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From re-instrumenting to re-purposing farm support policies

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February 2023

Working Papers in Trade and Development

No. 2023/04

From Re-instrumenting to Re-purposing Farm Support Policies

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Abstract

Food production has been globally inefficient for many decades, with too many resources employed in agriculture in high-income countries and too few in numerous low-income countries where governments heavily taxed farm exports. Over recent decades policy instrument choices of advanced economies have moved away from mostly price support at the border to also domestic output and input price supports and then to somewhat-decoupled payments, to direct income payments to farmers, and to more-concerted payments to farmers for their co-provision of public goods. Even so, many agri-food policy instruments are far from economically optimal for attaining society's stated objectives, and (according to our global modeling) their global economic welfare cost is still high. The paper concludes by outlining ways in which present farm supports could be re-purposed in high-income and emerging economies to achieve more-efficient, more-equitable, healthier and more environmentally friendlier outcomes.

Keywords: Policy instrument ranking; Welfare cost of farm price supports; Re-purposing farmer assistance; Institutional and policy reform; GTAP modelling of farm policy reform.

JEL Codes: F13, F14, O13, Q17, Q18

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1 Introduction

The world's agrifood systems have served society well since 1798 when Malthus anonymously published *An Essay on the Principle of Population.* That is especially so since the 1950s, when famines became a thing of the past except where deliberately contrived by a country's leaders or rebels for local political purposes (Ravallion 1987, 1997). Yet global food supplies have not been produced very efficiently, equitably or sustainably, especially during the past seven decades. Nor has food been consumed so as to optimize individuals' nutrition and health. Institutions and policies have contributed to this unsatisfactory outcome, particularly insofar as they distort incentives facing producers and consumers, and thereby dampen investor incentives. Moreover, numerous communities are calling out for a major overhaul of agrifood systems and policies, demanding among other things that they do more to improve nutrition and human health and ease natural resource and environmental stresses, particularly in the face of changing climates (United Nations 2021, Gautam et al. 2022, FAO et al. 2022).

Food production has been globally inefficient partly because too many resources have been employed in agriculture in high-income countries, where farmers have received government assistance in various forms, and too few in those low-income countries where governments have heavily taxed exports of many of their farmers (Anderson 2009). The net effect of those policies in the 1980s was to over-produce farm products globally and thus depress their international prices (Tyers and Anderson 1992). That was still the case (though to a lesser extent) even in the mid-2000s following complete implementation by members of the World Trade Organization (WTO) of the multilateral Uruguay Round Agreement on Agriculture (Anderson and Martin 2005, 2006). As well, irrigation water institutions and policies have been poorly designed, leading to excessive water use by farmers in some settings and under-utilization in others (Rosegrant, Ringler and Zhu 2009; Wheeler 2021). Subsidies to purchase farm inputs such as chemical fertilizers and pesticides have distorted input use on farms too – and have added to pollution. Yet malnutrition remains prevalent in many parts of the world (Masters, Finaret and Block 2022). Meanwhile, there has been global under-investment in agricultural research, as indicated by the persistence of extremely high marginal social rates of return and social benefit/cost ratios from such investments (Rao, Hurley and Pardey 2020).

Early this century, agricultural price-distorting policies accounted for more than three-fifths of the global economic welfare cost of all goods' trade-related policies, three-quarters of which was due to the farm policies of high-income countries (Anderson, Valenzuela and van der Mensbrugghe 2010) – even though agriculture accounts for less than 3% of their economies. Among those welfare-reducing

agricultural policies, import market access restrictions (mostly tariffs) were responsible for 93% of that global welfare cost, while export subsidies and domestic support policies contributed just 2% and 5%, respectively (Anderson, Martin and Valenzuela 2006). Export subsidies were outlawed by the WTO in 2015 and so almost all were removed by 2017, while domestic supports – potentially less market distorting than border policies – have grown in importance.

The political economy reasons behind these and other features of past policies affecting the world's agricultural and food markets are the subject of an extensive review by Anderson, Rausser and Swinnen (2013), and so will be mentioned only briefly in what follows so this chapter can focus more on the economics and political economy of evolving agrifood policy instrument choices of advanced economies: away from mostly price support at the border (import tariffs, licences and quotas, and export subsidies) to also domestic output and input price supports, then to somewhat-decoupled payments, to direct income payments to farmers, and to more-concerted payments to farmers for their co-provision of public goods.

The policy dynamics in this chapter are in the structural space, as defined in Ch. 1 of this volume. In particular, the chapter recognises that the relative power of various vested interests and the differing values of various groups have important influences on institutional and policy formation and reform, but that conceptual and empirical economic analyses and ideas also can and do inform those processes.

The chapter begins by summarizing the evolving stated objectives of agrifood policy instruments chosen by high-income countries. It then draws on standard welfare economics of open economies to rank the chosen policy instruments in terms of their efficiency in raising the mean and reducing the variance in farm household incomes, and simultaneously contributing (positively or negatively) to equity, national food and nutrition security and sustainable economic growth. That exposes the political economy behind the sub-optimal instrument choices, as many agrifood policy instruments are shown to have been far from economically optimal for attaining those objectives of high-income countries in the past. They will be even less appropriate for efficiently attaining the even broader range of 'non-economic' objectives of today's societies (to use a term popularized by Bhagwati 1971), suggesting the need for further reform. New estimates of the global economic welfare cost of supports to agriculture in 2017 (i.e., prior to Trump-inspired tariff 'wars' and COVID-19), using the Global Trade Analysis Project (GTAP) model, are then summarized. The contributions to that global cost in 2017 from import tariffs and domestic supports are shown to be little different from those estimated for 2001. However, the agricultural policies of emerging economies are now responsible for the majority of that cost, suggesting recent political economy forces at work there may be similar to those that operated earlier in advanced industrial economies. The final sections conclude by discussing what might be done to ensure re-purposing of farmer assistance in high-income and

emerging economies is directed to more-efficient, more-equitable, healthier and more environmentally friendly policy instrument choices to better meet societies' evolving objectives and the UN's Sustainable Development Goals.

1 Evolving objectives of agrifood policy instrument choices

Two fundamental facts characterize agriculture. One is that its production is subject to weather, so in free markets the prices of outputs and the earnings of farmers inevitably will fluctuate. The other is that the agricultural sector typically declines in growing economies. The price of farm relative to non-farm products tended to decline over the past century's course of long-term economic growth, and hence so too did the shares of agriculture in total output and employment (for reasons summarized in Anderson and Ponnusamy 2023). Indeed, the absolute number of farmers has declined in high-wage economies as profitable labor-saving technologies became available and were widely adopted and thus lowered farm product prices. Since an exit by farmers from agriculture often requires re-locating to an urban area, delays/procrastination in doing so are inevitable. Relatively poor-quality education in rural areas adds to the difficulty of securing a lucrative-enough non-farm job, such that the average education of those remaining on farms falls further behind that of urban workers. All this means that, in the absence of government intervention, farm household incomes tend to not keep up with rising incomes of non-farm households in growing economies.

