United States Department of Agriculture

Agricultural Economic Report Number 809

March 2002

Electronic Report from the Economic Research Service

www.ers.usda.gov

Structural Change and Agricultural Protection: Costs of Korean Agricultural Policy, 1975 and 1990

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Abstract

The economic development of South Korea is often considered a model for developing countries. We use 1975 and 1990 data in a general equilibrium framework with a highly disaggregated sector specification to evaluate the opportunity cost of its agricultural protection. We show that although agriculture's share of the gross domestic product (GDP) declined between 1975 and 1990, the cost of agricultural protection, as measured by the loss in GDP, did not fall. The larger gap between domestic and world prices for the protected sectors exacerbated the distortions in resource allocation. Simulated removal of 1990 agricultural border protection reduced the share of agricultural GDP to the level actually observed in 1996, demonstrating how protection can impede economic structural development. The public policy implication is for developing countries to adopt policies that help the agricultural sector become competitive. Otherwise, as in Korea, the resource costs of delaying adjustment grow over time.

Keywords: South Korea, food policy, agricultural development, computable general equilibrium, protectionism, trade liberalization, and rural development.

Acknowledgments

The authors thank Colin Carter, David Coady, John Dunmore, Praveen Dixit, Joy Harwood, and William Kost for their comments on this report. In addition, we greatly appreciate the contributions of the editor, Sharon Lee, and the designer, Susan DeGeorge. The Bank of Korea generously provided the data on which this report is based.

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Contents

Introduction

The economic evolution of Japan, South Korea, and Taiwan is often considered a model for developing countries to follow, and many of them may consider adopting the East Asian pattern of policy choices. The model is usually interpreted as a national orientation toward exports, orchestrated by the government and complemented by large investments in infrastructure. Policies emphasized a well-educated and powerful government bureaucracy, raising educational levels, and ensuring labor-management harmony in a nationalistic drive toward higher economic performance and rewards. In agriculture, because an export-oriented strategy proved infeasible, strong trade barriers were erected against competition from cheaper imported foodstuffs.

There is an impressive literature on agricultural protection in Asia. Does it merit another examination? There are several reasons to reconsider Asian agricultural protectionism. First, the Asian economies remain very important to world agricultural trade, and the extent to which their policies affect trade is of high interest. Second, multilateral agricultural trade negotiations are under way, and a new round of World Trade Organization (WTO) negotiations is being considered. The Uruguay Round increased the scope of WTO discipline over members' agriculture trade policies. But there is much unfinished business. In particular, developing countries have been granted latitude for intervention in their agricultural sectors. To what extent should they intervene? Third, the economic policies of East Asia have undergone particular scrutiny in the 1990s, especially in the wake of the financial crises of 1997 and 1998. There is now less agreement than before that the overall development policies in East Asia were well chosen, and an updated assessment of the costs of the associated agricultural policies is in order.

The virtues of East Asia's development policies have been widely presented.[1] However, strong critiques of the policy regimes have recently emerged. Young (1992 and 1995) demonstrated that most of the economic growth realized by the "Asia tigers" resulted from growth in factor inputs such as capital accumulation. When one accounts for the dramatic increase in human capital embodied in the education of the postwar generations, growth in East Asian total factor productivity is unexceptional.[2] Indeed, Singapore exhibits negative growth in total factor productivity. The lesson offered by East Asia, if Young and others are right, is that inducing households to accumulate capital by saving and educating their children can lead to economic growth in the right circumstances. However, as global economic conditions change, the East Asian economies may no longer have sufficient vigor for further rapid growth. The Asian financial crisis of 1997 exposed the fragility of industrial finance and governance in much of Asia. Finally, whether or not the competitiveness of the economy as a whole benefited from far-sighted government management, East Asian agriculture has not been globally competitive. Once the flow of postwar food aid ceased, protectionism characterized the agricultural trade policy in much of the region, along with self-sufficiency goals for rice, the staple food. Behind the trade barriers, East Asian agriculture became less competitive with agriculture in the rest of the world.

Within East Asia, why focus on South Korea? South Korea (Korea) is an important destination for U.S. agricultural exports. Its degree of border protection for agriculture is among the highest among major trading nations. Korea's economy has changed greatly in structure in the last 30 years. Conclusions by previous studies about the effect of agricultural protection on the economy may not be valid, given these changes. Finally, earlier studies have been either partial equilibrium or, if general equilibrium, too aggregated. Aggregation involves information loss; a thorough analysis of the costs of protection requires cross-commodity and cross-sector detail. The models used in this report retain more subsector detail than earlier studies, within a general equilibrium framework.

Our analysis of the changing costs of agricultural protection involves 2 years, 1975 and 1990. For each year,

[1] For example, Adelman and Robinson (1978); Page (1994); Eswaran and Kotwal (1992); Wade (1990); Amsden (1989); Corbo, Krueger, and Ossa (1985); and Corbo and Suh (1992).

[2] Total factor productivity is defined as the ratio of total output to total inputs. A *Foreign Affairs* article by Paul Krugman (1994) gave wide exposure to Young's results. Section VII of Young (1995, pp. 664-70) provided a critical survey of earlier total factor productivity growth in Korea. Kwon and Paik (1995) also examined total factor productivity and found unexceptional performance. Titles of recent books indicate the skepticism: Fishlow et al. (1994), *Miracle or Design? Lessons from the East Asian Experience;* Weder (1999), *Model, Myth or Miracle: Reassessing the Role of Governments in the East Asian Experience;* Adams and Ichimura, (1998) *Will the East Asian Growth Miracle Survive*?

we model the economy by using the same structural representation. The two models represent radically different stages of Korea's economic transformation. This allows us to compare the cost of protection (that is, the opportunity cost of not liberalizing) at different levels of development. We show that for Korea the cost of agricultural protection in all its forms (tariffs, bans, and quotas) increases with the level of economic development. In terms of overall economic growth, it would have been better to liberalize sooner rather than later.

Korean Agricultural Policy

Policy Development

From its formal annexation by Japan in 1910 until 1945, Korea was developed as a source of food, minerals, and low-cost labor for the Japanese Empire. Japanese rule is unfavorably viewed by historians, but it did result in significant infrastructure investment (especially roads, rails, and ports), agricultural extension, and technology transfer.[3] World War II and the Korean Conflict devastated and divided the country. The region south of the 38th parallel was the poorer, rural half; the northern half, now North Korea, contained industrial centers and most of the mineral resources. U.S. and United Nations advisors overseeing reconstruction in the 1950s saw poor prospects for South Korea, and its income per person was lower than that of India or French Indochina.

Moon and Kang (1991) provided a lucid discussion of the development and political economy of Korean food policy. They identified three policy regimes from 1950-86. To organize the discussion of this section, we have adapted the following interaction table from their study (table 1). They noted that the Korean Government has endorsed several objectives in formulating its food and agricultural policies: (1) securing price stability, (2) enhancing farm income, (3) ensuring food self-sufficiency, (4) conserving foreign exchange, (5) limiting government spending, and (6) controlling real urban wages (or inflation). Moon and Kang made *ex post facto* judgments of the revealed weights the Korean Government placed on these (often conflicting) objectives within each of the food policy regimes.

The implementation of land reform in South Korea in 1954 distributed large landholdings to former sharecroppers and introduced the system of very small landholdings still prevalent in Korea today. Despite the poverty of the dominant farm sector, until the mid-1960s, the Korean Government followed a policy of "three lows": low grain prices, low interest rates, and a low exchange rate (that is, an overvalued domestic currency). Grains, particularly rice, were central to Korean economic life in the 1950s, and because of the importance of food in household budgets, grain price policy was an adjunct to monetary policy. The price of rice was a principal determinant of inflation and thus real urban wages. Food problems in Asia, as well as the cold war and surplus agricultural production in the United States, supported passage of U.S. P.L. 480—the U.S. food aid program. Korea was one of the largest recipients of U.S. food aid between 1954 and 1970. The flow of free or concessionally priced grain kept Korean consumer prices low but also reduced farmers' incentives to produce grain (Kuznets, 1994). A coup d'état in 1961 brought Park Chung Hee to power. Park adopted an aggressive economic policy, and the government engaged actively in economic planning throughout his rule, which ended in 1979. The first two 5-year plans (1962-66 and 1967-71) stressed export promotion. Initial successes in light industry exports (textiles, leather products, etc.) were joined by increasing exports from heavy industry, which also benefited from military spending by Korea and (indirectly) the United States during the Vietnam Conflict.[4]

The period 1969-71 was a turning point in Korean grain policy. The cost of P.L. 480 rice increased, as the United States, facing balance of payment problems,

[3] Economic historians are paying more attention to the economic legacy of the Japanese rule of Korea: Cha (1998) and Kimura (1993). Allen (1946) remains useful, and Keidel (1981) is a rich source of provincial agricultural data.

[4] Cho (1994). See Adelman (1969) on the role of economists and economic models in the formulation of the second plan.

