

FOOD SECURITY AND AGRICULTURAL PROTECTION IN SOUTH KOREA

JOHN C. BEGHIN, JEAN-CHRISTOPHE BUREAU, AND SUNG JOON PARK

South Korea has been pursuing food self-sufficiency using high tariffs and high administrative prices in key agricultural and food markets. Using a dual approach to trade and trade restrictiveness indices, we analyze the impact of these market distortions on welfare and trade volume. Then, we compute second-best distortions, which minimize the welfare cost of meeting observed levels of self-sufficiency and production. We rationalize these second-best distortions to what could be claimed as legitimate protection under a “food security” (FS) box in World Trade Organization (WTO) negotiations. FS-box protection is sensitive to changes in the definition and the extent of the FS objectives. We show that FS via production targets and reliance on imports would be more palatable to consumers and trade partners, while preserving income transfer to the farm sector.

Key words: agricultural distortions, food security, Korea, protection, targeting, WTO negotiations.

The Republic of Korea has supported its agricultural sector at a relatively high level compared to that of other member countries of the Organisation for Economic Cooperation and Development (OECD). Public intervention mainly consists of high production prices supported by government purchases, together with high tariffs that protect domestic producers from foreign competition and, implicitly, tax consumers. Trade liberalization recently took place in certain sectors, and Korea is now a major importer of oilseeds and coarse grains. However, Korea only reluctantly exposed its agricultural sector to the provisions of the Uruguay Round Agreement on Agriculture (URAA) (IATRC 1997). It has kept very high tariffs in the rice, meat, and dairy sectors; high production subsidies in most other sectors; and significant nontariff trade barriers on many commodities, including administra-

tive barriers (import monopolies) and sanitary restrictions (IATRC 1994, Thornsby et al.).

Exporting countries have stressed that Korean farm policy imposes high food costs on consumers and increases the cost of labor for its manufacturing sector. By artificially maintaining resources in agriculture, Korean agricultural policy allegedly slows the growth rate of the entire domestic economy (Diao et al.). Other World Trade Organization (WTO) member countries complain that Korea, while benefiting from global manufacturing export opportunities, imposes considerable obstacles to other countries' exports of food products.

The Korean government motivates its agricultural policy by food security (FS) reasons. In particular, it stresses the need for ensuring an adequate supply of food in all market conditions. It motivates its resistance to eliminating farm subsidies by the fact that food security goes beyond a multilateral trade issue.

FS is not the only motivation for Korea's agricultural policy, which has been criticized by Korean and other Southeast Asian economists (Im; Kako; Moon and Kang; Sumner, Lee, and Hallstrom; Vincent and Lee). High agricultural prices are partly motivated by political economy concerns. One objective of East Asian countries agricultural policy is to transfer income from progressively urbanized consumers to rural areas, to offset the consequences of a rapid industrialization and urbanization (Anderson and Hayami, Anderson). One might argue that raising farm incomes

John C. Beghin is the Marlin Cole professor at Iowa State University, and visiting researcher at the Institut National de Recherche Agronomique (INRA) Paris-Grignon. Jean-Christophe Bureau is professor, Institut National Agronomique Paris-Grignon, and head of Unité Mixte de Recherche Economie Publique at INRA Paris-Grignon. Sung Joon Park is economist, Bank of Korea, Seoul. Bureau was a visiting researcher at Iowa State University during part of this research project.

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and land values, reducing the pace of rural-urban migration and alleviating possible externalities (e.g., congestion of infrastructures) through an implicit taxation of food consumption meet some public finance objectives because rice consumption represents a large and inelastic tax base. However, because the WTO does not recognize political economy as a legitimate reason for subsidizing agriculture, Korea stresses food security motives to justify its agricultural policy.¹ Even though this stated objective is likely to hide other motives, there is evidence that the Korean population is anxious about the supply of food in the future (Kako).

Korea defines FS as a perplexing joint reliance on trade, domestic production, and self-sufficiency (WTO 2000a,b; 2001b). Despite some trade concessions under the URAA, Korea has nevertheless openly pursued food self-sufficiency as the desirable way to achieve the stated objective of FS (Sumner, Kako). FS based on self-sufficiency is a recurrent theme among developing members of the WTO. Less dependence from foreign suppliers is implicit in India's proposal for a "FS" box (WTO 2001a). Korea makes a strong case that Net Food Importing Developing Countries (NFIDCs) should be able to support the domestic production of staple crops and argues that such measures should be exempted from reduction commitments, on the grounds of FS (WTO 2001b). This leading stance echoes developing countries' proposals for "FS" and "development" boxes, which would legitimize larger support to domestic production and trade barriers. Recent debates under the auspices of the World Bank (2001) show a large coalition of sympathizers with Korea's position on FS. Free trade, it is argued, is not a guarantee of reliable access to cheap food under all conditions.²

However, self-sufficiency objectives are detrimental to (poor) consumers because of

high food prices, and alternative policies, such as production subsidies, are a more targeted way to achieve FS objectives. Korea and India's promotion of self-sufficiency, which penalizes consumers, seems inconsistent with their endorsement of FS as "access to food for all," proposed during the World Food Summit of the Food and Agriculture Organization (FAO).

Our article contributes to the agricultural trade policy debate by providing a rigorous assessment of current agricultural policies in South Korea and, more generally, of FS strategies promoted by many developing economies. In a first step, we abstract from other objectives or concerns motivating the present agricultural policy in Korea. We evaluate the stated policy objectives, that is, FS, from an economic point of view. The first contribution of our paper is to estimate the welfare costs and trade implications of Korean agricultural policy, using a multimarket dual approach to trade based on Anderson and Neary (1996). We consider major policy instruments such as tariffs, price support, input subsidies, and consumption taxes. A comparison of these costs since 1979 makes it possible to assess how the policy changes that took place in the 1990s translate into welfare.

Second, Korea is a member of a multilateral trading system based on the most-favored-nation clause. The latter implies some import volume expansion as all member countries integrate and expect to gain access to each other's markets as soon as a single member country obtains some trade concession. We measure the degree of restriction, expressed in volume of trade that is generated by Korean agricultural policy, using the "mercantilist" indicator of trade restrictiveness (Anderson and Neary 2000). This index provides a metric of foregone trade opportunities by other WTO members.

Finally, we estimate how Korea could rationalize its policy instruments for several objectives (self-sufficiency, then production/income transfer). We begin with self-sufficiency in each of the staple crops and meat, and present the structure of second-best consumption taxes and production subsidies, together with their welfare and trade impacts. We then look at FS attained under joint reliance on commodity imports and production targets for various sets of commodities. Because production targets induce income transfer to producers, we provide an evaluation of these implied income-transfers. Transfers are motivated by the domestic politics of rapid industrialization to buffer the adjustment cost of resources

¹ Recent policy decisions in the rice sector suggest that the Korean government might pursue income transfer between social groups, even though it invokes FS as a motivation for farm support. The increased government purchase of rice after the November 2001 demonstrations against international pressures to cut production subsidies reflects political economy motivations rather than FS. Rice surplus is likely to result (projected 1.4 million tons in 2002, twice the 1999 amount) and end up in food aid shipments.

² Several arguments exist. Food aid often decreases when world prices rocket and when aid is most needed. The European Union export tax set on grains in 1996, a poor harvest year, signaled that domestic consumers of exporting countries could matter more than NFIDCs consumers, in case of a grain shortage. Successive U.S. embargoes (e.g., the 1973 soybean exports ban) and the versatile foreign policy of successive U.S. administrations compromise the trust of these countries in world markets.

flowing out of the rural sector and to mitigate income differentials between rural and urban sectors. We show the sensitivity of the level and nature of protection to the commodity coverage of the target through cross-price effects in production and consumption. We conclude the targeting section by drawing implications on strategic considerations for trade negotiations regarding support levels under the development or FS box.