Given those two facts, it is not surprising that over the past century farmers have sought government assistance aimed at stabilizing and raising prices of farm products and thereby also farm household incomes. In response, governments have sought ways to assist such that the marginal political benefit to politicians from doing so is more than the loss of political support from tax-paying non-farm households and businesses (Rausser 1982, Gardner 1983, Swinnen 1994, 2018). For a long period that political support calculus worked in favor of farm price supports in rich industrial countries (Anderson 1995, Gründler and Hillman 2021); but, with the agrifood sector's share of the economy and of voters ever-shrinking, a threshold eventually is or could be reached when such inefficient and inequitable provision of social welfare is challenged (Hillman 1982, Cassing and Hillman 1986). That point was reached in the 1980s in Australia and New Zealand, for example, although there the policy reforms were part of broader microeconomic reform programs that included also phasing down government support to import-competing manufacturers (Anderson et al. 2009).

The most prominently used instruments aimed at both raising and stabilizing farm product prices have been import restrictions such as variable tariffs and occasionally prohibitions. For example, in 1906 Japanese rice farmers succeeded in their lobbying for a tariff to be applied to rice imports, and that broadened into an imperial rice self-sufficiency policy embracing also Japan's then-colonies of

Korea and Taiwan (Anderson and Tyers 1992). And when low agricultural prices hit in the late 1920s, and the US introduced the Smoot-Hawley tariff hikes of June 1930, governments elsewhere responded with beggar-thy-neighbor protectionist trade policies that together helped drive the world economy into depression (Hynes, Jacks and O'Rourke 2012). Real prices of farm products in international markets slumped, initially from oversupply because of a recession and then from increases in trade barriers (see Findlay and O'Rourke 2007, pp. 447-48 and references cited therein).

Meanwhile, in agricultural-exporting countries where import tariffs would do little to raise or even stabilize farm prices, alternative measures were used. In Denmark import restrictions were placed on just grain while export-focused livestock producers received domestic subsidies (subject to production quotas to avoid encouraging oversupply). In the United States, counter-cyclical land retirement programs were made available from 1936 (Swinton 2022). In Australia, so-called home consumption pricing schemes were used from the 1920s: instead of subsidizing exports from the treasury, these schemes raised average producer prices via state marketing boards that were given monopoly control of supplies to allow them to charge domestic consumers well above the export price in the domestic market and to ban imports (Mauldon 2021).

The first attempts to reverse that growth in farmer assistance in advanced economies were discriminatory, benefitting Europe's colonies at the expense of other trading partners. By the end of the 1930s, protectionism was far more entrenched than in the late 19th century when only non-discriminatory tariffs had to be grappled with. Indeed, nontariff trade barriers were so rife as to make tariffs almost redundant unless and until 'tariffication' of those barriers occurred.

Out of the interwar trade policy experience, many in Britain and the United States were convinced that liberal world trade required a set of multilaterally agreed rules and binding commitments based on non-discriminatory principles. An International Trade Organization was proposed but, after much negotiation, the US was unwilling to do more than sign on, in 1947, to a General Agreement on Tariffs and Trade (GATT). The GATT was signed by a total of 23 trading countries – 12 high-income and 11 developing – who at the time accounted for nearly two-thirds of the world's international trade. The GATT provided a forum to negotiate subsequent tariff reductions and changes in rules, plus a mechanism to help settle trade disputes. Eight so-called rounds of negotiations were completed in the subsequent 46 years, as a result of which many import tariffs on at least manufactured goods were progressively lowered in most high-income countries. Global merchandise trade grew faster in the half century following the coming into force of the GATT than in any other half century in history. But following Prebisch/Singer advice, many developing countries chose not to participate. That thwarted their trade growth, especially with former colonisers (Head, Mayer and Ries, 2010), and it also weakened the demand by agricultural exporters for reform of agricultural trade-related policies. It was only the last of those GATT negotiations, the Uruguay

Round (1986-94), that culminated in agreements to liberalize agricultural trade (and to replace the GATT's Secretariat in Geneva with the WTO) in January 1995.

In the interim, the European Economic Community (EEC, later to enlarge and become the European Union) from its inception in 1957 used variable import levies to both raise and stabilize domestic prices of farm products, while the United Kingdom (UK) (before it joined the EEC in 1973) generated a similar outcome for farmers with its deficiency payments (in place from 1919) being transformed into price guarantees in the UK's 1947 Agriculture Act. That deficiency payment method of domestic support to farmers – unlike import quotas, tariffs and variable import levies – avoided also raising domestic consumer prices in the UK that would have added more harm to farm exports from current and former British colonies and dominions (Josling 2009). An argument invoked to bolster political support for these protectionist measures in Europe was food security. Based on the experiences of drastic food shortages in two world wars during the first half of the 20th century, this was often interpreted as requiring food self-sufficiency (Swinnen 2010).

Meanwhile, as real international food prices continued to fall after World War II, agricultural exporting countries such as Australia used marketing boards to prop up producer receipts, under the guise of 'price stabilization'. While sometimes being dressed up as necessary for improving the efficiency of domestic resource use by reducing farmer uncertainty and countering import protection for manufacturers, they served mainly as an excuse for paying above market price in what were deemed to be low-price years. When that generated surpluses as for wheat in the late 1960s, production quotas were introduced to prevent further supply expansion (Edwards and Watson 1978). Only when international wheat prices spiked upward in 1973-74, such that the ceiling of the price stabilization band was breached for the first time, did Australia's wheat growers vote to abandon their price stabilization scheme. Attention then turned to more-directly address farm income fluctuations and risks (IAC 1978).

Assistance to farmers everywhere became less necessary during that high food price crisis of the mid-1970s. But thereafter tariff protection rose again through to the mid-1980s in Western Europe and to the mid-1990s in Japan and Korea. The rise was so great in Europe that it and technological improvements generated food surpluses that had to be disposed of with the help of export subsidies from the early 1980s. That triggered a food export subsidy "war" across the North Atlantic, which in turn stimulated non-subsidizing food-exporting countries to form the so-called Cairns Group and demand that the next General Agreement on Tariffs and Trade (GATT) round of multilateral trade negotiations (launched in Punte del est, Uruguay in 1986) have agricultural policy reform high on its agenda.