Table 1—Relative importance of policy objectives, 1950-86

Period	Price stability, urban consumer welfare	Farm income, food self-sufficiency	Government costs	Foreign exchange	Implications of policy orientations
		Weights sum to 100			
1950-69	50	30	20	0	Food aid, urban wage/export bias
1970-75	30	50		20	Two-price policy
1976-86	30	20	30	20	Budget and structural adjustment

Source: Moon and Kang, 1991, p. 28, tables 2-3.

began to demand payment in dollars rather than local currency. In 1969, Korea increased procurement prices for rice and barley and, thus, began to subsidize rather than tax the rural sector. The third 5-year plan (1972-76) placed explicit emphasis on self-sufficiency in basic food grains—principally rice and barley. The objectives included conservation of foreign exchange, enhancement of rural incomes, protection from international price instability (particularly important after the price shocks of 1972-75), and favorable consumer prices. The two-price policy, procuring at high prices and selling to consumers at lower prices, drew heavily on government finances.[5]

From the late 1970s until the late 1980s, Korea followed a policy that allowed relatively free imports of wheat, corn, soybeans, cotton, hides, and rubber, but virtually banned most other agricultural imports. Green revolution technology boosted rice production, and farmers were encouraged to diversify into livestock. Agricultural prices within Korea rose relative to world prices.

An extremely small rice harvest in 1980 caused the government to import over 2 million tons of rice. The effect on rice prices within the relatively small international market for rice was very high. Farmers in exporting countries responded to the high prices with larger plantings for the subsequent year, only to find that Korea had returned to its ban on imports. Korean consumers found that much of the imported rice was not the right quality. The incident illustrated some perils of self-sufficiency—when weather was bad and Korea needed imports, they were expensive and not the right quality. The incident also focused the attention of foreign rice producers on the Korean market.

In 1989, several countries successfully challenged Korea's quantitative import restrictions at the General Agreement on Tariffs and Trade (GATT, now the WTO). Korea claimed the right to impose quantitative trade barriers under Article XVIII of the GATT, which allowed developing countries suffering from sustained deficits in their balance of payments (BOP) to impose such restraints on trade. However, Korea's economic success in the 1970s and 1980s was reflected in a surplus in the balance of payments in the late 1980s, and its trade partners in the GATT pressed it to disinvoke use of the BOP clause. Korea did so in 1989, and a program of trade concessions was undertaken which committed Korea to ending most of its quantitative restrictions on imports in several stages. This liberalization schedule was adjusted during the GATT Uruguay Round (which concluded in 1994). By mid-1997, the planned liberalizations were complete, except for beef (scheduled for 2001). However, Korea held back on ending the quantitative restriction for imports of its most important agricultural commodity, rice. Although the formal quantitative restrictions are largely gone, severe constraints on trade in a number of agricultural commodities remain, including high tariffs, restrictive tariff-rate quotas, and phytosanitary barriers. Reluctance to give greater access to agricultural imports persists; external pressure seems to be the principal force driving Korea's gradual dilution of its protection for major agricultural commodities.

Outcomes of Korean Agricultural and Rural Policy Choices

Korea's Governments have sought since the late 1960s to keep the welfare of the rural population from falling behind that of the urban population in a period of rapid economic development. Many government interventions, focused on agricultural and nonagricultural activities, tried to help rural households increase their living standards and their ability to interact with a modernizing economy. From Moon and Kang (1991), we plot the economic transfer to, or from, the agricultural sector effected by agricultural policy (fig. 1). Until 1970, intervention led to a transfer of resources out of agriculture, which was tantamount to a tax on the sector. Policies shifted in 1970-74, when the government attempted to subsidize farmers and consumers. Since 1975, the government has pursued policies that provide high transfers to farm households. In 1980-84, 34 percent of farm gross domestic product (GDP) resulted from direct and indirect policy-induced transfers.[6]

[5] Martin and McDonald (1986) discussed the shift in policy and measured some of its cost. Ban (1987) discussed some of its effects on productivity growth in agriculture.

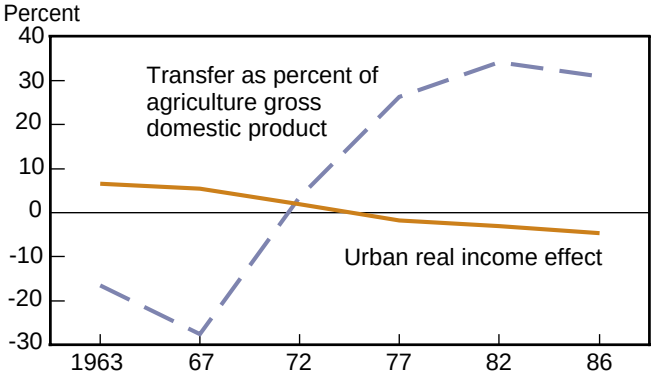
[6] Alternative measures, the Producer and Consumer Subsidy Equivalents (PSE) and (CSE), show even higher impacts for a subset of traded commodities (USDA, 1993; and OECD, 1999). In the early 1980s, 60-70 percent of Korean producer income for these commodities could be attributed to policies that bolstered or protected production, while about 50-60 percent of the cost of these commodities to consumers was due to the same set of policies.

After 1970, one policy goal, boosting agricultural income, was at least partially met. The annual income of rural households rose above that of urban households in 1974-77 and again in 1982-83. In other years, rural household income was only slightly less than urban levels. Through this period (1970s–90s), the pronounced difference between the size of rural and urban households was decreasing. In 1975, the average farm household had 5.4 members; in 1990, it was less than 3. (fig. 2). This is not merely the result of the demographic transition to smaller family size. It also reflects the outmigration of working-age adults. Thus, with higher household income shared by fewer people in each household, welfare at the individual level rose.

Gains in rural household income were due to more than higher prices for agricultural products. The proportion of farm household income derived from off-farm sources (wages from off-farm sources and remittances from urban relatives) significantly increased from 18 percent in 1975 to 43 percent in 1990 and more than 50 percent today (fig. 3). Of the income that still comes from farming activities, the composition has also changed. Rice, which accounted for 55 percent of gross farm receipts in 1975, fell slightly to 48 percent in 1990, a significant decline given the level of subsidies. Shares of vegetables and livestock increased sharply between 1975 and 1990. This increase is consistent with the stronger demand for these products at higher levels of income per person (fig. 4).

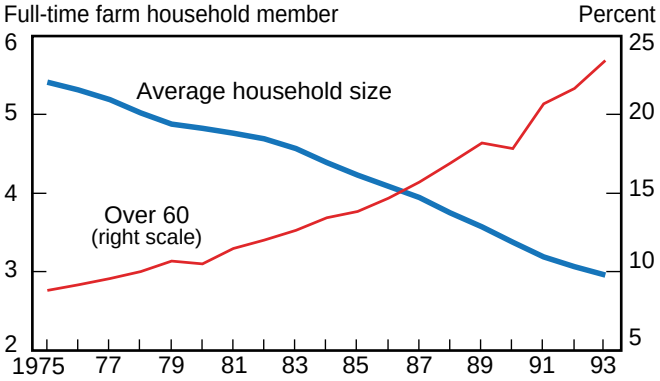
The transformation of Korean farms and farm villages in the 1970s and 1980s was not just a function of government price policy. The Saemaul movement (new village movement), begun in 1971, was a government-conceived mass movement aiming to lift rural living standards through the group efforts of farmers. The

Figure 1—Economic transfers to agricultural sector from government intervention, 1963-86



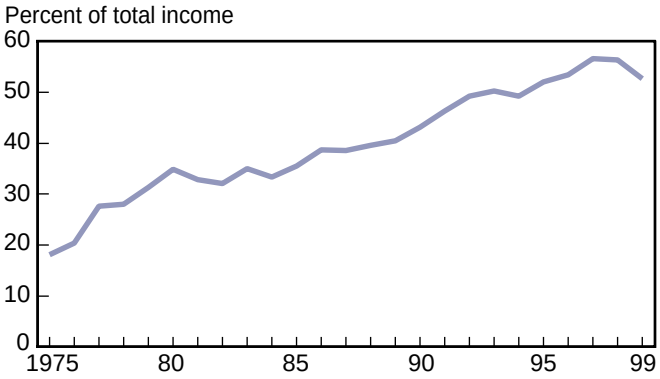
Source: Moon and Kang, 1991.

Figure 2—Farm demographics, 1975-93



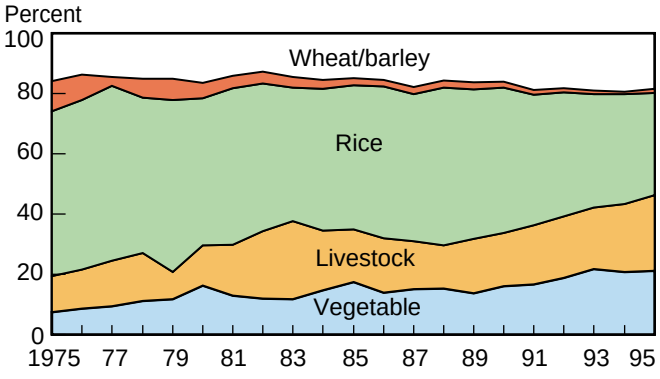
Source: Ministry of Agriculture, Forestry, and Fisheries, various years.

Figure 3—Nonagricultural income of farm households, 1975-99



Source: Ministry of Agriculture, Forestry, and Fisheries, various years.