The policy recommendation punch line of our paper applies to all members of the WTO who, for genuine reasons or for income transfer motives, endorse or contemplate FS objectives, such as the EU policy debate to increase EU self-sufficiency in proteins. These countries should advocate deficiency payments rather than trade barriers for their agricultural production and open their borders simultaneously. This strategy is much less antagonizing than self-sufficiency for trade partners and much more beneficial to consumers and small producers who are net buyers of the targeted commodities. If one considers that FS is mainly a pretense for domestic income transfers, production subsidies are a major step in the right direction toward better-targeted distortions. Policy rents to farmers would be essentially unaffected relative to the current situation, making it possible to satisfy domestic political constraints.³

The Analytical Framework

We use a multimarket model of Korean agriculture and food markets embedded in a dual approach to trade to estimate the supply and demand response to government intervention and the subsequent welfare effects. Following Anderson and Neary (1996, 2000), these distorted markets are treated as being separable from the rest of the economy. The set of policy instruments that is considered here affects output prices, consumption prices, and input prices. Tariffs and government purchases translate into producer and consumer prices higher than the border price. Input subsidies and direct payments are modeled by lower input prices that are specific to agriculture (fertilizer, irrigation, and credit subsidies). Consumption subsidies are modeled by lower consumer prices. We cover rice, wheat, barley,

corn, soybean, dairy, beef, pork, and poultry. Details on the policy instruments and information on the data are provided in Beghin, Bureau, and Park.

Demand for food is represented by an incomplete Linquad demand system calibrated to existing estimates of income and price elasticities for agricultural and food products (LaFrance, LaFrance et al.). The sub-demand system for agricultural and food products is constructed assuming that other consumption goods are a composite single good. Homogeneity in prices of the complete system is accounted for by expressing all prices relative to the price index of the composite nonagricultural good.⁴ Let \mathbf{x} be an n -vector of agricultural goods on demand, \mathbf{q} be an n -vector of corresponding consumption prices, and \mathbf{q}_z be the consumption price of nonagricultural goods \mathbf{z} . Variable R is total income or expenditure. The Linquad expression of the vector of Marshallian demands for agricultural and food goods is

$$(1) \quad \mathbf{x}^M = \varepsilon + \mathbf{V}\mathbf{q} + \chi(R - \varepsilon'\mathbf{q} - \frac{1}{2}\mathbf{q}'\mathbf{V}\mathbf{q} - \delta(\mathbf{q}_z))$$

corresponding to the expenditure function

$$(2) \quad e(\mathbf{q}, \mathbf{q}_z, u) = \varepsilon'\mathbf{q} - \frac{1}{2}\mathbf{q}'\mathbf{V}\mathbf{q} - \delta(\mathbf{q}_z) + \theta(\mathbf{q}_z, u) \exp(\chi'\mathbf{q}).$$

The properties of this partial demand system are presented in LaFrance et al. It is particularly attractive because of the possibility of calibrating the parameters using prior information. It is also rather flexible, due to the quadratic terms in prices, is consistent with the assumption of nonhomothetic conditional preferences for agricultural goods, and there are no restrictions on individual income coefficients. In addition, the expenditure function (2) is the only way to derive demands linear in income and quadratic in price consistent with weak integrability (LaFrance et al.) The elements of the n -vectors ε and χ in equation (1), together with the elements of the $n \times n$ matrix \mathbf{V} , are calibrated using the procedure described in Beghin, Bureau, and Park. The calibration imposes homogeneity of degree one in prices for e and symmetry of the Hessian of e . Concavity is verified locally.

³ Fully decoupled lump-sum transfers would be preferable to distortionary policies, but these pure transfers are often not available or feasible because of transparency issues.

⁴ In the following, \mathbf{p} , \mathbf{q} , and \mathbf{p}_z express nominal prices deflated by the aggregate price index of nonagricultural goods.

The whole production sector of the economy is represented by a gross domestic product (GDP) function, $gdp(\mathbf{p}, \mathbf{p}_z, \boldsymbol{\gamma})$, with \mathbf{p}_z denoting the price of non-agricultural netputs, and $\boldsymbol{\gamma}$ denoting a vector of fixed endowments and the technology (Samuelson, Dixit and Norman, Woodland). We assume that gdp is separable into the agricultural and non-agricultural components, Π and g , so that

$$(3) \quad gdp(\mathbf{p}, \mathbf{p}_z, \boldsymbol{\gamma}) = \Pi(\mathbf{p}, \boldsymbol{\gamma}_f) + g(\mathbf{p}_z, \boldsymbol{\gamma}_f)$$

where $\boldsymbol{\gamma}_f$ denotes the agricultural endowments. The agricultural component Π is represented by a quadratic revenue function, which satisfies the usual properties of profit functions,

$$(4) \quad \Pi(\mathbf{p}, \boldsymbol{\gamma}_f) = \boldsymbol{\eta}\mathbf{p} + \mathbf{p}'\mathbf{W}\mathbf{p} + h(\boldsymbol{\gamma}_f)$$

leading to supply functions being linear in relative prices. We define variable \mathbf{y} as the m -vector of agricultural netputs, including n (positive) agricultural outputs and $m - n$ (negative) inputs, and \mathbf{p} is the corresponding price m -vector. As for the demand system, the price responses of agricultural supply and demand for inputs are calibrated using prior information on price elasticities, homogeneity of degree zero in netput prices and symmetry of the Hessian \mathbf{W} , as explained in Beghin, Bureau, and Park. Convexity of π in prices is verified locally. This multi-market model is then imbedded in a dual approach to trade, namely, the Balance of Trade (BoT) function (Anderson and Neary 1996).

The BoT function, B , is defined as the sum of the value of a consumer's excess demand over income at external prices. It is built up from the consumer's expenditure function and the revenue (GDP) function, net of the government tax revenue function, or

$$(5) \quad \begin{aligned} B(\mathbf{p}, \mathbf{p}_z, \mathbf{q}, \mathbf{q}_z, u, \boldsymbol{\gamma}, \boldsymbol{\beta}) \\ = e(\mathbf{q}, \mathbf{q}_z, u) - gdp(\mathbf{p}, \mathbf{p}_z, \boldsymbol{\gamma}) \\ - [(\mathbf{q} - \mathbf{p}^*)' \mathbf{x}(\mathbf{q}, u) \\ - (\mathbf{p} - \mathbf{p}^*)' \mathbf{y}(\mathbf{p}, \boldsymbol{\gamma}_f)] + \boldsymbol{\beta} \end{aligned}$$

where \mathbf{p}^* denotes the m -vector of world prices for agricultural inputs and outputs, and $\boldsymbol{\beta}$ is the sum of the tariff revenue on nonagricultural goods and the net financial transfers from abroad, both of which are assumed constant in the rest of the article. We assume perfect competition and exogenous world prices. Derivative properties applied to e and gdp yield com-

pensated consumption and netput quantities and their difference yields imported quantities.

The BoT function includes a general equilibrium concept. Expenditure and revenue functions characterize the private sector structure of supply and demand of the distorted sectors analyzed in the economy. However, because of the tax revenue raised by distortions, both government and private behavior are summarized by $B(\mathbf{p}, \mathbf{q}, u)$, where we omit the constant elements $(\mathbf{p}^*, \mathbf{p}_z, \mathbf{q}_z, \boldsymbol{\gamma}, \boldsymbol{\beta})$. The BoT function represents the external budget constraint and is equal to the net transfer required to reach a given level of aggregate domestic welfare, u , for a given set of domestic prices. Net government revenue from agricultural and food distortions is equal to $[(\mathbf{q} - \mathbf{p}^*)' \mathbf{x}(\mathbf{q}, u) - (\mathbf{p} - \mathbf{p}^*)' \mathbf{y}(\mathbf{p})]$, where the fixed endowments are ignored to simplify notation. Consumption subsidies are captured by $(\mathbf{q} - \mathbf{p}^*)$ negative, the cost of tariffs and taxes to consumers by $(\mathbf{q} - \mathbf{p}^*)$, and the producer prices, including support and subsidies, by $(\mathbf{p} - \mathbf{p}^*)$.

