PUBLIC REGULATION OF FOOD AND AGRICULTURAL MARKETS

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Summary

Seminal changes have occurred in recent years in how scientists perceive and act on their perceptions to best regulate food and agriculture. Arguably, the most important happening in economics in recent decades has been emergence of the standard model. Evidence is compelling that any country that is willing to follow policies specified in the model can have economic success. That economic success relies mainly on markets, but cannot be separated from public measure to address externalities and provide public goods. Examples were presented of conceptual and practical guides to allocate resources where free markets alone do not suffice.

One reason why the standard model application is so important is because economic progress eventually bring zero population growth. Another notable trend is toward better care of the environment as per capita incomes rise (Ruttan). Based on a cross section of countries Hervani and Tweeten found that concern for protecting the environment coupled with the science and technology to act brings a transition from positive to negative income elasticities of demand for environmental degradation and natural resource depletion between $10,000 and $20,000 of income per capita. That is, the Kuznet's Curve for a wide range of per capita environmental and natural resource variables is an inverted U-shaped peaking in degradation per capita at $10,000 to $20,000 of income per capita and declining at higher incomes. Population growth also has a negative income elasticity. Thus, empirical results indicate that marginal income increments help preserve the environment and natural resources at higher income levels because of lower birth rates and policies that protect the environment.

As important caveat is that, whereas improved models and policies reported herein can do a better job of regulating food and agricultural markets, appropriate public policy is not perfunctory. Environmental degradation and natural resource depletion can fall as incomes rise only if attitudes and institutions mature to implement sound public policies.

1. Introduction

Public regulation is interpreted broadly herein to include all means by which the public regulates food and agriculture to serve society's objectives subject to social, political, economic, and technological constraints. The paper briefly addresses the current coordinating and regulating framework but mainly proposes options to improve the current framework consistent with sound economics.

The paper is organized as follows: the setting examines successes and failures in food and agriculture that could require changes in regulatory systems. Next, the paper recognizes the unique attributes of food and agriculture that influence how the industry is regulated. This is followed by a conceptual analysis of a more nearly optimal regulatory framework as dictated by welfare economics. The final sections propose a workable framework or standard model for regulation of food and agriculture recognizing the unique attributes of the industry as well as the need for a sustainable system meeting the needs of society. Several regulatory mechanisms are outlined.

Companion papers will supplement this overview of the food and agricultural industry. These companion papers address agriculture price support mechanisms and regulatory principles, institutions, and policies.

2. Successes and Failures in Global Food and Agriculture

The regulatory frameworks for agriculture must be doing something right. The successes of global agriculture are impressive. More people are better fed today than at any time in recorded history. While the world's population increased by 1.7 billion persons from 1969-71 to 1990-92, the number of chronically undernourished people in developing countries fell from 917 million to 839 million (FAO). FAO projected that numbers chronically undernourished in developing countries will fall to 680 million persons or 12 percent of the population in year 2010 compared to 21 percent undernourished in 1990-92 and 35 percent in 1969-71 (FAO).

Global food supplies increased 0.5 percent per capita per year from 1969-71 to 1990-92 and are projected to grow 0.3 percent per year from 1990-92 to year 2010 (FAO). Even greater increases are projected for developing countries as an aggregate.

The proportion of consumers' income spent on food is declining even as they purchase more food and food services. In the United States, for example, consumers spend only one-tenth of their income for food, freeing other income to be spent for education, health care, recreation, and other manifestations of an affluent society. The share of income spent on food has declined in part because Engel's Law is working – the share of income spent on food declines as income rises from greater productivity in agriculture and other occupations where consumers earn their incomes.

American agriculture supplied four times as much food and fiber in 1996 as in 1910-14 using only 10 percent more total farm resources (constant dollar value) than in 1910-14 (see Council of Economic Advisors, p. 440, and earlier issues). Productivity gains not only allowed US farmers to cover production costs at farm level, but also allowed the nation to feed its people plus millions abroad on only one-fifth of its land in crops. The vast majority of the remaining land is supporting wildlife diversity, recreation, forests, and other uses. Similar shares of land available for non-crop uses characterize other continents, and forest area is increasing in Europe and North America(World Resources Institute, 1998, pp. 298,299).

Improved productivity of crops and livestock (so that production can concentrate on fewer "safer" hectares) coupled with conservation tillage and other production practices have enabled the cropland annual sheet and rill (water) erosion rate to fall from 4 metric tons per hectare in the late 1930s to 1.4 metric tons per hectare in the 1990s (see Tweeten and Amponsah, p. 48). Wind erosion also fell.

