MTID DISCUSSION PAPER NO. 74

PRODUCER SUPPORT ESTIMATES (PSEs) FOR AGRICULTURE IN DEVELOPING COUNTRIES: MEASUREMENT ISSUES AND ILLUSTRATIONS FROM INDIA AND CHINA

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ABSTRACT

In many developing countries, governments rely on price-based measures (including border protection and subsidies on inputs and outputs) more than on budgetary payments to achieve agricultural policy objectives defined to include price stabilization or food self-sufficiency. Assessing the effects of these price-based measures is thus important to evaluating whether agriculture is being protected or disprotected by commodity or in the aggregate. This aspect of producer support estimates (PSEs) is simple to describe conceptually but difficult to evaluate well empirically. Developing countries may face higher international transport and port costs for imports and exports than developed countries or may have substantial internal handling, transportation and processing costs. Separating these structural effects on farmers from agricultural policy effects that drive a wedge between the domestic farmgate price and an adjusted international reference price requires extensive data and judgments.

In this paper, we describe the PSE measurement issues and illustrate their importance. We estimate product-specific market price support, budget expenditures and PSEs for three important agricultural commodities (wheat, rice and corn) in India (1985-2002), using representative disaggregated state-level results, and for five commodities (wheat, rice, corn, soybeans and sugar) in China (1995-2001). The results for India suggest that ignoring factors such as internal transport costs, marketing margins and quality differences can result in inaccurate price support estimates and PSEs that may be of the wrong sign. We also explore how relaxing or changing certain standard PSE assumptions (such as altering the "scaling up" procedure or computing the PSE as a percentage of value of production at world reference prices) can have large impacts on the results. Finally, for commodities that are near self-sufficiency, we follow Byerlee and Morris (1993) and define a relevant adjusted reference price based on the relationship between an estimated autarky price and the import and export prices. We discuss this procedure and use the resulting reference prices to compute the market price support component of the PSE for India.

Based on our three-commodity PSEs for India, support is largely counter-cyclical, rising when world prices are low (as in the late 1980s and 1990s) and falling when world prices strengthen (as in the mid 1990s). From our more preliminary five-commodity PSE estimates for China, a trend decline in disprotection is more evident. Further research is needed to confirm and elaborate on these results.

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PRODUCER SUPPORT ESTIMATES (PSEs) FOR AGRICULTURE IN DEVELOPING COUNTRIES: MEASUREMENT ISSUES AND ILLUSTRATIONS FROM INDIA AND CHINA

Kathleen Mullen, Dongsheng Sun, David Orden and Ashok Gulati[1]

1. INTRODUCTION

Various indicators of agricultural protection can be computed to measure the degree of subsidization or taxation of the agricultural sector as a whole and of important commodities individually. In contrast to the Aggregate Measure of Support (AMS) on which production-related domestic support commitments are based under the World Trade Organization (WTO) Uruguay Round Agreement on Agriculture (URAA), the Producer Support Estimate (PSE) is a broader measure of the transfers to farmers from border protection and domestic policy interventions. It is defined by the Organization for Economic Cooperation and Development (OECD) as "an indicator of the annual monetary value of gross transfers from consumers and taxpayers to agricultural producers, measured at the farmgate level, arising from policy measures that support agriculture, regardless of their nature, objectives or impacts on farm production or income" (OECD, 2002 p. 59). Thus, the PSE includes transfers arising through market-intervention domestic and border policies and direct payments to producers. The OECD's calculation of PSEs has been limited to its member countries and some transition economies, but others have applied variants of the approach to several developing countries (Pursell and Gupta, 1996; Valdés, 1996; Cheng and Sun, 1998; Gulati and Narayanan, 2003; Cheng 2001; Tian et al., 2002).

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In this paper we describe and assess the PSE methodology and make applications to India and China. Because developing countries often rely more on border support and other price-based policy measures (input and/or output price controls) than on fiscally-budgeted support payments, most of the protection or disprotection of producers may be given by the gap between domestic and international output or input prices. In comparing a country's domestic price to an international price, an accurate estimate of the policy-related gap must account for factors such as external and internal transport costs and marketing margins, as well as processing costs and quality differences between the products being compared. Moreover, the net trade status of the commodity in question may itself be the result of policies in place and attention must be directed to determining the appropriate price that would prevail in the absence of the policies.

One objective of this paper is simply to describe these measurement and conceptual issues. Then, taking these factors into account, we apply the PSE methodology to three commodities (wheat, rice and corn) in India for the period 1985-2002 (2003 for wheat), using disaggregated analysis for representative surplus and deficit states, and to five commodities (wheat, rice, corn, soybeans and sugar) in China for the period 1995-2001.[2] These two countries both are large agricultural producers, as well as importers and exporters, and have undergone varying degrees of agricultural policy reforms. The policy reform processes in India and China display a gradual transition from an autarkic and state-led setting to a more deregulated market environment with greater integration into the world economy and a new and larger role for the private sector. The reform process has not been uniform over time or across the two countries, and in both it is marked by occasional policy reversals and setbacks. However, it has been two decades since reforms began in China and over ten years since India launched its broad-based economic reforms. At this juncture, it is useful to have the quantitative measure of

[2] Kathleen Mullen and Ashok Gulati are responsible for the initial research on India's PSEs. The basic research on China's PSEs was undertaken by Dongsheng Sun (2003). See also Sun, Diao, Mullen and Gualti (2003). These papers are part of a larger study of protection and disprotection of agriculture in developing countries. A full paper on India is scheduled, along with papers on several other countries individually. Mullen et al. (2004) provides a synopsis of the discussion material and analysis presented herein.

agricultural protection from PSEs to evaluate the current level of protection (or disprotection) that exists for major agricultural commodities. Such measures, while subject to limitations, inform the debate on how to proceed with agricultural reforms from a domestic policymaking perspective and from the standpoint of international trade negotiations currently ongoing in the WTO Doha Development Round.

The paper is organized as follows. In the following section, we first briefly compare the agricultural reform processes in India and China in order to provide a context for interpreting the PSEs. Next we lay out the basic PSE methodology and note critical measurement and conceptual aspects for applications to developing countries. We then apply the methodology to the selected commodities in India and China, paying particular attention to data limitations and their implications. Our results demonstrate that accounting for factors such as internal transport costs and marketing margins can have a large impact on the resulting product-specific PSEs and that observed trade status is not always an appropriate indicator of the relevant price in the absence of policy intervention. We present empirical estimates of support given by the PSEs in the context of how well the indicators describe the policy scenarios that have prevailed for each commodity. We also present estimates of total support or disprotection of agriculture (total PSEs) in India and China. Finally, we conclude with a discussion of the implications of our results and directions for future research.

2. THE REFORM PROCESS AND CURRENT POLICY SETTING IN INDIA AND CHINA

There were many similarities in the domestic market and foreign trade policies prior to reform in India and China. The policies were based on a fundamental philosophy that markets could not be trusted in agriculture. As in many other developing countries with smallholder dominated agricultural sectors and poorly developed market infrastructure and institutions, government interventions instead of the market were pursued to achieve the twin goals of self-sufficiency and low food prices for consumers. While similarities in both countries' agricultural trade policies should not be overstated, a few basic similarities are as follows:

(1) Both countries pursued a series of closed economy policies and formed an autarkic environment for agriculture. Self-sufficiency was believed to be the necessary and sufficient condition for the nation's food security (Srinivasan, 1994; Lin, 1994).

(2) Both countries extremely restricted the market's role in balancing supply and demand of agricultural products. In India, a set of complicated agricultural price, procurement, distribution, storage and subsidy (mainly on inputs) policies were employed. The initial government interventions in the market in China were quite similar to those the Indian government pursued; the market-mistrust, combined with Communist orthodoxy, resulted in the entire economy being almost fully planned by the government.

(3) In both countries, agricultural trade policies served as complementary instruments to make the economy effectively closed. Even though exports of some agricultural products had to be encouraged in order for foreign exchange earning to cover imports of capital equipment and industrial intermediates, trade in major agricultural products, often called strategic commodities, was highly restricted.

(4) India and China have utilized many trade policy instruments, such as import tariffs, quantitative restrictions, import and export licensing, and marketing restrictions to limit foreign trade in agriculture, and all these policies had to be implemented by the state trading enterprises (STEs), which were often an extension of the government bureaucratic system.

While the policies the Indian government pursued reflected heavy central planning in their features, the country was fundamentally a market economy, both in terms of clearly defined private property rights and the policymaking process. In China, a planned economy built on socialist principles, there was a lack of basic market institutions, farmers had no fundamental rights, and private traders simply did not exist.

2.1 INDIA'S REFORM PROCESS

India's agricultural policy has long been characterized by domestic and border interventions aimed at achieving self-sufficiency in food production and providing food to consumers at reasonable prices. To achieve these goals the Government of India (GOI) has implemented myriad policies including tariffs and non-tariff barriers, quantitative restrictions, import licensing, domestic price and marketing controls, and export restrictions. These policies have been applied with a view to reconcile domestic demand and supply, export potential, and the balance-of-payment situation (Gulati and Hoda, 2003). When India embarked on its broad-based macroeconomic reforms in 1991, this was largely restricted to the non-agricultural sector. It was not until later in the decade that direct reforms in agriculture started to take hold. With the signing of the URAA in 1994, some adjustments were made. In the initial years, even this was limited, although a series of steps have been taken since 1994 to gradually open up the agricultural sector. Most notable is the abolition of quantitative import restrictions completed in 2001. However, these quantitative restrictions were in many cases replaced by high bound and applied tariff rates, as it was feared that surges of imports would harm domestic producers.

Following the 1991 economic reforms, India progressively trimmed the list of products that were restricted to import by STEs. Imports of a few critical commodities continue to be controlled by STEs including copra and coconut oil (State Trading Corporation) and some cereals (Food Corporation of India (FCI)). Exports of most agricultural commodities were also subject to burdensome government restrictions. Together with import restrictions, high tariffs and overvalued exchange rates, there was a considerable anti-export bias in the economy prior to reforms (Gulati and Hoda, 2003).

Exports of a number of agricultural products were subject to strict controls, and after the 1991 reforms the number of products subject to quantitative export controls has been progressively reduced. After 2002, export restrictions apply only to onions and basmati rice (Hoda and Sekhar, 2003).

India's domestic agricultural policies have also only been partially affected by the economic reforms of 1991. Restrictions on movement, stocking and licensing requirements have recently been abolished and futures markets, which had been banned, are now permitted. But basic staples in India continue to be subject to Minimum Support Prices (MSPs), the stated objectives of which are to ensure remunerative prices to the farmers, reduce the risk that farmers face, promote agricultural diversification, and ensure food security for the poor (Vyas, 2003). Large increases in the MSPs for wheat and rice in recent years have led to a massive accumulation of food grain stocks, reaching 63 million tons in 2002 against a minimum buffer norm of 24 million tons. To reduce stocking levels, the government has expanded domestic food aid and food for work programs, increased open-market (including export) sales of food grains at prices much below acquisition cost and provided incentives for exporters. In 2000 and 2001, the government also reduced the "issue price" of food grains delivered through the public distribution system for families both above and below the poverty line and introduced the "Antyodaya Anna Yojana" (AAY) program to distribute grain at highly subsidized prices to the poorest of the poor (GOI, 2003). In 2002 and 2003, the issue prices for above and below the poverty line families remained unchanged, though the allocation of foodgrains was increased for families covered under the AAY, and for families above and below poverty line (GOI, 2003). In the long run, however, the Government acknowledges, "open-ended procurement by the FCI at a high price and disposal at a heavily subsidized price is not sustainable" (GOI, 2002b, Part A, paragraphs 27-28).

In recent years, input subsidies have increased and now also seem to be financially unsustainable (Gulati and Narayanan, 2003). Some of the subsidies, e.g. the fertilizer subsidy, and under-pricing of power and irrigation, have also become environmentally harmful. It is often argued that a large portion of the fertilizer subsidy is going to support an inefficient fertilizer industry, rather than to provide farmers with low cost inputs. Gulati and Narayanan (2003) calculate the implicit fertilizer subsidy accruing to farmers is only half of the government's expenditures on fertilizer subsidies over the period 1981-82 to 1999-00 when account is taken of low pricing of gas to fertilizer plants. Under-pricing of power to agricultural users represents the largest input subsidy to the sector, though one must be cautious in interpreting these figures since agricultural power usage is not metered and is obtained as a residual, with perhaps as much as 40 percent of the consumption going to non-agricultural users (Gulati and Narayanan, 2003). Electrical power to agriculture is offered at a very low tariff in most states, or in a few cases it is even free. Like fertilizer subsidies, a portion of the budgetary subsidy is actually used to support the inefficient supplier, in this case the State Electricity Boards (Gulati and Narayanan, 2003). Irrigation subsidies, charged against states' budgets, have remained a mainstay of agricultural input subsidies despite repeated attempts at reform. In most states, the pricing of canal waters does not cover more than 20 percent of the operation and maintenance costs, to say nothing of capital recovery cost (Gulati and Narayanan, 2003). With the rising support prices for food grains and increasing input subsidies, many have begun to question whether Indian agriculture has shifted from an "implicitly taxed" to an "implicitly subsidized" sector. Indeed rising stocks of food grains and subsidization of exports would seem to point to positive protection levels, at least in the wheat and rice sectors.

2.2 CHINA'S REFORM PROCESS

In China, unlike in India, reforms in agriculture began earlier and on the domestic front. The introduction of the now well-known Household Responsibility System (HRS) granted production decision-making power to the farm households and allowed farmers to sell surplus crops freely at market-determined prices only after they had fulfilled their obligations under the state order system. Early reforms centered on decollectivization and increasing incentives to farmers, while later reforms have attempted to gradually liberalize prices and markets (de Brauw et al., 2002). Market liberalization began with non-strategic crops including fruits, vegetables, fish and livestock (Huang and Rozelle, 2002). Market reforms continued intermittently throughout the 1980s and 1990s with progress depending on the stability of production and food prices. The state procurement and distribution systems were substantially liberalized in the early 1990s following several years of market stability. However, when food price inflation appeared in 1994, the government reinstated compulsory grain procurement (Huang and Rozelle, 2002). The Governors' Grain-Bag Responsibility System (GGBRS), introduced in 1995 shifted the responsibility of management of grain supplies from the central government to the provinces and mandated that the provinces maintain an overall balance of grain supply and demand and use local reserves to regulate markets and stabilize prices (OECD, 2002). Despite such periodic delays in the reform process, markets have gradually emerged in China's agricultural sector. According to Lardy (2001), the share of the agricultural commodities sold through markets was just 6 percent in 1978, and this share increased to 40 percent by 1985, 79 percent by 1995, and 83 percent by 1999.

China's foreign trade reforms in general involved four aspects: lowering trade barriers, depreciating the exchange rate, decentralizing the trading system, and introducing competition into foreign trade so that prices could play a role in determining resource allocation (Martin, 1999). The early foreign trade reforms were mainly pushed by the demand induced by reform in the domestic economy, and hence, also adopted the dual-track approach. Such a dual-track approach included a two-tier exchange rate system before 1994, a two-tier foreign exchange retention system, and dual export and import systems. In terms of the dual export system, for example, under the 1984 reform, with the decentralized Foreign Trade Corporation (FTC), about 60 percent of exports were still under the mandatory plan made by the central government, an additional 20 percent were assigned as value targets to the provinces, but the remaining 20 percent were non-plan exports. For the mandatory export plans, the procurement prices were fixed and target quantities were assigned to the producing enterprises, similar to the domestic trading system. However, for the non-mandatory exports, procurement prices faced by FTCs were much more flexible, but were still not fully linked with international prices. Analogous policy adjustments were also applied to imports. However, the agency system under which the FTCs acted as agents of the production enterprises was much more prevalent for imports than for exports.

For agricultural exports, the commodities that fell into the mandatory categories were those that still had production quotas, such as grains, oil crops, cotton, and other major industrial material export crops. Various vegetables and fruits and other small crops were the first group of commodities that could be freely exported through the FTCs, which resulted in a significant increase in agricultural exports of these products. Overall, China has been a net exporter of agricultural products since 1984 (China National Bureau of Statistics, 2002).

In January 1994, the exchange rate was unified to the prevailing swap-market rate, which led to a significant depreciation of the official exchange rate of about 50 percent. The unification of the exchange rate further stimulated China's exports, as prices faced by producers significantly increased measured in the domestic currency.

Adjustments in China’s trade policy, including tariff reduction policies, significantly changed China's agricultural export and import structure. Agricultural trade has moved in a direction that is more consistent with China's comparative advantage. For example, calculated by Huang and Rozelle (2002), the proportion of grain exports fell to 20 percent of total agricultural exports in the 1990s, from more than 40 percent in the 1980s. Horticultural, animal, and aquatic products accounted for more than 80 percent of agricultural exports in the late 1990s. By re-grouping trade data according to factor intensity in production, Huang and Rozelle (2002) find that China's net exports of land-intensive bulk commodities, such as grains, oilseeds, and sugar crops, have fallen, while exports of high value and more labor-intensive commodities have risen.

To summarize, China's reforms have been carried out for more than two decades and India began its reforms 10 years ago, yet it seems that more reforms are required in both countries. Frequent policy reversals plague the reform process of both countries particularly on the external trade regime with intermittent bans and licenses issued on imports and exports of strategic commodities depending on domestic food prices, availability and foreign exchange concerns. In India and China various local marketing taxes and fees burden farmers, while at the same time in China agricultural products sold into the market by farmers are exempt from the value-added tax (VAT) system. At the wholesale level, the VAT is only assessed on traders' marketing margins, rather than on the sale price, and thus offers domestic agriculture significant protection over imports that are taxed on their entire value (Huang and Rozelle, 2002). Both countries have recently used subsidies to increase export shipments of some commodities. In India, wheat and rice for export have been estimated to receive sizeable subsidies on freight and stocking costs, almost up to 50 percent of product value (Wailes, 2003). In China, corn and cotton exports have been estimated to receive subsidies in 2001 in the order of 34 percent and 10 percent, respectively (Huang and Rozelle, 2002). And as discussed above, increasing procurement prices for wheat and rice and rising input subsidies in India are putting significant pressure on the government budget. Strong growth in the non-agricultural economy is contributing to government's motivation to offer subsidies to agriculture, as has not been possible in the past. Given the dynamic policy setting in both countries, an indicator of agricultural support such as the PSE is a useful yardstick to measure if reforms taken to date have reduced or even reversed the direction of market distortions.

