

## Introduction

Information is valuable because it allows individuals to adjust their actions to suit the situation at hand. Quantifying the value of information involves determining the expected value of actions with and without the benefit of information and subtracting the second from the first.

Information is an economic good, but it is not the same as other economic goods like oranges, airplanes, or computers. Markets do not always create and disseminate information as efficiently as they handle other kinds of goods and services, mainly because it is hard for businesses to control access and charge all users. The government can step in to provide information, like hurricane or crop forecasts, that private markets may not provide when that information is needed by individuals to make better personal decisions. The U.S. Department of Agriculture (USDA) and other agencies also implement regulations that create incentives for individuals and businesses to provide information they otherwise may not. For example, the Food and Drug Administration (FDA) requires “Nutrition Facts” labels on food products. FDA also regulates food additives and drugs, requiring extensive testing via clinical trials, which provides information about their safety and efficacy. These examples are only a few of many ways government influences the creation and dispersal of information.

Because information is not normally traded in competitive markets like oranges are, quantifying its value is difficult, mainly because it involves quantifying what decisions would have been made without the information, and what the consequences of those decisions would have been. Information usually has some value because it matters to most decisions. Housing price forecasts influence demand and supply of homes. Information on the prices of everyday consumer goods at various retailers affects where people shop, how much they spend, and how much they can afford to buy. The magnitude of this information may or may not be as great as that stemming from forecasts of natural disasters, but the basic concept of value is much the same: Information simply allows individuals to make better decisions. The explosion of Internet use and the growing wealth of information it provides surely generate great value, despite the difficulty of quantifying it.

Type and timing of information are probably preeminent influences on value. Old information is hardly ever worth very much, nor is information of poor quality, even if it arrives on time. In determining the quality of information, the integrity of the source and its reputation are crucial because information, unlike many other kinds of goods and services, have many public goods attributes (see box, “Public Goods: Why Information Is More Like a Sunset and Less Like an Apple”). Characteristics of consumers of information, such as risk tolerance, and the structure of the market in which they operate also affect the information’s value.

Agriculture is an area in which various kinds of timely information can profoundly affect market and individual actions. Katz and Murphy conducted a relatively detailed analysis of the value of advance weather information, but little is known about factors influencing the value of early-warning systems for plant disease. This report begins to fill this gap.

To illustrate the value of early-warning systems for plant disease, this report considers as a case study the value of real-time, county-level information provided to farmers via the publicly accessible website <http://www.sbrusa.net>. USDA developed the website and its underlying coordinated framework to help soybean farmers cope with a new pest, *Phakopsora pachyrhizi*, a fungus commonly known as soybean rust (SBR). SBR, a recurrent problem for soybean producers in much of the southern hemisphere, was first detected in the U.S. in fall 2004, late enough in the season that it posed no threat to that year's soybean crop. After overwintering in the South, SBR posed a new, uncertain, and potentially large threat at the beginning of the 2005 U.S. soybean season. Farmers anticipated that fields infected with SBR would see markedly reduced soybean yields, but with sufficient notice, the fields could be treated in advance with preventative fungicides. An alternative response to an SBR threat is to monitor and treat with curative fungicides, but this requires even more timely information on the spread of SBR. The website and infrastructure were built and tested before SBR had caused any significant U.S. crop losses. They were developed to provide real-time forecasts of

### **Public Goods: Why Information Is More Like a Sunset and Less Like an Apple**

Economists distinguish public goods from private goods, not by whether government or private markets physically provide them, but according to two characteristics of the goods themselves: rivalry and excludability. An apple is a rival good because, if one person consumes it, there is nothing left for someone else to consume. In contrast, one person watching a sunset probably does little to diminish the value of another person watching the same sunset—sunsets are nonrival goods. Like a sunset, information, such as a good SBR infection forecast, is nearly as valuable to the second person as it is to the first. An apple is also excludable: It is relatively easy for a person who owns it to keep others from consuming it. In contrast, it is more difficult to exclude others from consuming information and sunsets—they are nonexcludable. So, a private good is both rival and excludable, and a public good is both nonrival and nonexcludable.

The private-good label comes from the natural incentive of private markets to efficiently create and allocate rival and excludable goods and services. Private markets have less of an incentive to provide efficient amounts of nonrival and nonexcludable goods, which is why governments are more likely to provide public goods. Some argue, however, that few if any goods are purely public or private; most are somewhere in between. As a result, it is often debatable whether or not the Government should be involved with provision of goods that have public-good characteristics but are not pure public goods. Even sunsets, or at least some of the best places to watch them, reside on private property, so property owners can exclude others from watching them. And if a good viewing point becomes congested with too many sunset watchers, it may become congested, diminishing the value of the view to others. So a sunset can be partially rival, too. Similarly, information can sometimes be partially excludable and partially rival. But the public-good nature of SBR forecasts suggests that private markets may have not held an incentive to develop and distribute information as detailed and comprehensive as that provided by the SBR coordinated framework.

the local impending SBR threat and therefore to aid efficient monitoring of crops and application of preventative and curative fungicides—the first time a web-based system was used for this purpose.

Now, a full year after its first detection in the U.S., SBR has posed thus far little threat to the 2005 U.S. soybean crop. Given the expense of developing the website and its underlying infrastructure, some have questioned whether the infrastructure was a worthwhile endeavor. After all, if some farmers had simply managed their crops as if there were no SBR threat, it is possible that they would have fared as well or better than they actually did in 2005.

This view overlooks a key point: Although weather conditions did not facilitate dispersion of SBR spores to key soybean-producing regions in 2005, this factor could not have been known in advance. A potential SBR threat existed at the beginning of the season, but how farmers might have prepared for that threat in the absence of the coordinated framework is not clear. Indeed, without the framework, individual farmers may have incurred even greater expenses by monitoring their own fields, perhaps spraying fungicides for a threat that did not exist in their area, or forgoing planting entirely.<sup>1</sup> Even if you build it and rust does not come, the information from the coordinated framework could have significant benefits.

This study shows how various factors influence the benefits to farmers from the framework. It explains how farmers' prior beliefs about the likelihood of infection (based on location and perhaps other factors), the perceived accuracy of the framework's SBR forecasts, and the costs and benefits of different rust management strategies collectively influence the value of information provided. The value may also depend on farmers' risk preferences and how soybean prices would be affected by SBR-induced production shocks.

Our analysis indicates that the value of the coordinated framework depends on how much it enables farmers to fine-tune their management practices rather than the presence of rust itself. Information is most valuable to farmers when ambiguity is greatest about whether or not to apply chemicals. Regional factors, including the likelihood of rust, farm size, profitability, and yields in the absence of rust, create information values that vary across the country. This report estimates the value of the framework only for soybean producers. The framework, however, could also benefit other groups: fungicide companies, which might use the information to shift stocks of chemicals between outlets to meet evolving needs; livestock producers, who might be able to fine-tune their management decisions; and consumers (e.g., livestock producers), who might benefit from accurately anticipating supply shifts and their implied effects on soybean prices.

<sup>1</sup>In this case study, we do not consider farmers' planting decisions, only their fungicide application decisions, provided they do plant. By ignoring this decision, we underestimate the value of information provided by the framework.