That so-called Uruguay Round took eight years to conclude, and implementation of its agreements took another decade. However, from the outset it was anticipated that agricultural import restrictions would have to be tariffied, bound and gradually reduced, and export subsidies phased down as well. Since that could stimulate policy re-instrumentation, disciplines on domestic support measures, especially producer price subsidies, also were demanded by the Cairns Group and many developing countries.

The United States had begun re-instrumenting in the 1980s away from price supports to direct payments to farmers and decoupling them from production and prices. The European Union began to follow that trend with the McSharry reforms of 1992, as did Switzerland (Josling 2009). In the case of the EU, internal budgetary pressure to reduce the Common Agricultural Policy's support for farmers came with the EU's gradual expansion from the 1980s to absorb poorer, more-agrarian southern countries (Greece, Portugal and Spain) and then ten eastern countries in 2004 (Anderson, Rausser and Swinnen 2013). Similar programs to Australia's operated in post-World War II Canada through to the 1980s following its Agricultural Stabilization Act of 1958. Canada's farm assistance rates grew more rapidly than and to well above those in the US, and for six years longer until 1991, when Canada introduced its Farm Income Protection Act. Thereafter Canada's programs became more like those in the US, gradually focusing more on stabilizing gross revenue of farmers – a form of subsidized farm income insurance (Gardner 2009).

In response to the political pressure to further reduce agricultural protection and even limit domestic supports, farmers' lobbying in the latter 1990s took a new turn: protected farmers claimed not only to be good stewards of their land and animals but also to contribute to 'non-economic' objectives of society by providing a stream of non-marketed ecosystem services. A new term was coined to capture the latter notion, namely farming's 'multifunctionality'. The claim was that agricultural production was multifunctional in that it provided positive externalities and public goods for which farmers were not being compensated. Among the examples pointed to were food security, environmental protection, and the economic viability of rural areas (OECD 2008). Such claims did not stand up well to scrutiny, however, as they ignored the negative externalities from farming (and farm input subsidies) listed above, and there were more-efficient instruments for achieving those social objectives than narrowly focused measures that support farm prices, reduce trade, and benefit the largest farmers/landowners most (Anderson 2000).

More recently, governments of advanced economies have come under political pressure from other groups to meet an ever-widening set of societal demands. The following are among the ones most pertinent to agriculture's social licence to operate: mitigating climate change, slowing biodiversity loss, reducing chemical and ruminant animal pollution of air, soil and water, improving food safety and quality in addition to basic food and nutrition security, and enhancing animal welfare. Ruminants (most

notably beef and dairy cattle plus sheep) are major contributors of the greenhouse gas methane (IPCC 2020, 2021, 2022), land clearing for monocropping is a major contributor to biodiversity loss (Dasgupta 2021), farm chemical inputs are perceived not only as pollutive but also as potentially diminishing food safety and nutrition, and intensive livestock raising is seen as harmful to animal welfare. All this, plus the need for farmers to adapt to climate change, has contributed to calls for major changes to food systems to ensure they can contribute more efficiently, equitably and sustainably to national and global economic growth and human health, and do less harm to the natural environment.

One response by farm groups has been to transform the most plausible of the environmental protection component of those earlier 'multifunctionality' claims into ones that, via alliances with some environmental groups, could be supported more strongly by governments. This can and has been done by rebadging requests for assistance as payments for 'ecosystem services', deemed to be necessary to ensure society gets closer to the optimal use of its natural capital. An example has to do with carbon sequestration in soils, demand for which will be greater the higher the taxation of carbon emissions and the more developed the market for tradable emission permits nationally and abroad (Simone et al. 2017).

To see how agrifood policies might be best re-purposed to meet these changing societal demands, the next section draws on basic welfare economics to rank policy instruments in terms of their efficiency in meeting these various objectives, and then Section 4 summarizes changes in key policy instruments' estimated contributions to producer and consumer support estimates in high-income and developing countries.

2 Basic welfare economics of agrifood policy instruments

Welfare economics provides economists with the ability to rank policy instruments for meeting various policy objectives, be they economic (e.g., improving efficiency of resource allocation), environmental (e.g., reducing pollution) or social (e.g., reducing income or wealth inequality and variance through time). In this section, we discuss the agrifood policy instruments used for achieving the following societal objectives in advanced industrial economies: raising the mean and lowering the variance of farm household incomes, reducing inequality, increasing food sovereignty and national food and nutrition security, and boosting agriculture's net contributions to sustainable economic growth and improvements in the natural environment.

2.1 Raising the mean and lowering the variance of farm household incomes

As noted early in the previous section, tariffs on imports have been the most common policy instrument for raising farm incomes. The economics of lowering import tariffs are well understood by trade negotiators: gains from opening to trade can come from exchange when consumer preferences at home are different from those abroad; from production specialization when relative factor endowments or technologies differ between the countries involved and when economies of scale are present; from intra-industry trade when seasons or product qualities or product varieties differ; and from increased competition from abroad driving down monopolistic pricing domestically. The gains from production specialization are becoming even greater as global value chains increase in importance.

A potentially important exception to the gains-from-trade arguments has to do with whether the environmental damage from greater transportation when importing food is more or less than the pollution from producing abroad instead of locally. This argument has motivated many of the "food miles" campaigns and "eat local"/ "locavore" advocacy efforts. However, in a comprehensive global study by Avetisyan, Hertel and Sampson (2014), transport costs are shown to be important in the case of dairy products but, overall, environmental benefits from differences in domestic emission intensities of production outweigh transport costs in about 90% of the country/commodity cases they examine, thereby undermining one of the rationales for the local food movement.

Distortionary policies such as import tariffs or quotas, or export subsidies, diminish the benefits from trade by raising domestic prices above the border prices of affected goods for not only producers but also consumers. Hence a switch from a trade measure to a domestic producer subsidy at that same rate would eliminate the consumer-distorting half of the trade measure without reducing assistance to farmers – assuming there are no greater costs associated with collecting tax revenue by means other than import tariffs, and no costs of dispersing some of it as a producer subsidy (see Bhagwati 1971; Corden 1997). That shifts the ranking from 3rd best to a 2nd best policy instrument.