3. PSE METHODOLOGY: DESCRIPTION AND ISSUES IN APPLICATIONS TO DEVELOPING COUNTRIES

The starting point of our analysis is the methodology utilized by the OECD to measure PSEs in its member countries (Portugal, 2002). The first calculations of PSEs (then referred to as Producer Subsidy Equivalent) were undertaken by the FAO for five countries and five commodities over the period 1968-70 (Josling and Tangermann, 1989).

This original PSE was defined as the level of per unit producer subsidy that would be needed to replace the actual package of farm policies employed in a certain country and leave farm income unchanged.[3] The PSE is based on the small country assumption (price taker) and on existing world prices. It is most appropriately viewed as an *ex post* measure of the gross transfers to producers based on observed output and prices, and thus it implicitly assumes that supply curves are perfectly inelastic.[4] A product-specific PSE can be expressed in monetary value per unit of output, as an aggregate monetary value for total national production of the given commodity, or on a percentage basis, usually reported as a percentage of the value of production plus budgetary support provided to that commodity. The product-specific PSEs can then be aggregated for a subset of commodities or for all of agriculture, again expressed either as a monetary value or as a percentage. The original PSE excluded the effects of factor market policies, of non-agricultural policies at both the sectoral and macroeconomic levels (e.g. tariffs on fuel and exchange rate distortions), and of agricultural policies on inputs (e.g. feed prices in livestock production). In addition to the work by the FAO, by the mid 1980s, the OECD and USDA (1994) had also undertaken PSE studies.

3.1 BASIC METHODOLOGY

The OECD originally adopted a very broad definition of the PSE to include direct and indirect income support, research and extension expenditures, certain taxation benefits, costs of structural measures, capital grants and interest subsidies, and policies at the sub-national level. Josling and Tangermann (1989) argue that the heterogeneity of the included policies put strain on any assumption of relatively equal impacts on farm output per dollar of transfer, a result demonstrated by Dewbre et al. (2001).

[3] A corresponding Consumer Subsidy Equivalent or Consumer Support Estimate (CSE) measures protection or disprotection to consumers of agricultural products.
[4] This is one of the ways in which the PSE is distinct from the economic concept of producer surplus, where, given a price change, production also changes, assuming the elasticity of supply is greater than zero. Another important difference is that the PSE is a gross measure, while producer surplus is a net concept. We discuss these differences briefly in section 3.3.

The most recent revision of the OECD methodology took place in 1999 and was applied at that time to the OECD member countries.[5] The current OECD approach expands and refines the PSE methodology employed in the FAO and USDA studies and the earlier OECD studies. The OECD reports the PSE in monetary terms or as the percentage PSE, which at the aggregate level is a ratio of the total PSE to the value of total gross farm receipts measured by the value of production at domestic farmgate prices plus all government transfers (OECD, 2000). Within the PSE, policies are categorized into one of eight subcategories. Market price support (MPS) is defined as the component of the PSE that is an "indicator of the annual monetary value of gross transfers from consumers and taxpayers to agricultural producers arising from policy measures that create a gap between domestic market prices and border prices of a specific commodity measured at the farmgate level" (Portugal, 2002 p. 2). It is calculated based on the difference between the domestic price and an equivalent world price of a commodity. The seven other subcategories of support are measured by budgetary outlays for various types of government payments that support farmers. On average for OECD countries, the total MPS (for all of agriculture) accounted for 63 percent of the total PSE in 2000-2002 (OECD, 2003).

3.1.1 Estimating Market Price Support (MPS)

Assuming competitive markets, *ex post* price certainty, and a small country case whereby a nation's domestic and border policies do not affect world prices, the domestic farmgate price of a commodity, P_d, is compared to an adjusted reference price, P_{ar}. The types of adjustments made to determine P_{ar} are shown for an imported and an exported commodity in equations (1) and (2).

[5] The OECD has also used this methodology to compute PSEs for six transition countries: Estonia, Latvia, Lithuania, Romania, Russia and Slovak Republic in 1986-2001 (OECD, 2002).

Equations (1) and (2). Calculation of the Adjusted Reference Price

In the case of an importable:

(1)	Adjusted reference price for an import	=	Reference price at border	+	(Port charges	+	Transportation, handling and marketing cost from port to internal wholesale market)	-	(Transportation and handling costs from farm to wholesale market	+	Marketing and processing costs from farm to wholesale market)	-	Quality adjustment
	P_{ar}	=	P_r	+	(C_p	+	T_{d1})	-	(T_{d2}	+	M)	-	Q_{adj}

In the case of an exportable:

(2)	Adjusted reference price for an export	=	Reference price at border	-	(Port charges	+	Transportation, handling and marketing cost from port to internal wholesale market)	-	(Transportation and handling costs from farm to wholesale market	+	Marketing and processing costs from farm to wholesale market)	-	Quality adjustment
	P_{ar}	=	P_r	-	(C_p	+	T_{d1})	-	(T_{d2}	+	M)	-	Q_{adj}

Source: Adopted from Melyukhina (2002).
Note: $Q_{adj} > 0$ implies that the domestic quality is lower than the quality of the internationally traded commodity.

The reference price at the border, P_r, is the "world market" c.i.f. price for an importer or f.o.b. price for an exporter expressed in the domestic currency.[6] The adjustments, such as those in equations (1) and (2), are made to P_r to bring it on par with the domestic farmgate price. Alternatively, one can think of adjusting both P_r and P_d so that they are compared at the level of some market in which the international and domestic good would compete. For example, in the case that the country is an importer of the commodity, the adjustments in (1) are equivalent to adjusting international and domestic farmgate prices to the domestic wholesale market. Wherever the price

[6] The c.i.f. price includes transportation and insurance costs associated with moving the good from the exporting country to an importing country. The f.o.b. price refers to the price of the good loaded onto the ship at the export port, but before international shipping. It does not include the costs of transporting the good from the exporting country to the importing country.

comparison is assumed to take place, it is important to compare prices of products that are "like with like" (Portugal, 2002).

The ideal comparison is one thing, but practical comparison for empirical work is quite another. Starting with P_r , if the commodity is imported the reference price might be measured in at least two practical alternative ways. First, it can be imputed from the f.o.b. price of a major exporting country, $P_{exporterfob}$, plus the international freight, T_i , and other international costs (including insurance and margins) of moving the commodity from the exporting country to the importing country, C_i , according to:

$$(3) \qquad P_r = P_{exporterfob} + (T_i + C_i)$$

With perfect information, $P_{exporterfob}$, T_i , and C_i are known with certainty and equation (3) holds as an arbitrage condition. Alternatively, the reference price at the border for an imported commodity might be available as an observed c.i.f. price (pre-tariff and pre-any other policies of the country) at its border.[7]

In the case that the country is an exporter of the commodity, there are equivalent reference price measures. The point of comparison in world markets between the country's export price and the international price takes place as arbitraged at the border of a third country importer (i.e. the c.i.f. price in that third country). Similar to (3), the reference price at the border of the exporting country can be imputed from the c.i.f. price of a major importing country, $P_{importercif}$ minus the costs associated with moving the commodity from the exporting country in question to the importing country according to:

$$(4) \qquad P_r = P_{importercif} - (T_i + C_i)$$

Again, with perfect information $P_{importercif}$, T_i , and C_i are known with certainty in equation (4). Alternatively, the reference price for an exported commodity can be

[7] The importance of international and internal transport costs as factors affecting trade is demonstrated by the fact that for 168 out of 216 U.S. trading partners international transport costs (for all goods, not just agricultural goods) were larger than tariff barriers (World Bank, 2002). For developing countries, international freight costs of bulk commodities may as much as one-quarter of the import value, as is the case for India in our empirical analysis.

measured from an f.o.b. price observed at the border, if such a price at which the country's product competes in world markets is available.[8]

Regardless of whether the commodity is imported or exported, the reference price P_r is adjusted by the costs of handling, transporting and marketing between the border and the wholesale market (C_p and T_{d1}), the costs of handling, transporting, marketing and processing the commodity between the farm and the wholesale market (T_{d2} and M), and by any needed adjustment for differences in quality between the domestic and internationally produced commodity (Q_{adj}).[9] The price gap at the farmgate level, ΔP, then is a monetary measure of market price support per unit of output:

$$(5) \qquad \Delta P = P_d - P_{ar}$$

Ideally, ΔP captures the differences induced by visible and invisible policy interventions between P_d and P_{ar}. Expressed in percentage terms relative to the reference price ($\Delta P/ P_{ar}$), the price gap is a traditional nominal rate of protection (NRP), or as we refer to it later, the "%MPS."

Together with the effects of policies, estimated price gaps will reflect any measurement errors in the price comparison adjustments. For P_r , these arise from empirical measures of $P_{exporterfob}$, $P_{importercif}$, and/or ($T_i + C_i$) as relevant to the commodity under consideration. In addition, there are four types of potential measurement errors that arise in assessing the within-country adjustments:

1. in the costs from port to domestic wholesale markets (measurement error in ($C_p + T_{d1}$));

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[8] Unlike an import, where the appropriate reference price excludes any policies of the country under study, for an export the appropriate reference price is the price offered by the country inclusive of any export subsidies or taxes.

[9] Again, these cost adjustments can be substantial. Inefficient internal transport systems, cumbersome certification requirements, poorly integrated inter-modal transport systems and lack of competition in transport services markets in developing countries represent real barriers to trade. For example, according to a World Bank (2002) study, in China truck rates for moving a container 500 kilometers inland are estimated to be three times more costly and take five times longer than they would in the U.S. or Europe.

2. in the cost from farmgate to wholesale markets (measurement error in $(T_{d2} + M)$);
3. in the levels of farmgate prices (measurement error in P_d); and
4. in the comparability of the domestic and internationally produced goods in terms of quality (measurement error in Q_{adj}).

The difficulties in assessing market price gaps are likely to be particularly important in developing countries compared to developed countries for a number of reasons. First, the developing countries are even more likely than the OECD countries to utilize border policies or commodity price support programs backed up by market interventions and government stockholding. These are policies whose effects are measured in an MPS. Second, with less well-developed infrastructure, various costs associated with adjusting the reference price are likely to have larger magnitudes in developing countries, so taking them into account (or not) will have a larger effect on the estimated MPS and its interpretation. Real transportation costs could be high, for example, either because of poor roads (a public investment issue) or an aged and high-cost fleet of trucks (a private investment issue). Third, developing countries may be more likely than developed countries to switch from importer to exporter of a commodity across years, and the relevant reference price adjustments for internal costs can differ depending on the circumstances for a given period. Fourth, even if competitive market forces are functioning relatively well in the handling, transportation, processing and marketing sectors, acquiring the requisite data on various costs may be particularly resource intensive (beyond plausible research budgets) or consistent data over a range of years may simply not exist.

The price gap in developing countries, and difficulties in assessing its policy component, may also be affected by imperfect competition in the handling, transportation, processing or marketing sectors. At an extreme, a private (or state operated) monopoly in one or more of these sectors could either have excessive costs, extract excess profits, and/or be the instrument for implementation of such policies as import restrictions or an export subsidy. Each would affect the observed price gap, but with different implications. For example, both inefficiencies in processing and hidden export taxes would push the observed farmgate price below the reference price, but it might be impossible to separate the two effects with their different policy implications. By contrast, in the competitive markets assumed (perhaps more reasonably) to prevail in developed countries when PSEs are calculated, the MPS would come closer to capturing only the effects of the export policy.

Since a substantial amount of data is required to calculate the price gaps, attempting to assess market price support in a developing country context requires making judgements on how to reduce the measurement error given available data and research resources. For the reference price, if T_i , and C_i have to be estimated to impute P_r a degree of error may be introduced by the cost measurements. If instead P_r is assessed from observed prices at the country's border, T_i and C_i do not have to be estimated, but the issue of quality adjustment may be more severe. A different source of measurement error would be introduced, for example, if the qualities of the commodity imported and the domestic commodity differ more than for a corresponding quality of the product traded internationally but not imported by this particular country.

The importance of measurement error related to various within-country adjustments to the reference price will vary among situations. For some commodities, there is complex processing, such as conversion of sugarcane to raw or refined sugar, so a substantial determinant of the MPS will be associated with adjustments to the reference price for these processing costs. In such cases, a comparison might be made, for simplicity, between the reference price of the processed commodity adjusted to the wholesale level and the domestic price of that processed commodity at the wholesale level. Such a comparison would not separate protection (or disprotection) between domestic farmers and processors. This could be an important distinction, especially if processing is inefficient or non-competitive.[10]

Another example where the relative importance of various adjustments to the reference price may differ is based, for an imported commodity, on the proximity of domestic consumers to the port of entry versus domestic production regions. To give an extreme example, the port could be the national capital and population center, while domestic production takes place far in the hinterland. In this case, farm to wholesale marketing costs are likely to be the more important adjustment. Conversely, perhaps another country is landlocked and far from port, while domestic production lies in eyesight of capital buildings. Adjustments from the observed reference price of imports to the domestic wholesale market would be most important in this case.

When reliable data series on all of the adjustment factors are not readily available, one approach the OECD has applied to estimating market price gaps has been to make an assumption that certain "mark-ups" to the reference price are approximately cancelled out by certain "mark-downs." Under this assumption, a net correction can be made only for those adjustments that don't cancel out. Melyukhina (2002), for example, made the following reference price assumptions to simplify the calculation of the price gap in the case of non-OECD member transition economies:

$$(6) \qquad P = (P_w + (T_i + T_{d1}) - (T_{d2} + Q_{adj}) - M)$$

where P_w = EU f.o.b. export price. Equation (6) includes adjustments similar to (1) for an imported commodity. Melyukhina then assumes that:

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[10] For example, in the case of sugar, the MPS is often measured by the price gap between the domestic wholesale and international price of refined sugar. The price gap is then converted to equivalents at the farmgate level using appropriate technical coefficients (Cahill and Legg, 1990). Agricultural processors, in this case sugar millers, are assumed to be operating under perfect competition. Doyon et al. (2001) discuss the case when the sugar millers have market power. They point out that sugar millers with market power may increase the domestic wholesale price of sugar without increasing the price paid to farmers for sugarcane. In this event, the calculated MPS would increase without farmers actually receiving any benefits.

(7) $(T_i + T_{d1}) - (T_{d2} + Q_{adj}) \approx 0$

so that:

(8) $\Delta P = P_d - (P_w - M)$

By this formulation the price gap equation reduces to the difference between an approximation to the domestic wholesale price (farmgate price plus marketing costs between the farm and wholesale market) and the world f.o.b. export price (for the EU in this case). Compared to (6), equation (8) looks more like partial adjustments for an exported commodity.[11] Melyukhina argues that while this procedure introduces an estimation error, in the absence of sufficient data, it seems to be pragmatic (p. 11). Yet in our formulation, where 1) international adjustments are likely to be determined by different economic forces and measured perhaps more accurately than domestic adjustments, 2) adjustments for the imported commodity could well differ from those for the domestic commodity, and 3) differences in quality might be important, it seems odd to assume the approximation in (7). At a minimum, such approximation would seem to require some empirical confirmation.

3.1.2 Budgetary Payments

According to the OECD approach, budgetary payments are divided into seven subcategories depending on the conditions of eligibility on which transfers are made to farmers: those based on 1) output; 2) area planted/animal numbers; 3) historical entitlements; 4) input use; 5) input constraints; 6) overall farming income; and 7) miscellaneous payments. With the increased use of support payments in developed countries that are at least partially decoupled from current production of any particular crop, the OECD is in the process of redefining if and how different program payments should be allocated to individual commodities (OECD, 2003).

[11] Brooks and Melyukhina (2003) explore the issue of price transmission in the case of Russian crop markets and point out that even in perfectly adjusting markets, policy or world price changes may not be fully passed through. This work has obvious implications for the degree of price transmission in the agricultural sector in developing countries and for measuring the effects of policy reform in general.

Patterns and levels of budgetary expenditures on agricultural support by developing countries are likely to differ substantially from those of wealthier OECD countries. In transition (and developing) economies, particular care must be taken to include all budgetary assistance, even that which is not associated with direct payments to farmers (Melyukhina, 2002). Preferential prices for inputs such as electricity, fertilizer, irrigation and transportation may also be more important in developing than developed countries. These subsidies would be categorized as budgetary payments, though subsidies on tradable inputs at the farmgate level may be better measured through a price gap method analogous to the calculation of MPS for output commodities, as Gulati and Narayanan (2003) have demonstrated.

3.1.3 Calculating PSEs

The total PSE expressed in nominal terms for all agricultural producers is the sum of a total of MPS, which is the price gap per unit of each output multiplied by the quantity of output, summed over all outputs included in the analysis, and aggregate budgetary transfers. Data on the aggregate budgetary transfers to producers are often more readily available than budgetary transfers by commodity. The calculation of total MPS is more problematic. According to the OECD approach calculation of total MPS consists of three steps. First, a nominal value of MPS_j is estimated for each individual product "j" included in the analysis, the set of which is known as the "MPS commodities." For OECD member countries, these products typically include wheat, maize, other grains, oilseeds, sugar, milk, beef and veal, pigmeat, poultry, and eggs. OECD member countries have agreed that the set of MPS commodities should cover at least 70 percent of total value of agricultural production (Portugal, 2002).

The second step is to sum the product-specific MPS_j into an aggregate MPS for the covered commodities. For *N* commodities this yields:

$$(9) \qquad MPS_c = \sum MPS_j \, ; \;\; j = 1 \ldots N$$

One method to estimate the nominal PSE for a country (not used by OECD) is to include only the market price support derived for covered commodities (MPS_c) in the calculation:

$$(10) \qquad PSE_c = MPS_c + BP$$

where *BP* is the total budgetary payments to producers. In percentage terms (of total transfers to producers, from MPS_c and BP, to gross farm receipts measured by the value of production at producer prices plus budgetary payments), this version of the PSE is:

$$(11) \qquad \%PSE_c = \left(\frac{MPS_c + BP}{VP + BP}\right) * 100$$

where *VP* is the total value of agricultural production at domestic producer prices.

