TESTIMONY

OF

MOLLY K. MACAULEY*

Fellow

Resources for the Future

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*The views expressed herein are those of the author only. Resources for the Future takes no official position on any proposed legislation.

Congressman Brown, Congressman Walker, and distinguished members of the House Committee on Science, Space, and Technology. Thank you very much for inviting me to appear before you today to present my views on how the nation might meet the challenge of having a well-functioning and cost-effective civilian remote sensing program in the 1990s and beyond. My comments are intended to raise questions which I think need to be considered in any redirection of remote-sensing activities.

By way of background, let me briefly describe my own experience in space issues. I am an economist, having received my PhD in economics in 1983. Since that time my primary employment has been at Resources for the Future, a nonprofit, nonadvocacy research and educational institution here in Washington. I also am an associate professor of economics at Johns Hopkins University. For the last 10 years I have specialized in analyzing how best to mix government involvement and private economic incentives in the nation's space activities. My work on earth observations has included both research and practical issues of program design, including working with NASA on implementation of its Earth Observations Commercialization Applications Program.

Key Questions

I believe this background in economics is essential, though often overlooked, in addressing two overarching questions regarding the nation's civil earth observation program -- and here I might add that I urge the committee's deliberations to consider jointly Landsat and the Earth Observing System (EOS): (1) How much should the nation be willing

to spend on earth observations? (2) How should we organize an earth observation program to ensure that it works -- in particular, what are the most desirable respective roles for the government and private sectors? Specifically, we must understand what the goals of different "privatization" measures are with respect to Landsat, and how the public and private sectors should operate to achieve these goals. If the aim of privatization is simply to reduce Federal budget outlays, it may well be impossible to preserve a viable earth observation program. If, in contrast, the goal is to achieve an effective blend of market forces and government actions, then economic issues come right to the forefront.

The Policy Challenge: Earth Observations as a Quasi Public Good

Two attributes of earth observations have complicated the design of public policy for space-based remote sensing every since the technology's inception three decades ago. One attribute is that remote sensing data are an information good or commodity, thus once having invested in the infrastructure to obtain the data, multiple copies can be made at typically very low costs of reproduction. But if prices of the data are set at these low costs, how do we cover costs of the infrastructure to ensure supply, to provide incentives for technological innovation, and to protect intellectual property? I will return to this pricing issue shortly, but let me assure you that it is frequently encountered and dealt with rather well in a host of industries. These include software, publishing, movie and VCR rental industries, and stock market data. I might point out that we pay more to see a movie at the theater than to rent it for our VCR, and some stock market investors pay hundreds of dollars to have real time access to stock quotes while other

investors pay merely a quarter to see yesterday's quotes in the daily newspaper. A look at how these industries price can be illustrative for remote sensing data.

The illustration is not fully analogous, however, because of the second attribute of remote sensing data. This characteristic is that the data are not just a source of private information, but are information about public goods -- natural resources, climate change, pollution, agricultural yield. It is inherently difficult to establish the value of information about public commodities and processes. The information may also have national security or foreign policy implications. At the same time, the data are not exclusively public in value, as they frequently have private value for resource management-- in managing commercial timber farms, in oil exploration, in commercial fishing and agriculture.

It is not surprising, then, that public policy has been so difficult to formulate for the nation's earth observation programs. The information and natural resource character of the data make them neither exclusively the responsibility of the public or private sector to provide -- thus both sectors would like the other to foot the bill.

Frame of Reference

Even when we start to think about earth observation as a scientific cutting-edge technology (as well as a business undertaking for government and private sector resource managers), we must ponder the same questions as those which arise in studying the behavior of other industries and markets. The following questions may seem pedantic but

they must be answered in designing policy -- and, unfortunately, many of these questions have never even been asked:

-- What is the nature of demand for the product? Information has value only when it is acted upon -- that is, when it causes us to take (or to avoid taking) action. Thus, what is the information value of earth observation data? How are different "bundles" or configurations of remote sensing data valued; how much complementarity is there among different types of space and non-space based data? What kinds of substitutes are available, at what cost, and with what compromise in terms of foregone information? What kinds of "public good" values are served by earth observation, which of these values must be secured only through government action (perhaps national security), and which might be obtained through contracts with the private sector? What values are more private and thus more amenable to proprietary provision?

-- What is the nature of supply possibilities for different sets of remote-sensing data? Data enhancing or other scale economies are increasingly being questioned (witness the EOS engineering review). Can other approaches (e.g., small scale space-based alternatives, aerial photography, ground data) provide close substitutes for components of a large space-based system? Does government necessarily have to be the producer, as distinguished from the provider purchasing from a private producer, of data for public purposes?