The gradients of partial derivatives of the BoT function with respect to domestic prices (\mathbf{p}, \mathbf{q}) preceded by a minus sign, $-\nabla_{\mathbf{p}}B$ and $-\nabla_{\mathbf{q}}B$, are the vectors of marginal welfare costs of domestic price distortions in production and in consumption, respectively. As $d\mathbf{p}$ and $d\mathbf{q}$ represent the producer and consumer price distortions, the total deadweight loss from these distortions is equal to minus the change in the foreign exchange to support u , or minus $(\nabla_{\mathbf{p}}B'd\mathbf{p} + \nabla_{\mathbf{q}}B'd\mathbf{q})$. This is the additional foreign exchange required to compensate for a change in distorted prices $(d\mathbf{p}, d\mathbf{q})$ and to maintain the initial welfare level. Gradients $\nabla_{\mathbf{p}}B$ and $\nabla_{\mathbf{q}}B$ are derived from totally differentiating B , and can be parameterized and estimated using the calibrated food demand and supply responses as explained in Beghin, Bureau, and Park.

Welfare Costs of Korean Agricultural Policy

The producer support estimate (PSE), measured by the OECD and expressed as a percentage of the value of production, reaches 73% in Korea compared to an OECD average of 34% in 2000. The Korean government provides a few direct payments and some input subsidies (fertilizers and interest subsidies). The main policy instruments are transfers from consumers, which account for 95% of the support to farmers (OECD 2001). Many consider such forms of public intervention most

distortionary and believe that they impose welfare costs on the society as a whole.

The welfare effect of the various policy instruments can be derived from the BoT function by constructing the Trade Restrictiveness Index (TRI), which is a welfare-based single tariff equivalent of the various policy instruments (Anderson and Neary 1996). The TRI is the uniform scaling factor (or uniform price deflator Δ) that, when applied to period 1 prices, permits the representative consumer to attain his or her initial level of utility u_0 while holding the BoT constant at its original (period 0) level b_0 :

$$(6) \quad \Delta (\mathbf{p}^1, \mathbf{q}^1, u_0) \equiv [\Delta : B(\mathbf{p}^1/\Delta, \mathbf{q}^1/\Delta, u_0) = b_0].$$

The scalar Δ is the uniform deflator, which, if applied to all imported goods prices, would ensure a constant balance of payments at the initial level of utility. Consider the case where the comparison is between a protected situation 0 and free trade (i.e., $\mathbf{p}^1 = \mathbf{q}^1 = \mathbf{p}^*$, or $\tau^1 = 0$, with the equality $\mathbf{p}^i = (1 + \tau^i) \mathbf{p}^*$ defining the ad valorem uniform tariff $\tau^i, i = 0, 1$). Then we have the equivalence between deflator ($1/\Delta$) and uniform tariff factor ($1 + \tau^0$):

$$(7) \quad B(\mathbf{p}^*/\Delta, \mathbf{p}^*, u_0) = b_0 = B((1 + \tau^0)\mathbf{p}^*, u_0).$$

The uniform tariff equivalent, $\tau^0 = (1/\Delta - 1)$, leads to period 0 welfare when applied to the set of world prices.⁵ In our case, specific production and consumption price distortions exist, and the TRI methodology applies to any subset of price distortions in any sector of the economy. In our application, the uniform deflator is only applied to agricultural goods, and the nonagricultural tariffs are left unchanged. In the rest of the paper, Δ is referred to as the uniform deflator and $\tau^0 = (1/\Delta - 1)$, as the uniform unit price distortion. In the general case, without a general equilibrium model, the changes in Δ have to be locally approximated. Total differentiation of B in equation (6) yields the percentage change in Δ as a local approximation of the change in welfare

$\nabla_{\mathbf{p}} B' d\mathbf{p} + \nabla_{\mathbf{q}} B' d\mathbf{q}$ normalized by the factor $\nabla_{\mathbf{p}} B' \mathbf{p} + \nabla_{\mathbf{q}} B' \mathbf{q}$, or

$$(8) \quad \hat{\Delta} = \frac{\nabla_{\mathbf{p}} B' d\mathbf{p} + \nabla_{\mathbf{q}} B' d\mathbf{q}}{\nabla_{\mathbf{p}} B' \mathbf{p} + \nabla_{\mathbf{q}} B' \mathbf{q}}$$

where the derivatives of B are evaluated ($\mathbf{p}^1/\Delta, \mathbf{q}^1/\Delta, u_0$). That is, the change in the TRI deflator is a weighted average of the proportional changes in domestic prices. The weights are the shares of marginal deadweight loss due to each policy-induced price variation. The numerator of equation (8) measures the deadweight loss of the distortion changes and corresponds to the change in compensation measures (EV or CV) induced by $d\mathbf{p}$ and $d\mathbf{q}$, or the change in the money metric utility for the same $d\mathbf{p}, d\mathbf{q}$ up to normalization by the shadow price of foreign exchange (Anderson and Martin). Table 1 provides the deadweight loss of the agricultural policy based on estimates of the components of $\nabla_{\mathbf{p}} B$ and $\nabla_{\mathbf{q}} B$. When comparing the observed (distorted) situation 0 and the situation 1 without public intervention (at the vector \mathbf{p}^* of free trade prices without input and consumption subsidies), it is possible to calculate the different components of the numerator of equation (8). The figures shown in table 1 are in billion won at 1995 prices.

The results provided in table 1 show how costly the social transfers induced by Korean agricultural policy are in terms of welfare. The deadweight loss associated to the transfer of 10 won to farmers amounts to roughly 5.8 won. This is mainly caused by the particular policy instruments fully coupled to production and taxing consumers. High tariffs and administrative prices reflect the Korean preference for self-sufficiency objectives, regardless of the cost to consumers in sectors such as rice, pork, or poultry.

Table 2 provides a measure of the TRI uniform distortion equivalent relative to free trade. Equation (8) leads to the proportional change in the uniform tariff. When comparing the observed (distorted) situation 0 and the situation without public intervention, equation (9) provides an approximation of $\tau^0/(1 + \tau^0)$:

$$(9) \quad \hat{\Delta} = \frac{d\Delta}{\Delta} = -\frac{d\tau^0}{1 + \tau^0} = \frac{\tau^0}{1 + \tau^0}.$$

Scalar τ^0 would lead to the present welfare if the reference prices were increased by this amount (i.e., if all the components of \mathbf{p}^* , the vector of netput world prices, were

⁵ Note that in more general cases, where the comparison holds between two protected situations, the TRI is the uniform tariff surcharge equivalent that keeps period 0 welfare when applied to period 1 prices of imported goods.

Table 1. Transfers and Welfare Losses Induced by Korean Agricultural Policies (Billions of 1995 Wons)

| Period (3-Year Average) | Increase in Agricultural Revenue | Tariff and Tax Revenues ^a | Deadweight Loss Consumption | Deadweight Loss Production | Deadweight Loss Total |
|-------------------------|----------------------------------|--------------------------------------|-----------------------------|----------------------------|-----------------------|
| 1979–81 | 6,640 | 1,762 | 1,557 | 1,553 | 3,111 |
| 1990–92 | 10,982 | 1,532 | 3,015 | 3,650 | 6,665 |
| 1998–2000 | 10,571 | 1,228 | 2,430 | 3,722 | 6,152 |
| Cumulative 1979–2000 | 218,595 | 26,258 | 49,976 | 69,277 | 119,254 |

^aThese revenues include rents and revenues under licenses and quotas schemes.

increased by a factor $\tau^0 \mathbf{p}^*$). Scalar $[\nabla_{\mathbf{q}} B^0(\mathbf{p}^* - \mathbf{q}^0) / \nabla_{\mathbf{q}} B^0 \mathbf{q}^0]$ is the weighted sum of the unit distortion of consumption prices; the weights are the normalized deadweight loss associated with the unit distortion on a particular good. The comparison of this indicator (column 4 in table 2) with the sum of each consumption distortion weighted by the consumption of each good n (column 5) shows that the use of the marginal deadweight loss on consumption as a weight results in a larger overall index. The deadweight loss weighted average of the production distortions, $[\nabla_{\mathbf{p}} B^0(\mathbf{p}^* - \mathbf{p}^0) / \nabla_{\mathbf{p}} B^0 \mathbf{p}^0]$ (column 6 of table 2), is only slightly larger than the average distortion weighted by the share in production (column 7).

