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International Trade and the Future of American Agriculture

Bruce L. Gardner

American farmers have gained substantially from agricultural trade, despite the competition posed for producers of imported commodities. Because of U.S. comparative advantage in most agricultural products, the farm sector would be smaller and farmers would be poorer with reduced trade. Evidence indicates that in the 1990s, each dollar of additional export sales is worth about 40 cents in additional net farm income. Two crucial elements in future export growth are continued productivity gains and further reductions in barriers to agricultural trade around the world. The two are linked in farm income determination, in that elastic demand is important for productivity gains to translate to farm income growth.

Key Words: agricultural exports, farm income, GATT, productivity

American agriculture since the founding of the Republic has relied upon exports as an outlet for its surplus production. In the 1990s, about one-fourth of U.S. farm product sales have been export sales. Figure 1 graphs the real value of agricultural exports for the last 100 years. As the chart shows, there have been periods in which the volume of exports has lagged, notably in the 1930s. The periods in which exports have risen sharply—the two world wars, the 1970s—have been periods of farm prosperity, and the period in which exports were lowest was the Great Depression. Most recently, there is a clear association between declining exports in 1996–99 and today's depressed farm prices and farm incomes.

In this paper my objectives are twofold: first, to review some quantitative evidence on the relationship between export demand and farm income, and second, to discuss policies most suitable for U.S. agriculture's future in the global economy.

Evidence on Exports and Farm Income

Figure 2 shows exports plotted against cash farm income for the years 1994–99, and the least-squares regression equation explaining income as a function of exports. The data points are few, but the story the regression line tells is that each $1 billion in

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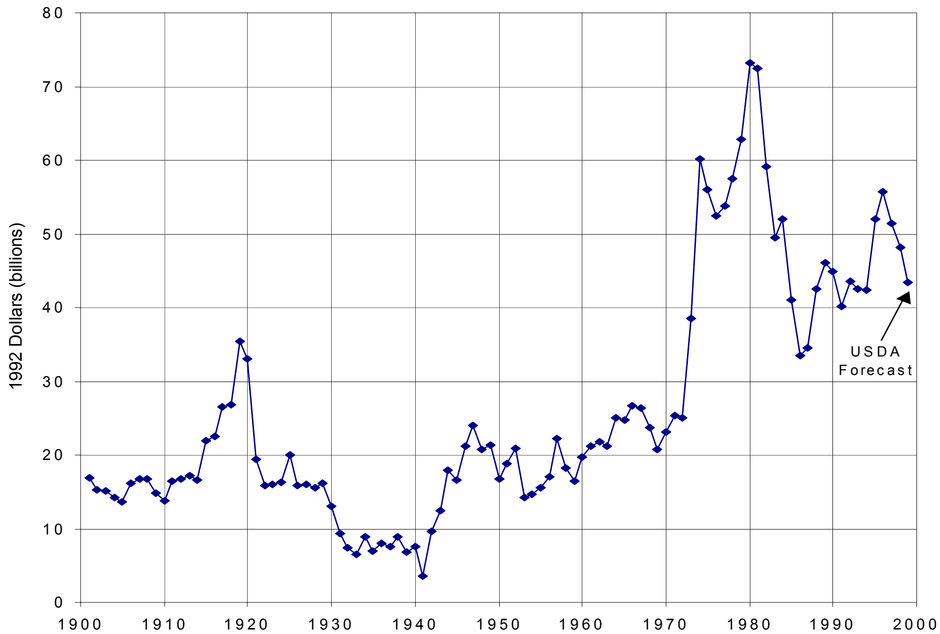
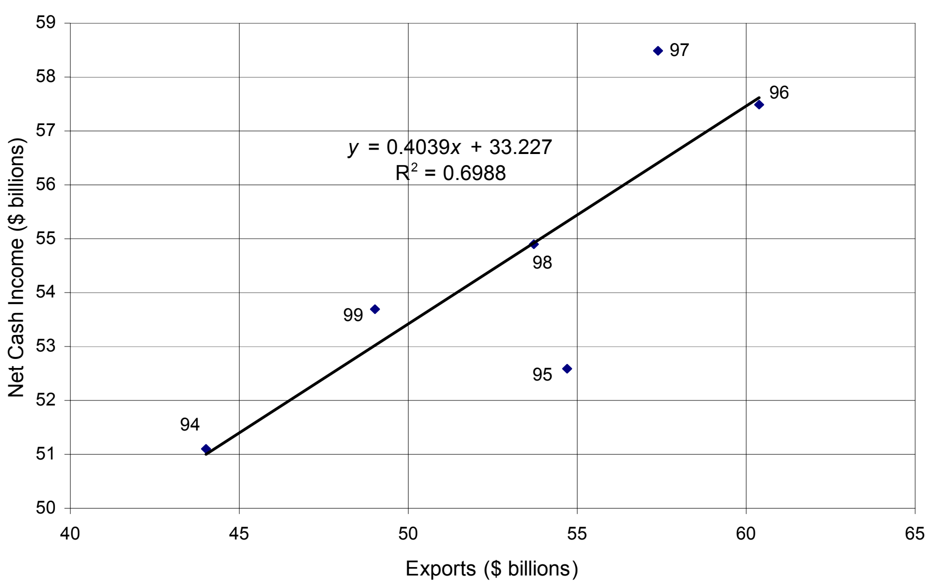