Figure 4—Composition of Korean agricultural gross receipts, 1975-95



Source: Ministry of Agriculture, Forestry, and Fisheries, various years.

movement, recently documented by Park (1998), emphasized infrastructure improvements, especially better roads, which allowed farm products to get to market and more machinery to be used. Many aspects of village and household affairs, from wells to roofs, were modernized, freeing farm labor time and increasing farm families' well-being. Extension services and farmer training proliferated, along with improved seeds, techniques for raising animals, market information, and other services. Many of these efforts improved farmers' productivity and farming incomes, as well as their ability to earn nonfarm income.[7]

Another stated objective of Korea's food policy was attainment of food self-sufficiency in basic grains. If defined narrowly, that has been attained. Korea's Ministry of Agriculture and Forestry calculates a self-supplying ratio of domestic production to domestic use. Exports and changes in stocks are not included in calculating use. This indicator reveals that self-sufficiency was achieved for rice in most years and, in general, for barley (fig. 5). Agricultural productivity grew at a faster rate in the 1970s than before, and Ban (1987) credited the Saemaul movement, the introduction of high-yielding rice varieties, and the high farm price regime for rice with spurring this growth. Korea's rice yields surged in the 1970s and 1980s to some of the highest levels in the world. In its determination to achieve complete self-sufficiency in rice and barley, the Korean Government sought to reduce consumption in addition to boosting production, by raising consumer prices for rice, banning the feeding of barley to livestock, limiting industrial use of rice, and imposing outright quantitative limits on household use of rice.

Korea is almost completely reliant on imports for wheat and corn, and for over 90 percent of its soybean use. As consumption of livestock products increased, the self-sufficiency ratio for total grains fell from 78 percent in 1975 to 43 percent in 1990, because Korea imported increasing amounts of feed grains. Despite its efforts to maximize domestic grain (and livestock) production, Korea is highly dependent on imports (fig. 6).[8]

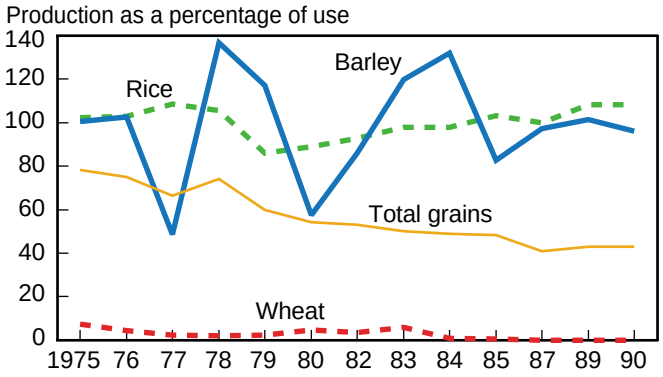
The progress Korea made in boosting agricultural income and domestic grain production came partly through higher retail prices. Korean consumers paid prices for basic foodstuffs—for instance, rice or beef—that were considerably higher than prices prevailing in other countries.[9] The effect of higher consumer prices (after 1975) was unevenly distributed, with impacts on lower income urban households proportionately greater than for higher income households. These high prices tended to force real urban

[7] Park's assessment (1998, p. 125) of the achievements of the 1970s is relevant: "Clearly, the decade of the 1970s was an exciting period for farmers in Korea, for the age-old thatched roofs, traditional lamps, carrying things on men's backs and women's heads had vanished. For the first time in the history of villages, vehicles were coming into villages, and plowing by draft cattle was being replaced by engine-powered tillers. Cash incomes were increasing annually, allowing them to afford the purchase of consumer goods. The villagers obtained a confidence that 'we can do' and 'we can live better.'"

[8] More information about Korea's policies and their evolution can be found on the USDA/ERS website at http://www.ers.usda.gov/briefing/southkorea/policy.htm#self

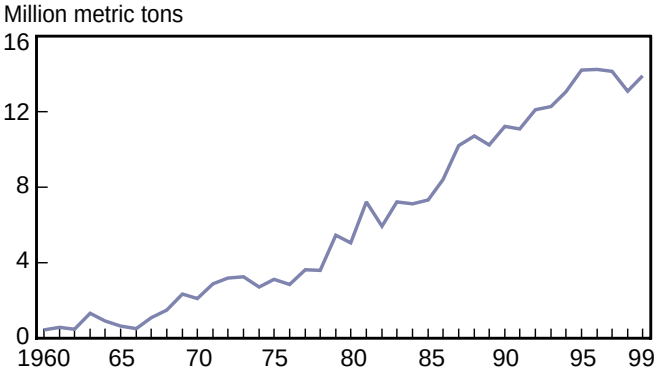
[9] See USDA, 1993; and OECD, 1999.

Figure 5—Korean grain self-sufficiency, 1975-90



Source: Ministry of Agriculture, Forestry, and Fisheries, various years.

Figure 6—Korean grain imports, 1960-99



Source: Ministry of Agriculture, Forestry, and Fisheries, various years.

wages higher, reducing Korea's international competitiveness and contradicting the government's longstanding policy goal of keeping food prices low to dampen inflationary pressures.

The Korean Government's direct purchases of rice, at above-market prices, necessitated heavy budgetary expenditures. The subsequent resale of the rice at less than its purchase and storage costs entailed large annual deficits that have accumulated over the course of three decades. Korea's Government could have chosen to forgo such payments and reduce taxation or spend the money in other ways to assist agriculture or the nonagricultural sectors. The opportunity cost of these expenditures is likely to have been high.

Korea's agricultural trade barriers reduced imports below free-trade levels and thus saved Korea's foreign exchange for other uses. One cost of this policy, as noted earlier in this report, was higher consumer prices, as Korean consumers were unable to take advantage of lower priced imported supplies. The barriers to imports also reduced Korean consumption of some foods below levels that would otherwise have prevailed.[10] This situation arose because high food prices led to reduced purchases and some foods were not produced in Korea. As Korea's prosperity rose and its balance of payments position became less worrisome in the 1980s, the importance of saving foreign exchange declined.

Besides the accounting made above of the success or failure experienced by Korea in achieving its explicit agricultural policy goals, a key outcome of the policies was a weakening of the international and domestic competitiveness of its farming sector. The walls that Korea erected against imports sheltered Korean farmers from competition with farmers elsewhere. Over time, the difference between farm prices in Korea and in exporting countries grew. Thus, the potential shock that Korean farmers would feel from an end to the barriers also grew. Korea's nonagricultural sectors grew at a faster rate than the agricultural sector, and drew labor, capital, and entrepreneurial skills out of agriculture. The choice facing entrepreneurial farmers was either to remain within a small-scaled agricultural sector that had little chance of competing internationally or to move to nonagricultural sectors that benefited from opportunities to participate in international trade. Korean agriculture, once a source of pride and wealth, became a backwater in the economy.[11]

[10] Bananas are a good example. When Korea liberalized the banana trade in 1991, consumption surged from about 0.5 kilogram (kg) per person to over 4 kg per person per year (Korea Customs Administration, 1990 and 1991, and Korea Rural Economic Institute, 1998).

[11] See Hayami (1988) for a detailed analysis of the similar situation in Japan.

Assessing Macroeconomic Costs of Korea's Policies: Previous Studies, the Model, and Data

Korea's agricultural policy goals were partly met (higher farm income, self-sufficiency in rice) and partly contradicted (consumer prices were high, and budgetary costs were substantial) by the policies chosen. A number of studies considered the wider economic effects of the policies. These studies can be divided into partial and general equilibrium analyses. Previous analyses of the effects of Korea's agricultural policies used partial equilibrium methods to focus mainly on specific sectors. Such sector analyses cannot properly evaluate the complete economywide impacts of Korea's agricultural protection policies, because they cannot account for intersectoral linkages in the output and input markets related to agriculture. General equilibrium models incorporate such intersectoral linkages. Nevertheless, partial equilibrium approaches can be quite powerful in capturing commodity-specific consequences of policy changes. Studies by Anderson (1989) and Kim (1996) used partial equilibrium methods to assess scenarios of broad agricultural trade liberalization.

Anderson's extensive study of Korea's agricultural protection policies used the Tyers and Anderson global partial equilibrium framework with seven interrelated agricultural sectors. The model evaluated the effects of Korea's food protection policies on food production, consumption, and trade. The specific scenario examined compared an elimination of agricultural protection in 1987 with an extension of 1980-82 protection levels. The results indicated a transfer of $11 billion (in 1985 dollars) from consumers and taxpayers to support agricultural protection. Farmers would receive only part of this, with $5 billion amounting to a deadweight loss.

Kim (1996) examined the effects of removing tariffs and quotas on 49 commodities, most of which are agricultural. For 1992, his partial equilibrium analysis indicated consumer gains of 8-9 trillion won, equivalent to over 3 percent of Korea's GDP in that year, from removing tariff and quota barriers for the subset of agricultural goods.

Braverman et al. (1987) used a model that represents rural and urban responses to changes in policy variables affecting barley and two kinds of rice. They looked at the impact on four urban income groups of changes in the consumer price of grain and the impact on four rural income groups of changes in the consumer and producer prices of grain. The analyses were based on 1979 data. One scenario, a free-trade equilibrium, resulted in an increase of 2.48 percent in national real income, as consumer gains (from lower prices) in urban areas outweighed producer losses in the rural area. Self-sufficiency fell to 73 percent.

The literature of general equilibrium analyses on Korea's economic policies includes some studies that give particular attention to agriculture. Adelman and Robinson (1978) constructed a computable general equilibrium model of Korea's economy and simulated the effects of different policies on income distribution. Their study focused on the distribution of income and alleviation of poverty during Korea's industrialization process, and the model developed for the study included substantial disaggregation by household level of income for the rural and urban sectors. However, agriculture was aggregated into only two categories: grain crops and other activities. Altogether, the model included 29 sectors, including the two agricultural and three agriculture-related sectors. Their results indicate the importance of keeping the domestic terms of trade favorable to agriculture. Because of the relatively high concentration of poverty in the rural population, the income-enhancing effects of higher prices for farm goods did more to lessen poverty and reduce income inequality in Korea than most other policy choices. However, their analysis, reflecting the experience of the 1970s, is less relevant to later periods, such as 1990, when the relative (and absolute) size of the rural population had decreased.

