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ELECTRONIC INFORMATION - THE PUBLIC/PRIVATE SECTOR INTERFACE

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Information technology and its associated products have received increasing attention from both the private and public sectors. Compelled by the vast potential for technological advance and by the dramatic social change associated with the information revolution, entrepreneurs, bureaucrats and scholars alike have flocked to the field of information goods.

The flow of human resources into the field of information technology has not been without controversy. There has been debate and occasional open conflict between private and public sector participants competing for similar roles. Should universities be in the information systems business? Will the private sector provide adequate information products to the agricultural community? Is it appropriate for land grant faculty to use commercial networks to disseminate their findings? Should academics develop and/or endorse separate dissemination systems?

It is the purpose of this paper to discuss some of the broad issues regarding the public vs. private role in the electronic information business with a particular emphasis on land grant universities. The paper is organized in two parts. In the first section, the economic definition of a public good is used to classify information goods according to private or public goods characteristics. The second part of the paper focuses on a specific information commodity: electronic information systems. The experiences and development of a national electronic information system called AGNET are used to highlight issues regarding the role of land grant participants in the electronic information systems business. The paper concludes with a summary and suggestions for further research.

Public and Private Characteristics of Information Goods

Economic theory provides a useful framework for the debate about public versus private participation in the information business. Simply put, it tells us that public sector participation should be confined to those cases in which the market fails to allocate goods efficiently. According to welfare economics, a commodity may be undersupplied by the market due to one or both of the following characteristics:[1]

1. consumers cannot be excluded successfully from the market (sometimes called nonexclusion or the free rider problem), and/or

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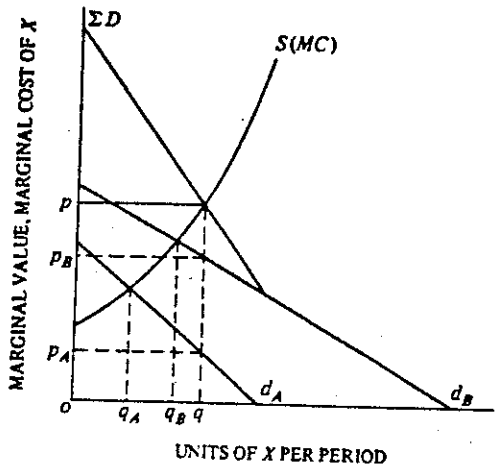
[1] The following discussion, including Figure 1, is based on Chapter 4 of Pogue and Sgontz.

2. the consumption of the good by one person does not exclude the consumption of the same good by another person (sometimes called nonrivalry in consumption or a special class of externality).

For example, consider Figure 1, where a simple economy has two consumers, each with a demand curve for good X.

FIGURE 1.
MARKET OUTPUT OF A PURE PUBLIC GOOD



Assume for our purposes that X is national statistics on acreage. Once the statistics are produced in amount q, individual A can use them without lowering the value to B (due to nonrivalry). Hence to derive the aggregate demand, the individual demand curves must be added vertically, rather than horizontally, which is the case for private goods. The community value of q, for example, is equal to p, which is $p_A + p_B$.

In Figure 1 the socially optimal supply of statistics is q, but undersupply will occur because neither A nor B will be willing to pay the price required to increase supply beyond q_B. Only if the producer can charge p_A to A and p_B to B will there be an economic incentive to produce beyond q_B. Such differential pricing is impossible if consumers cannot be excluded. In summary, when both nonexclusion and nonrivalry hold, the market will not provide a socially optimal amount of the good without public sector participation.

Only goods which are both nonrival and nonexclusionary are considered pure public goods. However, in cases where a commodity is characterized by either nonrivalry OR nonexclusion, there still may be an argument for public sector participation. Consider the matrix in Figure 2, which illustrates the various combinations of nonexclusion and nonrivalry.[2]

[2] The author wishes to acknowledge the help of Christine Ranney in clarifying this classification system.