The gains from switching from a trade measure to a domestic producer subsidy would be greater if, in the process of reform, the variance of rates of assistance among industries within the farm sector were reduced (Lloyd 1974). Furthermore, if trade barriers are managed by inefficient institutions such as distributors of import or export quota licenses, the gains from removal of such barriers will be larger than those from removing standard trade taxes or subsidies (Khandelwal, Schott and Wei 2013). Also, a switch from subsidizing a sub-set of farm inputs to spending that outlay on farm output price

subsidies would reduce distortions to farm input use and so shift it from 3rd best to 2nd best, assuming the cost of dispersing those payments by those two alternative means are similar.[1]

Domestic producer price subsidies are a more-inefficient way to raise the mean and lower the variance of farm household incomes than direct income supplements decoupled from production, because the latter but not the former can also compensate for weather-induced production fluctuations from year to year. That is what many non-farm households have access to in hard times, in the form of generic social safety nets – or, better still, trampolines that help struggling households bounce back and become more resilient to future shocks.

2.2 Reducing income and wealth inequality

Import tariffs or export subsidies on farm products, together with home consumption price schemes that set domestic consumer prices of food above export prices, are inequitable in two respects: they benefit farmers and landowners in direct proportion to their output and land holding size and so raise the incomes and wealth of large farmers/landowners most, with tenants gaining little because their rents are raised (Floyd 1965, Ciaian et al. 2021); and they hurt the poorest domestic consumers most in proportional terms, because the share of disposable income spent on food is higher the poorer the household. A switch from border measures to direct producer subsidies removes the consumer effect of the border measures and so reduces the extent of that contribution to real income inequality.

2.3 Increasing food sovereignty and national food and nutrition security

Greater openness is seen as harming national food sovereignty by those who equate the latter with reducing the share of domestic consumption supplied by imports (i.e., with raising the nation's food self-sufficiency rate). Import protection is not an efficient way to boost food sovereignty though, and may also be inequitable. It is inefficient in that the optimal policy intervention to reduce import dependence is not an import tariff that eliminates food imports (and thus raises no government revenue) but rather a lower tariff plus a tariff-revenue-funded domestic producer subsidy (Nettle, Britten-Jones and Anderson 1987). The optimal tariff rate is that which equates the marginal social benefit from allowing some imports with the perceived marginal social cost of the resulting degree of dependence on imports. Import protection also is inequitable in those settings where the domestic households that are farm owner-operators or owners of farmland they rent to tenants (and hence beneficiaries of that protection) have more real income or wealth than the domestic households that are net buyers of food (whose cost of living rises with a restriction on food imports).

[1] Analysis by Warr (1977) and others of the inefficiency of fertilizer subsidies in Australia led to their eventual phasing out.

Food security is perceived by some as being related to food self-sufficiency. However, it is defined by FAO as the condition in which all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life. Improving food security requires improving the three interrelated elements of food availability, access and utilization, as well as reducing market instability.

How much access households have to the available food supplies depends heavily on their income, assets, remittances or other entitlements. How well household heads utilize the foods that are accessible to them depends on their knowledge and willingness to ensure a healthy and nutritious diet for all members of their household. That in turn depends on the level of education in the household, particularly of adult females, which again is closely related to household income and wealth or other entitlements. Thus, food insecurity is a consumption issue that is closely related to household poverty.

Any initiative whose net effect is to raise real incomes, especially of the poorest households, may also therefore enhance food and nutrition security. Since openness to trade raises national income (and increases food diversity, quality and safety), it should be considered among the food policy options available to national governments. If all countries were open to international trade and investment, that would optimize the use of resources devoted to producing the world's food, maximize real incomes globally, and minimize fluctuations in international food prices and quantities traded. Openness thus contributes to three components of food security: availability, access and market stability. Yet some countries continue to restrain food imports because enough of their voters place a high value on national food self-sufficiency.

2.4 Boosting agriculture's contributions to sustainable economic growth and the natural environment

Opening up to trade does more than just provide a single step up in the level of a country's income. Far more importantly it generates dynamic gains from trade, raising *the rate of increase* in future living standards. This is a further reason for governments to shy away from both trade measures and domestic subsidies that raise producer prices. In their place are numerous policy options capable of raising instead of lowering the contribution agriculture can make to sustainable national and global economic growth and environmental enhancement.

Sustainability refers to more than just ensuring long-term economic security. Increasingly, affluent societies value the sustainable use of natural resources and the sustainability of the natural environment. Insofar as market production or consumption would alter the stock of natural resources (e.g., native forests) or the quality of the natural environment (e.g., biodiversity loss), optimal environmental policies need to be in place and enforced such that the marginal social value of that

marketed production or consumption equals the marginal social value foregone in terms of the environment. Opening up to trade would still be beneficial (Ch. 2 of Anderson and Blackhurst 1992), but it would require the level of environmental intervention to be altered in order to remain optimal for that country. However, in cases where the environmental damage spills over to other countries or is global, the calculus is necessarily more complex and the politics much less tractable. There remains a place for trade openness, but typically international agreements are needed to achieve globally optimal outcomes.[2]

3 Contributions of various policy instruments to national producer and consumer support estimates

The inverted-U trend since the mid-1950s in nominal rates of border protection and overall assistance to farmers in high-income countries is depicted in Figure 1. Peaks and troughs around that trend are when international prices of farm products slumped or spiked up, respectively. The growth in protection to the mid-1980s and its even-more-dramatic fall in the subsequent 20 years has been followed by no further decline in the most-recent 15 years.

[insert Figure 1 around here]

Also shown in Figure 1 is the consumer tax equivalent of agrifood policies: that it so closely traces the nominal rate of border protection to farmers reflects the fact that the majority of the farmer support had come from trade measures until recently, especially import tariffs which are equivalent to a producer subsidy and a consumer tax at the same rate.

Table 1 shows the changes in nominal rates of assistance to farmers by the individual member countries of the OECD, plus for key emerging economies. What is clear from that ordering of countries is that the high-income ones' NRAs are spread over the full spectrum from just 1% for New Zealand to more than 100% for Norway and Switzerland in 2020; but that is far smaller than the range – peaking at more than 300% -- in the late 1980s.

[insert Table 1 around here]

Accompanying that reduction in producer assistance has been substantial change in the instruments providing support. Figure 2 summarizes that for all OECD members and for its three biggest contributors, namely Japan, the EU and the US. Most of the assistance to Japan's farmers

[2] For a thorough review of the subtle literature on trade and the environment, see Copeland and Taylor (2004) and Copeland, Shapiro and Taylor (2022).

continues to be via market price supports. This is mostly due to very high tariffs on rice but also restrictions on imports of livestock products. However, in recent years domestic payments based on current production have been added. In the US, output and input supports have accounted for half or more of farmer assistance, with payments based on current production making up most of the rest, although payments based on non-current production have been added this century.

[insert Figure 2 around here]

It is the EU that has changed most its mix of policy instruments: having relied almost entirely on trade measures (tariffs and export subsidies) in the late 1980s, tariffs contributed only half the support by 2001-03 and only 20% by 2016-18 while export subsidies were phased out. Input support has gradually risen over those three decades. Payments based on current production rose to two-fifths of the EU total by early this century, but by 2016-18 payments based on non-current production were equally important.