Van Wijnbergen (1987) adapted a quarterly model of the Korean economy to simulate reducing agricultural prices to world levels over the course of 1981. The addition of an agricultural sector was limited to separating the consumer price index into agricultural and nonagricultural components and to differentiating rural and urban propensities to save. Compared with a simulation with no price changes, Van Wijnbergen found that changing to world prices of agricultural goods would have made GDP about 3 percent higher. Much of the impact came from the translation of lower food prices to real wages. When the model was run over a 5-year period, the level of exports in the fifth year was 20 percent higher in the simulation with world food prices than in the simulation with unchanged Korean prices.

Anderson and Warr (1987) built a small general equilibrium model to analyze the economywide effects of Korea's protection for agriculture. They broke the economy down into food production, manufacturing, and nontradable services, with each sector employing skilled and unskilled labor. The model simulated 1980. The scenario examined was a 20-percent increase in agricultural protection above the actual levels for 1980. By raising the prices of domestic agricultural output, this increase in protection raised farm output and the farm use of unskilled labor, leading to wage increases for all unskilled labor. However, the price of food rose, and wages for skilled workers fell. Korea's manufactured exports fell significantly. "National economic welfare, or the index of real consumption for the economy as a whole, would fall by 2 percent" (Anderson and Warr, 1987, p. 254).

Vincent (1989) reported a general equilibrium evaluation of the effects of agricultural protection on Korea's economy using the framework of the ORANI model (Dixon et al., 1982), but with parameters chosen for Korea and data from the 1980 input-output accounts of Korea (Bank of Korea, 1980). Vincent's model had 13 aggregate production sectors, of which three (cereals, livestock, and other crops) were agricultural, and others (forestry and fishery, food and beverages, and textile and leather) were closely related. Vincent simulated the complete removal of agricultural protection, using two different assumptions about labor. Under each assumption, the removal of agricultural protection resulted in a large reduction in agricultural production, replaced by imports. The output of the food- and beverage-processing industries grew modestly (by 4-5 percent), while the output of the textile-leather industries increased greatly—by about a third. Labor was released from agriculture, and then flowed to the export-oriented light industries. Under the assumption of constant nominal wages, the fall in food prices that accompanies agricultural trade liberalization implies an increase in real wages. The GDP declined by 0.7 percent. If real wages were assumed constant and the supply of labor allowed to grow, real GDP would have increased by 5.0 percent. Under Vincent's other scenario, the supply of labor was fixed and real wages rose. The result was an increase in GDP of 0.2 percent.

Each of the studies discussed above found that agricultural protection was quite important to the Korean economy. Our study aims to extend these earlier analyses in two ways. We first pose the question: Does the cost of agricultural protection to the Korean economy fall once the economy becomes more developed and agriculture becomes a small share of the economy? If the answer to this question is no, the implication for other developing countries—which may consider adopting Korea's policy choices—is that the earlier the protection is removed, the better off will be the economy as a whole. We try to answer this question by employing the same model structure with behavioral coefficients for 1975 and 1990. The structure of the Korean economy changed substantially during these 15 years, but the regime of border protection for agriculture was essentially static. Only in the 1990s did Korea dismantle some of its trade barriers, especially its quantitative restrictions, in accordance with the Uruguay Round of the GATT and other trade agreements. By applying the same model specification to 1975 and 1990 and comparing periods with substantially the same form of border protection, we can isolate how the welfare cost of sectoral protection differs at two very different levels of economic development.

Second, we examine the effects of agricultural protection on the Korean economy through a much more disaggregated set of data related to agriculture than previous reports used. Aggregation involves information loss, especially in the case of Korea's agriculture. Among Korea's agricultural and agriculture-related sectors, there exists a wide range of protection rates (see app. table A2). For example, refined sugar and leather products are highly protected, while raw sugar and hides are traded freely. If one were to aggregate raw and refined sugar, for example, the average tariff rate for sugar would greatly overstate the protection for raw sugar and grossly understate the protection for refined sugar. Thus, a thorough analysis of the costs of protection requires cross-commodity and cross-sector detail. Moreover, keeping within-sector activities separate and identifiable at different levels of food and fiber processing allows the construction of a realistic model of Korean agriculture and its nonagricultural linkages and allows one to trace the outcome of policy experiments.

The Model Structure

The detailed model structure can be found in appendix 1, while the following discussion highlights the major features of the model. The model constructed for the study includes 79 production sectors, of which 41 are agricultural and agriculture-related sectors (app. table

1). Each production sector is assumed to produce a single commodity by employing inputs of labor, land, capital, and a set of intermediate products. With sectoral detail, the cross-commodity and cross-industry linkages are easily traced in the model. Besides input-output linkages, sectors also compete for primary inputs—mainly labor, land, and capital—according to a profit maximization principle. The derived final demand of total consumers for each commodity is included in the model and is consistent with a maximized social utility function. Domestic and foreign goods are treated as imperfect substitutes, following an Armington specification.

A set of equilibrium conditions is also included in the model. In a general equilibrium framework, factor supply and input demand must be equal, which allows the prices for production factors and wages to be endogenously determined. Similarly, the prices for domestic goods are determined endogenously by the equilibrium conditions in commodity markets. Cross-commodity and cross-sector linkages are evident given such equilibrium conditions. For instance, suppose that tariffs (or nontariff barriers) on beef imports were removed. The price of imported beef would fall relative to the price for domestic beef. Consumers would buy more imported beef to substitute for domestic beef. The fall in demand for domestic beef would result in a decline in the price for domestic beef. In a partial equilibrium approach, equilibrium is attained when domestic supply is reduced to clear the beef market. It does not account for changes necessary in the markets for other goods and factors. In a general equilibrium framework, when beef production falls, some inputs used in this sector are released. Some sectors may employ more primary inputs to expand their production, while some other sectors may reduce output supply due to a weak demand by the beef sector on intermediate inputs. A general equilibrium model explicitly accounts for these indirect linkages to markets for all goods and all factors. When the magnitude of a distortion is large, as in Korean agriculture, ignoring these indirect effects may yield a gross underestimate of the actual impact of a policy reform.

The Data

Data used for this report are primarily from the 1975 and 1990 social accounting matrices (SAMs) of Korea, developed by the Bank of Korea. A social accounting matrix is a data set that includes data for sectoral production activities such as inputs and outputs, intermediate and aggregated consumers' final demand as well as imports and exports of each sector's goods, factor endowments and their allocation across sectors, and trade policy instruments (tariffs and export subsidies/taxes) by sector. The data in a SAM are 1 year's data, organized to obtain a balanced outcome. For example, the output of raw sugar becomes input for refined sugar in the SAMs. Total demand for refined sugar equals total domestic production minus exports and plus imports, while demand consists of consumption, intermediate and investment demands, and an increase in inventory. The cost of refined sugar consists of the value of raw sugar as a part of intermediate costs and production factor costs such as wages and returns to capital. The original SAMs included more than 400 production activities. For this report, we reduced the rank of the SAMs by aggregating to 79 subsectors. As our focus is with agriculture, most of the detail of the original SAMs is retained for agriculture.

Support to Korean agriculture is principally manifested by border measures. While import tariff rates can be obtained from the SAMs, measures of other policy effects, such as quantitative restrictions and producer subsidies, have to be obtained from other sources. For instance, the tariff rate on rice in 1975 and 1990 (5 percent) does not reflect the extremely high barrier posed by complete government control over rice imports or direct subsidies to production. We use data from OECD (1999) and ERS/USDA (1993) to adjust the tariff equivalent rates for certain agricultural commodities by incorporating the market price support (calculated as the difference between domestic and world prices, then multiplied by production quantity) afforded by import bans and by adding direct government subsidy payments to producers and input subsidies. The result is a rate of protection. OECD and ERS data on market price support and government subsidies were not available for 1975. The earliest data available were used as a proxy for the 1975 protection rate for certain agricultural commodities. Average data from the 1979-81 period (from the OECD) were used for rice, red meats, milk products, oilseeds, sugar, and poultry meat and data for barley came from ERS estimates for 1983. Estimates for 1990 from the same sources were used for 1990 protection rates. For other commodities, data in the SAM were used, unadjusted, for both years. The protection rates for different sectors used in the model are presented in appendix table 2.

Protection data for the studied products are from different sources. To be consistent with the policy effects of these protections on constraining imports, we further compared the levels of protection across sectors and the ratio of imports to total consumption across sectors. We observed that in the sectors in which the import-consumption ratio was low, the level of protection rate was high (see app. tables 2 and 3 for the comparison). That is, a high sectoral protection rate effectively blocked imports in that sector. Moreover, in a general equilibrium analysis, not the absolute degree, but the relative degree of protection afforded to a commodity matters. That is, as the general equilibrium model reflects the real side of the economy, production and consumption decisions (including import and export decisions) are based on the level of relative prices. Thus, we further check whether the relative degree of protection afforded to different agricultural commodities reflects the ratio of imports over consumption, which partially represents the outcome of the protection policies. The comparison shows a consistent outcome.

The protection rates in appendix table 2 are ranked according to the 1975 rate, from high to low. In 1975, there were 30 sectors (among the 79 sectors) in which the nominal protection rate was above 50 percent. That is, in those 30 sectors, domestic prices were at least 50 percent higher than the border prices. Appendix table 2 also shows that most sectors with a high protection rate were agricultural and agriculture-related sectors, indicating a highly protected agriculture in Korea's economy. In 1990, the number of sectors in which the protection rate was above 50 percent had declined to 10. All 10 sectors were in agriculture, and for some of them, the protection rate had increased (for example, milk, soft drinks, refined sugar, oilseeds, beef, and pork) compared with 1975.