Note: USDA forecast taken from *Agricultural Outlook* (July/August 1999).

Figure 1. Agricultural exports in 1992 dollars, 1900–2000



Sources: Data taken from USDA, *Agricultural Statistics* and from *Agricultural Outlook* (July/August 1999).

Figure 2. Agricultural exports and net cash income, 1994–99

exports is associated with a $400 million increase in farm income (from the coefficient on exports, *x*, in the linear regression equation shown in the diagram).[1] There are, of course, caveats against drawing firm conclusions from these data. Not only are the observations few, but there is also the problem that both income and exports may be influenced by other variables that are not included in the regression, so the association may be spurious.

A much more complete set of causal factors and structural relationships is used in the U.S. Department of Agriculture's (USDA's) *Supply and Demand Estimates*, and its *Agricultural Baseline Projections.* These publications provide, respectively, monthly and annual assessments of how exports and other factors will affect farm-level commodity prices in the current and following crop years. USDA's analytical procedures are not spelled out in an econometric model, but the department's thinking can be seen in the evolution of the projections, especially the longer term baseline projections. The baseline incorporates the outlook for exports in its forecast of future farm prices and incomes, looking forward up to 10 years. In updating the baseline periodically, USDA estimates the effects of external forces changing the supply-demand balance by means of multipliers that generate the results of export prospects on farm commodity prices and farm income.

The decline in export prospects since 1996, attributable to the Asian crisis and other factors, provides an opportunity to assess USDA's view of exports as related to farm income. The USDA baseline published in 1999, using information available through November 1998, contained substantial changes from the previous baseline largely because of changes in the export situation and outlook. USDA listed the causes of the changed outlook as declining economic growth abroad, exchange rate developments unfavorable to exports, strong export performance by competitors, and China's trade policies (USDA/Economic Research Service, 1999).[2]

The changes in projected exports, and associated changes in net farm income, are shown in table 1. During 2000–2005, exports are expected to average $13 billion less than was expected a year earlier. Net farm income is projected to average $5.7 billion less over the same period, indicating that each $1 decline in exports generates a 44-cent decline in net farm income. This estimate is not derived from an explicitly specified equation, but summarizes the results of a large number of parameters and subjective expertise that USDA uses to trace through the supply-demand consequences of a particular commodity mix of changes in export prospects. The estimate is quite close to the 40-cent decline implied by my simple analysis of figure 2.

The key point is that this is a large impact. It says that if half of the $65 billion in exports projected for 2000–2005 were to disappear completely, net farm income

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[1] Note that the export data are on a fiscal year basis while farm income is for calendar years. Thus we are saying, for example, that exports from October 1995 through September 1996 influence calendar 1996 income.

[2] Other changes, of course, occurred during 1998, most notably crop failures and low prices, the resulting $6 billion agricultural relief legislation, and modest strengthening in the U.S. macroeconomic outlook. But these are mainly short-term (one- or two-year) factors and probably did not account for a significant part of the change in USDA's projections for 2001–2005. Indeed, USDA's "Baseline Highlights" publication lists no factors causing changes in the baseline other than those influencing exports (USDA/Economic Research Service, 1999).