So, for the OECD as a whole, the contribution of output supports has shrunk from about 90% to 40% of the total, input support has grown from a little under to a little over 10%, and the share of direct payments based on current production has more than doubled, to 20%.

Table 2 shows those breakdowns of instrument contributions by country as of 2019. Particularly noticeable is the unimportance to date of payments for environmental services, with their share being non-trivial only for the EU, Switzerland and Mexico. This is a striking fact: despite all the hype about increasing support to farmers for providing better environmental outcomes, inefficient and inequitable market price supports continue to play by far the most dominant role in assisting farmers in advanced economies.

[insert Table 2 around here]

Two other stylized facts that were revealed in the World Bank's study of distortions to agricultural incentives (Anderson 2009) and that remain true today for high-income countries are that (a) assistance to agriculture is greater in agrifood-importing than in agrifood-exporting countries, and (b) a wide dispersion of rates of farm assistance persists across industries within each of those two agricultural sub-sectors of each country. In particular, a strong anti-trade bias in agrifood policies remains in countries regardless of whether they are net exporters or net importers of agricultural products. The political economy reasons for this are complex but in one respect they are the same in agriculture as they are in manufacturing: import tariffs (or export taxes) *raise* government revenue and are less likely to be scrutinized

in each year's government budget whereas export subsidies *deplete* government coffers and so are more exposed in the budget papers each year.

To help understand why farmers are assisted relative to manufacturers in rich industrial economies (RIEs) and why the opposite bias has prevailed in poor agrarian economies (PAEs), and hence why countries have transitioned from taxing to subsidizing farmers relative to manufactures as their economies grow, it is helpful to look at the way government price supports alter the incentives those two sets of producers face. Anderson (1995) calibrates the simplest numerical economywide model (2 tradables sectors plus nontradables, 3 sector-specific factors plus intersectorally mobile labor) to such economies and estimates the elasticities of real incomes of farmers and industrial capitalists to changes in the prices of their products. As shown in Table 3, in the PAE the elasticity of the industrialists' incomes with respect to the price of farm products is ten times that of farmers, and with respect to the price of manufactures it is more than twenty times that of farmers. By contrast, in the RIE the elasticity of the industrialists' incomes with respect to the price of farm products or manufactures is one-fifth or less that of farmers. While this is only one determinants of the altering political economy of sectoral support in growing economies (differing costs of collective action by pertinent interest groups is another), it suggests emerging economies may be facing political economy forces at work that are similar to those that operated earlier in advanced industrial economies.

[insert Table 3 around here]

4 Contributors to the global costs of present forms of support to agriculture

To estimate the global costs of present farm-support policies, we use the latest version of the GTAP model (Hertel 1997; Corong et al. 2017) and its latest Data Base (pre-release 4 of Version 11) which is calibrated to 2017 (updated from Aguiar et al. 2019). The Data Base has been aggregated to 56 countries/regions and 30 sectors in our new modelling. In particular, it distinguishes primary agricultural sectors from processed food sectors, since the latter are becoming increasingly important in both production and trade as incomes grow and value chains lengthen (Gollin and Probst 2015; Barrett et al. 2022).

This version of the GTAP Data Base draws on domestic support estimates from the OECD (2021). It includes payments based on output (A2), intermediate input payments (B1+B3) and factor payments (B2, C, D, and E).[3] Payments vary in the extent to which they are decoupled from current

[3] As shown above in Table 2, the OECD classifies policy measures into seven broad categories, A to G, based on whether the basis is explicitly linked or not to current outputs or inputs and whether production is a prerequisite for receiving the payment (OECD 2021). Category A1 covers product market price support, A2 covers payments based on output, B covers payments based on

production, and some of them may even be welfare-improving for society (such as rewards for providing ecosystem services), in which case they likely fall into the WTO's 'Green Box'. For subsidies not tied to specific sectoral output, integration in the GTAP Data Base requires that assumptions be made to allocate these subsidies across sectors (Huang and Aguiar 2019; Boulanger, Philippidis and Jensen 2019).[4]

The scenario reported here involves full removal from the 2017 GTAP Data Base of all domestic agricultural supports and agrifood import tariffs and remaining export subsidies in all countries. The extent of domestic support to farmers and the average applied import tariff equivalents at the border as a percent of imports in the updated GTAP Data Base are shown in Table 4, which reveals that agrifood tariffs are more than twice those of other goods, and that farm subsidies nearly double the support provided by tariffs to farmers (i.e., 'primary agriculture', while raising the support to food processors only slightly). Our purpose here is to report firstly how costly are agrifood policies of high-income countries to the world compared with those of developing countries, and then how costly are agrifood tariffs and export subsidies versus farm domestic support measures of high-income countries versus developing countries to those country groups and to the world. It is those costs that could be lowered greatly by re-purposing agrifood policies to better serve the transition of the world's food systems.

[insert Table 4 around here]

The results, reported in Table 5, suggest that full liberalization of agriculture and food sectors in 2017 would have led to a 0.06 percent increase in real GDP, equivalent to almost US$50 billion globally per year. Of this, almost $46 billion is due to tariff removal, with removal of domestic subsidies contributing most of the rest ($3 billion). Liberalization in high-income countries contributes $21 billion (42%) to global GDP, almost all of which is due to reform of their own policies. Developing country liberalization contributes a little more ($28 billion or 58%) to global GDP, of which again almost all is due to reform of their own markets. Thus, developing countries would have benefitted somewhat more from complete liberalization of global agrifood policies in

input use, C covers payments based on current production, D covers payment based on non-current production with production required, E covers payments based on non-current production with production not required, F covers payments based on non-commodity criteria, and G is miscellaneous payments (see OECD 2021 for details). The GTAP Data Base does not include OECD data for categories F and G, and market price support (A1) is excluded to avoid double counting with tariffs already in the GTAP Data Base (Boulanger, Philippidis and Jensen 2019). We follow Anderson et al. (2023) in adjusting the GTAP Data Base to better account for primary factor subsidies.

[4] We modify the GTAP model code to separate primary factor subsidies from primary factor taxes, enabling us to directly target reductions in primary factor subsidies rather than subsidies net of any taxes on primary factors, as in the standard GTAP model code (Anderson et al. 2022).

2017 than high-income countries – in contrast to 2001, when three-quarters of the benefit would have come from high-income country liberalization (bottom row of Table 6). This means there are more developing countries likely to be resistant to reforming their agricultural policies now than was the case two decades ago when the WTO's Doha Development Round was launched. It may be partly why the WTO membership has struggled to get traction in multilateral negotiations in its Agricultural Committee, and so has narrowed its focus in recent years to just domestic support policies.