In the OECD approach, a third step is made to calculate the PSE. The MPS_c for covered commodities is "scaled up" to all products based on the share (*k*) of the covered commodities in the total value of production. Algebraically, the final step or "MPS extrapolation procedure" can be expressed as:

$$(12) \qquad MPS = \frac{MPS_c}{k}$$

where MPS is the estimated total market price support. With the scaling up, the OECD "Total PSE" is calculated as:

$$(13) \qquad PSE = MPS + BP$$

The percentage PSE is:

$$(14) \qquad \%PSE = \left(\frac{MPS + BP}{VP + BP}\right) * 100$$

Using the first approach of not scaling up (equations 10 and 11), commodities not covered are assumed to receive no market price support, while in the scaling-up step (12) commodities not included in the analysis are assumed to have market price support equal to an average of the MPS among covered commodities. Either approximation introduces error, and any error is relatively more or less important as the MPS component of the PSE increases relative to the budget payment component. The error introduced can be minimized by including as many products as possible in the set of covered commodities (Melyukhina, 2002). But for developing countries, feasible coverage is likely to be less than for the OECD countries, and the assumption imposed by scaling up may be unrealistic if support is concentrated among those commodities included in the analysis.

3.1.4 Producer Support as a Percentage of World Market Value

The above measures of percentage PSE utilize the value of production at domestic prices plus budget payments as the denominator. This is essentially a “subsidy counter’s” approach. An alternative (“trade economist’s”) approach (denominator) is to express support received by farmers as a percentage of the value of their output at farmgate-equivalent international prices. This is consistent conceptually with measuring nominal protection or %MPS. For the total PSE, this alternative measure is:

$$(15) \qquad \%PSE^* = \left(\frac{MPS + BP}{VP^*}\right) * 100$$

where *VP** is the total value of agricultural production at international prices. For one thing, this calculation avoids the systematic error of giving activities with higher protection greater weight in the denominator (Pursell and Gupta, 1996).

Since data on the value of total agricultural production at world prices is not available, the denominator in equation (15) has to be approximated. One approach is simply to subtract the MPS_c for the covered commodities from *VP*. Alternatively, *VP** can be approximated by scaling up the value of production of the covered commodities at world prices by the same “*k*” as above.

3.1.5 Product-Specific PSEs

The calculation of a product-specific PSE_j, where again "j" denotes a specific commodity, requires that budgetary payments be allocated across commodities to determine the budgetary support for a given product, BP_j. If such payments are reported by commodities, the procedure is straightforward. However, for payments such as input subsidies or general subsidies such as tax or capital grants, allocation across commodities can be more complicated. In this case, the payments are often assumed to be distributed on the basis of each commodity's share in total value of agricultural production (Melyukhina, 2002). Other criteria, such as the share of acreage also provide plausible approximations, although each may introduce a measurement error. Silvis and van der Hamsvoort (1996) note that the method in which program payments are allocated across commodities is not always clear.

Once budgetary payments are allocated among commodities, the product-specific PSE_j is the sum of the nominal MPS_j and budgetary support for that commodity. The product-specific PSE_j can also be expressed on a percentage basis two ways, either using the proportion of gross farm income that is a result of policy measures $(VP_j + BP_j)$ as the denominator or using the value of output at farmgate-equivalent international prices, VP_j^*. Production is valued at international prices in the $\%MPS_j$ and the trade economist's $\%PSE_j$. Since the PSE_j includes the market price support and budget payments, the "trade economist's" product-specific $\%PSE_j$ will always be at least as high or higher than the $\%MPS_j$. Quite different numerical representation of the policy effects can arise with the "subsidy counter's" $\%PSE_j$ because the denominator for this measure is the value of farm output at domestic prices plus budget payments.

3.1.6 Additional Measurement Issues

Beyond the mechanics of calculating PSEs, as described above, numerous other computational concerns arise (for simplicity, we don't carry forward the specific-commodity and covered commodities subscripts "j" and "c" unless needed for clarity). Additional measurement issues particularly relevant in calculating PSEs in developing countries include: 1) the exchange rate, 2) the need for regional-level analysis, 3) the use of post-harvest or annual average prices, and 4) the choice between marketable surplus or total production.

Calculating reference prices requires the use of an exchange rate. Most PSE studies utilize the nominal exchange rate prevailing each year. Krueger, Schiff, and Valdés (1992), in contrast, fully accounted for the effects of exchange rate misalignment through a decomposition method in their seminal analysis of agricultural pricing policies in developing countries. Harley (1996) also used decomposition analysis to provide a measurement of the contribution of annual variation in different PSE components, including the exchange rate, to the overall annual PSE change. Others have used the adjusted (shadow) exchange rates, mostly based on Purchasing Power Parity (PPP), in PSE calculations. For example, Liefert, et al. (1996) show that the 1994 PSE estimates for Russia change from negative to positive if a PPP exchange rate is used instead of a nominal one. Doyon et al. (2001) contend that in the context of comparing support levels across countries, PPP adjustments would provide a better conversion factor than nominal exchange rates. More generally, modern macroeconomic models could be used to estimate equilibrium exchange rates and the effects of any exchange rate misalignment on PSEs could be evaluated. Exchange rate adjustments can be particularly important for developing countries where exchange rate disequilibrium can be large and persistent.

A second issue of particular importance in measuring PSEs in large developing countries is the need for regional-level analysis where there are substantial differences in the within-country adjustments to the reference price or where support policies differ across states or provinces. In these large developing countries, it is possible that producers in some regions could be benefiting from policy interventions, while in other regions they could be losing.[12] If internal markets are well integrated, observed differences in regional prices presumably result from differences in real costs, rather than being the result of policy interventions. Yet different adjustments for internal transport and marketing costs could lead to different PSEs by region when, for example, pan-territorial farmgate price support is provided by the government. If there are movement restrictions, state-level variations in minimum support prices, or other policies that vary at the sub-national level, as can be the case in large developing countries, PSEs may again differ markedly by region.

One useful distinction when state-level analysis is necessary for a particular commodity is to separate states in a country that are "net surplus" producers of that commodity from those states that are also important producers of the commodity but are "net deficit" regions. The deficit regions both produce and must purchase the commodity from other states or internationally in order to meet regional demand. In these states, the relevant reference price may vary slightly from that in equation (1). Gulati et al., 1990, and Pursell and Gupta, 1996, suggest that, assuming the commodity is an import, the domestic price in the deficit states should be compared with the lower of the (i) observed border price plus port charges plus transportation, handling and marketing costs from the border to the deficit region, or (ii) the adjusted reference price for a nearby surplus region given by equation (1) plus the transportation, handling and marketing costs from the surplus region to the deficit region. Pursell and Gupta (1996) find that in the case of wheat in Lucknow, Uttar Pradesh, India, the latter adjustment gives the lower price, meaning that without trade or price interventions farmers in the deficit region would have to compete with domestic wheat from the surplus region. This adjusted reference price compared to the state-level domestic farmgate price gives a measure of the degree of protection (or disprotection) for farmers in the deficit region.

[12] The same could be true among regions in a developed country, but in developed country PSE computation it is usually assumed that there is one domestic and import (or export) adjusted reference price for each commodity.

The choice of annual (calendar year, crop year or fiscal year) or average harvest season prices can also affect the results, particularly in developing countries. The OECD (2003) uses annual average prices in the PSEs it computes for its member countries. Pursell and Gupta (1996), in contrast, use average prices during the period in which the bulk of the specific commodity is harvested to calculate nominal protection coefficients (NPCs) for Indian agriculture. They argue that annual average prices capture the storage costs of traders in addition to the prices received by farmers. In many cases, due to capital market inefficiencies and limited on-farm storage facilities, smallholder farmers in developing countries sell their products immediately after harvest. Under these circumstances, it may be more appropriate to use harvest season prices rather than annual average prices, keeping in mind that both the time of the year and duration of the harvest season is commodity- and region-specific.

Several authors have suggested that agricultural support indicators for developing countries be measured based on the quantity of marketable surplus rather than on the entire quantity produced, since a large portion of the output produced by smallholder farmers is consumed on the farm (Sun, 2003; Gulati and Hoda, 2003). However, in a household model framework, each producer maximizes utility by selling a portion of his or her output and allocating the rest to home consumption. This assumes that the producer values all production at the market price. In this case, PSEs should be computed based on total production valued at producer prices rather than on marketed surplus, as the OECD has done for the transition economies (Melyukhina, 2002).[13]

[13] The use of official value of production for the non-OECD member countries (transition economies) was viewed as problematic because on-farm consumption was valued at shadow prices that differ significantly from market prices (Melyukhina, 2002).

3.2 MODIFIED PROCEDURE TO ACCOUNT FOR DOMESTIC MARKET-CLEARING PRICES

Beyond the practical difficulties in obtaining the necessary data to compute PSEs, as described above, there is another factor that may be particularly relevant to the measurement and interpretation of PSEs for developing countries. In some instances, the presence of policy distortions can alter a commodity's trade status. This is particularly the case for countries that are near self-sufficiency in a particular commodity, have producer and/or consumer price controls in effect, and are large or landlocked and therefore have relatively high internal or external transport costs (Byerlee and Morris, 1993). These conditions describe the situation for cereals in many developing countries. Byerlee and Morris (1993) contend that under these circumstances agricultural protection indicators computed by the conventional methods of comparing the domestic price to an import or export adjusted reference price can lead to an incorrect estimate of the level and even the direction of protection. They suggest that a corrected protection measure be calculated based on the market-clearing equilibrium price as the "adjusted reference price" rather than the import or export price. For example, Pakistan was more than 85 percent self-sufficient in wheat during 1985-90, had a controlled producer price slightly above the export price and well below the import price, and was a net importer of wheat. Conventional measures of support showed the domestic price as much as 40 percent lower than the adjusted reference import price. But Byerlee and Morris (1993) assert that if controls were removed the price would increase only to a domestic market-clearing equilibrium price, below the import price level. Using an estimated domestic equilibrium price instead of the adjusted import price, they calculated that wheat prices would increase only 10 percent if the price controls were removed.

World price fluctuations, changes in the government intervention price levels, and domestic supply and demand shocks are all factors that affect whether a country will be importing or exporting, or, alternatively depleting or accumulating existing stocks. As

Byerlee and Morris (1993) point out, the likelihood that any of these factors will result in a change in the trade status (or direction of stock depletion or accumulation) of a country is greater if the country is near self-sufficiency in a particular commodity and has relatively high internal or external transport costs, so that there is a wide gap between the adjusted reference price for imports and the adjusted reference price for exports.

Following Byerlee and Morris (1993), we can explore when the MPS as defined by Portugal (2002) and based on current trade status is an appropriate measure and when a Byerlee-Morris comparison with the market-clearing domestic price is appropriate in computing the MPS components of PSEs. Because there are many factors influencing the current direction of trade, net trade status may not be the best determinant of which adjusted reference price to use. In cases where the direction of net trade changes when the policy interventions are removed, the "conventional" MPS based on observed trade does not unambiguously answer the question of what is the level of protection or disprotection with respect to the adjusted reference price level that would be relevant in the absence of the policy.

Instead of relying on the current direction of trade to dictate which adjusted reference price should be used, a more systematic approach can be followed to select the appropriate adjusted reference price. From here on, for clarity, the adjusted reference price for exports will be denoted P_e and for imports P_m. In order to know which price will be relevant when the policy intervention is removed, one must know the relationships among the autarky equilibrium price, P^*, and the adjusted reference prices P_m and P_e. Because of international and domestic cost adjustments, it is always the case that $P_m > P_e$. Then:

$$(16) \quad \begin{cases} \text{(a) if } P^* > P_m \text{, then } P_m \text{ is the relevant } P_{ar} \\ \text{(b) if } P_e > P^* \text{, then } P_e \text{ is the relevant } P_{ar} \\ \text{(c) if } P_m > P^* > P_e \text{, then } P^* \text{ is the relevant } P_{ar} \end{cases}$$

Depending on whether P_d is greater than, less than or equal to the relevant adjusted reference price, one can determine the level of protection or disprotection relative to the price level that would exist in the absence of the policy interventions.

In this analysis, we maintain the assumptions of a small country model and of fixed supply (i.e. perfectly inelastic supply curves). We assume further a downward sloping demand curve inclusive of private stockholding decisions. For simplicity we also assume the consumer price is equal to the government-fixed producer price of P_d, though if appropriate, this assumption could be relaxed. In each of the three cases (a) – (c) above, there are four scenarios that can be distinguished based on the relationships among P_d, P^*, P_m and P_e.[14] In cases (a) and (b), there are scenarios where net trade retains the same direction and where its direction changes when the policy interventions are removed.

Starting with case (16a) where $P^*>P_m$, Figure 1a shows four scenarios where P_d would be equal to P_m under free trade, and thus P_m is the relevant adjusted reference price for calculating MPS with the policies in place. In the first and second scenarios, P_d is held relatively low, with $P^*>P_m>P_e>P_1$ and $P^*>P_m>P_2>P_e$, respectively. In both of these scenarios, the commodity is imported (or government intervention stocks are being reduced), and farmers are disprotected relative to P_m. In these scenarios, the adjusted reference price based on current net trade, and based on the relevant price in the absence of the policy interventions are the same. Under free trade the domestic price would increase to P_m, with domestic demand and imports and decreasing.

In the third scenario in Figure 1a, $P^*>P_3>P_m$. In this scenario, the commodity is imported (or government stocks are being reduced), but the domestic price is greater than P_m so farmers are now protected, for example by a tariff. The adjusted reference price based on current net trade, and based on net trade in the absence of the policy interventions are again the same in this scenario.

[14] Actually, there are seven distinct scenarios, but for simplicity we are ignoring the cases where $P_d=P_m$, $P_d=P_e$, and $P_d=P^*$.

In the fourth scenario, the domestic price is set even higher, with $P_4>P^*>P_m$. In this scenario, the commodity is exported or government intervention stocks are accumulated under policies that hold the domestic price above the autarky price. However, under free trade, the domestic price would fall to P_m and the commodity would be imported. For $P_4>P^*$, the conventional MPS based on the adjusted reference price P_e corresponding to the current trade status would overestimate the level of protection since $P_m>P_e$. Comparing P_4 and P_e would provide an estimate of the level of per unit subsidy needed to export the commodity, but not of the OECD MPS definition of the gross transfers to producers from taxpayers and consumers.[15]

In case (16b), $P_e>P^*$, and P_e is the relevant adjusted reference price. The four scenarios shown in Figure 1b for this case are symmetrical to those for (16a). In the first scenario in Figure 1b, $P_e >P^*>P_1$ and the commodity is currently disprotected and imported. In this scenario, because the world price is higher than in Figure 1a, if the policy interventions were removed, the domestic price would increase to P_e and the commodity would be exported. In the second scenario, $P_e>P'_2>P^*$. The commodity is again disprotected but is exported. Under free trade the price would increase to P_e. In the third and fourth scenarios, $P_m>P'_3>P_e$ and $P_4>P_m$, respectively. The commodity is protected relative to P_e and is exported under these two scenarios. If the policy intervention were removed, the domestic price would fall to P_e.

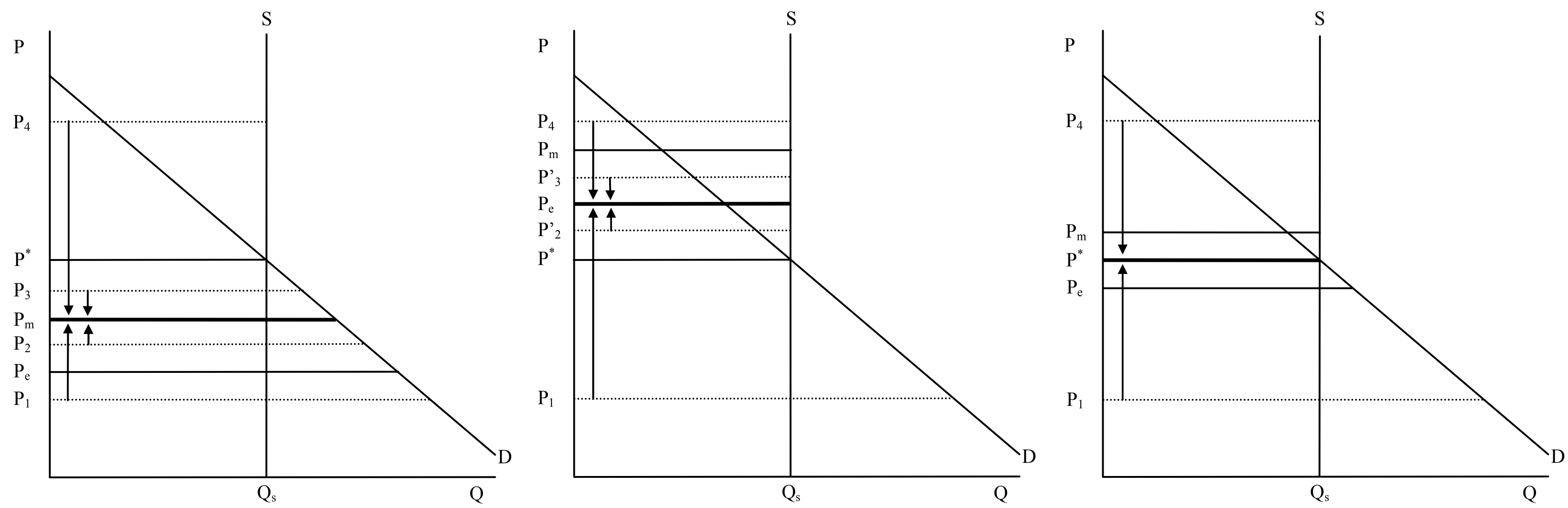
To summarize, in Figure 1a, at P_1, P_2 and P_3 the commodity is imported and at P_4 the commodity is exported. At P_1 and P_2, the commodity is disprotected relative to P_m, and at P_3 and P_4, the commodity is protected relative to P_m. In each scenario, if the policy interventions were removed, the domestic price would equal P_m because $P^*>P_m$. The country would import or draw down its intervention stock levels. In Figure 1b, at P_4, P'_3 and P'_2 the commodity is exported and at P_1 it is imported. At P_4 and P_3, the commodity

[15] One way to capture both the gross transfers from taxpayers (the export subsidy component) and the gross transfers from consumers (due to the higher domestic price relative to the price that would exist without the policy in place) is to sum P_4-P_e multiplied by the quantity exported and P_4-P_m, multiplied by the quantity of domestic consumption, the transfer from consumers.

is protected relative to P_e and at P_2 and P_1, the commodity is disprotected relative to P_e. In each of these scenarios, the domestic price would go to P_e because $P_e > P^*$.