Table 1. USDA Projections for Agricultural Exports and Net Farm Income, 1997–2005

	Agricultural Exports ($ billions)			Net Farm Income ($ billions)			Net Income Gain per Dollar Increase in Exports ($)
Year[a]	February 1998[b]	February 1999[b]	July 1999[c]	February 1998[b]	February 1999[b]	July 1999[c]	
1997	57.3	57.3		45.3	49.8		
1998	58.5	53.6		46.2	48.0		
1999	59.7	50.5	49.0	47.2	46.4	43.8	0.42
2000	62.6	50.2		49.0	43.8		0.37
2001	66.2	53.9		49.9	45.3		0.38
2002	69.4	56.7		50.8	46.0		0.47
2003	72.6	59.9		53.3	47.3		0.53
2004	76.0	62.8		56.0	49.0		0.47
2005	79.8	65.2		57.3	50.5		

[a] Fiscal year for exports, ending September 30 of year shown; calendar year for income.

[b] 1998 estimates from USDA/World Agricultural Outlook Board (1998); 1999 estimates from USDA/World Agricultural Outlook Board (1999).

[c] From USDA/Economic Research Service (February 1999).

would fall by $14.3 billion; that is, about a third of net farm income would disappear (even though half of exports amount to less than 15% of farm product sales).

Of course, the analytical basis for both my calculations and USDA's projections could be wrong. But events of the mid- to late 90s provide evidence that they are correct. Not only have commodity prices and farm incomes fallen in line with the reduction of exports over 1995–98, but the further declines in exports that have occurred during 1999 are associated with still further market weakness and reduced farm income prospects. As the second 1999 column (labeled July) of table 1 indicates, exports now appear $1.5 billion weaker than expected at the beginning of the year, and farm income prospects are now $2.6 billion lower (not counting emergency assistance that it now appears certain Congress will provide).

Will the recent dismal performance soon turn around? There is reason for hope on one score, namely that the economic downturns that pervaded Southeast Asia in 1997–98 have almost uniformly turned around, even in the worst cases like Indonesia. The value of the dollar relative to foreign currencies generally has come off its highs, making U.S. goods more affordable abroad, and products from export competitors (notably Brazilian soybeans) less of a bargain relative to U.S. commodities. And indeed, most U.S. farm commodity prices have risen from their lows of early 1999. My point here, though, is not to forecast a recovery, but more fundamentally to say that a recovery of U.S. farm income would be accomplished by an expansion of exports.

Table 2. Georgia's Top Five Commodities by Value of Sales, 1997

USDA Rank	Commodity	Percent of Total Sales
1	Broilers	38.6
2	Cotton	12.0
3	Peanuts	6.1
4	Eggs	6.1
5	Cattle and Calves	5.9

This does not mean producers of every agricultural commodity gain from increased exports. Foreign markets are important to the grains, oilseeds, cotton, tobacco, and many fruit and vegetable producers. And, in recent years, broilers, hogs, and other livestock products have reaped important gains from increased exports (and suffered losses when these markets have failed, as in the case of broilers in Russia). But producers of commodities that the United States would import in greater quantities under free trade have interests that are quite different. Notable cases are sugar and peanuts, which are of course of special interest in states such as Georgia. Nonetheless, agriculture has a general interest in free and open global markets even in states producing farm products that would be imported if U.S. trade restrictions were eased.

Using Georgia as an example, table 2 lists the top five commodities by value of sales in 1997, according to USDA data. Overall, Georgia is estimated by USDA to have exported $1.3 billion in agricultural products in 1997, led by poultry products, cotton, and tobacco, but also including $107 million in peanut products.

Longer-Term Export Prospects

A major force in the demand for U.S. farm products is how the supply-demand balance evolves in the rest of the world. Despite recent slowdowns in birth rates, worldwide population continues to grow impressively, by almost 100 million people annually. This means we can expect to add 2 billion to the world population over the next two to three decades.