The high protection rate was associated with restricted imports. Appendix table 3 presents the ratio of imports to total consumption for 1975 and 1990. In 23 agricultural and agriculture-related sectors, imports accounted for less than 3 percent of total consumption in 1975. In 1990, the number of such sectors had fallen to 13, although in 20 of the 42 agricultural and related sectors, the share of imports was still below 5 percent.

Economic Cost of Agricultural Protection

Korea was still a relatively poor, although rapidly industrializing, economy in 1975. Agriculture accounted for about a third of its GDP. Fifteen years later, in 1990, Korea was far richer, and agriculture's share of its GDP had fallen to one-tenth. One might conclude that a high rate of protection for a secondary and declining sector does not place a major burden on the economy, and in light of Korea's high growth rate, that agricultural protection, however measured, could not have been particularly costly. Our analysis is structured to empirically evaluate this argument for Korea. We show that the costs were indeed significant.

The focus of the policy experiments of the study is agricultural trade policies. Using the computable general equilibrium models constructed for 1975 and 1990, we conducted two experiments (EXP-75 and EXP-90) in which protection of the agricultural sector was removed for the given year. Tariff revenues are part of government income in the economy. While revenue concern was not the major policy purpose in Korea in 1975 or 1990, tariff income, especially the revenues generated from agricultural imports, significantly increased in 1990, compared with 1975. Agricultural tariff revenues, however, accounted for a small portion of government revenues. The share of tariff revenues on all goods, not just agricultural, was equivalent to 11 percent of government total revenues in 1975 and 8 percent in 1990.[12] To minimize the effect of the government budget condition on the social welfare and GDP in the experiments, we did not separate government revenue and consumption from the aggregate consumer's income and consumption. That is, the total government revenues are transferred to the aggregate household. Thus, when the agricultural protection is removed in the model experiments, we need not be concerned about whether and how the balance or imbalance of the government budget will affect the economy.

Some changes in the economy may have occurred between 1975 and 1990 that are not captured in the model structure chosen. Weather or disease may have affected particular subsectors of agriculture, although both years had relatively normal weather. The technology embodied in the SAMs may imperfectly describe the economic relations in either year or both. Consumer preferences are assumed to be the same in each period. To the extent that there were changes or exceptional circumstances not captured in the model, the comparison between the 2 years may be biased. However, the SAMs are careful depictions of the structure and technology of Korea in a given year, and the modeling exercise is to assess how the same policy changes—removal of agricultural protection—affected Korea in 2 years characterized by considerably different economic structure and technology.

[12] National Bureau of Statistics, Economic Planning Board, Republic of Korea, 1977 and 1991.

Cost of Agricultural Protection Rose in 1990

While the simulations reveal that agricultural protection distorted the economy in 1975 and 1990, the cost of such protections—as measured by the loss in national purchasing power due to the policy, the equivalent variation—was greater in 1990 than in 1975 (table 2). Given that agriculture's share of GDP fell from one-third to one-tenth between 1975 and 1990 (table 3), one might expect the cost of protection to be smaller in 1990. Our analysis suggests that this is not the case. Two reasons account for the larger cost of protection in 1990. First, while the average level of protection in the economy fell in 1990, the level of agricultural protection was higher in 1990 than in 1975 (app. table 4). Second, the distribution of protection among agricultural goods was more distorted in 1990

Table 2—Effects of agricultural trade liberalization on selected aggregate economic indicators in the model

Indicators	EXP-75	EXP-90
	Percentage change from base value	
Real GDP[1]	0.69	4.58
Agricultural GDP[2]	-32.40	-44.04
Manufacturing GDP[2]	2.18	0.15
Service GDP[2]	0.30	0.14
Consumer price index	-1.84	-1.74
Primary agriculture	-1.97	-20.04
Processed agriculture	-6.82	-2.82
Producer price index	-5.73	-4.76
Primary agriculture	-14.40	-47.44
Processed agriculture	-27.73	-27.85
Equivalent variation[3]	1.81	5.69
Total exports	2.70	2.38
Total imports	2.12	2.35

[1]Real GDP is normalized by the consumer price index.

[2]Sectoral GDP is not normalized by the consumer price index.

[3]Equivalent variation, the maximized level of a social utility function, is a measure of the dollar equivalent of an effective change in national income or purchasing power caused by a policy change.

Source: Model simulations.

than in 1975. The greater distortion in agriculture leads to a more inefficient allocation of resources. The average tariff-rate equivalent in 1990 was more than double that in 1975 for primary agriculture, while it fell for forestry, fisheries, and processed agricultural goods (app. table 4).

The standard deviations of the tariff-rate equivalent between the 2 years for all 42 agricultural subsectors give further evidence of disparity within the agriculture sector. The standard deviation (SD) is one of the most commonly used indicators of dispersion, because it gives a measure of the spread or distance of most observations from the mean. The calculated SD of agricultural protection rates rose by 10 percent for total agriculture from 1975 to 1990. Within agriculture, the standard deviation rose by 40 percent for primary agriculture and fell slightly for processed agriculture (-7 percent).[13]

To check whether these two reasons explain the large welfare loss due to agricultural protection in 1990, we artificially imposed 1975's agricultural protection rates on the data for 1990 and then changed the protection to zero in a simulation. The purpose of this exercise is to determine whether we can obtain a similar welfare loss in 1975 and 1990 were the agricultural protection rate (the gap between domestic and world prices) to remain the same in the 2 years. Measured by the change in the equivalent variation, this simulation generated an outcome for 1990 similar to that obtained in EXP-75, which supports our earlier arguments in this report.

Changes in economic structure influence the cost of agricultural protection. Korean agriculture is characterized by very small landholdings. Compared with the rest of the Korean economy, agriculture is labor-intensive; capital employed per worker in agriculture is less than in the rest of the economy. Protecting agriculture causes more labor to be employed in agriculture than otherwise and lowers the return to capital in the rest of the economy. As the capital share of GDP increases with economic development, the negative effect of agricultural protection on the economy is augmented. Between 1975 and 1990, Korea realized a rapid rate of investment growth. With capital deepening and labor productivity growth increasing in the nonagricultural sectors, the same amount of labor can manage more capital and produce more output, thus contributing more to the GDP. Agricultural protection policies, by inhibiting labor mobility within agriculture and between agriculture and nonagriculture, caused a greater resource loss to the Korean economy in 1990 than in 1975, even though agriculture accounted for a lower share of GDP. The burden of the cost of protection was borne mainly by the rest of the economy—manufacturing and services. The simulations show that protection caused the GDP shares of manufacturing and services to significantly fall (table 3). In proportion to its share of GDP, manufacturing dropped more than services in 1975, but in 1990, the rate of decrease was roughly the same in those two sectors.

[13]The Ramsey-optimal rule of commodity taxation is that tax rates should be inversely proportional to demand elasticities (Atkinson and Stiglitz, 1976). Thus, a reduction in the coefficient of variation does not always indicate a welfare improvement; however, the divergence of rates is much greater than the divergence of demand elasticities, so it is very likely that the level of distortions in 1990 is greater than in 1975.

Table 3—Effects of trade liberalization on the structure of the Korean economy in the model

Indicators	1975		1990	
	Base	EXP-75	Base	EXP-90
		Percent		
Agricultural share of GDP	28.6	21.1	11.0	6.5
Primary agriculture	8.1	7.0	7.4	3.4
Processed agriculture	17.1	10.5	2.2	1.7
Manufacturing share of GDP	20.9	23.5	27.8	29.3
Textile	5.6	6.3	3.9	4.1
Nonagriculture-related manufacturing	13.8	15.5	22.0	23.2
Service share of GDP	50.5	55.4	61.2	64.3
Share of exports in total output	13.9	14.7	13.2	13.9
Share of imports in total consumption	17.9	18.6	13.8	14.9
Primary agriculture	18.4	19.1	15.8	21.7
Processed agriculture	10.0	15.6	5.9	24.6

Sources: Data in the Base columns are from the SAMs provided by the Bank of Korea. Data in the EXP-75 and EXP-90 columns are from model simulations.

Agricultural Liberalization and Economic Structure

Agricultural liberalization in 1975 reduced agriculture's share of GDP from 28 to 21 percent, the level actually reached by Korea in 1980. Liberalization in 1990 reduced this share from 11 to 6.5 percent, a level almost the same as that actually achieved in 1996. One interpretation of these results is that agricultural protectionism retarded Korean economic development by 5 to 7 years, and that the retardant effect increases the longer the liberalization is postponed.

Protectionism also retarded structural change within agriculture between 1975 and 1990. Agriculture's share of GDP fell from 29 percent in 1975 to 11 percent in 1990, but the share of primary agriculture fell proportionately less, from 8.1 to 7.4 percent. The bulk of the decline was in processed food and fiber, which fell from 17.0 to 2.2 percent (table 3). Agricultural liberalization in 1990 (EXP-90) would have sharply reduced the share of primary agriculture in total value added below its actual level. The removal of protection would have affected the share of processed agriculture in total value added in the whole economy as well, but the level was already low. The change of greatest significance to Korea's economy would have been the reduction in primary agriculture's role.