There is a third case (16c) to consider, as shown in Figure 1c. In this case $P_m > P^* > P_e$ and P^* is the relevant adjusted reference price. The conventional MPS definition does not seem to allow for cases where the relevant adjusted reference price would be the autarky price, P^*. However, if the gap between P_m and P_e is large, which is likely for some developing countries where internal and external transport and handling costs are high, the autarky price could fall between P_m and P_e, as was demonstrated empirically for wheat in Pakistan by Byerlee and Morris (1993). Regardless of whether the country is currently using policy interventions that are disprotecting producers relative to P^*, as at P_1, or the country is currently protecting producers relative to P^*, as at P_4, when the policy interventions are removed, the domestic price will go to P^* and the country will be self-sufficient. The commodity will be non-traded if the policy interventions are removed because P_m is "too high" relative to P_d for imports to be competitive in the country and P_e is "too low" for exports to compete in the world market.

Figure 1—Computing the MPS Under Alternative Price Scenarios



a. If $P^*>P_m$, then P_m is the relevant P_{ar}

b. If $P_e>P^*$, then P_e is the relevant P_{ar}

c. If $P_m>P^*>P_e$, then P^* is the relevant P_{ar}

Figure 1 shows that the relevant reference price depends on the relationship between P^* and P_m and P_e. In the three panels, P_1 - P_4 are possible prices set by domestic policy. As shown in panel 1c, if $P_m>P^*>P_e$, then P^* is the relevant reference price. Whether the domestic policy supports agriculture (at P_4) or disprotects agriculture (at P_1), when the policy is removed the price becomes P^*. Likewise in panels 1a and 1b, regardless of the level of the domestic price set by policy or the corresponding trade pattern, P_m and P_e are the relevant reference prices under the price relationships specified. In the figure and our empirical calculations, we treat annual production as pre-determined (consistent with interpretation of PSEs as transfers to farmers given an observed fixed supply) but allow demand to adjust to clear the market in our counter-factual annual determinations of P^* . If we let the supply also adjust, the P* obviously would be different.

Using the scenarios in the three cases above, we can describe the circumstances under which the conventional MPS will be different than the "modified" procedure of selecting a relevant adjusted reference price based on the relationship among P_d, P^*, P_m and P_e and when the two results are the same. If the commodity is imported, for the conventional MPS the domestic price is compared to P_m. Thus, at P_1, P_2, P_3 in Figure 1, the conventional MPS would be given by a comparison of the domestic price and P_m. However, as shown for P_1, the appropriate comparison may be P_m, P_e or P^*, depending on whether P^* is above, below, or between P_m and P_e. Generalizing, for an imported commodity that is disprotected relative to P_m, the conventional MPS may not be an appropriate measure of the gross transfers to producers resulting from support policies. In order to differentiate these cases, one must compute P^* and compare it to P_m and P_e. However, if the commodity is imported and *observed to be protected*, for example at $P_3>P_m$ in Figure 1a, then the appropriate MPS is unambiguously given by comparing the domestic price to P_m. In this scenario, one would not have to compute P^* to obtain this result.

If the commodity is exported, as at P'_2, P'_3 and P_4 in Figure 1, the conventional MPS is based on a comparison of the domestic price and P_e. Yet, at P_4 for example, P_m, P_e or P^* may be the relevant adjusted reference price, depending on whether P^* is above, below, or between P_m and P_e. Generalizing, for commodities that are exported and protected relative to P_e, the conventional MPS may not be an appropriate measure of the gross transfers to producers required to keep farm income constant when the policies are removed. In order to differentiate these situations, one must compute P^*. But here, if the commodity is exported and *observed to be disprotected*, for example at P'_2 in Figure 1b, then the appropriate MPS is unambiguously given by comparing the domestic price to P_e. Again, one would not have to compute P^* to obtain this result.

To review, following Byerlee and Morris (1993), a comparison of the autarky price to the computed import and export adjusted reference prices can be used to identify the relevant adjusted reference price. In doing so, the MPS concept can be applied to situations where a commodity would be non-traded if the existing policy interventions were removed, a situation the conventional MPS does not accommodate. We have demonstrated herein that unless a commodity is imported and protected relative to P_m or exported and disprotected relative to P_e, the MPS based on current trade status can be misleading.

3.3 ECONOMIC CRITIQUES OF THE PSE

While the preceding discussion focuses on adjustments relevant to PSE largely within the framework laid out by the OECD (Portugal, 2002), it is also useful before proceeding to our empirical analysis to summarize a few of the broader conceptual critiques that have arisen over the derivation and interpretation of PSEs. The concerns broadly fall into two categories, those related to the assumptions of the PSE concept and those related to its interpretation.

Silvis and van der Hamsvoort (1996) argue that the assumption that the domestic price and quantity and international prices are independent (that all countries are small and therefore cannot individually affect world prices) is unrealistic. On this basis alone, PSEs may overestimate agricultural support in OECD or other countries because they are based on current world prices instead of long-term equilibrium (free trade) prices. Although long-term equilibrium prices are difficult to estimate, they are expected to be higher than current world prices that are depressed by subsidies, so using equilibrium prices would result in a PSE that is smaller than the OECD's estimates for its member countries (Oskam and Meester, 2003). For developing countries, the subsidies and border protection of OECD countries with protected agriculture drive down world prices, resulting in disprotection to their farmers being implicit in the adjusted reference price from world markets. Beierle and Diaz-Bonilla (2003) review numerous studies of these price effects and conclude that "a common estimate of the extent to which OECD policies depress prices is 10 percent" with larger effects on commodities such as sugar, sheep meat and milk. This external effect tempers the interpretation of PSE for developing countries calculated on the basis of observed world prices.

On technical grounds, the PSE implicitly assumes that domestic and internationally produced goods are perfect substitutes or that a quality adjustment can be made to make them such. This is a departure from the Armington assumption often employed in computable general equilibrium (CGE), and some partial equilibrium, models. Under the Armington assumption, similar goods from different countries are imperfect substitutes for which equilibrium prices will not be equal even when adjustments are made for arbitrage. In these models, various elasticities of substitution in production and consumption are assumed between domestic and traded goods. Changes in output quantities affect prices in the models, and effects of policy change can be evaluated at the resulting equilibrium prices under each scenario.

The assumption that the price elasticity is equal to zero may be consistent with an *ex post* measurement of the gross transfers to producers, yet it cannot substitute for a modelling approach to measuring the price, production, consumption, trade, income or welfare effects of agricultural policies either *ex ante* or over time (Herrmann et al., 1992). PSEs cannot be used directly to predict the trade effects of policy changes. For example, the liberalization of a production quota and price guarantee policy with equivalent PSE measures would have very different effects on trade (Silvis and van der Hamsvoort, 1996).[16] Herrmann et al. (1992) argue that the PSE, as an income-oriented measure, is not well suited to capture the trade effect of agricultural policies. Instead, they propose a "trade distortion equivalent" based on the difference between the quantity traded with policy interventions in place and a hypothetical quantity traded under free trade.

It is particularly important to realize that PSEs are not the same as producer surplus, though sometimes they are misinterpreted as such (Oskam and Meester, 2003). PSEs based on current prices and fixed quantities are neither linked with the welfare

[16] Oskam and Meester (2003) also show that if a quota system is in place, the PSE methodology may underestimate its effects on producers.

economic theories of producer surplus, nor are they comparable to the estimated benefits of agricultural liberalization derived from partial equilibrium or CGE models, when there is a supply response. Oskam and Meester (2003) demonstrate, for example, with a stylised, one-commodity, three-country model that the MPS and producer surplus not only differ in magnitude, but can also be of the opposite sign. Moreover, the authors argue that it is difficult to interpret the total PSE, because of the simple aggregation of market price support and budgetary expenditures whose measurement is not related to general welfare economics.

Based on the strong assumptions on which the PSE is computed, its interpretation must be taken somewhat narrowly. The OECD originally adopted the PSE framework because it "incorporates explicitly all domestic agricultural policies directly or indirectly affecting trade" (Cahill and Legg, 1990 p. 14), and the PSE does provide a comprehensive measure of the support to farmers. But it is not feasible to interpret each dollar of PSE support as having the same effects on production or trade as any other dollar of support. The ultimate beneficiaries of support to agriculture are also an issue in the measurement and interpretation of PSEs for developed and developing countries. PSEs may overestimate the policy benefits to farmers if others capture a significant portion of the benefits. Several studies have demonstrated that a large share of the transfers from taxpayers and consumers to agricultural producers goes to other parts of the production chain or to fixed factors of production such as land. For example, Dewbre et al. (2001) find that subsidies on purchased inputs, which many developing countries rely on to transfer support to producers, are the least efficient in providing income to farmers. Burfisher and Hopkins (2003) calculate that farm operators may retain as little as 40 percent of the benefits of the decoupled direct payments in the United States because the majority of the payments are capitalized into land values, resulting in higher rental rates.

A comparison of two simple magnitudes illustrate the effects of these points vividly. While most CGE models indicate that full agricultural liberalization would increase world agricultural gross domestic product by US$40-80 billion per year (Oskam and Meester, 2003), the average 2000-2002 sum of total PSEs for OECD countries was US$235 billion (OECD, 2003). The sum of total PSEs is sometimes misinterpreted as the benefits that would accrue to non-subsidized agricultural producers under reform of agricultural policies, when those benefits are much smaller.

Despite these shortcomings, PSEs are widely reported measures of agricultural subsidies and protection. With full understanding of the assumptions on which the PSE is based and the context in which it should be interpreted, the PSE can be a useful measure for comparison of support across commodities and countries. For this reason, a careful application and analysis of the PSE for developing countries is timely.

4. PSEs FOR INDIA AND CHINA

We now turn to our illustrative estimates of PSEs for India and China. In the following sections we 1) describe our data sources, 2) specify the adjustment methods we employ in various cases, 3) examine in depth the market price support, budgetary paytments, and product-specific PSEs for wheat in India with particular attention to how alternative adjustments influence the estimates we derive, and 4) extend the results to additional commodities in India and China, evaluating the effects of alternative scaling up procedures on the total PSE results. This analysis provides several alternative estimates of market price support and PSEs for India and China and we discuss directions for further research.

4.1 DATA SOURCES

As discussed in section 3.1, computing PSEs is an intensive empirical exercise; for ideal research, data for all of the variables in equations (1) and (2) would be readily available. In reality, the empirical estimation of PSEs relies on both the available data and the analysts' judgments on how to minimize measurement errors.

Our calculation of PSEs for India draws heavily on previous studies by Gulati et al. (1990), Gulati and Kelley (1999), Gulati and Narayanan (2003), and Gulati and Pursell (forthcoming). Data for the computation of the MPS is taken directly from the detailed database for 1964-65 to 2001-02 of Gulati and Pursell (forthcoming). This data includes reference prices for all main Indian crops, exchange rates and port charges. Production quantities, farmgate and price-support or wholesale domestic prices, domestic transport costs, and marketing and processing margins are included for important producing states. Sources for international prices in the database vary depending on the commodity and include USDA and FAO for cereals, *Oil World* for some oilseeds, and IMF International Financial Statistics (IFS) for various other commodities. Exchange rates are taken from the IFS market rates. International freight for wheat is drawn from an annual series in the *FAO Trade Yearbook*, 1999 and adjusted for subsequent years. International freight for other commodities is given by adjusting the wheat freight rate if other rates are not available. Domestic prices are taken from *Agricultural Prices in India,* (various years) and production data is from *Agricultural Statistics at a Glance,* (various years). Estimates of port charges and domestic transportation costs are based on an earlier study by Sharma (1991) and are projected forward using the procedure described in Pursell and Gupta (1996). Marketing costs are taken as a percentage of P_d of each commodity and vary from 5 percent to 10 percent. For products requiring substantial processing, the prices included are at the wholesale (processed) level—for these commodities, subsequent MPS calculations are made with price comparisons between adjusted references prices and prices of equivalent commodities at the wholesale, not farmgate, level. Aggregate estimates of subsidies on fertilizer, power and irrigation are from Gulati and Narayanan (2003) and are projected for 2000-2003.

In the case of China we draw on results from work at IFPRI by Dongsheng Sun (2003). His data on agricultural production are drawn from *Agricultural Statistics of*

China and *China Rural Statistics Yearbooks* published by China's State Statistics Bureau (SSB). The producer prices at the farmgate represent average prices farmers receive when selling their products and are drawn from the farm household survey published by State Development and Planning Committee (SDPC) in *National Compilation of Costs and Benefits of Agricultural Products*. The survey covers 60,000 farmer households in 1,550 counties. The reference prices at the border (P_r) are calculated as unit value of exports or imports from *China Customs Statistics*. In the case of China, no adjustments to the reference prices are made for within country costs, but Sun (2003) makes several quality adjustments between the internationally traded and domestic goods.

Information regarding budgetary expenditures on agriculture in China is collected from various sources; for example, it is drawn for 1996-1998 from China's domestic support table submitted to the WTO (WT/ACC/CHN/22). The foreign exchange rates are the medium price of China's official exchange rate, from *China Statistic Yearbooks* published by SSB. Support that is not product specific is allocated across commodities based on their share of the total value of agricultural production. Sun's analysis covers the period 1995-2001 and is comparable to earlier work for 1985-1994 by Cheng and Sun (1998).

4.2 PSE ESTIMATION

The starting point for estimation of the MPS components of the PSEs are equations (1) and (2). For many commodities in India, the direction of net trade varies among the years of our period of analysis, 1985-2002. For this reason, we compute and compare MPS and PSEs assuming both that the commodities are importables ("importable hypothesis") and exportables ("exportable hypothesis") in each year to demonstrate the effects of various adjustments. Then, we use a *modified procedure* based on the Byerlee and Morris (1993) approach in which we compute P^* and compare this price to the national average adjusted reference price for an import commodity and an export commodity. Depending on the relationship between P^* and P_m and P_e (i.e. if P^* is above, below, or between P_m and P_e) we use the relevant reference price to compute the MPS, as discussed in Section 3.2.

4.2.1 MPS Calculations

In India, for importables, the major consumption region is assumed to be the port cities, for example, Bombay. Reference prices at the border for imported commodities are calculated according to equation (3) for the quality level that most closely resembles that produced in India.[17] Reference prices at the border for export commodities are taken as the export prices of major competitors, $P_{exporterfob}$, for an equivalent quality level. This represents a departure from equation (4) and implicitly assumes that the international freight from the competing exporting country to a third-country importer and from India to a third-country importer are equal.

Given the operation of the national price support policies, the existence of some state-level agricultural policies, and the interstate movement restrictions that were in place in India until 2002, farmers in various states are expected to receive different levels of protection or disprotection from the agricultural policy regime. For most of the major commodities in India, the Gulati-Pursell data allows representative analysis at the state level. Important producing states or regions are divided into "net surplus" and "net deficit" areas as described earlier. In calculating the MPS price gap, the point of comparison between the imported commodity and the commodity produced in the surplus region is assumed to be the wholesale market in the port city, with the adjusted reference price for a "net surplus" region under the importable hypothesis given by:

$$(17) \qquad P_{ar_s} = P_{exporterfob} + (T_i + C_i) + (C_p) - (T_{w:s} + M_s)$$

[17] Given the small trade volumes of the major commodities in India, there is substantial variation between import and export unit values and the commonly applied international prices series (i.e. U.S. hard red winter wheat f.o.b. U.S. Gulf, U.S. number 2 yellow corn f.o.b. U.S. Gulf, and Thai rice prices f.o.b. Bangkok). See Cheng (2004) for comparisons between unit values and international prices. Instead of using unit values, we follow Gulati et al. (1990) and select international prices for the quality level that is comparable to that produced domestically.

where the transportation costs from the port to the port-city wholesale market (T_{d1}) are assumed inconsequential, $T_{w:s}$ is the transportation cost from the surplus region to the port-city wholesale market, and M_s is marketing costs in the surplus region. The adjusted reference price for a deficit region can then be computed, following the procedure of Gulati et al. (1990) and Pursell and Gupta (1996), as either the adjusted reference price given by equation (1) for imports coming directly to the deficit region, or as the adjusted reference price of a nearby surplus region plus the transportation, handling and marketing costs from the surplus region to the deficit region, given by:

$$(18) \qquad P_{ar_d} = P_{ar_s} + \left(T_{d:s} + M_d\right)$$

where $T_{d:s}$ is the transportation cost from the surplus to the deficit region and M_d is marketing costs in the deficit region.

If the commodity is an export, only surplus regions are included in our analysis. In this case the adjusted reference price is:

$$(19) \qquad P_{ar} = P_{\exp orterfob} - \left(C_p\right) - \left(T_{d2} + M\right)$$

which is essentially equation (2) with T_{d1} assumed inconsequential and quality of the domestic and international commodity assumed to be equivalent.

Once state-level adjusted reference prices are derived, state-level nominal MPS can be computed. These results are then aggregated for the included states and the total expanded to an estimate of the national average MPS (see Pursell and Gupta, 1996). A national average P_m and P_e can also be computed using the value of production in the included states as the weights. It is the national average import and export adjusted reference prices that are compared to a P^* estimated at the national level to determine the adjusted reference price in application of the MPS modified procedure.

On the choice of timeframe, for India we use average harvest season prices where available. If the large majority of farmers sell their products during the harvest season, then seasonal prices are the best indicators of the incentives to farmers resulting from the difference between domestic and international prices. In cases where we use domestic harvest season prices, international prices and exchange rates pertaining to the same timeframe are also utilized. We calculate the MPS based on all production, rather than marketable surplus, thereby making the assumption that producers value all of their production at the domestic price, even if some is consumed on-farm.