Moreover, it is reasonable to expect that over the longer term, real income in developing countries will grow even more impressively. This is important because in these countries, unlike the United States and other high-income countries, when consumers get increases in income they spend a good portion of it—perhaps as much as one-half—on food, mainly on upgrading their diets to include, for example, more costly foods such as meats. With China and India having a population of over a billion people each, a relatively small change could have a big market effect. (If everyone in those two countries ate two more chickens a year, the additional demand would consume over half of U.S. annual broiler production.)[3]

The prospects for rapidly expanding food imports in China, however, are not as solid as they appeared a few years ago. Questions were being raised then about how the world could supply the excess demand for grain that China would soon be revealing. But that demand has not yet even begun to show up, and the recently completed 1997 Agriculture Census of China indicates that China's crop acreage is 25% to 30% higher than its previous statistics had indicated. The significance of this disclosure is that it suggests China's yields have been 25% to 30% lower than had been thought, which is taken by some observers to mean China has more room for potential yield growth in the future (Hsu and Tuan, 1999).

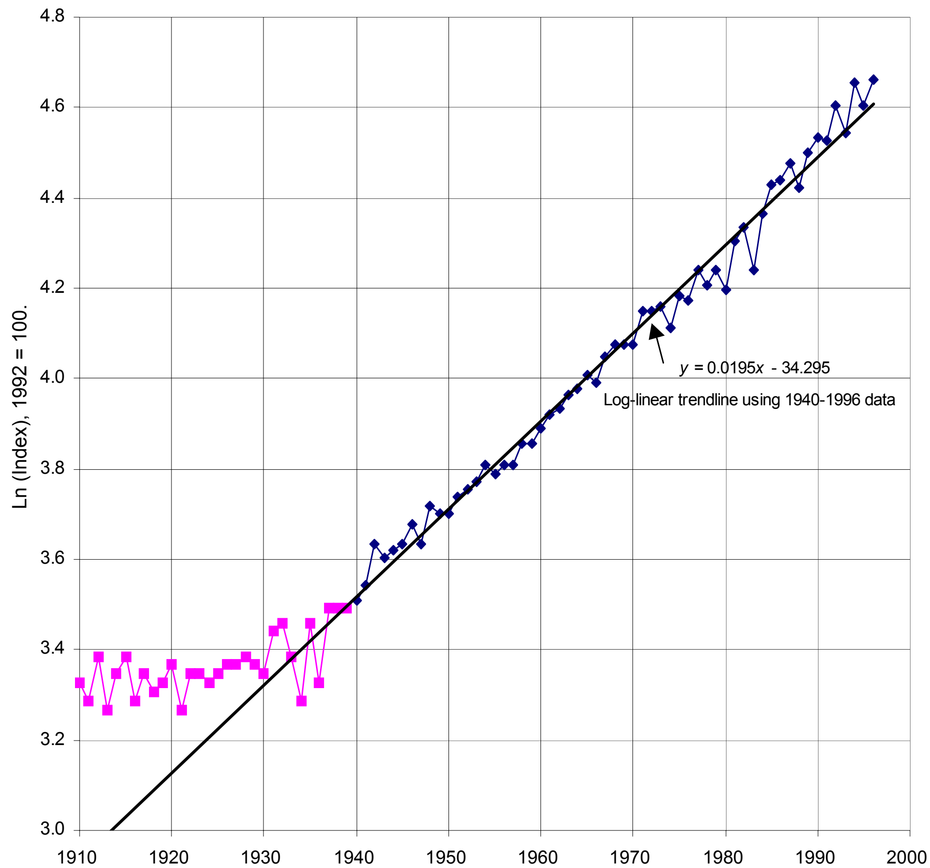
The larger point, however, is that the projected balance of supply and demand in the rest of the world is not the fundamental determinant of long-term U.S. agricultural export prospects. Japan didn't achieve penetration of the U.S. automobile market because we could not produce enough cars ourselves to meet U.S. demand. Rather, Japan was able to produce good quality vehicles at lower cost than U.S. makers could. Similarly, the factor underlying U.S. long-term prospects in world trade is the productivity of American agriculture as compared to that of other countries.

That productivity, as measured by USDA's index of output divided by all inputs, is shown in figure 3, for the period since 1910. Three things are noteworthy about productivity trends. First, after a long period of relatively slow growth, productivity took off after 1940. Second, productivity growth has remained at this high level for almost 60 years. The nonfarm economy suffered a productivity slowdown in the 1970s, from which the manufacturing industry has not recovered to this day. In agriculture there was no slowdown. Third, and least solidly based in data, productivity growth appears to have accelerated further in the 1990s. Nine of the last 10 years are above the long-term productivity growth trendline. It is quite likely that as the biotechnology revolution and structural changes in livestock growing come to fruition, this accelerated trend will be maintained.