The worldwide gains in income per capita that would have been impossible without a more productive agriculture are producing a trend of profound importance – the likelihood of zero population growth (ZPG) by year 2100 or earlier (see Tweeten, 1998 for World Bank, United Nations, and other projections). World population expanding from the current 6 billion to 10 billion by 2050 coupled with expected income gains will require at least a doubling of global annual food output before ZPG.

Smith, Alexander, and Lanfear (reported by the US Department of Agriculture, p. 85) found for 14 US water resources regions between 1980 and 1990 that phosphorus water pollutants declined in 13 regions, and suspended sediment pollutants declined in 11 regions. Nitrate levels declined in the only two water regions for which data were reported. Kuznet's Curves relating environmental variables to per capita income indicate that environmental improvements in the US are part of a global pattern apparent as nations achieve high incomes. Environmental indicators worsen in early stages of economic growth, but at higher income levels such as those in industrialized countries the environmental indicators begin to improve (see Seldon and Song). Natural resource use also declines at higher per capita income levels because economic activity shifts from goods to services and because population declines.

Agriculture is by no means an unmitigated success story, however. Family farms are treasured by society and many are being displaced by megafarms characterizing the industrialization of agriculture. The US farm population fell from 32.1 million in 1910 to 4.6 million in 1997, or by 86 percent (Council of Economic Advisors, p. 44 and earlier issues). The loss of family farms was nearly proportional to loss of farm population. Similar trends have characterized agriculture in other industrialized nations.

Turning now to food security, some 800 million people rarely get enough to eat. Africa in particular seems to be losing the capacity to feed itself. In Sub-Sahara Africa the number of undernourished people more than doubled to 215 million between 1969-71 and 1990-91, and the proportions of people undernourished in that region increased from 38 percent to 43 percent (FAO).

Globally, nonpoint source pollution is one of the most severe and widespread environmental problems and arises mainly from agricultural pesticides and fertilizers. Despite progress reported earlier in reducing agricultural pollution of surface water, an estimated 71 percent of US cropland is located in watersheds where concentrations of at least one of four common surface water contaminants (nitrate, phosphorus, fecal coliform bacteria, and suspended sediment) exceeded generally accepted criteria in 1989 (US Department of Agriculture, p. 85). The US Environmental Protection Agency reports that agriculture is the major source of impairment in estuaries. As much as 15 percent of the nitrogen fertilizer and 3 percent of pesticides applied to cropland in the Mississippi River Basin is eventually deposited in the Gulf of Mexico (US Department of Agriculture, p. 85).

Data are unavailable on historical trends in groundwater contamination from agricultural chemicals, but a US Environmental Protection Agency survey in 1990 found pesticide and nitrogen contamination as follows:

Chemical	Community Water Systems	Rural Domestic Wells
	(Percent of wells)	
Pesticides		
At least one pesticide detected	10.4	4.2
Exceeding safe standards	0.0	0.6
Nitrate		
Detected	52.1	57.0
Exceeding safe standards	1.2	2.4
Source: EPA		

In the United States, 10 percent of tested community water systems and 4 percent of tested rural domestic wells contained traces of agricultural pesticides (EPA). However, only 0.6 percent of rural wells had levels above safe standards set by the US Environmental Protection Agency (EPA). Over half of sampled wells had detectable nitrate levels, and 1.2 percent of community water systems and 2.4 percent of rural domestic wells exceeded EPA safe standards. Zero levels of contaminants would be desirable, but the cost could be high from lost value of chemical use in agriculture and on lawns. It is notable that the most frequently detected pesticide in the USEPA study was dacthal, a preemergence crab grass killer used mainly on urban lawns. Subsequent changes in regulations regarding use of the most frequently detected pesticides may reduce the numbers recorded above.

Global soil degradation varies widely by location and land use: according to Oldeman et al., 62 percent was due to water erosion, 23 percent due to wind erosion, 12 percent due to chemical contamination, and 2 percent due to other causes. The proportions of land slightly or more degraded by use and continent were estimated for 1945 to 1990 as follows:

Type	Latin America	Asia	Africa
	(Percent degraded)		
Forest and woodland	14	27	18
Permanent pasture	13	22	32
Agricultural land	50	35	62

A high proportion of agricultural land is degraded in each of the three continents, but especially in Latin America and Africa.

Dregne and Chou also estimated degraded lands by continent with results as follows:

Type	Africa	Asia	Australia-New Zealand	Europe	North America	South America
	(Percent degraded)					
Rainfed cropland	61	56	34	54	16	31
Irrigated land	18	35	13	16	28	17
Rangeland	74	76	55	72	85	76

Global degradation rates were 47 percent for rainfed cropland, 30 percent for irrigated land, and 73 percent for rangeland (Dregne and Chou). Over half of rainfed cropland was classified as degraded in Africa, Asia, and Europe. Proportions of irrigated land degraded by salt buildup and other reasons were generally low but were highest in Asia and North America. Rangeland degradation was high according to Dregne and Chou in all regions but especially in North America. Differences in numbers between Oldeman et al. and Dregne and Chou point to classification and measurement problems, but both sets of estimates highlight that soil degradation is a problem.

