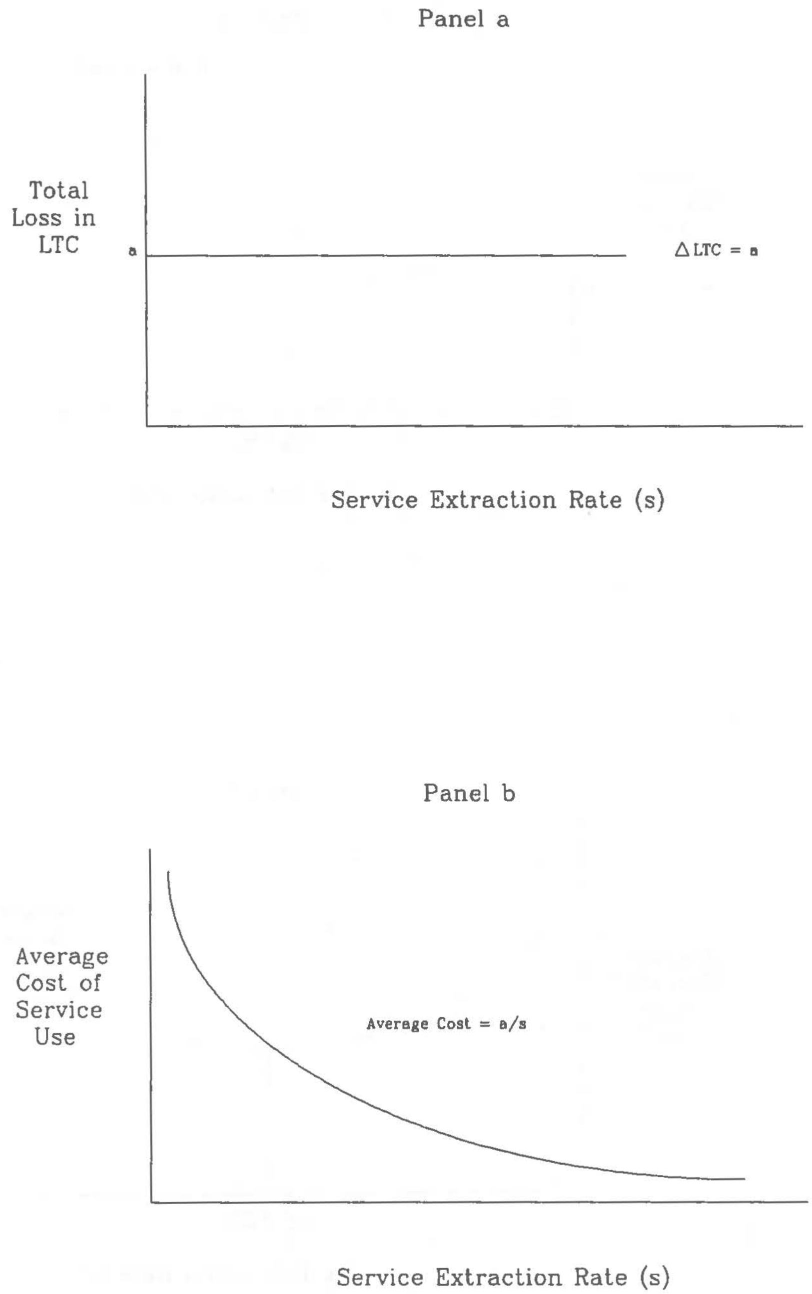

Figure 2.

The Total and Average Cost of Services From Durable Type 10, Divisible in Acquisition, Variable Use Rate, and Decay by the Passage of Time