Figure 2. Public Goods Characteristics

	Can Exclude	Cannot Exclude
Rival	(A) Market Works (Pure private good)	(B) Market Fails
Nonrival	(C) Market Fails	(D) Market Fails (Pure public good)

Based on the argument made earlier using Figure 1, it is clear that while the market will produce an optimal supply of goods in case A (pure private goods) , an undersupply of goods will prevail in case D (pure public goods). Categories B and C are not purely public goods in nature but undersupply still may be used to justify some public sector participation. For example, while exclusion provides the incentive for private production of goods in position C, (since users could be forced to pay and nonusers could be excluded) exclusion would not be socially optimal, since additional users could be accommodated at no extra cost (due to nonrivalry). Thus some public sector intervention might be appropriate. Alternatively, marginal cost is not zero for goods in position B, but since exclusion is impossible (or too costly) the free rider problem will discourage private production.

To illustrate the use of the matrix presented in Figure 2, consider a specific category of information goods: information that relates to commodity marketing (CMI). Nonrivalry will be discussed first, then the characteristic of nonexcludability.

In general, information goods like CMI can be considered nonrival (thus falling in category C or D) since information can be consumed by many individuals without being "used up". However, exceptions may arise if the value of the information good declines as it reaches a larger audience. For example, price quotes and very short term marketing recommendations diminish in value as the information is disseminated. The first person to "consume" the news of a freeze in Florida may benefit substantially by using that information in buying orange juice futures. However, as that news spreads, the market quickly "discounts" the information.

News with a longer life span is more easily viewed as nonrival. Even though in the end, the market "discounts" all news, the process is much less dramatic for long term CMI. There is a substantial lag between the production of long term CMI and the eventual results of decisionmakers using the information. In contrast, very short term CMI produces an immediate struggle between various interpretations of the information leading to a resolution in the form of price movement. In summary, the characteristic of rivalry may vary for CMI depending on the perishability or life span of the information.

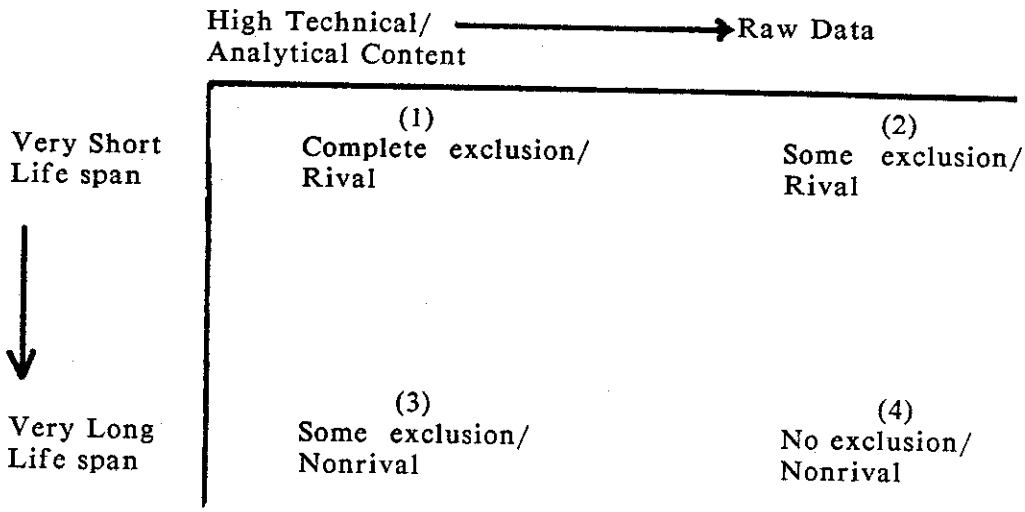
A similar argument can be made for the degree of excludability found in CMI. In the case of information goods, the ability to exclude depends crucially on how quickly "leaks" occur which allow for "free riders". Information goods belong in B or D when consumers cannot be excluded from CMI because the information

is easily found elsewhere for free. However, the lifespan of the information and the analytic content are two elements of CMI which may increase the ability of suppliers to impose excludability (and thus move the good to A or C).