The Effect of Korean Agricultural Policy on Each Agricultural Sector

The relative impact of the various policies can be seen by simulating the effect of the whole set of taxes and subsidies on a particular commodity. This requires taking into account the specific measures for each input, such as irrigation subsidies, capital grants, subsidies for fertilizer use, etc. These inputs were allocated to each production using annual input/output

coefficients (see Beghin, Bureau, and Park), and a reference input price was constructed for each commodity by allocating a detailed set of subsidies to the various agricultural productions based on the allocation used by the OECD for the calculation of PSEs.

The deadweight loss in consumption corresponding to commodity i is estimated by the scalar expression $\nabla_{\mathbf{q}} B^0(\mathbf{p}^{*i} - \mathbf{q}^0)$, where the elements of \mathbf{p}^{*i} are the reference price in the case of commodity i and the commodity-specific inputs and are the observed prices \mathbf{q}^0 in other cases. A similar computation is made for estimating the deadweight loss on the production side. The sum of the two components provides the total welfare effect associated with the government intervention on commodity i , which includes the market price support, the output enhancing subsidies, and the subsidies to the input used in the production of i (table 3, row 5). The contribution of the commodity-specific policy to the overall welfare is expressed as a percentage (table 3, row 6).

The effect of the policy on the revenue of agricultural producers can be derived from the agricultural component of the GDP function. The gradient of Π with respect to distorted prices, $\nabla_{\mathbf{p}} \Pi$, gives the amount of income

Table 2. TRI and Related Indicators

| Period (3-Year Average) | $d\Delta/\Delta$ | Uniform Unit Distortion τ^0 | Marginal Welfare Weighted Percentage Distortion on Consumption Prices | Consumption Weighted Distortion on Consumer Prices (% Actual Value) Output Prices | Marginal Welfare Weighted Percentage Distortion on Output Prices | Production Weighted Distortion on Output Prices |
|-------------------------|------------------|----------------------------------|---|---|--|---|
| 1979–81 | 0.58 | 1.39 | 0.59 | 0.55 | 0.58 | 0.58 |
| 1990–92 | 0.74 | 2.87 | 0.73 | 0.69 | 0.75 | 0.75 |
| 1998–2000 | 0.67 | 2.15 | 0.67 | 0.54 | 0.68 | 0.66 |

Table 3. Commodity-Specific Effect of Korean Agricultural Policy (in Billions of 1995 Wons; Average Effect 1998–2000)

| | Rice | Wheat | Barley | Corn | Soya | Dairy | Beef | Pork | Poultry | Overall |
|---|---------------------------|-----------------------|-------------------|-----------------|--------------------|-----------------------|-------------------------|-----------------------|---------------------|-----------------------------|
| Value of output at domestic price | 8,474 | 6 | 189 | – | 251 | 1,050 | 1,883 | 1,966 | 619 | 14,438 |
| Value of output at reference prices | 1,957 | 5 | 41 | – | 35 | 328 | 739 | 1,332 | 503 | 4,940 |
| Consumption at domestic prices | 8,140 | 631 | 215 | 1,593 | 665 | 1,215 | 3,132 | 2,009 | 693 | 18,293 |
| Consumption at reference prices | 1,935 | 629 | 73 | 1,585 | 444 | 388 | 1,197 | 1,385 | 575 | 8,211 |
| Product-related deadweight loss (consumption; production) | 3,569 (948) (2,680) | –0.3 (–0.3) (–) | 59 (57) (–) | 0 (0) (–) | 80 (26) (55) | 726 (325) (401) | 1,422 (927) (516) | 466 (144) (322) | 147 (3) (144) | 6,152 (2,430) (3,722) |
| Contribution to total welfare costs | 55% | 0% | 1% | 0% | 1% | 11% | 22% | 7% | 2% | – |
| Income transfers to producers ^a | 7,151 | 0 | 161 | – | 229 | 793 | 1,269 | 793 | 173 | 10,571 |
| Transfer efficiency ^b | 67% | – | 73% | – | 74% | 52% | 47% | 63% | 54% | 63% |
| Direct welfare effect | 2,708 | 0 | 100 | 0 | 81 | 586 | 1,348 | 378 | 44 | – |
| Cross-commodity welfare effect | –27 | –0.2 | –48 | 0 | –16 | 2 | –96 | –98 | –21 | – |
| Input welfare effect | 888 | – | 7 | – | 15 | 138 | 190 | 193 | 124 | – |

^aIncludes input subsidies.^bDefined as (transfers/(transfers + deadweight loss)).

transfer resulting from an increase in output (decrease in input) prices. By Hotelling's lemma, the gradient is the netput vector. That is, the income transfer effect of the agricultural policy is measured by $\nabla_{\mathbf{p}}\Pi'(\mathbf{p} - \mathbf{p}^*)$. A similar approach is used for estimating the income transfer effect of the agricultural policy on a commodity-specific basis. The efficiency of the agricultural policy, defined as the overall cost to the society of transferring income to producers, can be estimated by the deadweight loss (on both the consumption and production sides) associated with one unit of the extra producer income resulting from the policy. It therefore is defined as one plus the ratio of the income transfer effect ($\nabla_{\mathbf{p}}\Pi'd\mathbf{p}$) to the welfare effect ($\nabla_{\mathbf{p}}B'd\mathbf{p} + \nabla_{\mathbf{q}}B'd\mathbf{q}$) and is provided in Table 3, row 6, while estimates of income transfer are shown in row 7.

Rice growers get the largest transfer, followed by beef, pork, and milk producers. Rice policy has the highest contribution to foregone welfare, followed by beef, dairy, and pork. Beef has the lowest efficiency of transfer, at around 47%. The effect of government intervention on a particular product has implications in terms

of substitution on both the production and consumption of other products when prices are influenced. The deadweight loss generated by a commodity-specific policy can be decomposed in terms of an own-price effect, a cross-price effect, and an input effect that measure the impact of the public policy (both on output and input through prices subsidies) on input use. Input distortions induce the largest welfare losses in rice production and then in pork and beef sectors (row 11). However, deadweight losses induced by input subsidies are nearly negligible in all other sectors, except for dairy, and poultry.

Trade Impacts of Korean Agricultural Policy and Mercantilism

As a member of the WTO, Korea had to convert quantitative restrictions on imports into bound tariffs, reduce these tariffs over an implementation period, open its market to imports under the minimum access provisions, and reduce the most trade-distorting forms of domestic support in 1994. However, Korea

Table 4. Self-Sufficiency in Korean Agriculture

| | Rice | Wheat | Barley | Corn | Soybean | Milk | Beef | Pork | Poultry |
|---|-------|-------|--------|-------|---------|-------|------|------|---------|
| Production (10 ³ tons) 1998–2000 | 5,217 | 4 | 271 | 0 | 128 | 2,186 | 327 | 911 | 346 |
| Consumption (10 ³ tons) 1998–2000 | 5,148 | 3,113 | 469 | 9,438 | 1,667 | 2,595 | 547 | 959 | 401 |
| Net imports in % consumption 1979–81 | 19% | 97% | 21% | 100% | 66% | −0.1% | 19% | 14% | 0% |
| Net imports in % consumption 1990–92 | 0% | 99% | 15% | 100% | 85% | 6% | 53% | 0% | 9% |
| Net imports in % consumption 1998–2000 | −1% | 99% | 42% | 100% | 92% | 16% | 40% | 5% | 14% |

applied the Uruguay Round provisions so that it could protect its producers from foreign competition in key sectors (IATRC 1997). For example, Korea postponed the tariffication of rice for 10 years and negotiated an obligation to import only 4% of its consumption by 2004. In most of the staple foods, Korea has also kept import restrictions under domestic special rules. Prohibitive tariffs and administrative barriers still restrict imports of many agricultural goods to Korea (IATRC 1994). Self-sufficiency remains a policy objective (see table 4), particularly in the rice sector, because of the cultural content of this good and because of the possible reunification with North Korea, which has been experiencing dramatic shortages of rice, making this issue particularly sensitive.