[insert Tables 5 and 6 around here]

Yet of those potential total global real GDP gains as of 2017, the results suggest that just 6% is from removal of domestic subsidies, it being very similar for high-income countries as for developing countries. That contribution of domestic support removal is not much higher than that of earlier global estimates of 5% in 2001 (Table 7). The reason for the slightly higher share estimates due to domestic support in 2017 versus 2001 is mainly because tariffs in most countries were reduced over that period, but also because of the growth of domestic supports in high-income countries and, notably, China.

[insert Table 7 around here]

The GTAP model is also able to shed some light on the impact such reform would have on the environment, poverty and human health. According to the FAO, methane emissions and manure from cattle and sheep are responsible for three-quarters of agriculture's global contribution to greenhouse gas emissions (IPCC 2022, Table 3.5 of Gautam et al. 2022). Furthermore, in many countries feedgrains and oilseed meal are the dominant feed for those runimant animals, which raises the price of staple foods for the world's poorer consumers. Meanwhile malnutrition would be reduced if fruit and vegetables were more accessible to poor households. Our results suggest that removing all farm tariffs and subsidies globally would reduce pollution by shrinking the world's output of ruminant meat by 0.8% and of dairy products by 1.1% (Table 8). However, Table 8 also reveals that, in developing countries, the output of fruit and vegetables would *rise* (by 0.5%), as would that of ruminant meat (by 0.8%), thereby potentially improving human health of poor consumers there.

[insert Table 8 around here]

5 How best to re-purpose current agrifood policies

The task for governments challenged with demands to meet multiple policy objectives is becoming more complex as the voices of ever-more single-focused interest groups become louder via the megaphone of social media, and as concerns grow for the global commons. It is in this environment that there have been calls for transforming the world's food systems to

make production more sustainable, consumption safer and healthier, and both more resilient and inclusive and less damaging to natural resources and the environment (see, e.g., Fan et al. 2021). That would require major re-purposing of food policies in both high-income and developing countries (Gautam et al. 2022; FAO et al. 2022). We conclude by outlining several ways in which that could be done, bearing in mind the political economy forces at work.

5.1 Lowering trade barriers

Reform should begin by lowering trade barriers, since they are still by far the most dominant form of assistance to farmers globally. Even though they have declined slightly in importance relative to more-direct support measures over the past two decades, they still contribute around 94% of the economic welfare cost of all agricultural support policies globally, according to the above GTAP Model results.

Since one of the thorniest sectors to deal with at the WTO has been agriculture, Cahill et al. (2021) suggest new pathways for agricultural negotiations that, if taken up, could re-invigorate other parts of the WTO's long-inactive Doha Development Agenda. Consistent with the above GTAP model results, that note argues first for significant tariff reductions, with the extent being greater the higher are current tariffs. Second, it argues the highest rates of domestic supports also be lowered most. Certainly, those two moves would generate bigger economic gains nationally than flat across-the-board cuts. Just as certainly, such reforms are likely to be resisted by the groups that had the political influence on their national government to get them implemented in the first place. But mass media offers a potential counter pressure to those vested interests, and has been shown to have a helpful influence in high-income countries (Olper and Swinnen 2013).

The complexity of reaching multilateral trade agreements has been made more difficult by the fact that the global effects of international trade on the natural environment and resource sustainability are also under scrutiny (Copeland, Shapiro and Taylor 2022), including via agricultural trade (Baylis, Heckelei and Hertel 2021). Also, biodiversity loss (Matthews and Karousakis 2022) and biosecurity threats (Campbell et al. 2017) are becoming key foci in multilateral negotiations (Fan et al. 2021; Kehoe et al. 2019). Since agriculture is considered a major contributor to greenhouse gas emissions, future global trade analyses will need to draw on models that better integrate economic and environmental systems. Results

from such models would help in anticipating future policy demands of left-behind groups and the complementary policy adjustments that might be needed in response.

Should the Cahill et al. proposal for multilateral trade negotiations prove elusive, as suggested at the most-recent WTO Trade ministerial meeting in mid-2022, agricultural policy reform reliance in the coming years will need to be mostly on unilateral actions, supplemented by bilateral and regional preferential agreements.

As argued above, unilateral lowering of food trade barriers could bring gains not just in efficiency terms but also in terms of reducing inequality and especially poverty, food insecurity, malnutrition and ill-health. Openness is also the best national insurance against unexpected shocks to markets. The long-term decline in costs of trading internationally, and the consequent strengthening of global value chains (Barrett et al. 2022), add to that potential for openness to increase the trend rate of economic growth and to reduce its fluctuations, and to boost affordable access to healthy food as populations and incomes grow. Making those benefits from greater openness clearer to voters is one way to alter the political economy in their favour.

Since global warming and extreme weather events are becoming more damaging to food production in many regions (Jägermeyr et al. 2021), climate change is a further reason for nations to be open to international food markets so trade can buffer seasonal fluctuations in domestic production. The more countries that do so, the less volatile will be international food prices (Tyers and Anderson 1992, Martin and Anderson 2012).

5.2 Ensuring optimal national environmental policies are in place

The best option for national governments dealing with local natural resource and environmental issues is to directly target local market frictions and market failures that currently lead to inefficiency, inequality and environmental damage. That can be done via better education for the next generation of leaders, and also for those likely to be otherwise left behind by forthcoming technologies (Colantone, Ottaviano and Stanig 2022). The OECD's Trade and Agriculture Directorate's analyses and advocacy efforts are examples of efforts to boost leaders' understanding of these and related issues.

Specifically, to reduce the risk of back-tracking on the trade reforms of recent decades and to increase the prospect of continuing down the reform path, attention should turn to strengthening the measures that will make firms and households more resilient in the face of uncertainties, and more assured that optimal domestic policies and institutions are in place to deal with externalities and to supply needed public goods. For example, taxing greenhouse gas emissions would add to costs of

production, and more in agriculture than many other sectors, but it would also potentially stimulate new environmentally friendlier technologies. That could provide other income streams for some landholders in the form of carbon sequestration options or the provision of priced ecosystem services (see Section 6.5 below).