Crosson (p. 2) used data from Dregne and Chou to calculate that global soil productivity loss has averaged 0.3 percent per year. If the past loss rate remained constant, all soil productivity would be lost in approximately 1/0.003 or 333 years.

According to the International Food Policy Research Institute (p.2), 5 to 10 million hectares of land are lost to soil degradation each year. Another 1 million hectares of arable land are lost to urban development, half in developing countries (World Resources Institute, 1996, p.59). These losses will tend to offset millions of hectares of land that will begin to produce crops in Brazil, Sudan, the Congo (formerly Zaire) and other countries in coming decades. Numbers are unavailable to estimate global agricultural land lost to urban development.

The United States has been losing approximately 0.14 percent of its 167 million hectares of cropland to urban development each year since 1945 (US Department of Agriculture, p. 5). Several studies (Crosson 1992, 1996; Tweeten 1989, pp. 268-269) indicate that soil degradation is dropping effective US land productivity at the rate of 0.05 percent per year. Hence combined forces of development and degradation are reducing productivity at the rate of 0.14 plus 0.05 or approximately 0.19 percent per year. If that rate were to continue at a constant level each year, productivity would reach zero in 1/0.0019 or 526 years.

Multifactor productivity gains in US agriculture averaged 2 percent annually from 1950 to 1996 (Council of Economic Advisors, p. 440). Hence each year of multifactor productivity gains from application of nonconventional inputs including science and education offsets 10 years of productivity loss to land degradation and urbanization. Of concern is whether productivity gains can continue at past rates, however.

Partly due to continual soil degradation, the trend percentage rate of increase in global crop yields has been halved since 1960(Tweeten 1998). Of the five major categories of crops, yields have been increasing at a mostly linear rate since the 1950s and the trend percentage rate of increase was below the population growth rate in 1996. Only the cereal yield trend rate of increase was as high as the population rate of increase in 1996. Additions to irrigated cropland have been offset by losses due to water logging, salt buildup, depletion of underground acquifers, and urban development. If it were not for world population moving to ZPG, millions of hectares of land would have to be added to crop production (at the expense of the environment) in the 21st century to adequately feed people.

Other natural resource restraints could jeopardize the long-term sustainability of agriculture. Phosphorus is a basic building block of nature, has no substitutes, and is a stock resource. At current world rates of use, Paul Barton estimated global reserves are adequate for 242 years. Of course, use will increase in the future as food output rises, and more reserves will be found. An assumption that use will increase on average by 2 percent per year (about the rate of increase in food output) until zero population growth is reached in 2030 and remain constant thereafter combined with an assumption that actual reserves will be triple currently estimated reserves also would exhaust reserves in 242 years (see Tweeten and Amponsah, p. 61).

Nitrogen is another basic building block of nature supplied partly in synthetic fertilizer produced from abundant nitrogen in the air combined with limited natural gas or petroleum feedstocks. Barton estimated that reserves at current use rates will last 50 years for oil, 69 years for natural gas, and 258 years for coal. Energy reserves are less a potential threat to sustainability than are phosphate reserves because agriculture is a minor user of energy and can bid use away from lower value alternatives. Substitutes for fossil fuels are available in the form of nuclear, solar, or wind energy. Biotechnology such as nitrogen fixing grasses (including cereals) also may provide alternatives to commercial nitrogen fertilizers.

Recent data from the Center for Disease Control and other sources indicate that despite frequently headlines concerning dangers to consumers from agricultural chemicals, the chief threat to consumers comes from pathogens such as e-coli, salmonella, and lysteria. These pathogens cause death to approximately 5,000 Americans each year and cause illnesses to millions more. These pathogens have been around for many years and cause fewer deaths than in previous years, but are especially pesky because they persist despite modern science and technology including improved sanitation and safety measures. There is widespread agreement that markets acting alone will not provide adequate food safety.

In summary, the foregoing discussion is not exhaustive but identifies several problems of food and agriculture that regulatory policy cannot avoid. Among these are loss of family farms, natural resource degradation and depletion, and food safety and insecurity (undernourishment). All except food security (mainly caused by poverty) are externality problems. Externalities as explained later, are divergences of private from social costs, can cause market failure, and can warrant public regulation. The remainder of this paper mainly will address externalities and economic equity within the context of unique attributes of agriculture discussed in the next section.

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