For example, there are many sources for daily price quotes, news about weather, and short term movements in supply and demand, making it impossible to exclude users from this type of information except for the extremely short term. However, detailed econometric analyses of long term trends in supply and demand or highly technical analyses of commodity trading charts are easier to keep from nonpayers, since they are unlikely to "leak" to any widely distributed source. Likewise, tic-by-tic quotes of the futures market cannot be disseminated quickly enough to prevent exclusion, while CMI with a long term life span, such as information about historical basis, will become widely available over time. To summarize, while suppliers cannot exclude consumers of long term/low content information, if the CMI is very short term in nature or is difficult to disseminate due to its technical (analytical) content, it will not be characterized by free riders.

Using Figure 2 as a framework, it is clear that while some products such as long term supply/demand statistics, belong in box D of the matrix, other goods may fall into one of the other categories. Adding life span and analytic content of information goods, the matrix can be revised as in Figure 3.

Figure 3. Public Goods Characteristics and Information Goods



Positions (1) and (4) correspond to (A) and (D) in Figure 2. Position (2) is a good with strong tendencies toward a private good. The main distinction is that raw data can be leaked easily and so total exclusion may not be possible. Position (3) is a good with strong tendencies toward a public good. Some exclusion may be possible due to the difficulty of disseminating highly technical information, but otherwise (3) has similar qualities to a public good.

Information that falls in the middle of the matrix is even more problematic. If information is of a medium term nature and includes a moderate amount of analysis, is there an incentive for the private sector to produce the socially optimal amount? Can the public sector justify providing information of a medium term life span, even if it involves substantial value added analysis? Policy makers and land grant researchers dealing with goods falling in the middle ground in this matrix will be confronted with many questions of this nature.

To complicate the issue, the qualities of timeliness and analytic content may change with technological advances. Any microcomputer user will tell you that his or her definition of "short term" has changed radically over the last five years. The analytic capabilities of computers have greatly enhanced the ability to "add on" value to existing raw data. The pace of change requires constant reevaluation of goods that may have shifted across the matrix over time, thus moving into or out of the clear cut public goods or private goods area.

In summary, economic theory provides a useful framework for thinking about the issue of private vs. public sector participation. The closer information goods are to the cases of nonexclusion and nonrivalry, the stronger the case can be made for public sector involvement. There will also exist a substantial gray area in which some combination of public sector and private sector participation may be optimal. Technological change will continue to redefine the qualities attributed to information, both through changes in the products themselves and through changes in our perceptions of the product.

Electronic Information Systems and The Land Grant System

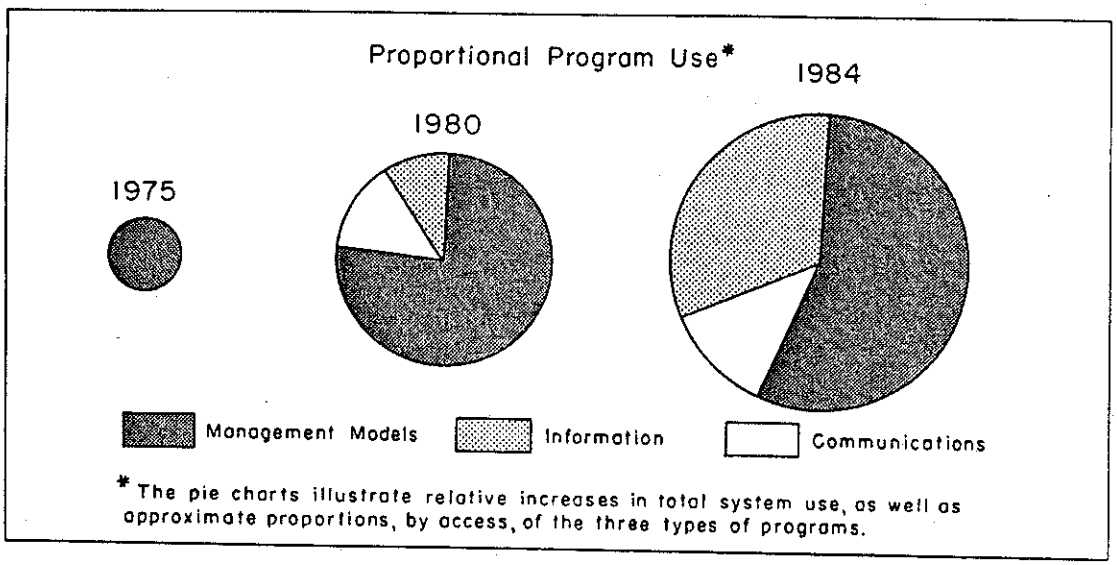
Information products in the land grant system can be sorted into at least three separate areas: electronic information systems, applications software, and experts systems/artificial intelligence. The focus in this section will be on the information systems area, but many issues raised will also have relevance for the other two areas.