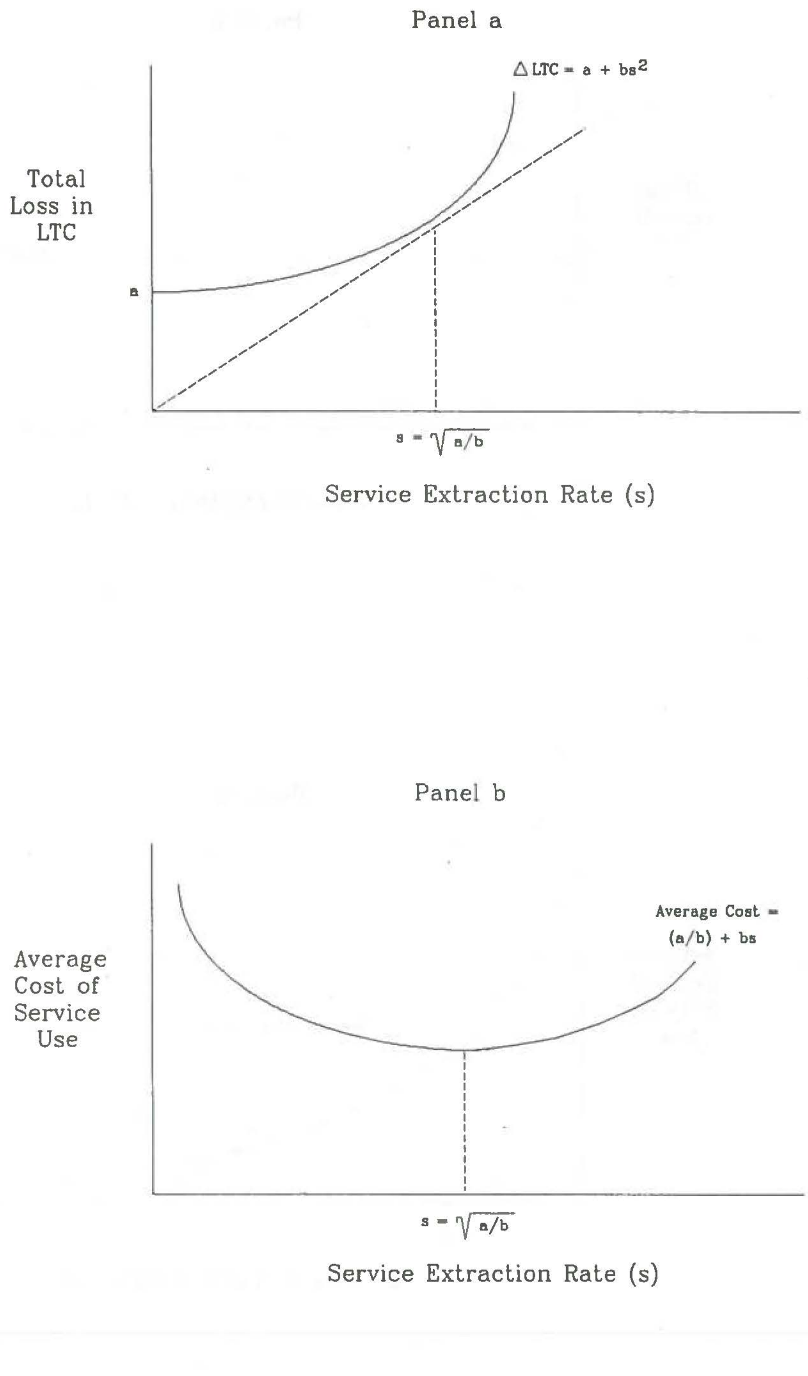

Figure 3.

The Total and Average Cost of Services From a Combination of Durable Types 10 and 11, Divisible in Acquisition, Variable in Use, and Decay From Use and the Passage of Time