5.3 Ensuring property rights are encouraging optimal investments in all forms of capital

The national economic welfare gains from trade opening will be greater, the more there are complementary first-best domestic policies and institutions in place for encouraging optimal accumulation of various forms of capital (natural, human, knowledge, financial, physical), for providing national public goods, and for offsetting local environmental and other externalities and risks. Key institutions that can boost optimal investments in primary production are well-established and enforced land, water, forest and fishery property rights, in addition to those for minerals and energy raw materials. And social costs associated with households and firms being more exposed to uncertain international markets and new innovations can be lowered with better-functioning financial and insurance markets (Jensen and Barrett 2017, Robles 2021), income tax systems, and generic social safety nets/trampolines. The latter also facilitate the adjustments by firms and households to reductions in trade barriers and subsidies, especially if those reforms are pre-announced and phased in over time.

5.4 Boosting public investments in rural infrastructure, R&D, education and health

An efficient way to compensate today's farmers for reducing their import protection would be to boost the current underinvestment in rural infrastructure (to lower transport and communication costs involved in getting to market farm products, especially nutritious but perishable fresh fruits and vegetables) and in agricultural R&D (to lower farmers' costs of production or raise the quality and thus price of their product). Both of those initiatives would benefit food consumers as well as producers. Rural education and health services often are inferior to those in urban areas, so they could be improved too. That would boost human capital of farm families, enabling them to become more resilient as farmers, or to more-easily take up more lucrative non-farm activities. Boosting such public investments is often not a high priority for elected politicians though, because the benefits may not be evident to voters until well beyond the current election cycle (Mogues 2015). More dissemination to voters, bureaucrats and politicians of the results of analyses that point to those future long-term benefits would help, but it continues to be a hard sell.

In the case of agricultural R&D, there continues to be a reluctance in many countries to allow the production or import of genetically modified (GM) seeds for local production and even the importation of GM foods for local consumption. This is unfortunate, since GM crops can be bred specifically to help mitigate climate change, reduce local pollution and improve nutrition. Indeed wider adoption in Europe of already-existing GM crops could result in a reduction equivalent to 7.5% of the total agricultural greenhouse gas emissions of Europe, according to Kovak, Blaustein-Reito and Qaim (2022). Moreover, the latest genome editing technologies could speed R&D's contributions to the environment and human health. While differences in values continue to make this issue politically contentious in Europe and hence its developing country trading partners, China at least is actively exploring these opportunities (see Ch. 9 in this volume by Barrett et al.).

5.5 Encouraging markets for ecosystem services

Much of the environmental protection component of those earlier 'multifunctionality' claims by farmers has been recently rebadged as payments for 'ecosystem services'. These are deemed necessary to ensure society gets closer to the optimal use of its natural capital. Where a contestable market can be developed such that the community can express its willingness to pay for such services, it would then be up to farmers to demonstrate that they are competitive suppliers of those services. That may well boost demand for targeted research on how best to design and implement institutions and policies in this space.

One example has to do with carbon sequestration in soils, demand for which will be greater the higher the taxation of carbon emissions and the more developed the market for tradable emission permits nationally and internationally (Simone et al. 2017). For individual farmers the first task is to estimate whether the up-front cost of changes in land management practices is more than offset by the subsequent flow of benefits from selling carbon credits (White, Davidson and Eckard 2021). Scientists have cautioned that the scientific basis for such payments is often not sound, so some have proposed a set of guidelines and principles to assist this process (Naeem et al. 2015). As well, much remains to be learned about the effectiveness of various schemes that have been tried (Börner et al. 2017). Their success to date has been hampered by inadequate design and implementation leading to adverse self-selection, poor administrative targeting, and noncompliance in the wake of limited willingness/organizational capacity to pay for environmental services (Wunder et al. 2020).

6 Conclusion

The per capita cost of global distortions to agricultural and food markets has fallen somewhat in recent decades with the reduced dependence on border measures, and their distributional

consequences may now be less inequitable than in the past. Yet the policy instruments currently used are still far from being the most efficient, equitable and sustainable ones available. The preceding section exposes some of the ways society could be better served through further changes in policy instrument choices. It remains to be seen whether political circumstances will allow such reforms to take place. While major reform via the WTO on its own seems unlikely in the foreseeable future, the prospect of pressure on national governments to contribute to mitigation of greenhouse gases (and biodiversity loss but to a much smaller extent) may add to domestic pressures from environmental groups for better environmental policies. That in turn might trigger new alliances between farm and environmental interest groups in high-income countries that could lead to more re-purposing of current supports to farmers away from inefficient and inequitable price-distorting policy instruments and toward instruments that support not just farmer welfare but also the natural environment. The research that has been triggered by the World Bank and IFPRI (Gautam et al. 2022) is one contribution that economists together with environmental scientists can make toward farm policy reforms that boost national and global environmental and social outcomes in addition to standard economic ones.