For the purposes of this paper,an information system is defined as a computer-based delivery system that provides information on marketing and management topics primarily to farm businesses. Examples of such networks are AGNET, AgriData Network, ANSER, CMN, COMNET, Farm Bureau ACRES, Grassroots, and Instant Update. While it is beyond the scope of this paper to detail the services and history of each system, discussion of the AGNET system will serve to highlight some of the broader issues.

AGNET was developed in 1975 by agricultural economists and agricultural engineers at University of Nebraska to extend interactive computer models for off-campus use by farm businesses. In the early stages of its life, AGNET was primarily funded by a federal grant, but evolved to a stage of self-funding by the early 1980s. Since then, the network has expanded service beyond the state to become a national force in the electronic information systems business.

Figure 4 shows how AGNET's mix of information products have changed in the course of "privatization". In particular, the programs providing information, as opposed to on-line number-crunching management models, have grown significantly. A point worth noting is that since becoming self-sufficient, AGNET's

improved information components have been mainly time-sensitive items, such as weather, cash bid prices, and commodity marketing related items.



Source: AGNET: The First Decade

Evaluating AGNET's evolution in light of the framework established in the first section of this paper, it is clear that at its inception, the information goods provided by the system were close to (3) in Figure 3. Analytic content of the management models was high, and the life span of the information was medium to long term. One reason AGNET was able to move toward a more private sector structure was its ability to limit consumption (exclude nonpayers) of its goods through communications technology. Another reason was that it sought out and added highly perishable (an therefore rival) information products closer to points (1) and (2).

AGNET's experience points up several important lessons:

* Producers are willing to pay for information.

* The better the ability to limit access, the greater the possibility for private sector participation.

* Information providers may go through an evolutionary phase with some initial public sector participation.

* Technological change can redefine whether a good should be publicly or privately provided

* The delivery mechanism is closely tied to the information product itself.

The last two points cannot be overemphasized. Technological change in the electronic delivery of information has added to the number of information products falling near points (1) and (2). Even information with a tiny life span,

such a tic-by-tic stock quote, may take on economic value if technology allows a user to access it (and/or act on it) before its value deteriorates.

Technological change can also alter access to information and hence the degree of excludability. On the one hand, innovations like the satellite and electronic communications greatly reduce the cost of disseminating information. The public press can access a broader range of information more quickly than it could five years ago. Thus, excluding users is becoming more difficult for private vendors of information with a medium or long term life span. However, the same technologies have created private electronic networks which allow vendors to deliver perishable information to a specific user in a timely and exclusive manner.

These observations greatly complicate the role of the public sector in the information systems business. While it is clear that basic research will be under-supplied by the private sector, as technology transfer occurs, it becomes difficult to say when the public sector should step completely aside.

The experience of AGNET is an interesting example of how a public sector information system can evolve to a more private good form. With regard to the future of the information systems business, two questions arise: will AGNET at some point go completely private, i.e., completely sever its ties to a public sector institute, and (2) if not, how can private sector participation be encouraged when a major competitor is endorsed (even though not supported monetarily) by a public institution? It should be emphasized that these issues are not just specific to the AGNET case, but broad questions that also arise with regard to other areas of information technology, such as applications software and expert systems development.