From the point of view of the other countries involved in the trade negotiations, the variable of interest is the volume of imports and exports of the given country, rather than its welfare. This motivates an evaluation of the restrictiveness of trade policy using trade volume as the reference standard rather than the utility of the representative consumer (Salvatici, Carter, and Sumner). Anderson and Neary (2000) have proposed the mercantilistic trade restrictiveness index (MTRI), which relies on the idea of finding a uniform tariff that yields the same trade volume as the original tariff structure. The definition of the MTRI shares the basic BoT framework of the TRI. It provides a metric of foregone trading opportunities induced by a set of distortions, while holding constant the balance of trade function but not utility.

Define \mathbf{m}^c as a vector of Hicksian import demand functions. This is the vector derived from the expenditure and revenue function:

$$(10) \quad \mathbf{m}^c(\mathbf{p}, \mathbf{q}, u) = \nabla_{\mathbf{q}} e(\mathbf{q}, u) - \nabla_{\mathbf{p}} \Pi(\mathbf{p})$$

where the set of exogenous variables $\boldsymbol{\gamma}$ is innocuously omitted. The general-equilibrium Marshallian import demand function depends on domestic and world prices and on exogenous income b for the entire economy, $\mathbf{m}(\mathbf{p}, b)$. Anderson and Neary (2000) relate the Hicksian import demand function to the GE Marshallian one, as both coincide when the balance-of-payments equilibrium holds, that is, when the BoT equates transfers from abroad b , or $B(\mathbf{p}, \mathbf{q}, u) = b$. This makes it possible to define the equivalent of a Slutsky identity for the import demand function and to relate both import demand functions, that is,

$$(11) \quad \nabla_{\boldsymbol{\pi}} \mathbf{m}(\mathbf{p}, \mathbf{q}, b) = \nabla_{\boldsymbol{\pi}} \mathbf{m}^c + \nabla_u \mathbf{m}^c \frac{du}{d\boldsymbol{\pi}} \\ = \nabla_{\boldsymbol{\pi}} \mathbf{m}^c - \nabla_b \mathbf{m} \nabla_{\boldsymbol{\pi}} B'$$

where $\boldsymbol{\pi}$ is used as a synthetic notation for either \mathbf{p} or \mathbf{q} vectors. The scalar import volume function, M , corresponding to the Marshallian import demand $\mathbf{m}(\mathbf{p}, \mathbf{q}, b)$ in equation (12) gives the volume of imports at world prices when domestic prices equal (\mathbf{p}, \mathbf{q}) and the trade balance equals b :

$$(12) \quad M(\mathbf{p}, \mathbf{q}, b) = \mathbf{p}' \mathbf{m}(\mathbf{p}, \mathbf{q}, b).$$

We use equation (11) and $\nabla_b M = \mathbf{p}' \nabla_b \mathbf{m} = [1 - (\mathbf{q} - \mathbf{p}') \nabla_R \mathbf{x}^M(\mathbf{q}, R)]^{-1} \mathbf{p}' \nabla_R \mathbf{x}^M(\mathbf{q}, R)$, where \mathbf{x}^M denotes the Marshallian consumer demands and R income, to retrieve the price derivatives of the Marshallian import volume function, $\nabla_{\boldsymbol{\pi}} M$, as shown in equation (13):

$$(13) \quad \nabla_{\boldsymbol{\pi}} M' = \mathbf{p}' \nabla_{\boldsymbol{\pi}} \mathbf{m}^c - \mathbf{p}' \nabla_b \mathbf{m} \nabla_{\boldsymbol{\pi}} B'$$

Note that $\nabla_b M$ is the marginal propensity to consume tariff-constrained imports; $[1 - (\mathbf{q} - \mathbf{p}') \nabla_R \mathbf{x}^M(\mathbf{q}, R)]^{-1}$ is the shadow price of foreign exchange and $\nabla_R \mathbf{x}^M$ is the marginal income response vector for the n consumption

goods (Anderson and Neary 2000).⁶ The Marshallian MTRI is the most relevant index for measuring the overall trade impact of distortions. The MTRI gives the uniform price deflator μ which, when applied to the prices in the new equilibrium situation 1 yields the same volume (at world prices) of tariff-restricted imports as in the initial situation 0:

$$(14) \quad \mu(\mathbf{p}^1, \mathbf{q}^1, M^0) \equiv \left\{ \mu : M(\mathbf{p}^1/\mu, \mathbf{q}^1/\mu, b_0) \right\} \\ = M^0 = M(\mathbf{p}^0, \mathbf{q}^0, b_0).$$

As was the case with the TRI, if \mathbf{p}^1 equals its free trade values \mathbf{p}^* , the scalar $(1/\mu - 1)$ is the uniform tariff, which is equivalent in import volume to the initial tariff-distorted trade structure.⁷ The effect of tariff changes in the MTRI can be approximated by using price derivatives of the Marshallian import volume function $\nabla_{\pi} M$, evaluated at $(\mathbf{p}^1/\mu, \mathbf{q}^1/\mu)$:

$$(15) \quad \dot{\mu} = \frac{d\mu}{\mu} \approx \frac{\nabla_{\mathbf{p}} M' d\mathbf{p} + \nabla_{\mathbf{q}} M' d\mathbf{q}}{\nabla_{\mathbf{p}} M' \mathbf{p} + \nabla_{\mathbf{q}} M' \mathbf{q}}.$$

Using the vector of prices in the absence of distortion as the reference situation 1, and the observed prices as situation 0, the MTRI change is estimated using the expression of the demand system (2) and the sectoral GDP function (3) to retrieve the derivatives of the import demand functions (13). Table 5 provides the results. The change in the MTRI in equation (15) is a weighted sum of the proportional changes in consumption and production prices between the observed situation and the situation in the absence of public intervention. The weights are the marginal import shares of each price change.

The uniform tariff equivalent has decreased dramatically during the 1990s. Recall that this is the tariff that should be applied to all goods under consideration (i.e., the list of the agricultural goods covered by the OECD PSEs) as this would give the actual level of imports in these goods. The decline by one-third of this indicator between 1990–92 and 1998–2000 is

⁶ The MTRI could be defined from the Hicksian volume import demand, which would help isolate the roles of substitution and income effects. The MTRI constructed from the compensated import demand function does not capture the whole effect of the tariff structure on imports, because it keeps the utility constant. Hence, it ignores the redistribution of the tariff revenues and taxes to the aggregate consumer.

⁷ In more general cases, the $(1/\mu - 1)$ is the uniform tariff surcharge that when applied to the situation 1 prices would lead to the same volume of trade at world prices as in situation 0.

mainly a result of the surge in imports of corn, wheat, and soybeans at relatively low tariffs, and an increase in the imports of beef (see table 4).

Table 5 shows that weighting individual tariffs (or, more exactly, their impact on both production and consumption prices) by the marginal trade impacts, as expressed by the MTRI, leads to higher measures of trade restrictiveness than those found using standard import-weighted average distortion.

Agricultural Policy in a Second-Best Framework

The special session of the WTO Committee on Agriculture was established for trade negotiations on agriculture during the years 2000 and 2001. Proposals made during the session show that many developing and food-importing countries share Korea's concerns about food dependency and possible price hikes, leading to difficulties in financing normal levels of commercial imports.⁸ Most of them are also dissatisfied in the lack of practical effect of the 1994 WTO decision that accompanied the URAA (WTO 1994). The "Decision" was supposed to address their concerns about FS.⁹

We saw in two previous sections that Korean food policy has costly welfare effects and frustrates mercantilist aspirations of trade partners by restricting agricultural trade. In this section, we take FS as a stated premise and investigate second-best distortion structures for several definitions of FS, including self-sufficiency.

Tax Structure for Self-Sufficiency Targets

First, consider Korea's negotiating claim that WTO commitments should allow it to pursue desired FS and rural development policies, by setting an objective of a given degree of self-sufficiency in the grain sector, in the meat sector, and for a set of commodities that Korea

⁸ See the proposals by India in the area of FS (WTO 2001a), the development box proposal (WTO 2000a).