For China, P_r is given by the import or export unit value. [18] Given the limited data available for China, in the preliminary calculations reported herein, we have only adjusted P_r to reflect differences in international and domestic quality, where such difference are assumed to exist. Thus, for these commodities:

$$P_{ar} = P_r - Q_{adj} \tag{20}$$

We recognize that in omitting internal cost adjustments our results for China have a downward bias in the case of import commodities whenever $(C_p + T_{d1}) < (T_{d2} + M)$. Omitting internal costs in the case of export commodities will result in a systematic downward bias, to the extent that $(C_p + T_{d1}) + (T_{d2} + M) > 0$. We plan to evaluate the magnitude of this bias for China in future research.

4.2.2 Budgetary Payments

For India, wherever possible we use subsidies on tradable inputs that have been computed via a comparison of farm-level prices with comparable adjusted reference ("import parity") prices, analogously to the output price gap calculations. In particular, we use Gulati and Narayanan's (2003) fertilizer subsidy estimates that are based on these price differences. Since it is not possible to obtain an import parity price for non-tradable inputs, subsidies or taxes on these factors of production must be measured via budgetary

[18] See Sun (2003). While the use of import or export unit values can be problematic for commodities where the trade volume is small or where the traded quality differs from the domestically produced quality, Cheng (2004) shows that for China, unlike for India, unit import and export values move reasonably closely with the international prices of major exporters. Use of unit values to compute the adjusted reference prices eliminates measurement errors in computing international transport costs, but could increase measurement errors due to quality differences.

outlays, or if data allows on the difference between the cost to the government of supplying certain services (i.e. power or irrigation) and the fees charged for those services (Gulati and Narayanan, 2003). Fertilizer subsidies are allocated across commodities based on the commodity's share of fertilizer usage, while irrigation and power subsides are distributed based on the share of irrigated area (as reported in USDA, 1994).

For China, budgetary outlays include input subsidies, relief payments and regional assistance programs. Agricultural taxes and forgone agricultural taxes are also included. Non-product specific payments are allocated to individual commodities based on their share of the total value of agricultural production.

4.3 RESULTS FOR INDIA

Turning now to our results for India, we draw on the detailed data available to demonstrate how various adjustments to the reference price affect the resulting MPS values for wheat (1985-2003), then extend our results to rice and corn (1985-2002) and estimates of a total PSE on this basis. India is the third largest producer and consumer of wheat. A minimum support price (MSP) has been and remains in place at which the government procures wheat, providing a price floor for farmers. The effects of the restrictions on domestic wheat movements among states and even districts, and the stocking limits on private traders have been to drive down the "farm harvest price" to the MSP. Thus, throughout the period of our analysis, the MSP is effectively the price received by producers.

World price fluctuations, government policy and domestic market shocks are factors that have affected both the net trade and changing stock levels of wheat in India. Since wheat is a storable commodity, the gap between supply and demand can be attributed to the sum of stock accumulation and net exports. Over the period 1985-2003, there is considerable variability in net exports and changes in stocks, though not always in the same direction (Figure 2). If supply is greater than demand for any given year, stocks are accumulating or the country is a net exporter, or both. If supply is less than demand for any given year, stocks are decreasing or the country is a net importer, or both. Sometimes these adjustments work in opposite directions: for example, with stocks rising and imports occurring.

In terms of India's wheat trade in particular, exports were restricted until 1995, and from 1985 to 1994 India imported very little wheat (see Figure 2) except in two years (1988 and 1992) when production fell short of domestic consumption. Recall that wheat and other cereal imports are subject to state trading by the FCI. In 1995, the Indian government moved wheat onto the list of freely exportable goods. As exports started picking up, there was upward pressure on domestic wheat prices and the government hastily banned exports in 1996 and opened up imports of wheat at zero import duty. In particular, the roller flourmills in southern India succeeded in securing the right to import wheat freely, although initially not much came in, as domestic prices were below world prices.[19] But in the following years, especially from 1998 onwards, the world prices of wheat and most other agricultural commodities fell, while Indian support prices continued to rise. India imported some wheat in 1998 and 1999, despite bumper crops harvested in these years. This led to a situation where imports were coming in even as domestic food grain stocks reached unprecedented levels. To stem the flow of imports, the government raised the import duty from zero to 50 percent on December 1, 1999 against a WTO bound rate of 100 percent. The government also started offloading wheat stocks to private traders for export at concessional rates—about 75 percent of the minimum support price in 2001 (USDA, 2002b). Under these policies, over the past three years India has emerged as a net exporter of low quality wheat, shipping an estimated 5 million tons in 2002/03 to South and Southeast Asia and the Middle East.

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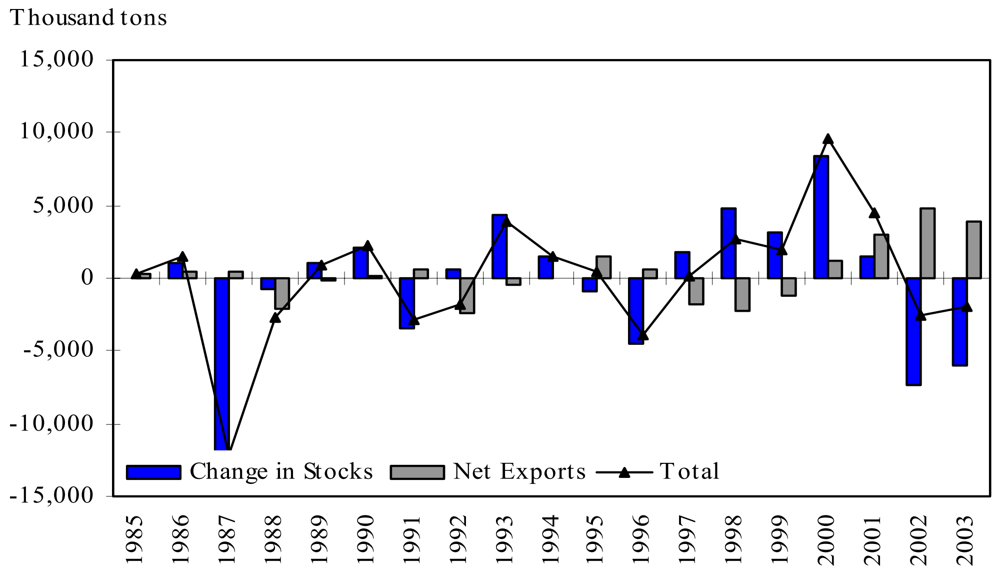
[19] The motivation behind this policy change reflects an interesting aspect of the political economy of trade policy. Roller flourmills have always complained about the constraints they face in procuring wheat (grown mainly in the northern states). They argue for instance, that the northern industry, which is closer to the central government and has better bargaining power gains from discriminatory pricing of the FCI's open market sale of wheat (Business Line, 2001).

Figure 2—India Wheat Net Exports and Changes in Stocks, 1985-2003



Source: USDA-FAS PSD database, February 2004.

4.3.1 MPS for Wheat Under the Import, Export and OECD Transition-Economy Assumptions

Price comparisons and annual estimates of the wheat %MPS for 1985 to 2003 are shown under several alternative assumptions in Table 1. In our calculations, we compute the MPS based on the difference between the minimum support price for wheat each year (P_d in Table 1) taken as a proxy for domestic farmgate price and the adjusted reference prices. The unadjusted reference prices for exports ($P_{exporterfob}$ in Table 1) are taken in U.S. dollars as the price of U.S. hard red winter wheat f.o.b. U.S. Gulf.[20] Adding the international transportation costs from the U.S. Gulf to India to $P_{exporterfob}$, gives P_{cif}, a U.S. dollar unadjusted reference price for imports. Simple multiplication of the prices and the exchange rate gives these unadjusted border prices in rupees per ton. The unadjusted reference prices are not shown in Table 1. Instead the average adjusted reference prices (P_m and P_e) are given following equations (17) – (19) and the data sources, internal

[20] There could be a systematic downward bias in the MPS given by a comparison of P_{ar} based on the price of U.S. hard red winter wheat without quality adjustments and P_d if the quality of U.S. hard red winter wheat is better than Indian wheat. The internationally traded wheat that is most similar in quality to Indian wheat is Australian Standard White or General Purpose (Stevens, 2003). However, export prices of Australian wheat are not available, thus we follow earlier studies and use U.S. prices, recognizing that our results could fail to account for quality differences.

adjustments and regional averaging described above. Our estimates (discussed below) of the market-clearing autarky prices (P^*) are also shown in Table 1.

Under the importable hypothesis, we compute the wheat MPS for two key surplus states (Haryana and Punjab) and one main deficit state (Uttar Pradesh). We then aggregate the results to a national level. Under the exportable hypothesis, we compute the wheat MPS by state for Haryana and Punjab and derive our national estimate from these results. In the MPS results in Table 1, the national results based on the internal cost adjustments and state-based aggregation are shown under both the importable and exportable hypothesis (these estimates are labelled "Adjusted Reference Prices"). We also compute a simplified MPS based on the difference between the minimum support price, MSP, and the unadjusted reference prices at the border (c.i.f. for importables, f.o.b. for exportables) without internal adjustments (labelled "Unadjusted Border Price"). We also report the MPS for wheat using the OECD transition-economy approximation given by equation (8) in Table 1.

These results in Table 1 suggest several important findings. First, for wheat in India under the importable hypothesis the results with internal adjustments do not differ significantly from those without internal adjustments. Recall in the specification of P_{ar}, that for imports C_p is added to P_r, while $T_{w:s}$ and M_s are subtracted from P_r, for a surplus region. While $T_{d:s}$, and M_d are added back to P_{ars} to obtain the adjusted reference price for a deficit region, the effect is that the net adjustment is small when averaged across regions, and the difference between the %MPS with internal adjustments and at the border without internal adjustments is also small.

Second, there is a greater difference for the unadjusted and adjusted reference prices under the exportable hypothesis than under the importable hypothesis. Under the exportable hypothesis, the %MPS results with the adjusted reference price are greater than for the unadjusted reference price by 12.0 percent (in 1996) to 59.9 percent (in 2000). Recall that in the specification of P_{ar} for an export that C_p, $T_{w:s}$ and M are subtracted from P_r. This has important implications for computing the MPS for export commodities. The MPS based on a comparison of domestic prices and unadjusted reference prices can have a large systematic downward bias if internal adjustments are large.

Third, when comparing the results for adjusted border price under the importable and exportable hypotheses with the OECD transition-economy approach, the latter method seems to be a hybrid of the two, with the results falling between the two. The %MPS under the OECD transition-economy approach are most similar to the %MPS under the exportable hypothesis at the unadjusted border price. The results under the OECD transition economy approach are equivalent to the %MPS under the exportable hypothesis at the unadjusted border price plus M/P_{ar} or $0.06*P_d/P_{ar}$, since the marketing and processing costs from the farmgate to the wholesale market are taken as a percentage (in this case six percent) of the domestic price.

Turning now to the substantive issue of levels of protection or disprotection, we focus on our estimates of the %MPS with adjusted reference prices. The results under the exportable hypothesis are greater than those under the importable hypothesis because under the exportable hypothesis, the domestic price is compared to the adjusted reference price of an efficient exporter, which is less than the adjusted reference price for India as an importer. Under both the importable and exportable hypotheses, there are large fluctuations in the %MPS over time, partly being counter-cyclical to international price movements and partly reflecting changes in the domestic support price. Generally, the level of protection (disprotection) increases (decreases) when world prices are low and decreases (increases) when world prices are high. The MPS is consistently negative under the importable hypothesis but varies from -4.3, -6.3 and -15.2 percent in 1986, 1987 and 2000, respectively, when world prices were relatively low, to -55.4 percent when world prices peaked in 1996 and 1997. Under the exportable hypothesis, the %MPS has a similar pattern, being highest in 2000 (74.8 percent) when the combination of rising support prices and falling world prices increased the implicit level of protection, and lowest in 1996 and 1997 (-34.1 percent) when world prices were high. Disprotection under the importables hypothesis is less, and protection greater under the exportables hypothesis, during 2001-2003 than during the 1990s.

Table 1—India Wheat Prices, %MPS and PSE Under Various Assumptions, 1985-2003

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Price Data																			
$P_{exporterfob}$ (US$/MT)	154	139	116	115	136	174	125	143	146	140	152	192	197	151	121	109	122	128	140
P_{cif} (US$/MT)	184	169	141	140	179	215	165	184	188	181	196	235	241	194	163	150	164	169	181
Exchange Rate (Rs/US$)	12.5	12.5	12.8	13.4	16.1	17.3	20.5	25.9	31.3	31.4	31.4	34.7	35.8	40.8	42.9	44.1	46.9	49.0	47.4
P_d (Rs/MT)	1520	1570	1620	1660	1730	1830	2150	2250	2750	3300	3500	3600	3800	4750	5100	5500	5800	6100	6200
P_m (Rs/MT)	2200	2009	**1693**	**1771**	2795	3608	3261	4654	5760	5537	6017	8061	8509	7747	6853	6482	7538	8125	8414
P_e (Rs/MT)	**1504**	1295	995	1007	1607	**2352**	1832	**2908**	**3652**	**3340**	**3614**	**5459**	**5767**	**4676**	3624	3146	4023	4459	4721
P^* (Rs/MT)	1496	**1468**	2318	1847	**1671**	1657	**2363**	2393	2355	3134	3411	4032	3789	4357	**4730**	**3928**	**5152**	**6225**	**6544**
Wheat %MPS Estimates																			
Importable Hypothesis																			
Adjusted Reference Prices	-31.0	-21.9	-4.3	-6.3	-38.2	-49.3	-34.1	-51.7	-52.3	-40.5	-41.9	-55.4	-55.4	-38.7	-25.6	-15.2	-23.1	-25.0	-26.4
Unadjusted Border Price (c.i.f.)	-33.7	-25.6	-9.9	-11.7	-40.1	-50.9	-36.6	-52.7	-53.3	-41.9	-43.1	-56.0	-55.9	-40.1	-27.1	-17.0	-24.7	-26.5	-27.8
Difference	2.8	3.7	5.5	5.4	1.9	1.6	2.4	1.0	1.0	1.5	1.3	0.6	0.5	1.3	1.5	1.8	1.6	1.5	1.4
Exportable Hypothesis																			
Adjusted Reference Prices	1.0	21.2	62.8	64.9	7.7	-22.2	17.4	-22.6	-24.7	-1.2	-3.1	-34.1	-34.1	1.6	40.7	74.8	44.2	36.8	31.3
Unadjusted Border Price (f.o.b.)	-21.0	-9.9	9.6	7.8	-21.2	-39.2	-16.1	-39.4	-40.0	-24.7	-26.5	-46.0	-46.2	-22.9	-2.1	14.9	1.0	-2.5	-6.2
Difference	22.1	31.1	53.2	57.1	28.9	17.1	33.4	16.8	15.3	23.5	23.4	12.0	12.1	24.5	42.8	59.9	43.2	39.3	37.5
OECD Transition Economy Approach	-16.3	-4.4	16.2	14.3	-16.5	-35.6	-11.0	-35.8	-36.4	-20.2	-22.1	-42.8	-43.0	-18.3	3.8	21.8	7.0	3.4	-0.6
Modified Procedure	1.0	7.0	-4.3	-6.3	3.5	-22.2	-9.0	-22.6	-24.7	-1.2	-3.1	-34.1	-34.1	1.6	7.8	40.0	12.6	-2.0	-5.3
Wheat PSE Under Modified Procedure																			
MPS (Rs. bil)	0.7	4.8	-3.2	-5.1	3.2	-26.0	-11.7	-36.7	-51.6	-2.4	-7.5	-115.4	-136.4	4.9	26.4	120.0	44.6	-9.2	-23.9
Budgetary Payments (Rs. bil)	8.7	10.3	8.4	15.5	21.9	26.2	34.9	36.9	42.0	47.8	68.9	83.5	88.8	96.1	108.2	114.9	126.6	135.8	148.9
Nominal PSE (Rs. bil)	9.4	15.1	5.2	10.3	25.1	0.2	23.2	0.2	-9.6	45.4	61.4	-32.0	-47.6	101.0	134.5	235.0	171.2	126.6	125.1
PSE (%)																			
OECD Denominator	12.4	17.9	6.5	11.2	21.7	0.2	15.1	0.1	-4.8	18.5	20.5	-10.4	-13.5	24.6	28.5	43.9	32.6	21.7	21.6
Trade Economist Denominator	14.2	21.9	6.9	12.6	27.8	0.2	17.8	0.1	-4.6	22.7	25.8	-9.4	-11.9	32.6	39.9	78.3	48.3	27.7	27.6

Source: Authors' calculations.

Note: Relevant adjusted reference price (P_{ar}) following the modified procedure is shown in **bold**. Multiplication of $P_{exporterfob}$ and P_{cif} by the exchange rate gives the unadjusted reference prices in rupees (P_r in equations 1 and 2, respectively, not shown in the table). P_m and P_e (shown above) are the adjusted reference prices from those equations as modified through the regional analysis and aggregation (see text).

The wide range of %MPS results for wheat over time and under the importable hypothesis compared to the exportable hypothesis, raise some questions as to what exactly have been the levels of protection or disprotection of wheat in India over various years. To further complicate matters, wheat is essentially a non-traded commodity (net trade less than 500,000 tons) in over one-third of the years between 1985-2003. Thus, it is not always clear if the domestic price should be compared to an import or export adjusted reference price. Given these concerns, we explore how the results change when we select the appropriate adjusted reference price based on the relationship between world prices and the autarky price in each year using our modified procedure.