Further disaggregation of the results among the subsectors of primary agriculture shows that the decline in output did not occur for all commodities. According to model results, rice output fell by 10 percent in 1975 and 27 percent in 1990 in the liberalization scenarios. The output of vegetables and fruits, however, rose by 1 percent in 1975 and 5 and 3 percent in 1990, respectively. Thus, the share of rice in the total value added by primary agriculture significantly declined, and the share for vegetables and fruits expanded (table 4). By protecting rice and animal products, Korea's border policies drew more resources—labor and land—into producing those commodities. With such protection removed, more labor and land were available for vegetable and fruit farming, which had much lower rates of protection in 1990 and, thus, were affected less by removal of protection. The disaggregation by major commodities reveals that agricultural protection did not protect all agricultural activities equally, and distorted the composition of Korean primary agriculture; moreover, the delay in policy reform increased the loss in allocative efficiency.

Agricultural Protection, Trade, and Welfare

We would expect that removal of agricultural protection would increase the demand for agricultural products by lowering prices for consumers and that imports would satisfy a greater share of consumption after liberalization than before, at the expense of domestic production. Indeed, our simulations support this but reveal differences within the sectors in the composition of trade and consumption (table 5). Consumption

Table 4—Simulation results of the effects of trade liberalization on Korea's agricultural production structure

Indicator	1975		1990	
	Base	EXP-75	Base	EXP-90
		Percent		
Share of primary agriculture in total value added	8.1	7.0	7.4	3.4
Share of processed agriculture in total value added	17.1	10.5	2.2	1.7
Share of selected commodities (output value of primary agriculture is 100):				
Unmilled rice	4.4	3.3	17.5	2.4
Vegetables	26.7	39.5	28.7	47.5
Fruits	10.8	12.0	9.1	15.0
Beef cattle	4.8	3.1	5.8	0.0
Hogs	2.6	1.5	10.5	0.8
Poultry and eggs	10.0	11.0	5.9	9.2
(Processed agriculture is 100):				
Beef and pork	4.7	5.1	4.9	1.0
Poultry meat	1.5	1.7	1.5	2.1
Milk products	1.5	1.6	3.6	3.5
Polished rice	28.3	27.7	8.9	4.6
Polished barley	3.8	2.3	0.5	0.0
Flours	9.4	7.0	1.7	1.8
Refined sugar	3.4	0.0	1.7	1.8

Sources: Data in the Base columns are from the SAMs provided by the Bank of Korea. Data in the EXP-75 and EXP-90 columns are from model simulations.

Table 5—Simulation results of the effects of trade liberalization on aggregate sectoral trade and consumption

Sector	1975			1990		
	Exports	Imports	Consumption	Exports	Imports	Consumption
	Percentage change from the base					
Primary agriculture	3.2	-3.6	-7.5	12.3	-27.0	-21.9
Forestry and fishing	5.6	2.1	-0.6	7.7	-3.4	-2.7
Processed agriculture	-30.8	55.9	-2.4	-13.8	219.5	-1.4
Textile	3.1	2.4	1.0	-0.9	5.6	1.1
Other agriculture-related manufacturing	5.1	-2.3	-0.0	1.6	-3.5	-0.6
Mining and manufacturing	6.2	-3.0	-0.9	4.2	-2.8	-0.3
Services	3.1	-3.3	0.2	3.4	-0.7	0.9

Source: Model simulations, aggregated to broad sectors.

includes final and intermediate demands. In 1975 and 1990 and for primary and processed food, final demand rose with liberalization, while intermediate demand fell. The rise in final demand could not compensate for the fall in intermediate demand. Hence, total consumption for agricultural and nonagricultural goods fell, with the exception of the textile and service sectors (table 5). Imports rose mainly in the processed agricultural sector, while imports of primary agricultural goods fell in both years, but more in 1990. As imported processed goods replaced domestic processing, the intermediate demand for primary agricultural output and imports declined. The increase in processed-product imports meant that most primary agriculture imports were imported in processed form.

One implication of heavy border protection is reduced levels of imports. In 1975 and 1990, imports provided a small or zero share of total consumption for most of the highly protected commodity sectors. For example, imports of rice and barley were effectively banned in 1990. Lifting these bans in the scenarios leads to striking changes. Production of barley ceased, and domestic demand for it was fully supplied by imports (table 6). For rice, 28 and 20 percent of domestic demand in 1975 and 1990, respectively, were met by imports.[14] In the Uruguay Round, Korea agreed to allow rice imports to increase to 4 percent of domestic consumption by 2004. These simulation results indicate that Korea's rice imports are likely to considerably exceed the 4-percent WTO minimum access level, given full liberalization. Other sharp increases in reliance on imports occurred in beef and pork, milk products, vegetable oil, and flour.

Table 6—Share of imports in total consumption for selected commodities

Commodity	1975		1990	
	Base	EXP-75	Base	EXP-90
	Percent			
Polished barley	38.5	67.1	0.0	100
Polished rice	13.6	28.1	0.0	20.3
Flours	2.4	3.3	3.9	10.7
Milk products	5.6	14	20.1	45.1
Vegetable oil	5.1	8.7	17.2	26.9
Soft drinks	1.9	4.3	2.6	7.1
Coffee and tea	1.9	4.3	0.7	1.7
Starches	1.5	4.6	2.9	6.7
Feeds	1.5	24.5	0.3	0.4
Poultry meat	0.9	1.2	0.3	0.4
Beef and pork	0.8	5.4	22.2	83.9

Sources: Data in the Base columns are from the SAMs provided by the Bank of Korea. Data in the EXP-75 and EXP-90 columns are from model simulations.

Agricultural Liberalization Effects on Farm Households

One objective of Korean agricultural policy is to enhance farm household income. Protection has increased gross receipts for protected commodities, with much of this increase captured as rents on factors of production, especially land, that are difficult to supply in greater quantities when prices increase. The intersectoral effects of agricultural protection may have also diminished rural households' incentives to migrate into nonagricultural work or to switch from protected crops to other agricultural activities. By slowing the flow of people out of agriculture and into the urban job markets, real urban wages increased in Korea, due to agricultural protection. This wage increase may have induced more investment in labor-

[14] The model employs a Stone-Geary demand system to represent nonhomothetic demand functions. This is particularly important for rice. The price elasticity of final demand used for rice is -0.2. The absolute value of this elasticity is much lower than for other food commodities used in the model; the price elasticity of final demand used for vegetables and fruits is -0.5 and for beef is -0.4.

Table 7—Effects of trade liberalization on farm income

Item	1975		1990	
	Without labor mobility	With labor mobility	Without labor mobility	With labor mobility
	Percentage change from base			
Total farm income	-23.9	-19.2	-51.0	-42.4
Wage income	-23.9	-2.6	-46.4	-1.0
Change in nonagricultural wage income	0.0	20.0	0.0	47.2

Source: Model simulations.

augmenting technology than would have occurred under a liberal trade regime.

The SAM data do not provide any direct information about rural households. For this reason, the effects of liberalization on farm households are evaluated by examining the returns to the factors (mainly land and capital) employed in primary agriculture and wages. The model assumes that land and part of capital cannot move across the aggregated sectors. Because income from nonagricultural sources accounts for a growing share of total farm income in Korea (fig. 3), it is clear that labor mobility among sectors is widespread, and the model assumes that labor can move across all sectors. Given these assumptions, the liberalization scenarios lead to reductions in primary agricultural income (from returns to land, capital, and labor) of 19 percent in 1975 and 42 percent in 1990. The higher degree of border protection in 1990 was more important to farm income than protection in 1975. Lower farm revenue means lower returns to the owners of farm sector-specific capital equipment and land and effects a reduction in the net worth of the owners of these assets. In addition, the wage rate slightly falls (table 7, "With labor mobility" column).[15]

[15] Hatton and Williamson (1992) have initiated an ambitious comparative analysis of the urban-farm wage gaps and intra- and international migration.

To understand how the diversification of farm household income would moderate such directly negative effects of agricultural liberalization on the average farm household, we further assume that labor employed in primary agriculture cannot freely move to other sectors, that is, rural-urban migration is not allowed. With this assumption, we find that primary agricultural income would further decline (table 7). Such decline is mainly due to a lower agricultural wage rate.

The simulation results show that when labor cannot move out of agriculture after liberalization, the wage income of agricultural labor falls by 24 and 46 percent, respectively, in 1975 and 1990. This provides evidence about the importance of nonfarm income to rural households. On average, wage income earned by rural labor from the nonagricultural sector would rise 20 and 47 percent (in 1975 and 1990, respectively), given the assumption that rural labor moves freely to find employment opportunities in nonagricultural sectors (table 7). Clearly, households with a greater (less) than average share of off-farm income will face a smaller (greater) loss than that reported for the average farm household. Increased employment outside farming compensates for some, but not all, of the rural household income lost because of lower returns on land and capital and the slight reduction in the national wage rate.

Conclusions

While the economic development of South Korea is often considered as a model to be followed by developing countries, Korea's agricultural sector is characterized by high prices and high levels of border protection. The costs of agricultural protection to the Korean economy were substantial in 1975 and 1990. And, because many of the policies of 1990 are still enforced, the cost remains substantial today. Although primary and processed agriculture accounted for about one-third of GDP in 1975 and one-tenth in 1990, agricultural protection accounted for a larger welfare loss to the Korean economy in 1990 than in 1975. This report does not take into account the welfare loss caused by protection in Korea's nonagricultural sector, especially services, as there are no data about nontariff barriers in the nonagricultural sector in the model. Hence, the results from our study may overestimate the distortion effect of agricultural protection. However, provided that the degree of protection for nonagriculture did not increase between 1975 and 1990, one of the main conclusions still holds: the declining importance of agriculture (that is, in its contribution to Korea's GDP) does not mean that the welfare cost of agricultural protection declines. The cost of protection, in all its forms, is increasing with the level of Korea's economic development.