⁹ The "Decision" was a response to the fears of many low-income countries that trade liberalization would open their domestic food markets to volatile world prices and threaten to undermine their FS. The "Decision" mentions four specific responses to this difficulty: food aid, favorable treatment with export credits, concessional financing for food imports, and technical and financial assistance to increase agricultural productivity and production. Matthews shows that in practice, the "Decision" did not address the main concerns of these countries. Makki, Tweeten, and Miranda provide an interesting analysis of buffer stock and trade as a strategy to hedge price volatility.

Table 5. Trade Volume Restrictiveness of Korean Agricultural policy

| Period (3-Year Average) | Volume of Trade Restriction (Billion 1995 Wons) | Uniform $d\mu/\mu$ Tariff | Trade Weighted Percentage Distortion on Consumption Prices | Marginal Trade Weighted Distortion on Consumption Prices | Trade Weighted Distortion on Production Prices | Marginal Trade Weighted Distortion on Production Prices |
|-------------------------------|--|---------------------------------|---|---|--|--|
| 1979–81 | 2,138 | 0.50 | 1.03 | -0.44 | -0.47 | -0.55 |
| 1990–92 | 2,120 | 0.51 | 1.07 | -0.45 | -0.47 | -0.58 |
| 1998–2000 | 2,273 | 0.39 | 0.66 | -0.27 | -0.33 | -0.49 |

Note: The unit distortion is measured as $(q_n^* - q_n)/q_n$ for consumption prices and as $(p_n^* - p_n)/p_n$ for production prices.

actually produces (meat, grains, dairy). Within a second-best framework, it is possible to optimize the tax structure for achieving a given level of self-sufficiency $\alpha = (\alpha_1, \dots, \alpha_k, \dots, \alpha_K)$ for $\alpha_k x_k = y_k$, with the subscript referring to commodity k and with $0 \leq \alpha_k \leq 1$, for all $k = 1, \dots, K$ and $K \leq n$. From the targeting principle in a small economy (Bhagwati, Panagariya, and Srinivasan; Vousden), the optimum second-best distortion structure calls for a production subsidy and a consumption tax that is equal to the α -share of the production subsidy. In addition, input subsidies are inferior to output subsidies and should not be used; that is, marginal rates of technical substitution should be left undistorted (Bhagwati, Panagariya, and Srinivasan).

Formally, consider the (specific) tax on consumption $\tau_k^c = q_k - p_k^*$ and the tax on production $\tau_k^p = p_k - p_k^*$ for good k . Efficiency costs should be minimized under the constraint of the distortion structure satisfying the self-sufficiency target. Imports represent a predefined proportion of demand at the distorted prices:

$$(16) \quad \alpha_k x_k (\mathbf{p}_{-k}^*, p_k^* + \tau_k^c, u) - y_k (\mathbf{p}_{-k}^*, p_k^* + \tau_k^p) = 0$$

where p_{-k}^* denotes world price for commodities other than k . Differentiating equation (16) and the BoT function leads to the following system of equations:

$$(17) \quad \left\{ \begin{aligned} & \left(\left(1 - \frac{\partial x_k^M}{\partial R} \tau_k^c \right) \right) \frac{\partial e}{\partial u} du = -\tau_k^p \frac{\partial^2 \Pi}{\partial p_k^2} dp_k \\ & \quad \quad \quad + \tau_k^c \frac{\partial^2 e}{\partial q_k^2} dq_k \\ & \alpha_k \frac{\partial^2 e}{\partial q_k \partial u} du + \alpha_k \frac{\partial^2 e}{\partial q_k^2} dq_k = \frac{\partial^2 \Pi}{\partial p_k^2} dp_k \end{aligned} \right.$$

Rearranging leads to the expression of du , in terms of dq and the first-order condition:

$$(18) \quad \frac{du}{dq_k} = 0 \Rightarrow \tau_k^c - \tau_k^p \alpha_k = 0.$$

The necessary condition for the second-best tax structure is that the relative consumption and production taxes verify $\tau_k^c = \alpha_k \tau_k^p$ for all k . To solve for the second-best tax, define the excess demand for import relative to the self-sufficiency target k at nondistorted prices, based on equation (16): $A_k(\mathbf{p}, \mathbf{q}, u) = \alpha_k x_k(\mathbf{p}^*, u) - y_k(\mathbf{p}^*) \Rightarrow \alpha_k dx_k - dy_k = -A_k$. This excess demand's response to second-best distortion τ_j^p is $\frac{\partial A_k}{\partial \tau_j^p} = \alpha_k \alpha_j \frac{\partial x_k^H}{\partial p_j} - \frac{\partial y_k}{\partial p_j}$, for targeted self-sufficiency levels α_k and α_j for commodity k and j . The second-best distortion reduces the excess demand (over the target) and minimizes welfare losses relative to a free trade situation, as expressed by the following equations:

$$(19) \quad \sum_{j=1}^K \tau_j^p \frac{\partial A_k}{\partial \tau_j^p} + \alpha_k \frac{\partial x_k^M}{\partial R} \frac{\partial e}{\partial u} du = -A_k$$

for K self-sufficiency multiple targets at level α_k with k and $j = 1, \dots, K$, and

$$(20) \quad \frac{\partial e}{\partial u} du = \frac{\sum_{k=1}^K \sum_{j=1}^K \frac{\partial A_k}{\partial \tau_j} \tau_k \tau_j}{\left(1 - \sum_{k=1}^K \alpha_k \tau_k \frac{\partial x_k^M}{\partial R} \right)}$$

to be minimized. The latter expression comes from the differentiation of the BoT function. Minimizing welfare losses (19) subject to (20) yields the second-best τ structure.

In a first set of simulations, we define the second-best tax structure under the constraint of achieving the historical level of self-sufficiency over the 1998–2000 period. Simulations were conducted in two ways: imposing the observed levels of self-sufficiency

for the whole set of commodities, and on a commodity by commodity basis.

Table 6 shows that the actual structure of taxes and subsidies is close to the one recommended for maximizing welfare under the constraint of the existing rate of self-sufficiency. Columns 3 and 4 of table 6 show that the ratio of the actual tax on consumption and subsidy of production is close to satisfying condition $\tau_n^c = \alpha_n \tau_n^c$. This is particularly the case for soybeans, a commodity whose production is supported at very high levels, but for which consumers face relatively few taxes. This suggests that, if one focuses on a self-sufficiency objective, relatively little can be gained from a reform of the tax structure under these constraints, except for the input subsidies distorting marginal rates of substitution in production. The gains from such a minor tax reform would be limited to 1,540 billion won at 1995 prices.

Self-sufficiency targets mean restricting demand by imposing high prices to consumers, which can lead to the absurd situation where a country insulates itself from the vicissitudes of world markets by starving its consumers. Consider the hypothetical case in which Korea would decide to become self-sufficient in proteins. In spite of a very high level of subsidies (equivalent to paying producers more than six times the world prices), Korean production of soybeans covers less than 10% of actual consumption. Simulations with the above model show that any self-sufficiency target could only be achieved by choking demand, where very high consumption taxes would restrict the use of soybeans to a level that would be close to actual production. In Korea, self-sufficiency in pork and poultry production is achieved only by importing large quantities of soybeans and corn, which is less absurd than producing the feed domestically, but still less effective than importing meat in a land-scarce country. These commodities face a relatively low tariff, while tariffs on meat are prohibitive. On this basis, self-sufficiency can hardly be defended on national security grounds: corn is supplied mainly by a single country, and the world market for soybeans has experienced some shortages in the past. This suggests that Korean self-sufficiency objectives in these sectors merely reflect simple tariff escalation and effective protection of meat products and income transfer to these sectors.

Finally, although we do not address this point formally, self-sufficiency penalizes poor consumers the most because it imposes a large expenditure share for food on them; this policy

hardly qualifies under the objective to "provide food access to all."

Tax Structure Supporting Production Targets for Food Security

A reasonable alternative would be to set production levels as targets in staple foods and rely on imports for additional sourcing of food items. Low or no tariffs on the consumer side would result in a higher demand, and the self-sufficiency ratio would decrease dramatically. However, domestic production would be maintained and would represent some insurance against world market uncertainty. The effect of this policy on domestic supply "security" would be the same as that of self-sufficiency policy, without distorting consumption decisions. In addition, this policy would achieve a similar income transfer for the targeted commodity, alleviating domestic political constraints.