4.3.2 MPS for Wheat with Possible Market-Clearing Domestic Prices

As opposed to applying the importable or exportable hypothesis based on net trade in each particular year, following the Byerlee and Morris (1993) procedure we compute the level of protection or disprotection relative to the relevant adjusted reference price (P_{ar}) given in equation (16). To do so it is necessary to compute an estimate of P^*, which requires some information on the price elasticity of demand and on domestic consumption quantities and prices.[21] The elasticity estimates available in the literature vary widely depending on the model and data used, and our calculation of P^* will vary depending on the elasticity assumed. Not binding ourselves to any particular estimate, we use -0.5 as an illustrative value, as used in Gulati and Kelly (1999).[22] We supplement the Gulati and Pursell database with domestic consumption for 1985-2003 from the USDA-FAS Production, Supply and Demand database (USDA, 2004).[23] For simplicity, we have assumed that the initial consumer price is equivalent to P_d. We then compute the %MPS

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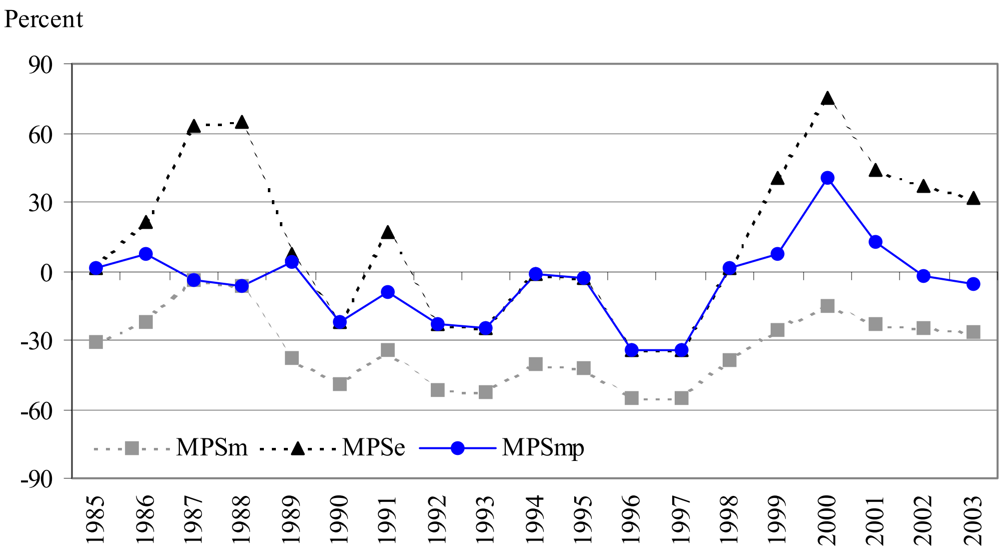
[21] Consistent with the standard PSE methodology, we assume that *ex post* supply is fixed. Supply elasticities are also needed if the PSE assumption of zero supply elasticity is relaxed.
[22] See Dev et al. (2004) for recent discussion of demand being even more inelastic, about -0.2.
[23] P^* is computed by first finding the slope of the demand curve (assumed to be linear) from the elasticity of demand, $\varepsilon_d = -(1/b)*(P_d/Q_d)$, where b is the slope and Q_d is the quantity demanded. Then b is used to compute the intercept, a, in $P_d = a - bQ_d$. We can then use this equation to solve for P^*, where the *ex post* quantity supplied, Q_s, is equal to Q_d.

(labeled "Modified Procedure") using the relevant adjusted reference price after comparing our estimated P^* for each year to the adjusted reference prices P_m and P_e.

In addition to the variability in the direction of trade over the period of analysis, the relevant adjusted reference price, shown in bold in Table 1, also varies across years. Between 1985-1991, there is fluctuation from year to year. The relevant P_{ar} is P^* in 1986, 1989 and 1991, P_m in 1987 and 1988, and P_e in 1985 and 1990. In these various years, if the policy interventions were removed, wheat, in principle, would have been not traded, imported and exported, respectively. By 1990, the domestic price, P_d was below the relevant P_{ar} and %MPS was negative (-22.2 percent in 1990 and -9.0 percent in 1991). During 1992-1998, P_e is the relevant P_{ar}, meaning that without policy interventions, India would have been an exporter in these years. Because the %MPS is negative in all of these years except 1998, producers were disprotected relative to P_e. Partly the disprotection arises from relatively strong world prices during this period and partly from a nominal depreciation of the Indian currency of 80 percent between 1990 and 1993 (the latter effect raises the adjusted reference price in domestic currency). Had the currency not been depreciated, the calculated levels of disprotection under the exportable (or importable) hypothesis would not have been as large; conversely, overvaluation of the exchange rate before the depreciation leads to lower reported disprotection than otherwise in those years.

During 1999-2003, P^* is the relevant reference price for wheat in India, implying that without policy interventions India would have been self-sufficient in wheat production, but would not have imported or exported (or experience changes in intervention stock levels) because P_m is "too high" for imports to be competitive and P_e is "too low" relative to P^* for exports to compete on the world market (as in Figure 1c). In 1998-2001, as world prices fell, cash subsidy payments to farmers in the United States and farm support in other developed countries were increased, allowing exports to continue even with low prices. In India, the MSP also rose, and wheat stocks built up that could not be exported without subsidies because the domestic price was higher than the world price. As a result of these international and domestic factors, the %MPS from our modified procedure reaches a high of 40.0 percent in 2000. But the estimated level of protection is less than under a conventional exportable assumption. In 2002 and 2003, the domestic price is slightly below P^*, corresponding to decreasing stocks, and resulting in a small negative %MPS in these years. Figure 3 shows the movements of the %MPS under this modified procedure compared with those under the importable and exportable hypotheses.

Figure 3—India Wheat %MPS Under the Modified Procedure versus Importable and Exportable Hypotheses, 1985-2003



Source: Authors' calculations.
Note: MPS_m, MPS_e and MPS_{mp} are computed under the importable and exportable hypotheses and the modified procedure, respectively.

4.3.3 Product-Specific Wheat PSE for India

We now dispense with all but our modified procedure estimate of the %MPS and proceed to the calculation of the product-specific %PSE for wheat. To the nominal MPS, we add the budgetary payments allocated to wheat producers, which are based on estimate wheat use of fertilizer (27.65% of the total fertilizer subsidies) and acreage under irrigation (31.05% of the total irrigation and power subsidies). Adding the nominal

MPS for wheat and the budgetary payments allocated to wheat gives the nominal wheat PSE.

Given the nominal PSE, we can examine the way a "subsidy counter" and a "trade economist" might compute the wheat %PSE. Recall that the subsidy counter is interested in finding the proportion of gross farm income that is a result of policy measures, while the trade economist is interested in comparing the magnitude of the transfers due to policy measures relative to value of production at adjusted reference prices. In the lower part of Table 1, we have computed the wheat %PSE under both approaches to choosing the denominator. The %PSE according to the trade economist's approach is always greater than the OECD or subsidy counter's approach (labeled "OECD Denominator" in Table 1) when the PSE is positive and less (in absolute value) than the subsidy counter's approach when the PSE is negative. These results follow from the relationship between the two denominators.[24] For wheat in India, the difference is often small and mostly less than 10 percent. An except is when the MPS is a large positive number. For example, in 2000, the %PSE under the trade economist's approach is 78.3 percent, compared to 43.9 percent under the subsidy counter's approach, a difference of 34.4 percent.

We have now used the example of wheat in India to explore empirically three related issues: 1) the impacts of internal cost adjustments on the resulting MPS calculation, 2) the relationship among the MPS under the importable and exportable hypotheses and the Byerlee-Morris type of modified procedure, and 3) an evaluation of the %PSE using the subsidy counter's and trade economist's measurements. In the next section, we extend our analysis to rice and corn and demonstrate empirically the issues related to scaling up from the commodities covered in the analysis.

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[24] The value of production at adjusted reference prices is its value at domestic prices minus the nominal MPS. The subsidy counter denominator is larger when product-specific PSE is positive because (MPS + BP) for the commodity is greater than zero. Conversely, when the product-specific PSE is negative, the subsidy counter denominator is smaller in absolute value because (MPS + BP) is less than zero.

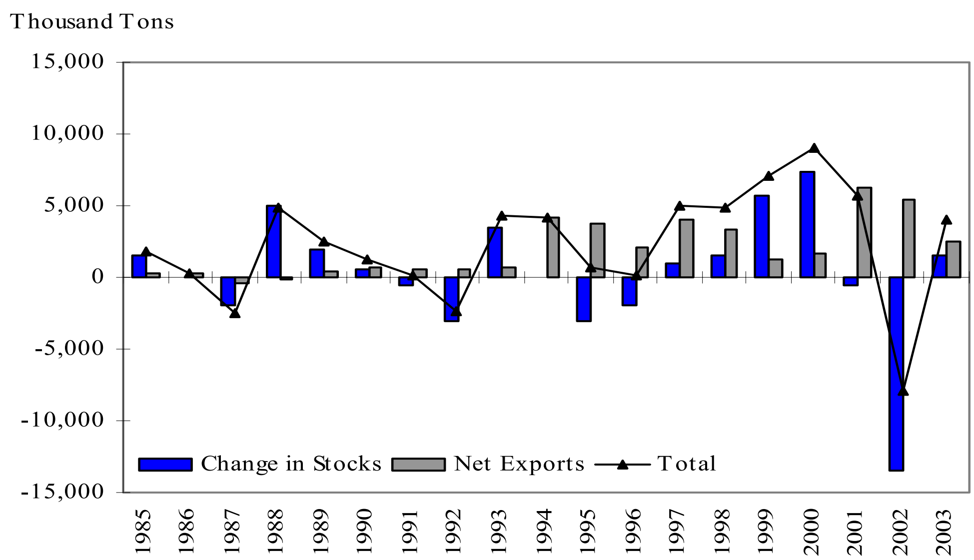
4.3.4 Multiple Commodities and "Total" PSE

Recall that if the MPS is not computed for all commodities, one is left with two choices on how to proceed with the calculation of the PSE for all of agriculture. One could assume that the MPS of the omitted commodities is equal to zero and thus the sum of the MPS for the covered commodities plus total budgetary payments to agriculture is the best estimate of the total PSE. Alternatively, one could assume that the MPS of the omitted commodities is equal to the average of the included commodities and scale up the MPS results as in equation (12). As discussed in Section 3.1.3, either assumption can misstate the actual protection or disprotection of the commodities not covered, and thus introduces a measurement error.

We can demonstrate the empirical impacts of these alternative assumptions by taking a three-commodity example. To our MPS for wheat computed in the previous section, we add the MPS for rice and corn in India. We continue to apply the modified procedure to estimate the price gap. Thus, we compute P^* for rice and corn for each year using the same procedure as for wheat and again assuming demand elasticities of -0.5. Using the relevant P_{ar} according to equation (16), we then compute the MPS for rice and corn in India. The results, their relationship to those under the importable and exportable hypotheses, and the stock and trade positions for both commodities are shown in Figures 4-7.

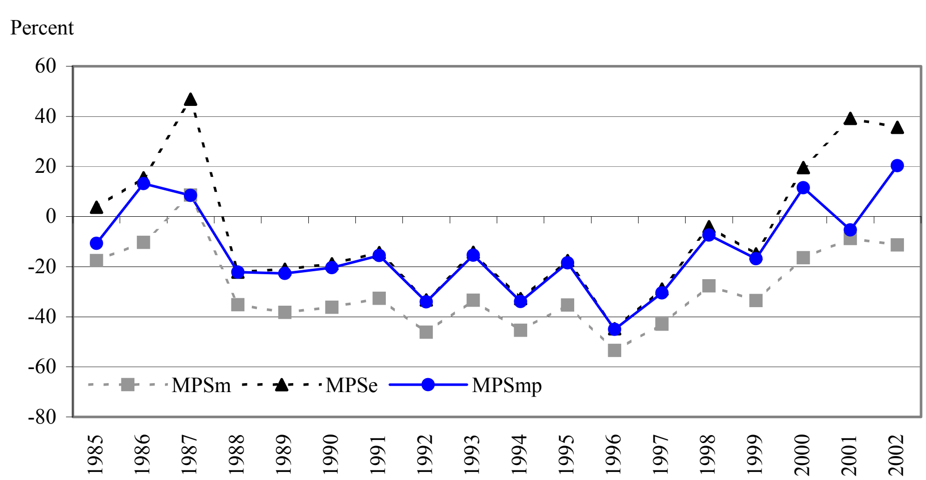
In Table 2, MPS_c refers to the sum of the nominal MPS for wheat, rice and corn. MPS is equal to MPS_c divided by the included commodities' share of the total value of agricultural production. In this example, these three commodities represent about 26 percent of the total value of agricultural production, less than the benchmark 70 percent that the OECD aims to cover. Yet, for illustrative purposes, our three-commodity set is sufficient to demonstrate, potentially in an exaggerated fashion, the effects of scaling up. Budgetary payments shown in Table 2 are the sum of fertilizer, power and irrigation subsidies for all agriculture.

Figure 4—India Rice Net Exports and Changes in Stocks, 1985-2003



Source: USDA-FAS PSD database, February 2004.

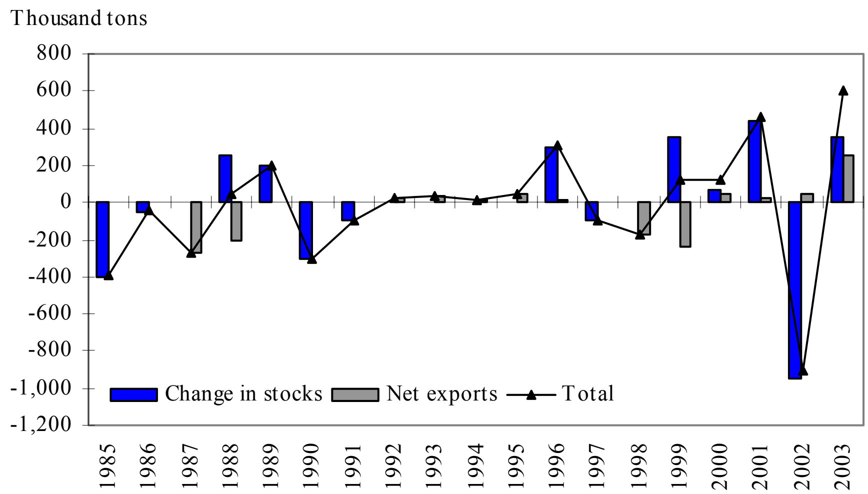
Figure 5—India Rice %MPS Under the Modified Procedure versus Importable and Exportable Hypotheses, 1985-2002



Source: Authors' calculations.

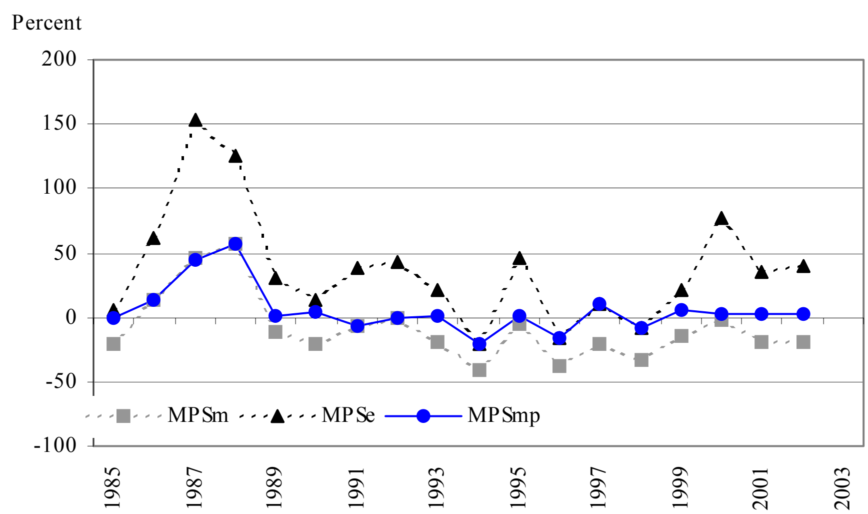
Note: MPS_m, MPS_e and MPS_{mp} are computed under the importable and exportable hypotheses and the modified procedure, respectively.

Figure 6—India Corn Net Exports and Changes in Stocks, 1985-2003



Source: USDA-FAS PSD database, February 2004.

Figure 7—India Corn %MPS Under the Modified Procedure versus Importable and Exportable Hypotheses, 1985-2002



Source: Authors' calculations.
Note: MPS_m, MPS_e and MPS_{mp} are computed under the importable and exportable hypotheses and the modified procedure, respectively.

Table 2—India "Total" PSE Under the Modified Procedure and Alternative Adjustments, 1985-2002

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Measured Support (Rs. bil)																		
MPS_c	-15.1	23.4	12.3	-37.4	-50.7	-82.1	-59.2	-185.8	-111.5	-221.8	-112.9	-504.5	-374.3	-49.3	-117.0	203.2	4.6	122.3
BP	29.3	34.7	27.1	50.3	72.6	87.6	117.5	122.6	138.9	157.5	230.4	279.4	296.6	318.4	357.5	377.0	415.7	444.9
Covered Share	0.26	0.28	0.27	0.25	0.27	0.26	0.27	0.23	0.23	0.24	0.26	0.24	0.25	0.28	0.26	0.28	0.25	0.25
MPS (Rs. bil)	-56.9	82.2	45.8	-148.6	-190.4	-319.2	-219.2	-816.4	-478.7	-943.7	-440.5	-2101	-1509	-177.5	-447.1	728.4	18.4	493.0
PSE (Rs. bil)																		
PSE_c	14.3	58.1	39.4	12.9	21.8	5.5	58.3	-63.3	27.4	-64.3	117.6	-225.1	-77.7	269.0	240.5	580.1	420.3	567.2
PSE	-27.6	116.9	72.9	-98.2	-117.8	-231.6	-101.7	-693.8	-339.8	-786.2	-210.1	-1821	-1212	140.9	-89.7	1105.4	434.1	937.9
PSE (%)																		
OECD Denominator																		
PSE_c	1.7	6.8	4.5	1.4	1.9	0.4	3.7	-3.1	1.2	-2.2	3.8	-6.8	-2.1	6.9	5.1	11.8	8.2	10.1
PSE	-3.4	13.7	8.2	-10.8	-10.0	-16.9	-6.5	-33.5	-14.5	-27.3	-6.8	-55.0	-32.1	3.6	-1.9	22.4	8.5	16.7
Trade Economist Denominator																		
PSE_c	1.8	7.3	4.7	1.4	1.9	0.4	3.9	-3.0	1.2	-2.2	4.0	-6.4	-2.0	7.4	5.4	13.3	9.0	11.2
PSE	-3.3	15.8	9.0	-9.8	-9.1	-14.4	-6.1	-25.1	-12.7	-21.5	-6.4	-35.5	-24.3	3.7	-1.9	28.9	9.3	20.0

Source: Authors' calculations.

Note: MPS_c and PSE_c include only the market price support calculated for wheat, rice and corn; MPS and PSE are based on scaling up this market price support by dividing MPS_c by the share of these commodities in the total value of agricultural production (see text for discussion).