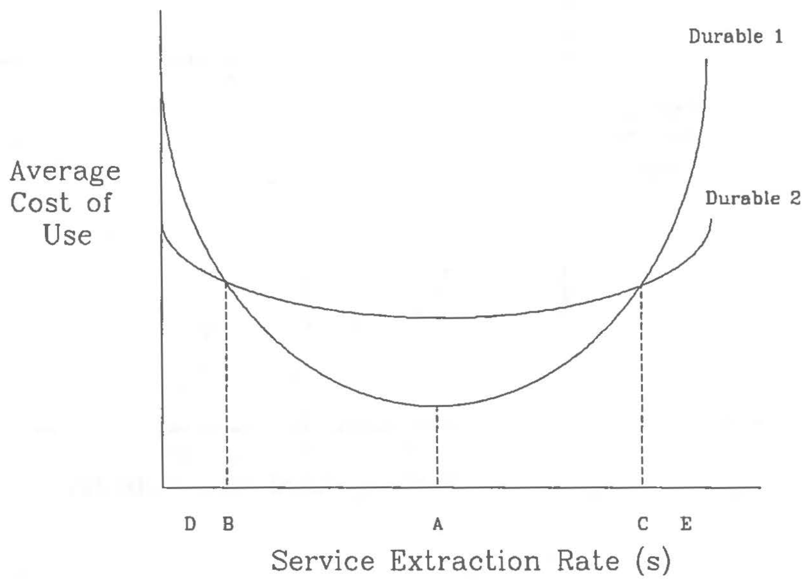

Figure 4.

Average Cost of Services Provided by Durables 1 and 2

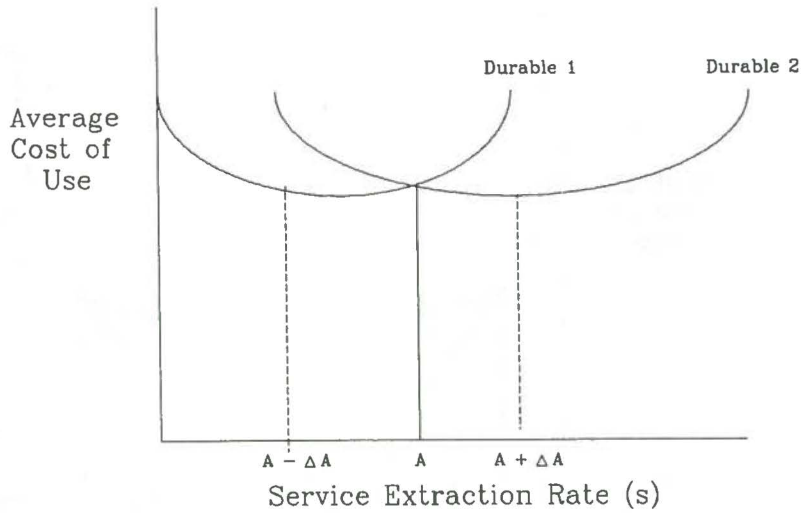

Figure 5.

Average Cost of Services Provided by Durables 3 and 4

Having described durable asset classes, we next show that for durables lumpy in acquisition, uniqueness will characterize average cost curves under risk. Recall that lumpiness in acquisition suggested that design consideration of durables is important; it is important because each size of operation requires a unique durable to operate efficiently.

To illustrate, suppose a durable that combines characteristics of durable types 10 and 11 is required to produce services s. If capacity costs C_c are p_c per unit, then to supply s units of service, the cost is:

$$(1)\quad C_c = p_c\,(a + bs^2)$$

Equation (1) describes how a particular durable's LTC may be reduced through time ("a" units per time period) and service use at rate s (bs^2). This relationship was described graphically in Figure 3.

Next, suppose that the engineers have determined that design costs C_d which include determining the magnitudes of "a" and "b" equal:

$$(2)\quad C_d = \frac{p_a}{a} + \frac{p_b}{b}$$

where p_a and p_b are exogeneously determined prices.

Now we add that the price the firm receives per unit of s is $\tilde{p}$ and is random with an expected value equal to p and a variance of $\tilde{p}$ equal to σ_p^2.

Finally, we add to our model the assumption that the expected utility of the i^{th} decision makers takes the form of the linear mean variance model:

$$EU_i(\tilde{\pi}) = E(\tilde{\pi}_i) - \frac{\lambda_i}{2}\,\sigma^2(\pi_i)$$

where, for the i^{th} individual, $\tilde{\pi}_i$ is stochastic profits, $E(\tilde{\pi}_i)$ is expected value of profits, $\sigma^2(\pi_i)$ is variance of profits, and λ_i is a risk attitude measure equaling a constant absolute risk measure if profits are normally distributed.