-- How should government policies, including controls on private behavior, be arranged to achieve the most effective configuration of earth observation systems and provision of data to users? Here "effective" refers both to cost-effectiveness in supplying data and efficiency in meeting demand -- ensuring no demand remains unmet where

willingness to pay exceeds cost of supply, while also ensuring fiscal viability on the supply side. Rules governing pricing of remote-sensing outputs and entry by new operators into the supply of such outputs clearly are central to this issue. Since these are the very issues that loom large in analyzing and regulating "natural monopolies" in the public utility sector, it follows that such industries may be a useful source for analogies when we think about the configuration of earth observation programs.

The "Demand" Side: What is the Value of Information and How Much and What Kind Is Most Worthwhile?

In the national and international discussion on climate change, much attention has focused on "we need to know more about the global natural system to form policy," or "we know human impact on the environment is serious and need to assess the benefits of alternative amelioration strategies." These are issues of interest that partly motivate our desire to preserve Landsat and to embark on the planned Earth Observing System, but the broad issues are only part of the story. Land remote sensing from space has of course been around for three decades, yet conventional wisdom alleges that a market for these data is quite small. But data alone do not make a market; the quality, quantity, and availability of data matter, as do ancillary infrastructure like computer hardware, software, and human capital (even today, space-remote sensing courses are not routinely part of curricula in relevant disciplines such as geology or land use). We also need to disaggregate looking at the value of particular information sources (e.g., space- and non-space based; Landsat and EOS) before we can see

the nature of the demand to be satisfied. In addition we need to know the urgency of these demands and the nature of possible substitutes so we can understand responses to different price rules. Finally, we need to sort out public and private goods. I will return to this discussion; presently, I might note that making data available at low cost is not necessarily the way to understand these issues.

The "Supply" Side

Small scale, redundancy, diversity, modularity, quick turnaround -- these attributes characterize today's industries, including electricity generation, computers, telecommunications, publishing, and even steel and auto production. We also see that dynamism in terms of generating employment and sales revenue is increasingly realized in smaller and medium sized businesses and nev starts, especially in high technology, software, and information services industries.

Why would identical trends not be realized in space remote sensing if entry barriers and other regulatory impediments were removed? These barriers include restrictions on pricing and uncertainty over government's attitude toward private sector participation in the space segment, especially regarding licensing, operations, access to data, and operating parameters like resolution and other capabilities. In business plans for private sector participation in earth observation technologies, legal costs budgeted to challenge or comply with these regulations alone add some 40 to 80% to expected entry costs.

Institutions

The role of government in providing (and using) remotely sensed data could vary widely. At one extreme, government could largely control the production of data, as in the past, as well as remaining a major user. At the other extreme, government could largely remove itself from the supply side except for the management of large fixed facilities like launch sites and tracking systems, and it could maintain or even increase separation of space-based science from the operation of space systems in order to avoid internal conflicts of interest (the search for functions to justify systems). In the case where government retains a substantial role in the supply of remote sensing information from new and existing systems, government is essentially treating remote sensing as a natural monopoly where services must be provided either by government or under government regulation.

Pricing

How should remote sensing outputs be priced in such cases? H.R. 3614 calls for pricing to educational and other nonprofit users at 'marginal cost.' It is not clear how the groups would be distinguished or how marginal cost would be defined under this policy, but if past experience with the pricing of shuttle services is any guide, charges to these favored groups might be set equal to 'additive cost' -- direct out of pocket expenses for extending data availability to another user, without any provision for recovering capital depreciation/replacement charges. A price equal to additive cost likely will be very low and, as H.R. 3614 acknowledges, will require efforts to prevent profit-seeking resale by favored users.

Marginal-cost pricing, particularly based on additive costs, is likely to have several very undesirable side effects. Presumably the capital costs would be recovered from other users, especially commercial users. However, it is not clear that this is feasible for maintaining fiscal solvency of a private or public remote sensing program. If the price gets too high, commercial users can turn to other vendors (e.g., Spot) or other alternative modes of information acquisition (e.g., ground or aerial data. overflights). Thus, while marginal-cost pricing would not thwart access to data for important public purposes (science and education), it could have the ironic side effect of perpetuating one of the very problems driving policy change: the inability to make remote sensing financially sustainable (whether or not it is privatized).

In addition, like most of the environmental/resource management industry, the Landsat industry is typically organized with for-profit firms serving as consultants to state, local, federal, and other nonprofit entities, frequently involving academics as consultants. A natural result, then, would be "free" data acquisition by for profit firms via nonprofit entities or academics. If prices to for profit users were set large enough to make up Landsat's capital costs, the attractiveness of data acquisition through the nonprofit client would be even larger.