The impact of the scaling up procedure is to magnify the positive or negative market price support for the included commodities. The MPS is greater in absolute value than the MPS_c (Table 2). The resulting PSE_c and PSE differ not only in magnitude, but also in sign for numerous years. For example, MPS_c and MPS are Rs. -117.0 billion and Rs. -447.1 billion, respectively, in 1999. Since the total budgetary payments are Rs. 357.5 billion, the PSE_c is Rs. 240.5 billion, while the PSE is Rs. -89.7 billion. Because of scaling up, the magnitude of the estimated (negative) market price support becomes greater than that of the (positive) budgetary payments. Overall, the PSE shows a pattern of disprotection during the 1990s and protection more recently. This pattern in muted in the PSE_c which only shows disprotection in a few years.

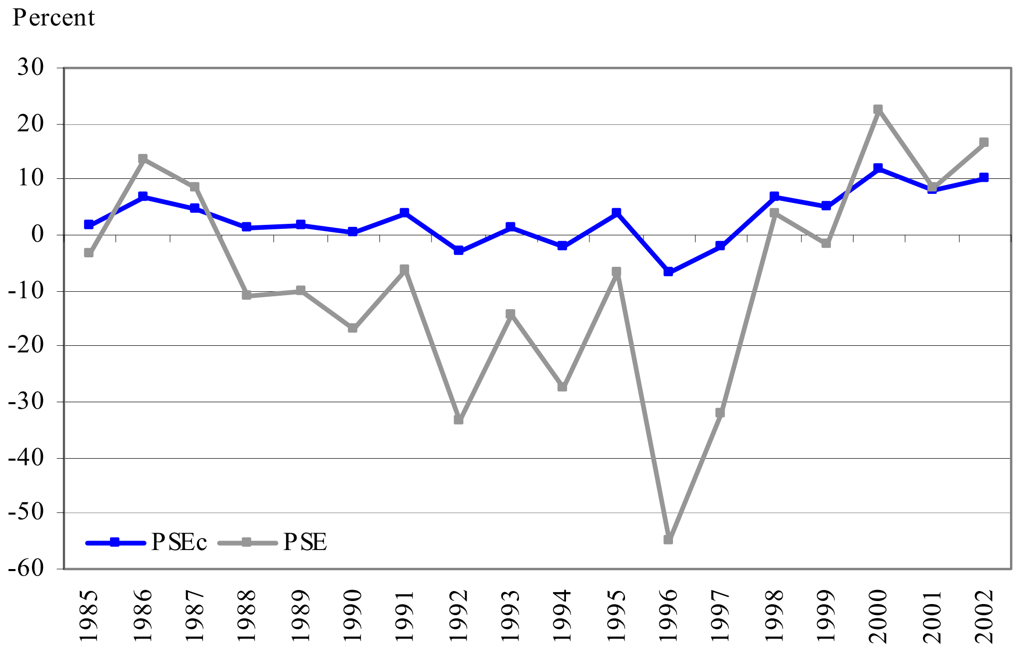
Table 2 also reports the $\%PSE_c$ and %PSE using the "OECD" (subsidy counter) and "trade economist" denominators.[25] The results with the OECD denominator are again larger (smaller) in absolute value than those for the trade economist denominator when the %PSE is negative (positive), but the differences are small in most years. For either measure, the difference between the $\%PSE_c$ and %PSE can be large and they can be of different signs.

Figure 8 presents the aggregate conclusion from our analysis for India in graphical form. The first estimate is $\%PSE_c$ from Table 2 (using the modified procedure, not scaling up, but using the OECD calculation of support as a percentage of domestic farm income). It shows policy to have been close to neutral in its aggregate effect from 1985 through the late 1990s, with a persistent increase in support since 1998. The second estimate is the %PSE (again using the modified procedure and OECD denominator, but now with scaling up). Here a more pronounced discrimination against agriculture is evident from the late 1980s to late 1990s, followed again by a period of aggregate support for agriculture. Thus, by either measure policy in India has recently been to support agriculture and to do so more than in previous years. Additional analysis with an

[25] For total value of production at international adjusted reference prices we have approximated simply by subtracting the nominal MPS for wheat, rice and corn from the value of total production at domestic prices.

extended set of covered commodities is needed to determine with more precision where the PSE for India lies with respect to these two estimates.

Figure 8—Estimates of India "Total" PSE Without and With "Scaling Up," 1985-2002



Source: Authors' calculations.
Note: PSE_c is without scaling up; PSE is with scaling up (see text for discussion).

4.4 RESULTS FOR CHINA

We turn now to the analysis for China for which our data is not as detailed as in the case of India. For China, we use unadjusted reference prices at the border computed primarily based on import or export unit values. We consider five commodities (wheat, soybeans, sugar, rice, and corn), based on an analysis by Sun (2003) for the period 1995-2001.[26] For each of these commodities, we utilize either the importable (wheat, soybeans, sugar) or exportable (rice and corn) hypothesis based on trade patterns to determine the

[26] This represents a subset of the twenty-one commodities covered by Sun (2003). However, by including only the major agricultural commodities, we avoid the difficulties of computing an appropriate adjusted reference price for some highly differentiated horticulture and livestock products, for which only very limited data is available.

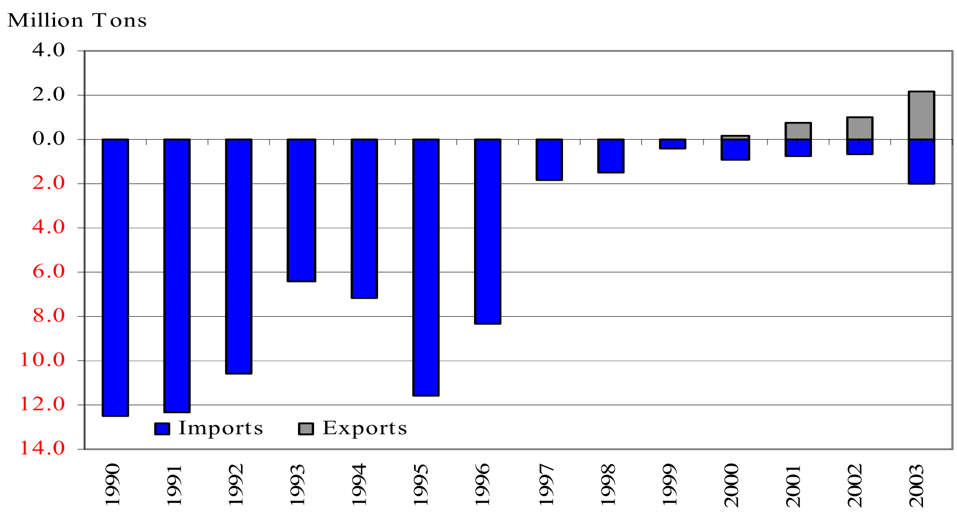
reference price based on the unit value—we have not applied the Byerlee-Morris type of modified procedure to these estimates. Thus our results for China are much less precise than for India. Still, some interesting patterns emerge. Beginning with the import commodities, we discuss each in turn in the context of how well the MPS measurements correspond to the existing policy setting and to other studies of price gap measures. Earlier studies of PSEs in China have mostly found that agricultural producers are disprotected, though the level of disprotection is highly variable across studies (Tian et al., 2002).

4.4.1 MPS for Five Major Commodities

In our work on India, for imported commodities, the port charges and the transport and marketing costs from the farm to the wholesale market tended to cancel out. Extrapolating from these results, if data are not available for these adjustments, and the quality of the domestic production is similar to the imported quality, then a comparison of domestic price and an unadjusted reference price, such as the import unit value, may provide a reasonable approximation of the MPS.

Beginning with wheat, China is the largest consumer, second largest producer, and from 1990-1996 was a large net importer (Figure 9). In response to stagnant grain production in the early 1990s, the government increased quota prices for grains by 40 percent (OECD, 2002) and introduced the GGBRS, as discussed above. As a result of this renewed emphasis on grain production, China's wheat imports fell and in 2000 China became a net exporter. With greater production, the domestic market price for wheat began to fall below the quota price and the implicit tax of the quota price on farmers became a subsidy. When domestic market prices for wheat (and corn) dropped dramatically in 1997, the government introduced a "protective price" below the quota price for the remaining amount of grain sold by farmers. The protective price was set to cover all costs and include a small profit (OECD, 2002). The quota and protective prices have been cut every year since 1998. However, the GGBRS led to a large accumulation of low quality wheat stocks requiring an increasingly interventionist administrative system to manage. In 1999 the government cut the amount of wheat procured within the quota system, further reduced quota and protective prices, set more stringent quality requirements for wheat purchased within the quota system, and excluded some regions from the protective price and quota system altogether (OECD, 2002). In the major producing provinces the protective prices remain in place, although for most of the past three years, they have been below market prices (USDA, 2003a). Reduced planted area in each of the past three years is attributed at least in part to the lower procurement price and reduced grain quota.

Figure 9—China Wheat Imports and Exports, 1990-2003



Source: Sun, 2003 for 1990-2002; USDA PSD Database, February 2004 for 2003.
Note: 2003 refers to projected trade for July 2003/June 2004. All others are calendar year.

When China entered the WTO in 2001, it agreed to tariff rate quotas (TRQs) for selected key import commodities. In 2002, the TRQ for wheat was set at 8.468 million tons, with an in-quota tariff of one percent and an over-quota tariff of 71 percent. Ten percent of the quota is allocated to non-state trade. By 2004, the quota is scheduled to increase to 9.636 million tons and the over-quota duty will fall to 65 percent. China typically imports mostly high quality wheat from North America, but during 2001-2003, China imported less than 3.4 million tons (Figure 9). Meanwhile, over the same period, China exported a total of 3.9 million tons of low quality wheat. China has subsidized exports of wheat in an attempt to reduce stocks (USDA, 2003a).

The MPS for wheat in China is computed based on the difference between producer prices and import unit values adjusted downward by 10 percent to account for the higher quality of imported compared to domestically produced wheat. Clearly, one must be cautious in comparing a single producer price of wheat in China, where many different qualities are produced to an import unit value that corresponds to the average import quality, which could very well differ from the average domestic quality of wheat (Huang and Rozelle, 2003). Yet, in this aggregate comparison the counter-cyclical pattern that was evident in the case of the MPS of Indian wheat and international price is less obvious in the aggregate data for the producer price in China and the world price. The domestic farmgate price in China actually decreased more than international prices after 1996. Correspondingly, the estimated MPS for wheat in China is negative in 1996-2001 (Table 3). Compared to other studies, Tian et al. (2002) find the PSE for wheat to be positive in 1994-2001, but only in the range of 1 to 7 percent. The authors conclude that the actual benefits to farmers of the new grain policies are small due to institutional arrangements that hamper the effectiveness of the procurement price scheme. In their computation of NPRs for China's major commodities, Huang and Rozelle (2002) find that the average NPR weighted by production shares of individual wheat varieties was 10 percent in 2001, which is again different from our results, suggesting that we may not have made an adequate adjustment for quality differences.

China's domestic oilseed markets have relatively less government intervention than the grain sector (OECD, 2002). Nearly all oilseeds are purchased at market prices and there are no restrictions on enterprises that import oilseeds and oilseed meals. China's current oilseed policy is focused on providing sufficient quantities of oilseeds for its growing crushing capacity (OECD, 2002).

Table 3—China MPS and "Total" PSE Under Alternative Adjustments, 1995-2001

	1995	1996	1997	1998	1999	2000	2001
%MPS							
Wheat	30.0	-5.4	-5.1	-4.4	-15.2	-19.5	-19.8
Soybeans	20.3	23.3	23.6	8.6	16.4	14.0	16.0
Sugar	44.6	31.7	27.8	20.0	11.2	17.7	16.4
Rice	-12.3	-25.3	-5.1	2.5	-10.4	3.8	11.7
Corn	38.2	-27.6	3.5	14.5	0.9	3.6	12.1
Measured Support (US$ bil)							
MPS_c	2.1	-27.6	-3.4	2.6	-7.7	-1.2	2.0
BP	-2.7	0.7	0.8	2.5	2.0	1.8	2.2
Covered Share	0.44	0.41	0.35	0.33	0.28	0.23	0.22
MPS (US$ bil)	4.8	-66.7	-9.9	7.9	-27.3	-5.4	9.1
Nominal PSE (US$ bil)							
PSE_c	-0.6	-26.9	-2.6	5.1	-5.7	0.6	4.1
PSE	2.0	-66.0	-9.1	10.4	-25.3	-3.6	11.3
PSE (%)							
OECD Denominator							
PSE_c	-0.3	-11.4	-1.0	2.0	-2.2	0.2	1.5
PSE	1.0	-28.0	-3.6	4.0	-9.9	-1.4	4.1
Trade Economist Denominator							
PSE_c	-0.3	-10.2	-1.0	2.0	-2.2	0.2	1.5
PSE	1.0	-25.1	-3.6	4.1	-9.6	-1.4	4.2

Source: Authors' calculations.

Note: MPS_c and PSE_c include only the market price support calculated for wheat, rice and corn; MPS and PSE are based on scaling up this market price support by dividing MPS_c by the share of these commodities in the total value of agricultural production (see text for discussion).

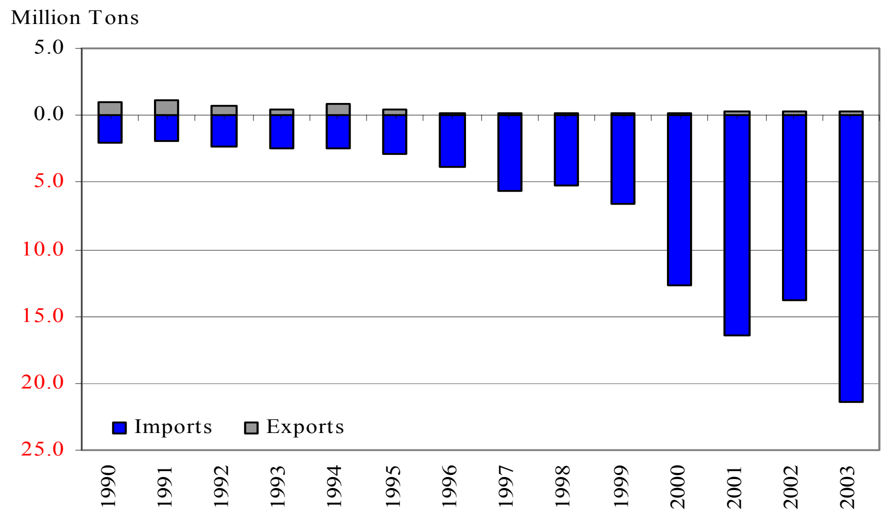
In 1998 and 1999 the government took several steps to reduce oilseed meal and edible oil imports and increase oilseed imports (see Figure 10) by reducing the quota on edible oil imports, cracking down on under-invoicing of edible oil imports, and reversing an earlier policy to offer a rebate on the VAT of imported oilseed meals (OECD, 2002). Soybeans and soymeal are subject to bound tariffs of 3 and 5 percent, respectively. In 2002, the soybean oil TRQ was 2.335 million tons with an in-quota duty of 9 percent and an over-quota duty of 48 percent. Two-thirds of the quota is allocated to non-state trade. After 2005, the soybean oil tariff regime will be converted to a bound tariff of 9 percent. China is the largest soybean importer, with purchases of over 21 million tons in 2003 (Figure 10). China was also the largest importer of soybean oil in 2003, surpassing India.

The soybean %MPS is positive, varying from 8.6 percent to 23.6 percent in 1995-2001 and averages 17.5 percent (Table 3). It may seem surprising that the %MPS for soybeans is greater than the import duty rate of 3 percent given that there are such large quantities of imports. However, the average %MPS in 1995-2001 is very close to the average NPR of 15 percent in 2001 in Huang and Rozelle's (2002) study. The authors point out that importers must pay a 13 percent VAT on imported soybeans, while domestic soybeans are taxed at a rate of less than one percent. Hence, the tax system provides a measure of protection to domestic soybean producers, which seems to be captured in our MPS estimates.

Sugar is also an important import commodity in China, although in 1992 and 1993, China was a net exporter of sugar (Figure 11). In 1999-2001, China was the third largest sugarcane producer after Brazil and India and the tenth largest sugar beet producer. Ninety percent of China's sugar production comes from sugarcane, while the remainder is from sugar beets (Mitchell, 2004). Most imports come from Cuba under a long-term trade agreement. In the 1990s, China pursued sugar policies aimed at achieving self-sufficiency and improving farm incomes (Mitchell, 2003; ERS, 2003). This included setting minimum procurement prices for sugarcane in major producing provinces that are linked to increases in sugar prices. In 2002, cane prices were required to increase $0.60

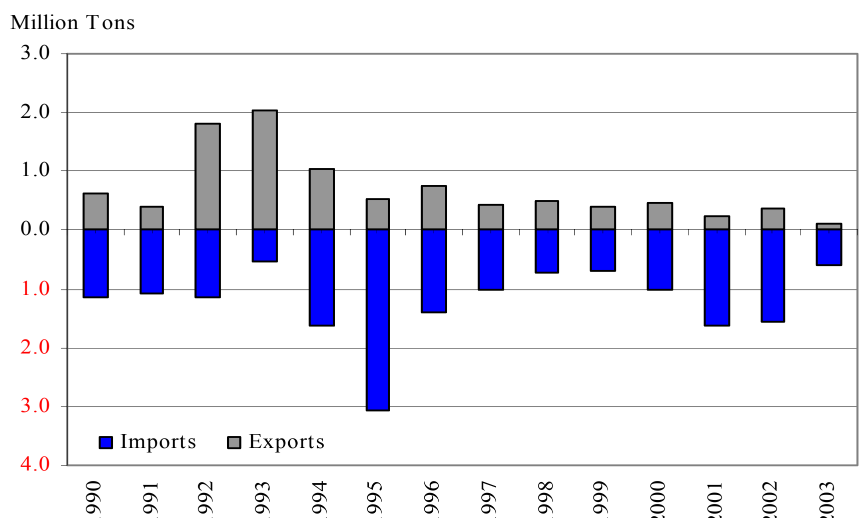
per ton for every $12 per ton increase in the market price for sugar above a set base of $325 per ton (ERS, 2003).