Setting the constraint of achieving historical production levels leads to set output subsidies but no consumption tax. The corresponding level of output subsidy on a subset of targeted commodities $k = 1, \dots, K$ can be found by solving the program $\tau^p = [\partial \mathbf{y} / \partial \mathbf{p}]^{-1} (\bar{\mathbf{y}}(\mathbf{p} + \tau^p) - \bar{\mathbf{y}}(\mathbf{p}^*))$, where $\bar{\mathbf{y}}_k(\mathbf{p}^* + \tau)$ is the level of production target for commodity k .¹⁰ The elements of τ corresponding to nontargeted commodities are equal to zero. The matrix $\partial \mathbf{y} / \partial \mathbf{p}$ is $K \times K$. Simulations show that this objective leads to production subsidies comparable to the present situation, which is not surprising given the limited production impact of Korean input subsidies. In our welfare calculation we include the social cost of public funds that are necessary to pay the subsidies to the farm sector. We use the most recent available estimate of such cost for Korea, which is set to 1.1 (Dalsgaard). The cost of public funds provides a more accurate measure of welfare gains of targeting because it accounts for the social cost of raising taxes elsewhere in the economy.

Table 7 compares the deadweight loss (EV from free trade) in the actual situation (column 1). It also shows the trade implications of the alternative approaches to FS, which are full self-sufficiency (columns 3–5), historical levels of self-sufficiency as a target (columns 6–8), and historical production levels as a target, as

¹⁰ A targeted historical income transfer for a specific commodity k leads to a second-best ad valorem subsidy τ_k , which would reach the historical target $T_k = p_k^*(1 + \tau_k) y_k(p_k^*(1 + \tau_k))$ which, expressed in won rather than in percent of world price, would be equivalent to the specific subsidy τ_k^p (Vousden).

Table 6. Targeting Historical Levels of Self-Sufficiency (1998–2000 Averages)

| | Actual Production Support (Ad Valorem Equivalent) | Actual Consumption Tax | Ratio Production/Consumption Tax | Historical Rate of Self Sufficiency | Second-Best Production Support | Second-Best Consumption Support |
|---------|---|------------------------|----------------------------------|-------------------------------------|--------------------------------|---------------------------------|
| Rice | 360% | 352% | 0.96 | 1.02 ^a | 342% | 342% |
| Wheat | – | 0% | – | 0 | 0 | 0 |
| Barley | 377% | 215% | 0.55 | 0.58 | 366% | 214% |
| Corn | – | 1% | – | 0 | 0 | – |
| Soybean | 688% | 54% | 0.08 | 0.08 | 696% | 52% |
| Dairy | 222% | 215% | 0.96 | 0.85 | 238% | 200% |
| Beef | 172% | 167% | 0.94 | 0.60 | 233% | 129% |
| Pork | 52% | 48% | 0.83 | 0.95 | 51% | 47% |
| Poultry | 26% | 23% | 1 | 0.87 | 25% | 20% |

^aWe constrain $\alpha = 1$ for rice.

resulting from a policy based on deficiency payments and no tariffs (columns 9–11). The third row of table 7 gives the value of imports of all commodities at world prices under four situations. The fourth row provides an indicator of the trade restriction caused by the corresponding tax structure, as measured by the numerator of the MTRI. Finally, row 5 provides the uniform MTRI tariff, that is, the tariff that should be imposed on all prices of tradable commodities in order to lead to the volume of trade at a world price that corresponds to a given tax structure.

Besides the welfare aspects, setting production targets rather than self-sufficiency targets represents a more palatable situation for mercantilist partners within the WTO and should

facilitate the negotiation of large deficiency payments. This policy, which has been used in the main U.S. programs for years, makes it possible to avoid the present deadweight losses on the consumption side. This generates extra Korean imports and a loss of limited tariff revenue that can no longer be redistributed to consumers. However, the decrease in food costs for consumers, as well as the increase in consumption, results in significant welfare gains, more than sufficient to pay for the farm program as we include the cost of public funds in our welfare analysis.

Targeted deficiency payments in the staple grains sector (rice and barley) that achieve historical production levels, while removing tariffs on imports, would result in a significant

Table 7. Welfare and Market Access Under Self-Sufficiency and Production Targets 1998–2000 Average (10⁶ Won at 1995 Prices, Except those in Percentages)

| | Actual Situation | Full Self-Sufficiency Target ($\alpha = 1$) on Subsets of Goods | | | Historical Self-Sufficiency Target on Subsets of Goods | | | Production Target, Historical Levels | | |
|-------------------------------------|------------------|---|-----------|--------------------|--|-----------|--------------------|--------------------------------------|-----------|--------------------|
| | | Staple Grains Only | Meat Only | Grains, Meat, Milk | Staple Grains Only | Meat Only | Grains, Meat, Milk | Staple Grains Only | Meat Only | Grains, Meat, Milk |
| Deadweight loss EV ^a | 6,152 | 2,725 | 4,001 | 9,730 | 2,540 | 1,444 | 4,614 | 2,371 | 663 | 3,455 |
| Value of imports at world prices | 3,275 | 4,843 | 3,702 | 2,270 | 4,842 | 4,357 | 3,381 | 5,044 | 5,065 | 4,431 |
| Trade restriction impact | 2,272 | 694 | 1,835 | 3,310 | 690 | 1,164 | 2,164 | 515 | 485 | 1,132 |
| Uniform equivalent tariff (percent) | 66 | 19 | 56 | 98 | 19 | 35 | 63 | 14 | 14 | 32 |

^aRelative to absence of public intervention.

welfare improvement (the deadweight loss would be reduced by 61% compared to the actual situation, to 2,371 billion won at 1995 prices). It would also result in a significant expansion of market opportunities. A synthetic indicator of these market opportunities, the MTRI uniform tariff equivalent would fall from 66% to 14%, and the volume of trade foregone would fall from 2,272 billion won to 515 billion at 1995 prices.

As a final note, we undertook a sensitivity analysis, which is reported in Beghin, Bureau, and Park. The simulations consider a 50% decrease and a doubling of the elasticities of the model, separately for supply, demand, and then jointly. The TRI and MTRI values are not sensitive to changes in elasticities. However and as expected, net welfare effects are more sensitive to changes in prices elasticities. A doubling of demand elasticities increases welfare losses by 40%, whereas a doubling of elasticities of supply increase welfare losses by 60%. The doubling of all elasticities is nearly additive, doubling the welfare losses.

Conclusions

Despite partial trade liberalization under the URAA, South Korea has been pursuing a policy of food self-sufficiency using trade restrictions and administrative prices in key agricultural and food markets, while following production targets with partial trade opening in lesser markets. These measures are part of a stated policy of food security, or FS. We analyzed the impact of these market distortions on welfare and trade volume and computed second-best distortions, which minimize the welfare cost of observed self-sufficiency and production objectives. We also computed second-best distortions for FS relying on domestic production and imports for all products. We rationalized these second-best distortions as what could be claimed as legitimate protection under an "FS" box in the new round of WTO negotiations.

Because Korea uses policy instruments that involve large production distortions and that impose high prices to consumers, we find that the present policies result in considerable welfare losses. The efficiency of transfers to producers is poor; each won transferred to farmers costs consumers and taxpayers roughly 1.6 won, and the objectives of self-sufficiency are obtained through a significant contraction of demand and high prices

that are unlikely to make food access easier for the less-favored consumers.

The observed system of taxes and subsidies is nearly optimal to achieve self-sufficiency. Nevertheless, similar objectives of FS could be achieved through production targets and open borders without the actual (considerable) welfare losses. The product target is nearly equivalent to an income transfer target and can be legitimized on either food security or political economy grounds. While the administration of programs such as deficiency payments might be difficult in some developing countries, which lack administration capacities and a large taxpayer basis, it is unlikely to impose more of an administrative burden than current policy, characterized by a high degree of state intervention.