Results from the counter-factual simulation exercise conducted here show the earlier the protections are removed, the better off Korea's economy as a whole would be. A national self-sufficiency food policy focuses on farmers' resources in activities (such as rice farming) that become less appropriate as an economy develops. A highly protected food grain sector postpones the necessary adjustments in farmers' productive activity (for example, a shift to vegetable production, or a departure from agriculture), hence, reducing their potential to improve their income in the future.

Korea's rural policies succeeded in improving the life of rural families, predominantly farm families. Korea's economic output as a whole grew faster than most other countries' in the 1970s and 1980s. Clearly, the agricultural policies chosen by Korea did not prevent large economic advances by the nation and its rural areas. However, this study indicates that the cost to the economy of agricultural trade barriers at the border was considerable. Can the same or better results for farm income and food security be achieved at a lower cost to national economic growth? Policymakers concerned with today's developing countries should regard Korea's policy choices with this question in mind and should seek out policies that help the agricultural sector become competitive and more productive, rather than just function as a welfare safety net, as development proceeds. Finally, the economic costs grew as Korea's agricultural sector shrank in relative importance. Korea's protectionist policies increasingly burden its economy. Other developing countries may also find that the cost of agricultural protectionism rises over time.

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Appendix 1—The Model

The model structure and basic assumptions are similar to most other computable general equilibrium (CGE) models that are neo-classical in spirit. The model assumes that the representative producer for each production sector maximizes profits by making production decisions (choosing levels of inputs and outputs), and the representative consumer maximizes a utility function by making consumption decisions and subjecting those decisions to the income constraints. All agents (producers and consumers) respond to the prices. When the relative prices change, due to removing or reducing import tariffs, for example, producers adjust their production level while consumers adjust their demand for commodities. In the international market, the country is assumed to be small in the sense that it takes world prices as given. A commonly used assumption in the CGE models is that imperfect substitutions exist between foreign goods and domestically produced goods. Hence, the domestic price for a commodity (for example, rice) is not necessarily equal to (even though highly affected by) the world price for the same commodity.

Production Sector

Let subscripts *i* and *j* denote the sector or commodity for $i = 1, 2, \ldots, 79$; *f* denotes factors and $f = l$ (labor), *d* (land), *k* (capital). Assume a constant returns to scale technology, such as the constant elasticity of substitution (CES) function used in the model. In matrix notation, equation 1 is the derived output supply function under a profit maximization approach, equation 2 is the factor demand function (by Shephard's lemma), and equation 3 is the intermediate input demand function.

$$\mathbf{Y} = y(\mathbf{PX}, \overline{\mathbf{V}}). \tag{1}$$

$$\mathbf{v} = \left[\frac{\partial c_i(\mathbf{w}, \mathbf{PC})}{\partial w_f} Y_i\right]. \tag{2}$$

$$\mathbf{x} = \left[\frac{\partial c_i(\mathbf{w}, \mathbf{PC})}{\partial PC_j} Y_i\right]. \tag{3}$$

In the equations, $\mathbf{PX} = (PX_1, PX_2, \ldots, PX_{79})$ is the output price vector faced by producers; $\mathbf{PC} = (PC_1, PC_2, \ldots, PC_{79})$ is the intermediate input price vector; $\overline{\mathbf{V}} = \left(\overline{l}, \overline{d}, \overline{k}\right)$ is the fixed factor endowment vector; and $\mathbf{w} = (w_l, w_d, w_k)$ is the factor price vector. PC_i is not necessarily the same as PX_i for the same good *i*, because good *i* domestically produced is not perfectly substitutable with good *i* imported from abroad. Finally, $c_i(\bullet)$ is the unit cost function.

Households

There is an aggregated household in the economy, and the aggregate consumer's final demand for each good, D_i, is derived from a maximized Stone-Geary social indirect utility function. In matrix notation, the demand (**D**) in equation 4 is decreasing in prices (**PC**) and increasing in income (*I*). Total household income in equation 5 is the sum of wage income from labor, capital, rental income, and profits to sector-specific resources, mainly land and land-related capital ($\mathbf{w} \bullet \overline{\mathbf{V}}'$) and government net income (*T*), which is endogenously determined by the tax revenues net of subsidy expenditures (while the rate of tax or subsidy is exogenous). Given that the government budget balance is not a serious issue in the Korean economy, the government expenditure on goods and services is ignored in the model.

$$\mathbf{D} = D(\mathbf{PC}, I). \tag{4}$$

$$I = \boldsymbol{w} \bullet \overline{\mathbf{V}}' + T. \tag{5}$$

Production Factors

Labor is assumed to be mobile in the economy in the two major simulations, EXP-75 and EXP-90 (only mobile within agricultural or nonagricultural sectors but not between them in the additional simulations—(see table 7). Land and land-related capital are assumed to be mobile only within the subsectors of agriculture. The model distinguishes four types of land and land-related capital: (1) paddy land used for rice and vegetable production, (2) dry land used for barley, wheat, soybeans, potatoes, cotton, and medicinal herbs production, (3) high land for fruits, tobacco, tea crops, and cocoons, and (4) land/capital for livestock production. Capital is mobile within each subsector but not mobile across them. In terms of capital use, there are seven subsectors in the model: (1) primary agriculture, (2) fishing and forestry, (3) processed agriculture, (4) textile, (5) other agriculture-related manufacturing, (6) other manufacturing, and (7) services.

Exports/Imports

With imperfect substitution between domestic and foreign goods, producers and consumers face a composite price system. We define **PX**, the composite price vector faced by producers in equation 6, and **PC**, the composite price vector faced by consumers as:

$$\boldsymbol{PX} = f\left(\boldsymbol{PD}, \boldsymbol{PE}\right), \text{ and} \tag{6}$$

$$\boldsymbol{PC} = g\left(\boldsymbol{PD}, \boldsymbol{PM}\right), \tag{7}$$

where **PD** = (PD_1, PD_2, …, PD_{79}) is the price vector for goods domestically produced and consumed; **PE** and **PM** are, respectively, export and import price vectors and:

$$\mathbf{PE} = \left(1 + te\right)\mathbf{PW}, \text{ and}$$
$$\mathbf{PM} = \left(1 + tm\right)\mathbf{PW}.$$

PW is the world price vector, which is exogenous to the Korean economy—under the small country assumption; *te* is the export subsidy rate and *tm* is the import tariff or tariff equivalent rate. Equations 6 and 7 can be solved by minimizing the total expenditure function for the economy, subject to the Armington (1969) function that has a CES form in the model. Arguments in an Armington function are domestic and foreign goods. The derivatives of equations 6 and 7 with respect to PD_i, PE_i, or PM_i multiplied by the total supply, Y_i, or total demand, TD_i, as appropriate, yield the supply and demand equations 8-11 for the domestic and foreign goods.

$$\mathbf{DY} = \left[\frac{\partial PX_i}{\partial PD_i} Y_i\right], \quad \text{**DY** is a vector of goods produced for domestic markets;} \tag{8}$$

$$\mathbf{E} = \left[\frac{\partial PX_i}{\partial PE_i} Y_i\right], \quad \text{**E** is a vector of goods exported;} \tag{9}$$

$$\mathbf{DX} = \left[\frac{\partial PC_i}{\partial PD_i} TD_i\right], \quad \text{**DX** is a vector of goods demanded by domestic markets; and} \tag{10}$$

$$\mathbf{M} = \left[\frac{\partial PC_i}{\partial PM_i} TD_i\right], \quad \text{**M** is a vector of goods imported;} \tag{11}$$

where $TD_i = D_i + \Sigma_j x_{i,j}$.

Equilibrium Conditions

Factor market-clearing conditions in equation 12 endogenously determine **w**, while the vector of factor prices, and the prices for domestic goods, **PD**, are determined endogenously by the equilibrium condition in equation 13. Equation 14 is the constraint for the current account in which $\overline{FSAV}$ is the trade deficit (observed in the data). In the simulations, the trade deficit is assumed not to change. Cross-commodity and cross-sector linkages are evident in the system in equations 1-13, especially in equations 12 and 13:

$$\sum_{i=1}^{79} \frac{\partial \mathrm{c}_i\left(\mathbf{w}, \mathbf{PC}\right)}{\partial w_f} Y_i = \overline{V_f}; \quad f = l, d, k, \tag{12}$$

$$DY_i = DX_i; \quad i = 1,2,...,79, \text{ and} \tag{13}$$

$$\sum_{i=1}^{79} PW_i\left(E_i - M_i\right) + \overline{FSAV} = 0 \tag{14}$$

Most parameters and coefficients used in the model equations are calibrated from the Korean SAMs, while the elasticities in the CES functions for trade are adopted from other studies. Like other static CGE models, the model has a medium-run focus. We report the results of comparative static experiments in which we first shock the model by changing or eliminating tariff and tariff-equivalent rates, and compute the changed equilibrium solution. We do not explicitly consider how long it might take the economy to reach the new equilibrium, or what other adjustments (such as an increase in labor employment, more capital investment, technology transfer, and productivity shifts) might occur as well. The model's time horizon has to be viewed as long enough for full adjustment of currently employed factors (including labor, land, and capital) to occur, given the shock. While useful to understand the pushes and pulls the economy will face after introducing a shock, this approach has obvious shortcomings. In particular, it does not consider the costs of adjustment, such as transitional unemployment, that might occur while moving to a new final equilibrium. Moreover, with its static feature, the model does not consider many dynamic factors, such as the linkage between opening the market to imports and economic growth, which are statistically proven to be strong and important in explaining Korea's economic growth and development.