Figure 10—China Soybean Imports and Exports, 1990-2003



Source: FAOSTAT for 1990-2002; USDA PSD Database, February 2004 for 2003.
Note: 2003 refers to trade for October 2002/September 2003. All others are calendar year.

Figure 11—China Sugar Imports and Exports, 1990-2003



Source: FAOSTAT for 1990-2002; USDA PSD Database, February 2004 for 2003.
Note: 2003 refers to trade for October 2002/September 2003. All others are calendar year.

When China joined the WTO in 2001, it agreed to a TRQ for sugar. In 2002, the TRQ was set at 1.764 million tons with an in-quota tariff rate of 20 percent and an over-quota rate of 76 percent. In 2004, the quota is scheduled to increase to 1.945 million tons, the in-quota rate will fall to 15 percent, and the over-quota tariff rate is scheduled to decrease to 65 percent. Thirty percent of the quota is allocated to non-state trade.

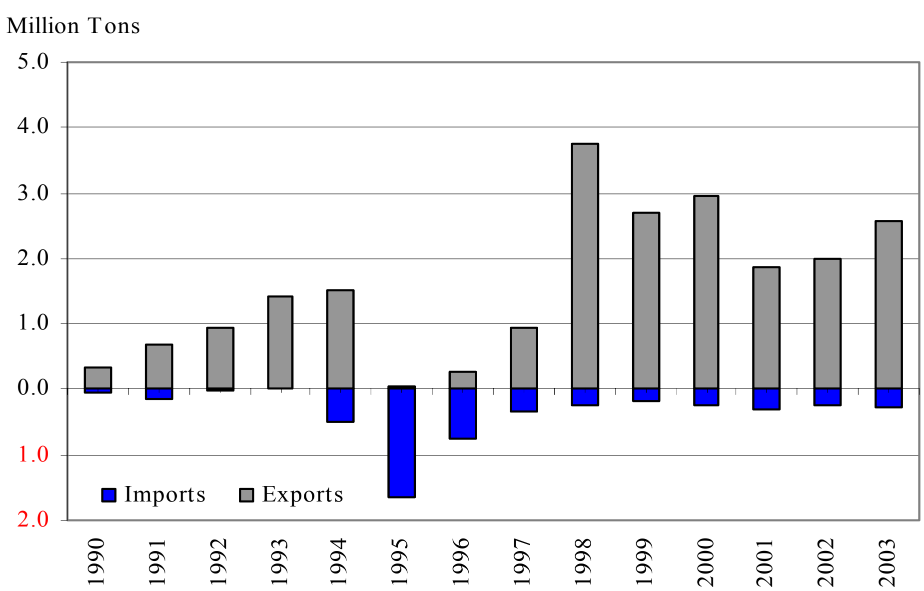
The %MPS for sugar is positive throughout the entire period 1995-2001, reflecting the protective sugar policies in place in China (Table 3). The %MPS decreases from 44.6 percent in 1995 to 11.2 percent in 1999, consistent with the falling domestic prices (in 1999) as a result of the record crop harvested in 1998/99 (Mitchell, 2004). Rising domestic prices in 2000 and 2001 leads to an increasing %MPS of 16-18 percent in these years, which is slightly less than the in-quota tariff rate of 20 percent. The MPS may underestimate the level of protection compared with the tariff due to the assumptions that we use to compute sugar prices from sugarcane prices. The domestic sugarcane price is converted to a domestic sugar price by dividing the cane price by the product of the recovery rate and farmer's share of the sugar price. If we have overestimated the recovery rate or farmer's share of the sugar price, the imputed sugar price will be lower than it otherwise should be. For comparison, Huang and Rozelle (2002) find the NPR for sugar is about 40 percent in 2001, while Tian et al. (2002) find the %PSE for sugar to vary between negative four and eight percent in 1995-2000.

Next we turn to the calculation of the %MPS for two of China's export commodities, rice and corn. Recall that our results for India suggest that the omission of domestic transport and marketing costs can lead to a systematic downward bias in the MPS results under the exportable hypothesis, since all the internal cost adjustments to the international reference price are subtractive (see equation 2).

China is the largest rice producing and consuming country and accounts for nearly one-third of the global rice economy. Rice is an important strategic commodity and its production has been managed with the use of procurement prices to ensure stable supplies (Wailes, 2003). As for wheat, the GGBRS also led to large increases in government stocks of rice in the late 1990s, which reached approximately 100 million tons, or 73 percent of domestic use (Wailes, 2003). In 1999 the government eliminated the purchase of low quality early season rice and lowered procurement prices for rice. In some coastal provinces, the procurement policy has been completely eliminated (OECD, 2002).

China is a significant exporter of low quality long grain and medium grain rice (Figure 12). Exports are made by the state trading enterprise COFCO, without significant export subsidies (Huang and Rozelle, 2002). China also imports mainly premium Thai jasmine rice for high-income urban consumers. In 2002, the total rice TRQ was 3.990 million tons, divided evenly between short and medium-grain and long-grain rice. The in-quota duty is one percent, the over-quota duty is 60 percent, and the share allocated in non-state trade is 50 percent for short and medium-grain rice and 10 percent for long-grain rice. The total rice TRQ is scheduled to increase to 5.320 million tons in 2004 and the over-quota tariff will decrease to 40 percent.

Figure 12—China Rice Imports and Exports, 1990-2003



Source: Sun, 2003 for 1990-2002; USDA PSD Database, February 2004 for 2003.

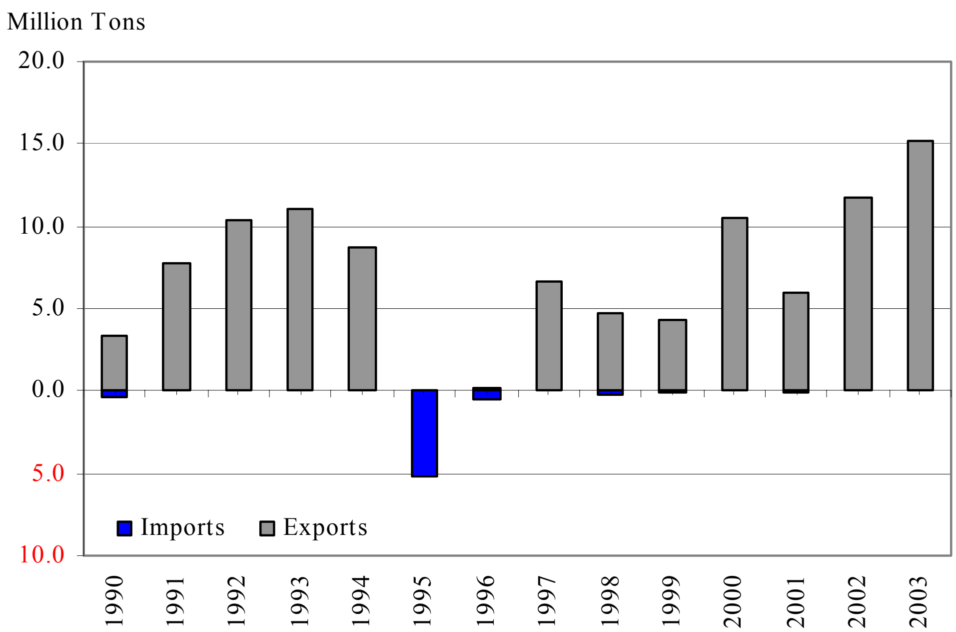
The %MPS for rice in China suggest that domestic rice is slightly protected in some years, for example in 2000 (3.8 percent) and 2001 (11.7 percent), as shown in Table 3. If we were to account for internal transportation costs and marketing margins in the adjusted reference price, this would reduce its value and lead to a greater computed %MPS. Our results are contrary to the average NPR (-3 percent in 2001) calculated on the basis of a survey over 100 grain traders and officials by Huang and Rozelle (2003) and the PSE results (-1 percent in 2000) of Tian et al. (2002).

Corn is another major export commodity in China. China is the second largest producer and consumer of corn and is among the three largest exporters. Feed demand continues to rise as domestic demand for livestock products increases with China's growing economy. Like wheat, when market prices for corn fell significantly below the quota price levels in 1997, the government introduced a protective price less than the quota price for out-of-quota corn sales (OECD, 2002). The reductions in quota and protective prices, in addition to subsidized exports of corn reduced the pressure on government stocks (OECD, 2002). In the long run, corn planted area is expected to be constrained by new, more profitable soybean varieties and by increasing vegetable and other commercial crop production (USDA, 2002a).

Although China established a TRQ for corn when it entered the WTO, imports have been practically nonexistent in 1990-2003, except in 1995 (Figure 13). China's corn TRQ was set at 5.850 million tons in 2002 with a one percent in-quota duty, a 60 percent over-quota duty, and one-third of the quota allocated to non-state trade. It is reported that in addition to the one percent duty, corn imports would be subject to a 13 percent VAT while most domestic production is not (USDA, 2002a). The TRQ is scheduled to increase to 7.200 million tons in 2004 with the over-quota duty falling to 40 percent and the allocation to non-state trade increasing to 40 percent. On the export side, China agreed to eliminate export subsidies when it entered the WTO and the government emphasizes that its subsidies on exports of corn are applied as WTO-consistent waivers on the VAT on exports and to offset internal transport costs (USDA, 2002a).

We find that the %MPS for corn is positive in all years from 1995-2001, except in 1996, following large imports in 1995 (Table 3). In 1997-2001, the %MPS varies from 0.9 to 14.5 percent, close to the range given by Tian et al (2002) of zero to nine percent. The use of export subsidies for corn in recent years has given some protection to corn producers. In their survey of grain exporters, Huang and Rozelle (2003) find that China's domestic corn prices are on average more than 30 percent higher than world prices. Our %MPS will underestimate the level of protection if domestic transportation and marketing costs are important elements in the calculation of a more accurate adjusted reference price.

Figure 13—China Corn Imports and Exports, 1990-2003



Source: Sun, 2003 for 1990-2002; USDA PSD Database, February 2004 for 2003.
Note: 2003 refers to trade for October 2002/September 2003. All others are calendar year.

4.4.2 "Total" PSE

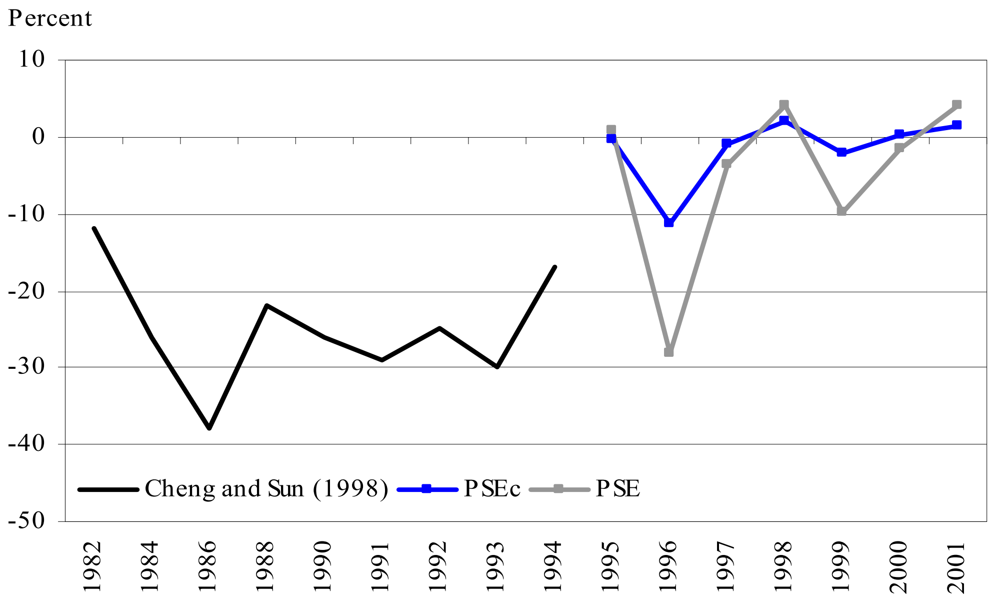
Using the five commodities for which we have computed the MPS, we can calculate the PSE and %PSE for China and again examine the impacts of scaling up. In Table 3, MPS_c refers to the sum of the nominal MPS for wheat, soybeans, sugar, rice and corn. MPS in Table 3 is equal to MPS_c divided by the covered share. Budgetary payments include input subsidies, relief payments and regional assistance programs, agricultural taxes, and forgone agricultural taxes (Sun, 2003). Budgetary payments are negative, for example in 1995, when the agricultural taxes dominate the payments. Over the period 1995-2001, the five commodities share in the total value of production decreases from 44 percent to 22 percent, and on average accounts for about 32 percent of the total value of production.

As we demonstrated for India, the impact of the scaling up procedure is to magnify the MPS for the included commodities. MPS is always greater than MPS_c in absolute value (Table 3). The nominal PSE_c is the sum of MPS_c and BP, while the nominal PSE is the sum of MPS and BP. Like for India, the nominal PSE_c and PSE differ in sign for several years. For example in 2000, PSE_c is US$ 0.6 billion and the PSE is US$ -3.6 billion.

Table 3 also gives our estimates of the %PSE based on the OECD and trade economist approaches and utilizing both the nominal PSE_c and the nominal PSE. The differences between the OECD and trade economist approaches are small and for several years when the %PSE is small, it is actually the same under both approaches. The differences between $\%PSE_c$ and %PSE under both approaches can be large (i.e. in 1996) and can differ in sign (i.e. in 2000).

In Figure 14 we present our estimates of the $\%PSE_c$ and %PSE (OECD denominator) for China based on our five-commodity analysis. We also present the results of Cheng and Sun (1998) for select years between 1982-1994 for comparison. Compared to their findings, our results seem to indicate that the level of discrimination against agriculture is decreasing. As for India, the %PSE_c tends to be closer to zero and less variable over time than the scaled-up %PSE. The %PSE shows a more pronounced disprotection in 1996 and 1999. By either measure, the results for 1998 and 2001 indicate that policies in China provide producers with very small levels of protection.

Figure 14—Estimates of China "Total" PSE Without and With "Scaling Up," 1985-2002



Source: Authors' calculations; Cheng and Sun, 1998.
Note: PSE_c is without scaling up; PSE is with scaling up (see text for discussion).

5. CONCLUSIONS AND POLICY IMPLICATIONS

Using different variants of the PSE methodology, we have explored how various adjustments and assumptions impact the results for three important agricultural commodities (wheat, rice and corn) in India (1985-2002), using disaggregated analysis for representative surplus and deficit states, and five important commodities (wheat, rice, corn, soybeans, and sugar) in China (1995-2001). The results for India suggest that ignoring factors such as internal transport costs, marketing margins and quality differences in the computation of the market price support (MPS) component of the PSE can result in inaccurate PSEs that may be of the wrong sign. We find that the omission of these factors has larger impacts on the PSEs for export commodities than for import commodities.

We demonstrate that other adjustments can also influence the PSE calculations. For example, in the OECD approach, the MPS for the covered commodities is "scaled up" to all products based on the share of the covered commodities in the total value of production. The impact of the scaling up procedure is to magnify the market price support of the included commodities. If the commodity coverage is less than complete, the scaling up procedure leads to a MPS of greater absolute value than the MPS for the covered commodities, and can result in percentage PSEs of different sign than the non-scaled up version.

There are also at least two ways in which the percentage PSE can be computed. The PSE can be expressed as a percentage of farm income at domestic prices, with the value of production at domestic prices plus budget payments as the denominator. The alternative trade economist's approach is to express support received by farmers as a percentage of the value of their output at farmgate-equivalent international prices. The differences between the two approaches are generally small when the magnitude of the percentage PSE is small, but can be large, for example when the percentage PSE takes a large absolute value.

In addition to these mechanical adjustments, we find that the usual procedure to compute the MPS based on a comparison of domestic price to an adjusted reference price that corresponds to the current direction of net trade can be problematic, especially when a country is near self-sufficiency and thus trade volumes are relatively small. Since there are many factors influencing the current direction of trade, net trade status may not be the best determinant of which adjusted reference price to use. To address the reference price issues, we follow the Byerlee and Morris (1993) procedure to compute the level of protection or disprotection relative to the relevant adjusted reference price that would exist in the country if the policy interventions were removed. The relevant price could be the autarky equilibrium price or the import or export adjusted reference price depending on the relationship among the three. Using this procedure, we compute the PSE for the three commodities in India, which have frequent changes in the direction of trade and stock adjustments over the period of analysis, or have small trade volumes. For example, for wheat in India, we find that for eight years the autarky price is the relevant adjusted reference price. For China, we do not have sufficient data to follow the Byerlee and Morris (1993) procedure and except for wheat the commodities we examine maintain a clear trade pattern of being imported or exporter during 1995-2001. This does not guarantee that an autarky price would not prevail in absence of interventions and if we extend the analysis to include the time period 1985-2003, there are several years when, due to production shocks, world price changes or government policy, the direction of net trade of major commodities changes. Thus it could be that autarky price would be the relevant adjusted reference price in some years, though this would have to be tested empirically.

Overall, our PSEs for India and China show two unique patterns. For India, support is largely counter-cyclical, rising when world prices are low (as in the late 1980s and 1990s) and falling when world prices strengthen (as in the mid 1990s). For China, a trend decline in disprotection is more evident but our analysis is more tentative. The contrasting results, if they hold up in further research, may have implications for how the two countries view possible outcomes of the WTO Doha Round negotiations on agriculture. For instance, additional disciplines could be more binding for countries with positive PSEs when prices are low.

Further analysis at state/province and regional levels would provide insights about protection and disprotection within geographic sub-regions of these two large developing countries. Extending the commodity coverage would provide additional insights into whether the results for the included commodities covered here apply to other commodities, while continuing the analysis for India and China through 2003, would indicate whether the patterns are persisting. Applying the Byerlee and Morris (1993) procedure to additional commodities would also be useful. Further country studies would allow one to generalize if either a counter-cyclical pattern of protection (or disprotection) or a trend decrease in disprotection is observed over time in the PSEs of other developing countries. In addition, the results would also be useful inputs into efforts to explain how domestic policy reforms and trade liberalization would affect producers across diverse developing countries. This paper will serve as a basis for further country analysis.

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