There is growing pressure for consideration of an FS box in a future WTO agreement and a growing recognition from developed countries that some of the NFDCs concerns in this area are legitimate. However, genuine concerns for FS should not be used as a justification for what is actually effective protection. From this point of view, the present Korean policy in the meat sector appears inconsistent. Most of the local production is achieved thanks to large amounts of imported feedstuffs, and the Korean policy corresponds mainly to tariff escalation and income transfer rather than to FS concerns. The setting of self-sufficiency targets appears to be dominated by other strategies when pursuing FS.

Reliance on free trade with production targets is more rational and could provide the same level of protection to producers and reduce welfare cost to consumers. We found that the welfare gains to such a policy are considerable, even when maintaining present levels of production. Such a reorientation of policy instruments also would increase demand and hence exports from mercantilist trade partners who find current Korean policy of nearly prohibitive agricultural tariffs unpalatable.

To conclude, our policy recommendation is that members of the WTO who endorse FS should advocate deficiency payments for their agricultural production and open their borders. This strategy, which mirrors U.S. policy, would be much less antagonizing than strict self-sufficiency objectives for trade partners and more beneficial to consumers and small producers who are net buyers of food. Policy rents to farmers and landowners would be unaffected, which might help transition toward deficiency payments. Deficiency payments are

a defensible second-best policy if the constraint is FS. If the stated objective of FS dissimulates other motives, such as transferring income from consumers to farmers and landowners, deficiency payments are less efficient than pure lump-sum transfers. Nevertheless these production subsidies constitute a major improvement compared to blunt instruments such as trade barriers.

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References

- Anderson, J.E., and J.P. Neary. "A New Approach to Evaluating Trade Policy." *Review of Economic Studies* 63(1996):107–25.
- . "The Mercantilistic Index of Trade Policy." National Bureau of Economic Research, Working Paper Series 6870. Cambridge, MA (revised version June 13, 2000).
- Anderson, J.E., and W. Martin. "The Welfare Analysis of Fiscal Policy: A Simplified Unit Account." Mimeo, The World Bank, Washington DC, 1996.
- Anderson, K. "Korea: A Case of Agricultural Protection." In Terry Secular, ed., *Food Pricing Policy in Asia*. Ithaca: Cornell University Press, 1989. pp. 109–33.
- Anderson, K., and Y. Hayami. *The Political Economy of Agricultural Protection: East Asia in International Perspective*. Sydney, London and Boston: Allen and Unwin in association with the Australian National University, Australia-Japan Research Centre, 1986.
- Beghin, J.C., J.-C. Bureau, and S.J. Park. "Food Security and Agricultural Protection in South Korea." Working paper (revised September 2002), Department of Economics, Iowa State University, Ames, Iowa (Available at <http://www.econ.iastate.edu/research/>).
- Bhagwati, J.N., A. Panagariya, and T.N. Srinivasan. *Lectures on International Trade*, 2nd ed. Cambridge, MA: The MIT Press, 1998.
- Dalsgaard, T. "The Tax System in Korea: More Fairness and Less Complexity Required." Working paper No 271, Economics Department. Organisation for Economic Cooperation and Development, December, Paris, France, 2000.
- Diao X., J. Dyck, D. Skully, A. Somwaru, and C. Lee. "Structural Change and Agricultural Protection: Costs of Korean Agricultural Policy 1975 and 1990." Washington DC: U.S. Department of Agriculture, Economic Research Service, AER report 809, March 2002.
- Dixit, A.K., and V. Norman. *Theory of International Trade*. Cambridge: Cambridge University Press, 1980.
- Im, J.B. "Optimal Policy Reform with Implicit Preference: The Case of Rice in Korea." *Journal of Rural Development* 23(2000):1–32.
- International Agricultural Trade Research Consortium (IATRC). "The Uruguay Round Agreement on Agriculture: An Evaluation." Commissioned paper, University of Minnesota, 1994.
- . "Implementation of the Uruguay Round Agreement on Agriculture and Issues for the Next Round of Agricultural Negotiations." Commissioned paper, University of Minnesota, 1997.
- Kako, T. "Economic Development and Food Security Issues in Japan and South Korea." *Food Security in Asia: Economics and Politics*. W.S. Chen, C.A. Carter, and S. Yi-Shei, eds. Chethenham, UK: Edward Elgar, 2000.
- Moon, P.-Y., and B-S Kang. "The Republic of Korea." In Anne O. Krueger, Maurice Schiff, and Alberto Valdes, eds., *The Political Economy of Agricultural Pricing Policy*. Vol. 2. Baltimore: Johns Hopkins University Press/World Bank, 1991, pp. 15–66.
- LaFrance, J.T. "The LINQUAD Incomplete Demand Model." Working paper, Dept. of Agr. and Res. Econ., University of California, Berkeley, 1998.
- LaFrance, J.T., T.K.M. Beatty, R.D. Pope, and G.K. Agnew. "The U.S. Distribution of Income and Gorman Engel Curves for Food." *Journal of Econometrics* 107(2002):235–57.
- Makki, S.S., L.G. Tweeten, and M.J. Miranda. "Storage-Trade Interaction Under Uncertainty: Implications for Food Security." *Journal of Policy Modeling* 23(2001):127–40.
- Matthews, A. "The Position of the Developing Countries in the WTO Negotiations on Agricultural Trade Liberalisation." *Development Policy Review*, in press.
- Organisation for Economic Cooperation and Development. *Agricultural Policies in OECD Countries: Monitoring and Evaluation 2001*. Paris, France, 2001.
- Salvatici, L., C.A. Carter, and D.A. Sumner. "The Trade Restrictiveness Index: The Potential Contribution to Agricultural Policy Analysis." G.H. Peters and J. Von Braun, eds. *Food Security Diversification and Resource Management: Refocusing the Role of Agriculture*. Aldershot: UK: Ashgate, 1999.
- Samuelson, P.A. "Price of Factors and Goods in General Equilibrium." *Review of Economic Studies* 21(1953):1–20.

- Sumner D.A. "Agricultural Trade Policy and Food Security." Working paper, Dept. of Agr. Econ., University of California at Davis, 2001.
- Sumner, D.A., H. Lee, and D.G. Hallstrom. "Implications of Trade Reform for Agricultural Markets in Northeast Asia: A Korean Example." *Journal of Agricultural Economics* 21(1999):309–22.
- Thornsbury, S., D. Roberts, K. DeRemer, and D. Orden. "A First Step in Understanding Technical Barriers to Agricultural Trade." Paper presented at the 23rd International Conference of Agricultural Economists, Sacramento, CA, August 1997.
- Vincent, D., and Honggue Lee. "Benefits and Costs of Agricultural Protection in Korea." *Journal of International Economic Policy Studies* 1 (1997):187–221 (in Korean, with English summary).
- Vousden N. *The Economics of Trade Protection*. Cambridge: Cambridge University Press, 1991.
- Woodland A.D. "International Trade and Resource Allocation." Amsterdam: North Holland, 1984.
- World Bank. "Agricultural Trade and the WTO." Electronic Forum, 2001.
- World Trade Organization (WTO). Uruguay Round Agreement. "Decision on Measures Concerning the Possible Negative Effects of the Reform Programme on Least-Developed Countries and NFIDCs," 1994.
- . "Proposal on Special and Differential Treatment and a Development Box by a Group of Developing Countries." Document G/AG/NG/W/13, 2000a.
- . "Notes on Non-trade Concerns." Committee on Agriculture, Special Session. Document G/AG/NG/W/36/Rev.1, 2000b.
- . "Fourth Special Session of the Committee on Agriculture, 15–17 November 2000." Committee on Agriculture, Special Session. Document G/AG/NG/W/74, 2000c.
- . "Negotiations on WTO Agreement on Agriculture. Proposals by India in the Areas of Food Security, Market Access, Domestic Support and Export Competition." Committee on Agriculture, Special Session. Document G/AG/NG/W/102, 2001a.
- . "Proposal for WTO Negotiations on Agriculture." Committee on Agriculture, Special Session, Republic of Korea, Document G/AG/NG/W/98, 2001b.