When is it appropriate for the public sector to step completely out of the picture? Innovators in the scientific research community face the question routinely and still do not have an easy answer (although the patent system provides a partial answer). It is common for scientists to work develop a new technology in cooperation with the private sector, but it is uncommon for scientists to actually produce and deliver the technology at the retail level.

It is difficult to draw a parallel between the experience of the scientific community and the issues raised in this paper because electronic information is of a different nature than a patentable new vaccine. Information has always been one of a university's primary products, but the electronic delivery mechanism has transported the commodity beyond familiar boundaries. The enhancement added by electronic delivery can have a profound effect on the use and dissemination of information. Land grant researchers are left wondering how to embrace the new technology which is now linked so closely to the information products they have produced for years. No one would debate whether land grant should produce information on farm management issues. But is that information "good" essentially transformed into a different entity if it is delivered electronically?

This line of questioning provides a link back to the framework provided in the first section. If delivery mechanisms or other technological innovations shift the position of a good on the life span/content matrix, then there is good reason to debate what mix of private/public participation will result in an efficient allocation of the good. If the public sector plays too strong a role, it will prevent private sector participation. If the public sector profile is very low, it will result in underallocation of the information good.

An example will help explain the point. Imagine a land grant faculty member who predicts hog prices on a biweekly basis, using an econometric model. Traditionally, the predictions have been disseminated in print as part of a biweekly newsletter. Although farmers find the information useful in tracking the market, they do not use it in day-to-day marketing decisions since the information is moderately dated by the time of receipt.

Now, imagine a change in technology that allows the immediate delivery of the price forecast through an electronic system. Since the information is received earlier, farm managers can use it in a different way, i.e. as a guide in marketing decisions. As a commodity, the price forecast has moved closer to the private goods part of the matrix. Using the analysis presented earlier in the paper, it makes sense to reevaluate private/public participation. If the land grant professor develops and maintains a vehicle for delivery, it may prevent the development of private sector support. However, unless the professor at least is open to producing information in a format amenable to electronic delivery, the result may an undersupply of the new "enhanced" information good.

There are more complex real-world examples in which the delivery vehicle is inextricably linked to the product. But even the simple example makes a clear point: public sector participants need to reevaluate their role in the information business as technology changes. Public sector domain in the early and innovative stages of technological change may be clear cut, but in the process of transfer of technology the lines may blur.

Conclusion

Information technology is a field that attracts both private and public participation, but the roles of each may not be easy to define. Land grant researchers face a particularly difficult challenge in determining when their participation is appropriate. In the first section of this paper it was argued that the need for public goods arises because it may be difficult to avoid free riders and because for some goods the marginal cost of providing it to the next consumer approaches zero.

In the area of information and information systems, two qualities affect whether or not public goods characteristics dominate: the life span of the information and the analytic content of the material. Those goods with a short life span and high analytic content are more likely to be allocated efficiently by the private sector. However, the longer the life span of the information and the lower the analytic content, the more likely that public participation is appropriate.

The experience of AGNET is an illustration of how a public sector information system matured into a quasi-private sector system. The example is a reminder that the process is dynamic: as technology changes, the public/private mix must be reevaluated. Finally, the AGNET experience raises the question about the future development of systems. Even though financially a system or information product may go through "privitization", a strong endorsement or association with the public sector may be a barrier for emerging private sector companies.

Researchers in the land grant community should be sensitive to these issues. An essential role must be played in the innovation stage and in the technology transfer stage. However, in the area of information systems, software design, expert systems development, and other information products, there must be continual reevaluation of the public role.

Future work in this area could include an expansion of the simple framework proposed here. No mention has been made of many other key issues, such as private sector market structure, externalities, freedom of information, professional reward systems in the land grant community, and other missions of the land grant system which may conflict with the conclusions presented here. A more complex analysis of public/private sector participation could be built using the framework presented here and undoubtedly would receive considerable attention from participants in both sectors.

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