How do U.S. farmers cash in on productivity growth? It's not easy, as shown by the fact, largely a consequence of productivity growth, that farm prices have a long-term trend of declining about 0.4% per year (figure 4). Not only do we get about 2% more output each year from given inputs, but the cost of those inputs is going down. The bad news about this trend is, agriculture being the competitive industry that it is, lower costs mean lower prices. The good news is that despite lower prices, real net income per farm keeps rising (figure 5).

How does agricultural trade fit in? The only way farm income can rise when productivity is rising is to find additional outlets for more production. Domestic markets cannot be relied upon to fill the bill because demand is inelastic—price necessarily falls by a larger percentage than quantity increases. In the case of factor-neutral

[3] The United States produced 7.6 billion broilers in 1996. China and India had a combined population of 2.2 billion people. If each individual ate two broilers, they would consume 4.4 billion broilers—58% of U.S. production.



Sources: USDA/Economic Research Service (February 1999), and U.S. Department of Commerce/Bureau of the Census (1976).

Figure 3. U.S. farm total factor productivity index

technical change, an elasticity of demand greater or less than unity (in absolute value) determines whether farmers gain or lose from technical changes (refer to the appendix). The value of the world market is that export demand tends to be elastic: there are many potential buyers who will respond to lower prices by purchasing more. Recently we have seen this happen in iced broilers, the process is under way in pork products, and many more opportunities will be coming.[4]

[4] The United States also appears to have a comparative advantage in many aspects of food processing (but apparently not fibers or textiles), and this leverage will be reflected in increased exports of processed food products. However, our productivity growth data for food processing is too sketchy to allow us complete confidence about our low-cost agriculture. Of course, competitiveness in trade is not a matter of our costs; it is a matter of our costs relative to other countries' costs. What increasing productivity means is that those other countries better be making progress too if they want to stay in the game.

Source: USDA, "Historical Statistics," *Agricultural Statistics.*
Note: USDA index, calendar years, deflated by GDP price deflator.

Figure 4. Real prices received by farmers

Given an elastic world demand, a given rate of productivity growth will generate more net income for farmers, the less elastic is supply—that is, the less farmers spoil their economic party by producing more in response to increases in returns to farming. What can most effectively choke off supply response is limited availability of farmland. Then rising land values increase costs (and rental returns). Indeed, further econometric evidence of the economic value of exports is that increases in exports are associated with increased land values. I develop evidence on this in Gardner (1999).

What could go wrong? The primary factor is what already has gone wrong: political resistance abroad to importing our products. This is where policy comes in.

Policy Issues

Two policy arenas are important in determining the openness of foreign markets to U.S. products: international negotiations and domestic legislatures. The former are exemplified by the Uruguay Round Agreement on Agriculture reached in the GATT negotiations that were concluded in 1994, and the upcoming World Trade Organization (WTO) talks scheduled to begin in December 1999. Our central focus for domestic policy is the U.S. Congress, though what other countries' governments do is, of course, also important.

Note: Deflated by GDP price deflator.

Figure 5. Real net income per farm

The Uruguay Round's Agreement on Agriculture was a breakthrough in that a significant global agreement on liberalizing agricultural trade was reached for the first time, after several attempts dating from the 1960s. The Uruguay Round required WTO members (the WTO itself being new, a rechristened and strengthened reformulation of the GATT) to reduce agricultural export subsidies, allow increased access for other members' imports, discipline certain trade-distorting domestic policies, and adhere to nonprotectionist principles in regulation of imports for sanitary or health reasons. The last of these was least precisely quantified, and a major reason for the new WTO was to provide a dispute-settlement mechanism that could authoritatively resolve import regulation issues on a case-by-case basis.