The i^{th} firm faces the challenge of finding its design parameters, a_i and b_i, and its ex ante choice of services s_i. It maximizes the function:

$$(3)\quad \max_{a_i,\, b_i,\, s_i} EU(\tilde{\pi}) = E(\tilde{\pi}_i) - \frac{\lambda_i}{2}\,\sigma^2(\tilde{\pi}_i)$$

where

$$E(\tilde{\pi}) = ps_i - p_c(a_i + b_i s_i^2) - \frac{p_a}{a_i} - \frac{p_b}{b_i}$$

and

$$\sigma^2(\tilde{\pi}) = s_i^2 \sigma_p^2$$

The first-order conditions are:

$$(4a)\ \frac{\partial EU(\tilde{\pi}_i)}{\partial s_i} = p - 2\, p_c\, b_i\, s_i - \lambda_i\, s_i\, \sigma_p^2 = 0\ ,$$

$$(4b)\ \frac{\partial EU(\tilde{\pi})}{\partial a_i} = -\, p_c + \frac{p_a}{a_i^2} = 0\ ,$$

and

$$(4c)\ \frac{\partial EU(\pi)}{\partial b_i} = -\, p_c\, s_i^2 + \frac{p_b}{b_i^2} = 0$$

The second-order conditions are satisfied and the solutions for a_i, b_i, and s_i are:

$$(5a)\ s_i = \frac{p - 2(p_b\, p_c)^{1/2}}{\lambda_i\, \sigma_p^2}\ ,$$

$$(5b)\ b_i = \left[\ \frac{\lambda_i\, \sigma_p^2}{p - 2(p_b\, p_c)^{1/2}}\ \right] (p_b/p_c)^{1/2}\ ,$$

and

$$(5c)\ a_i = (p_a/p_c)^{1/2}$$

Notice that a_i depends only on parameters exogeneous to the firm. This results from equation (2) which allowed the two design parameters to be selected separately. Thus all decision makers choose the same value of the design parameter a. But since b_i and s_i depend on the individualized risk parameter λ_i, the average cost for the i^{th} firms may be unique.

To demonstrate this latter point, we define what we call the durable's rated capacity--equal to the service level that minimizes its certain average costs. At the rated capacity level of output, the average cost is:

$$(6)\quad AC = \frac{p_c(a + bs^2) + \frac{p_a}{a} + \frac{p_b}{b}}{s}$$

equals marginal cost:

$$(7)\quad MC = 2p_c\ b_s$$

The service level that satisfies this condition, the rated capacity s_r, equals:

$$(8)\quad s_r = \left(\frac{a}{b} + \frac{p_a}{p_c\ a_b} + \frac{p_b}{p_c\ b^2} \right)^{1/2}$$

Moreover, as "b" increases,

$$\frac{ds_r}{db} = -\frac{1}{2b}\left(\frac{a}{b} + \frac{p_a}{p_c ab} + \frac{p_b}{p_c b^2} \right)^{1/2} = \frac{s_r}{2b_i}$$

Thus, each firm may choose a durable with a unique rated capacity, since it depends on the firm's choice of the design parameter b. But knowing how rated capacities vary between firms tells only part of the story. We ask next how will the average cost at the rated capacity change?

To answer this question, we substitute for s in the definition of AC, the right-hand side of equation (8) that identifies s_r. After the substitution and cancellation, we find:

$$\frac{\partial AC}{\partial b} = \frac{p_c\ s_r^3 + \frac{p_c\ as_r}{2b} + \frac{p_a\ s_r}{2ab}}{sr^2} > 0$$

Thus the family of average curves characterizing this particular industry may appear as they do in Figure 6.