Appendix 2—Appendix Tables

Appendix table 1—Sector classification in the model

I. Primary agriculture
1. Unmilled rice
2. Unmilled barley, wheat and other cereal
3. Vegetables
4. Fruits
5. Oilseeds
6. Potatoes
7. Cotton and hemp
8. Leaf tobacco and tea
9. Other crops
10. Natural rubber
11. Seeds
12. Dairy farming
13. Beef cattle
14. Hogs
15. Poultry and eggs
16. Other livestock
17. Cocoons
18. Agricultural services

II. Forestry and fishing
19. Forest planting
20. Timber
21. Fishing

III. Processed agriculture
22. Beef and pork meat
23. Poultry meat
24. Other meat
25. Milk
26. Milk products
27. Fish products
28. Polished rice
29. Polished barley
30. Flours
31. Raw sugar
32. Refined sugar
33. Noodles and other prepared foods
34. Animal oil
35. Vegetable oil
36. Starches
37. Coffee and tea
38. Feeds
39. Liquors
40. Soft drinks
41. Tobacco products

IV. Textile
42. Raw silk
43. Cotton yarn
44. Woolen yarn
45. Synthetic yarn
46. Other yarn
47. Silk fabrics
48. Cotton fabrics
49. Woolen fabrics
50. Synthetic fabrics
51. Other fabrics
52. Wearing apparel
53. Leather
54. Leather products
55. Fur
56. Fur products

V. Other agriculture-related manufacturing
57. Lumber
58. Plywood
59. Other wood products
60. Pulp
61. Paper and products

VI. Mining and manufacturing
62. Mining
63. Chemical products
64. Fertilizer
65. Pesticides
66. Petrochemical and coal products
67. Tires and rubber
68. Agricultural machinery
69. Electric and precision equipment
70. Transportation equipment
71. Other manufacturing

VII. Services
72. Utilities
73. Construction
74. Trade
75. Hotel and restaurant
76. Transportation and warehousing
77. Communication, finance, and real estate
78. Public administration and defense
79. Education

Sources: Selected categories from the SAMs of the Bank of Korea, organized for the purposes of this report.

Appendix table 2—Rates of protection in the model (ranking by 1975 protection rate)

Sector	Year		Sector	Year	
	1975	1990		1975	1990
	Percent			*Percent*	
Polished rice	396.5	230.8	Tires and rubber	41.5	13.0
Polished barley	179.4	111.2	Paper and products	38.2	13.2
Unmilled barley and wheat	157.7	345.1	Prepared foods	38.1	23.3
Liquors	152.1	192.3	Other meat	35.1	47.2
Lumber	99.3	12.9	Raw silk	34.8	12.9
Beef and pork	96.3	162.4	Other crops	34.7	12.8
Milk products	80.8	89.2	Cotton yarn	32.8	13.1
Tobacco products	80.6	32.4	Vegetable oil	32.4	25.3
Unmilled rice	80.0	189.4	Fertilizer	31.7	15.6
Oilseeds	78.7	203.6	Other livestock	26.6	26.7
Refined sugar	69.7	72.7	Cocoons	26.4	7.7
Potatoes	68.3	36.4	Dairy farming	25.9	19.9
Soft drinks	67.9	70.5	Beef cattle	25.9	33.2
Coffee and tea	64.7	48.5	Cotton fabrics	25.6	14.9
Plywood	64.7	16.8	Fur	25.6	6.4
Other wood products	60.7	14.0	Fishing	24.1	9.2
Starches	60.2	41.2	Natural rubber	23.9	1.9
Timber	60.1	10.0	Forest planting	21.2	7.1
Fruits	57.3	22.0	Fish products	20.6	22.2
Wearing apparel	56.8	20.7	Pesticides	20.6	12.8
Vegetables	55.7	20.2	Chemical products	13.9	10.5
Leaf tobacco and tea	55.6	31.7	Raw sugar	13.5	4.6
Agricultural machinery	54.4	8.8	Electric equipment	12.8	8.0
Feeds	52.9	17.6	Poultry meat	11.2	28.8
Woolen fabrics	50.9	14.7	Animal oil	10.2	4.8
Silk fabrics	50.6	13.6	Pulp	10.2	1.9
Synthetic fabrics	50.6	15.1	Other manufacturing	8.3	10.1
Other fabrics	50.6	15.1	Petrochemical products	7.5	6.9
Leather products	50.6	21.5	Transport equipment	7.1	7.7
Fur products	50.6	9.1	Mining	3.8	4.4
Flours	46.5	30.7	Leather	1.1	9.6
Cotton and hemp	46.0	27.0	Seeds	0.0	9.1
Synthetic yarn	44.1	13.3	Hogs	0.0	25.9
Woolen yarn	43.9	10.9	Poultry and eggs	0.0	19.4
Other yarn	42.4	13.0	Milk	0.0	63.9

Sources: For polished rice, beef and pork, milk products, oilseeds, refined sugar, and poultry meat, rates of protection were calculated from the production subsidy estimate (PSE) tables in OECD (1999). Information for soybeans was used for oilseeds. Beef and pork PSE information was aggregated. For unmilled barley and wheat, the PSE table for barley is from USDA, ERS (1993). For other commodities, original data in the social accounting matrices, provided by the Bank of Korea, were retained. PSE data for 1975 were unavailable from OECD or ERS. As a proxy, average PSE components for 1979-81 from the OECD and PSE components for 1983 from ERS were used.

Appendix table 3—Ratio of imports to total consumption (subsector ranking by 1975 ratio)

Item	Imports	1975	1990
		Percent	
Aggregate sector	Primary agriculture	18.4	15.8
	Forestry and fishing	34.1	25.6
	Processed agriculture	10.0	5.9
Subsector:			
More than 80 percent	Natural rubber	100.0	100.0
	Raw sugar	100.0	100.0
	Fur	100.0	76.7
	Cotton and hemp	97.2	99.9
	Animal oil	93.5	82.9
	Timber	92.4	92.6
	Unmilled barley, wheat, and other cereals	91.3	93.9
	Pulp	80.1	79.9
30-80 percent	Other livestock	58.6	60.3
	Leather	42.3	21.9
	Polished barley	38.5	0.0
10-30 percent	Leaf tobacco and tea	23.6	34.8
	Polished rice	13.6	0.0
	Oilseeds	13.4	73.6
3-10 percent	Milk products	5.6	20.1
	Potatoes	5.2	17.3
	Vegetable oil	5.1	17.2
	Other crops	4.5	6.8
	Fish products	4.1	7.6
Less than 3 percent	Other meat	2.9	4.6
	Flours	2.4	3.9
	Liquors	1.9	3.2
	Soft drinks	1.9	2.6
	Coffee and tea	1.9	0.8
	Starches	1.5	2.9
	Feeds	1.5	0.3
	Fruits	1.4	3.7
	Raw silk	1.2	67.1
	Noodles and other prepared foods	1.1	5.8
	Poultry meat	0.9	0.2
	Beef and pork	0.8	22.2
	Cocoons	0.5	24.0
	Fishing	0.4	8.8
	Vegetables	0.2	0.2
	Tobacco products	0.0	4.2
	Poultry and eggs	0.0	1.3
	Refined sugar	0.0	0.7
	Hogs	0.0	0.1
	Unmilled rice	0.0	0.0
	Dairy farming	0.0	0.0
	Beef cattle	0.0	0.0
	Milk	0.0	0.0

Source: Social accounting matrices supplied by the Bank of Korea.

Appendix table 4—Tariff equivalent rate for aggregated sectors in the model

Aggregated sectors	Tariff equivalent rate	
	1975	1990
	Percent	
Average rate for agriculture	64.7	104.0
Primary agriculture	70.9	164.0
Forestry and fishing	53.8	10.4
Processed agriculture	66.2	53.1
Textile	35.6	14.1
Other agriculture-related manufacturing	18.3	8.7
Mining and manufacturing	8.6	8.4
Services	0.9	0.6
Average rate in the economy	19.9	18.3

Note: The weights are the share of imports for each commodity. While this method is widely used for calculating the average protection rate for an aggregate sector, it is problematic, because commodities with a low or zero import share obviously include some that have no imports because of high protection (for example, unmilled rice). The importance of unmilled rice in Korea's agriculture means that if it had been included in an aggregation, aggregate protection of primary products would have increased between 1975 and 1990, following the increasing gap between Korean and world prices over that period. Also, protection for unmilled barley and wheat (not separable in the SAM) was very high for barley but low for wheat in 1990—producer protection was very high, but consumer taxation was much less. The large import share of wheat thus exaggerates the importance of the barley tariff equivalent. Alternatives are the weights by production share or by consumption level. However, they also pose problems, especially for primary agriculture, because agricultural imports of some products (for example, dairy) are almost always in processed form, and zero trade in the primary commodity happens not because of protection but because of transportation and technology factors.
Source: Calculated from the weighted protection rate used in the model.

National Agricultural Library Cataloging Record:

Structural change and agricultural protection : costs of Korean agricultural policy, 1975 and 1990.
(Agricultural economic report ; no. 809)
1. Agriculture--Economic aspects--Korea (South)
2. Protectionism--Korea (South)--Cost effectiveness.
3. Agriculture and state--Korea (South) I. Diao, Xinshen.
II. United States. Dept. of Agriculture. Economic Research Service. III. Title.
HD2095.5