Disciplines in export subsidies, market access, and distortionary domestic policies were quite precisely formulated, with numerical reductions in protection to be achieved over five years. But implementation was flexible enough that most countries could set their starting points sufficiently high (well above their actual protection) that after five years they would have roughly as much real protection in place as they did in 1995, when the Uruguay Round agreement went into effect. Nevertheless, some countries have had to make real changes, notably in export subsidies in Europe and the United States, and in permitting imports of previously excluded products, most notably rice imports into Japan and Korea (which began at 1% of domestic consumption allowed in through quota mechanisms and must rise to 4%—a small amount, but nonetheless hard for Japanese and Korean farm interests to accept). The reason the Uruguay Round mandated further negotiations in 1999 was precisely the anticipation that the disciplines imposed in the Uruguay Round would by now be just beginning to bite, so the real issue would be continuation of the path toward liberalization after 2000. The first big question for the next round of trade negotiations in agriculture is whether that goal can be achieved.

Other aspects of import regulation are less precisely disciplined in the Uruguay Round agreement. WTO settlement of health and safety regulatory disputes has proceeded, with effects that are still in doubt. The two most-watched cases in 1999 both developed from U.S. complaints against the European Union (EU). The first is the EU's banana import regime, which gives preference to former European colonies. The United States claims this unfairly excludes some Western Hemisphere bananas, which are exported by U.S. firms (Dole and Chiquita). The second WTO issue is the EU's restriction of imports of meat from animals grown using growth hormones. The U.S. claims there is no scientifically supported basis for this exclusion on grounds of health or safety of meat consumers.

The WTO has found in favor of the United States in both cases. However, the EU has so far refused to change its policies in either case. The U.S. can retaliate by excluding EU goods from the U.S. market, a threat which is in process of being carried out. But this could have been done without the WTO. If the "trade war" approach to negotiating such disputes prevails, it will be a major blow to the WTO (and to countries with trade policy complaints but without the retaliatory power of the U.S. and EU). The second big question for the new round of trade talks is whether and how the dispute settlement procedures, and agreements on health-safety regulation generally, can be made effective.

What are the prospects for further trade liberalization? This is the area where it is most difficult to be optimistic. The political forces abroad that reflexively oppose opening their markets to U.S. products are strong and will remain so. They are familiar political forces since the same ones are in play here, opposing opening the U.S. market to foreign sugar, peanuts, and other protected commodities. The problems of sectors that will lose from freer trade have to be taken seriously. The gains to the economy overall should be sufficient to compensate the sectors that will be harmed. The art of politics in the area of trade policy lies in finding ways to accomplish this end.

Summary

The argument that I want to press has three parts. First, U.S. agriculture has gained tremendously from its capabilities to export products around the world. This statement will be obvious to many, but is worth considering carefully because some have questioned the value of exports to the farm economy. There is a view that U.S. farmers have more to fear from imports of products from other countries than U.S. farmers have to gain from exports to other countries. This pessimism is unwarranted. The evidence is clear that without foreign markets our agriculture would be much smaller and our farmers would be poorer. The evidence suggests that in the 1990s, a dollar of additional export sales is worth about 40 cents in additional net farm income.

Second, the path to increased exports is maintained productivity growth. This has many policy implications that the present paper has not addressed. I have not addressed them because productivity gains would go for naught anyway, from the point of view of farm income, in the absence of a continually expanding export market. To achieve an expanding market, we need further reduction of barriers to trade around the world (which is my third point), and that implies reducing some of our own trade barriers in international negotiations. For the sake of the economic health of U.S. agriculture as well as the economy generally, it is important that this goal is reached.

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Appendix:
Farmers' Gains from Productivity Growth

The simplest way to model the market effects of productivity growth is to start with a shift in the supply function of agricultural output, and then ask what happens to producers' and consumers' surpluses. Consumers' surplus will always rise, since the product price falls. Producers' surplus may not. It depends exactly how the supply function shifts throughout its length (see Miller, Rosenblatt, and Hushak, 1988, and earlier references cited therein). There is a problem with producers' surplus, however, as a measure of farmers' gains. Producers' surplus incorporates not only gains to farmers, but also gains to nonfarm people, notably to suppliers of purchased agricultural inputs.

The gains that accrue to farmers are better measured as changes in the economic rents of farmer-owned factors of production. If an innovation causes no change in a factor price because the factor's price is determined outside agriculture, e.g., gasoline or electricity, then no rents are generated for that factor and its owners will neither gain nor lose from technical change in agriculture. Only specific factors—those which have an upward-sloping supply schedule to agriculture—can gain or lose. Following is a presentation of the simplest model that can distinguish between farm-owned and purchased specific factors.