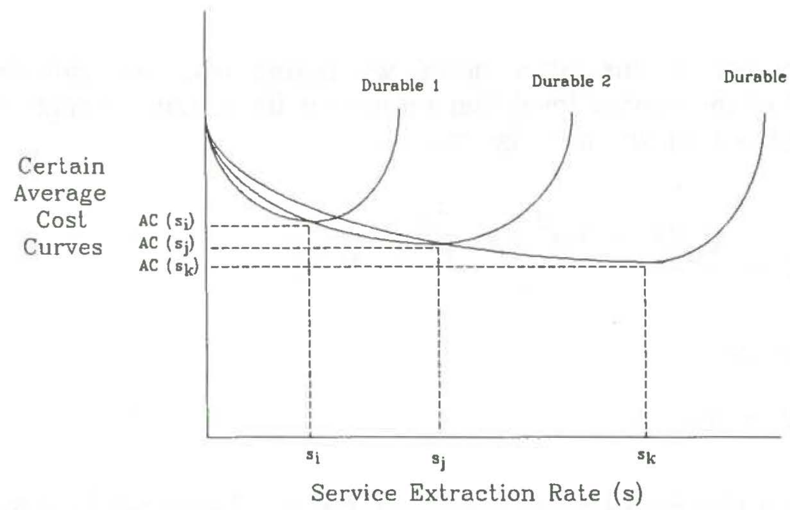

Figure 6.

The Average Cost Curves of Durables With Different Design and Capacity

Firms i, j, and k choose successively smaller values of b. As a result, both their rated capacities and their average costs at their respective rated capacities decline. The characterization in Figure 6 is as we have so often described the farm sector--as an industry with decreasing long-run average cost curves. But the important point is these are decreasing certain average cost curves. Once risk is introduced and risk costs added, neither firms i nor j has incentives to change their structure to become more like the h^{th} firm with its average certain cost and rated capacity.

We might, however, take the next step and impose industry equilibrium on this problem to see if equilibrium faces size adjustments on the firms. Suppose that a fixed supply of durable services is required. That is, let

$$\bar{s} = s_1 + s_2 + \ldots + s_n$$

Then, substituting for s_1, s_2, ..., s_n, we find equilibrium expected capacity price p_c equal to:

$$(9) \quad \left[\frac{p - 2(p_b\, p_c)^{1/2}}{\sigma_p^2} \right] \Sigma \frac{1}{\lambda_i} = \bar{s}$$

and

$$(10) \quad p = \frac{\bar{s}\, \sigma_p^2}{\sum_{i=1}^{n} \frac{1}{\lambda_i}} + 2(p_b\, p_c)^{1/2}$$

Substituting the expected equilibrium price into the solutions for "a", "b_i", and s_i, we find:

$$(11a) \qquad a_i = (p_a/p_c)^{1/2} \; ,$$

$$(11b) \qquad b_i = \frac{\lambda_i \left(\sum_{j=1}^{n} \frac{1}{\lambda_j} \right)}{\bar{s}} (p_b/p_c)^{1/2} \; ,$$

and

$$(11c) \qquad s_i = \frac{\bar{s}}{\lambda_i \sum_{j=1}^{n} \frac{1}{\lambda_j}}$$

Imposing equilibrium conditions on firms in the industry leaves unchanged our basic conclusions. Each firm in equilibrium may choose a different durable and produce on a different certain average cost under risk. Thus, to observe that our industry is characterized by so much uniqueness should not come as a surprise.

Conclusions

This paper has shown how, through a more careful description of durables and the introduction of risk, we may explain the uniqueness observed among agricultural firms. In the risk literature, uniqueness is seldom the rule. Efficient sets are often comprised of unique probability distributions of profit, none of which dominate others. A mean-variance set of choices is such an efficient set.

Given an efficient set that might arise because of differences between durables, only if all decision makers had identical resources and risk attitudes would they choose the same mean-variance combination.

This is a problem, however, that we cannot resolve. In an industry characterized by free entry and exit, those decision makers least risk averse would be attracted--most like the risk neutral decision makers. If there were a large enough supply of risk neutral decision makers, then once again firms would all look alike.

A partial response to this problem, however, may be that liquidity cost imposes barriers to entry. Moreover, distinctiveness even among risk neutral decision makers may be reflected in their subjective formations of probability distributions. Thus even if all decision makers were risk neutral, differences in subjective probability distributions may result in distinct differences between firms. And finally, even if all decision makers are risk neutral and each form identical subjective probability distributions, it may be possible that two different durables may have identical average costs.

Endnotes

[1]This section draws heavily on a paper by Robison and Gwilliam.

References

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