A second, perhaps even more insidious effect of unrestricted marginal-cost pricing is that it limits choices by restricting entry. Potential new providers of lower-cost or higher-quality services cannot practice such pricing for the reasons cited above -- the market would not tolerate the degree of price discrimination needed to fully recover

investment costs, and the new entrant could not run a perpetual deficit. This would not be a problem if the best design of a remote sensing system was self-evident. However, the smaller-scale technologies that drive other industries, and the debate surrounding EOS, definitely suggest that this is not the case.

Finally, even if it were decided to designate Landsat a public sector operation, below-cost data availability offers no clue whatsoever to the value of the information, thus no clue as to how much the taxpayer should invest in Landsat.

How might other pricing rules for earth observation data be constructed? We know that over the long run, prices should reflect the full marginal cost of service provision including capital replacement charges. In addition, where prices must be set above marginal cost to recover fixed expenses, the markups should reflect the relative valuations of the service by different users. Users with the most urgent or least flexible demands should pay relatively more. It may be that on this basis, groups providing public benefits should shoulder a greater share of the burden than commercial users if the latter have more competitive options.

Public Interests

These pricing rules obviously raise the question of whether public interests can be adequately served in the absence of preferential pricing. One strategy which could meet social goals while still retaining scope for choice in the provision of remote sensing data is 'information vouchers.' These data grants to the science and nonprofit communities would not require us to distort the price of data to

accommodate public interests, could improve the budgetary viability of earth observations, and be much easier to police than the enforcing of below cost data sales to preferred groups.

By the way, this approach might also be taken to accommodate foreign policy goals, including respect for an open skies policy. Special foreign grants for data access could be made available just as grants for numerous other activities with international implications routinely seek to preserve equal access.

The Undesirability of 'Back to the Future'

Concerning the role of public and private ownership in the provision of remote sensing data, results to date from privatization have been modest at best, and it might be tempting to conclude that ownership and operation of earth observation systems must be largely if not wholly the province of government.

Two routes make it quite possible, however, to offer large opportunities for private sector involvement while still maintaining financial viability of space-based remote sensing. One opportunity is to remove barriers to small-scale entry, as discussed earlier. If you are not a believer in the viability of small scale entry (e.g., you feel risk-adjusted capital costs are still too large, that markets are still too small), then another approach might work as follows. This approach would allow consortia of public and private information providers to jointly undertake investments in new remote sensing capacity while remaining competitors in the downstream provision of different information services to users. The design of the system would be by the consortium and based on the number of diversity of products sought by

the consortium. The system would be operated by a neutral party (e.g., a contractor hired by the consortium) to avoid favoritism. No party would be barred from the consortium provided they paid the incremental cost the consortium would bear in extending an additional product (e.g., adding and operating an additional sensor), along with a share of fixed general facilities and overhead costs. Nor would joining a consortium be obligatory, if a potential supplier thought it could supply a product at lower cost on its own. Pricing of services by consortium members would be unregulated (and coupled with vouchers as needed to meet public interest needs).

This approach, broadly patterned after the idea of 'competitive joint ventures' in utility systems for new capacity (e.g., new pipelines), seems to offer several possible advantages. There will be natural incentives within the consortium to exploit as many economies as are available without overbuilding the system. Entry is not barred to any party, particularly private actors, who can cost-effectively meet a market need. And competition among providers (buttressed by voucher subsidies) should provide efficient prices and usage of different services.

An important practical challenge in pursuing such an approach is ensuring that entry is in fact not unduly restricted. Incumbent remote sensing data providers could misrepresent costs of expanding system size or scope to deter new entrants, or they could unduly burden entrants in access to fixed facilities like launch and guidance systems.

Because government in general, and NASA in particular, have historically played such a large role in the nation's remote sensing program, it is especially important to guard against inadvertent or

deliberate efforts to stifle private sector participation or innovation. To that end, it may be critical to separate government collectors and users of data from government operators of systems to avoid "self-dealing" or other conflicts of interest. Proposals to reduce the Department of Commerce's role (or to redefine the role from promoting commerce to policing data access) and to expand the Department of Defense and NASA's roles go entirely in the opposite direction -- indeed, back to the future of almost three decades of government control. Budgetary pressures in part forcing this institutional change are unlikely to ever go away; rather, the financial demands on the family when the teenager returns home are likely to grow onerously and grudgingly for all concerned.

Thank you very much for your interest. I look forward to your comments and questions.