Consider a competitive industry with identical firms, which is sufficient for a linear homogeneous industry-level production function (Diewert, 1981). Let there be two specific factors of production, farm-owned inputs, *a*, and purchased inputs, *b*, with constant-elasticity production and factor supply functions. Six equations then determine market equilibrium:

(A1) $$x = T(k_a a^r + k_b b^r)^{1/r}$$ industry production function,

(A2) $$\frac{\partial x}{\partial a} P_x = P_a$$

(A3) $$\frac{\partial x}{\partial b} P_x = P_b$$

(A2)–(A3): VMP = factor price,

(A4) $$a = \gamma_1 P_a^{e_a}$$

(A5) $$b = \gamma_2 P_b^{e_b}$$

(A4)–(A5): factor supply functions,

and

(A6) $$x = A P_x^n,$$

where x is farm output; a is farm-owned inputs; b is purchased inputs; P_x, P_a, and P_b are their prices; and k_a and k_b are cost shares. The γ_i are constants. The elasticities of input supply (e_a and e_b), product demand (η), and substitution ($\sigma = 1/(1 + r)$) are parameters. The structure of the model is the same as that of Muth (1965).

The effects of productivity change due to improved technology in the model can be analyzed by differentiating the system with respect to the parameter T. Using results from Muth, and the fact that the marginal percentage change in rent is equal to the percentage change in factor price, the following expression gives the effect of technical change on the rents of farm-owned inputs:

$$\text{(A7)} \qquad \frac{ER_a}{ET} = \frac{(\sigma + e_b)(1 + \eta)}{\eta(\sigma + e_1)\sigma e_2 e_a e_b},$$

where ER_a is the percentage change in rents received by a owners, ET is the percentage shift in the production function, σ is the elasticity of substitution between a and b in equation (A1), η is the elasticity of total demand for x, and $e_1 = k_a e_b + k_b e_a$ and $e_2 = k_a e_a + k_b e_b$. The sign of expression (A7) depends only on the elasticity of total demand, η, which is negative. The denominator of (A7) is always negative, but the numerator is negative, and ER_a/ET positive, only when $|\eta| > 1$. Therefore, R_a increases if demand is elastic, but decreases if demand is inelastic.

This result can be explained as follows. Technical change that shifts the production function 1% means that a given bundle of inputs generates 1% more output and that the cost of producing a given output level falls by 1%. Unless output rises by more than 1%, the demand for all inputs will fall. Therefore, in order for input owners to gain, the demand for the product must rise by more than 1% when product price falls by 1%. But this is just the condition that the demand elasticity be greater than unity. This reasoning, and the formal result in equation (A7), suggest that the criterion $|\eta| \gtrless 1$ is a more general determinant of the likelihood of producer gains than the models of Lindner and Jarrett (1978), and Miller, Rosenblatt, and Hushak (1988) indicate.

The change in domestic consumers' surplus from technical change is:

$$\text{(A8)} \qquad \frac{EC}{ET} = k_d \frac{\sigma(1 + e_2) + e_1 + e_a e_b}{D},$$

where C is domestic buyers' surplus, k_d is the share of output consumed domestically, and D is the same denominator as in equation (A7). Since D is negative, the whole of equation (A8) is positive. Thus, consumers always gain from technical progress.

The preceding equations pertain to factor- (Hicks-) neutral technical change. Biased technical change, which increases the marginal product of one factor by more than the other, yields:

$$\text{(A9)} \qquad ER_a = \frac{\eta\sigma + (k_a\sigma k_b\eta) + e_b(1 + k_a\eta k_b\sigma)}{D} ET_a + \frac{k_b(1 + e_b)(\sigma + \eta)}{D} ET_b,$$

where ET_a and ET_b are the respective percentage increases in *a*'s and *b*'s marginal products. If $ET_a = ET_b$, equation (A9) reduces to equation (A7). Now it is more complicated to determine whether an innovation increases or decreases R_a. Farm-owned inputs can gain even if product demand is inelastic. For example, a new corn variety that has the same yield as existing varieties but requires half as much pesticides and fertilizer (so $ET_a = 0$) will increase the demand for land so long as $\sigma > |\eta|$.