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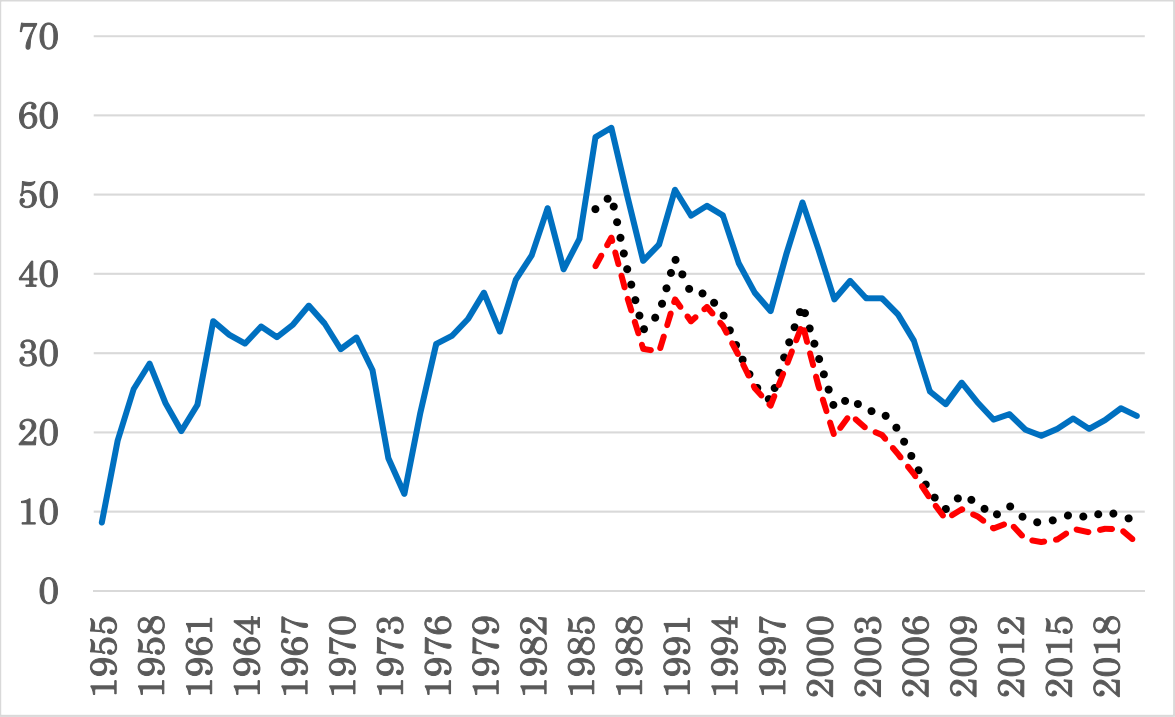
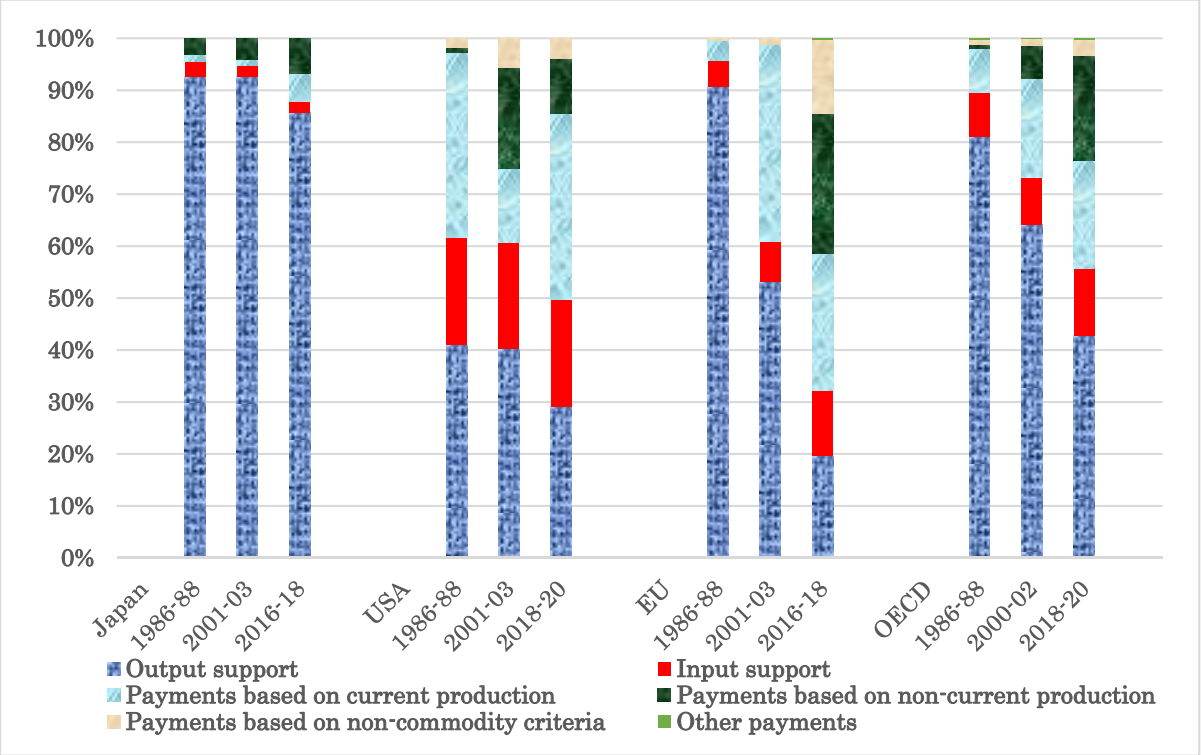
Figure 1: Nominal rates of border protection and of overall assistance to agriculture (blue solid and black dotted lines), and agricultural consumer tax equivalent (red dashed line), OECD countries, 1955 to 2020 (%)



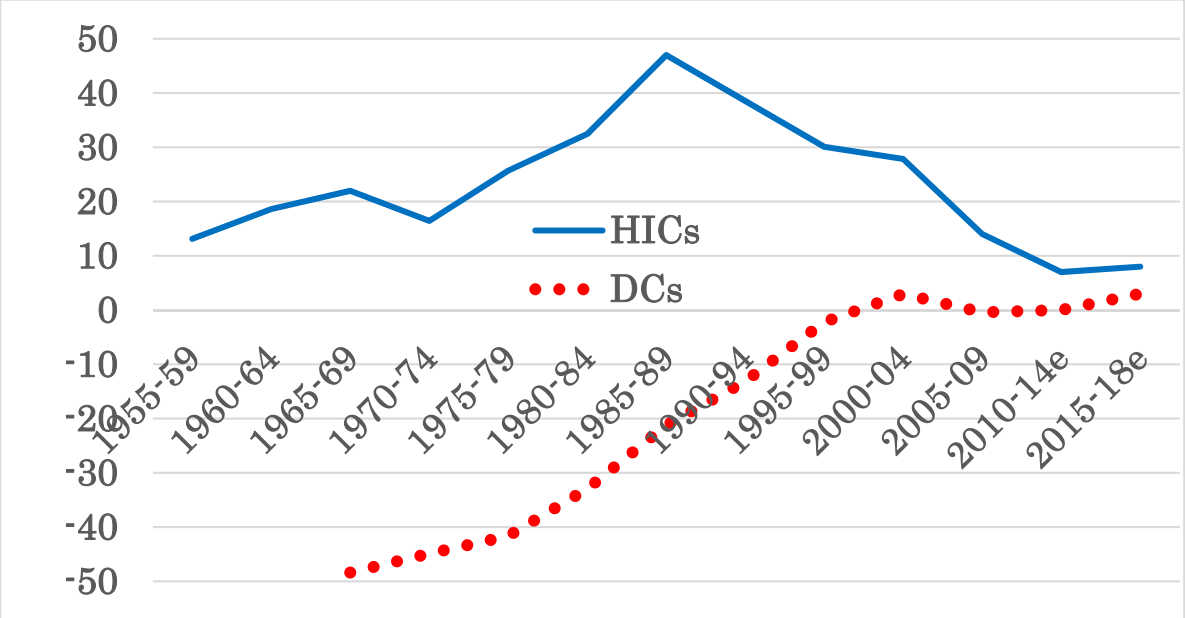
Source: Anderson and Nelgen (2013) to 1985, OECD (2021) thereafter.

Figure 2: Component shares of PSE in Japan, EU, USA and all OECD, 1986-88, 2001-03 and 2018-20 (%)



Source: Compiled from OECD (2021).

Figure 3: Relative rate of assistance to agriculture vs non-agriculture[a], high-income countries and developing countries, 1955 to 2018 (%, 5-year averages)



[a] RRA is defined as 100*[(100+NRAag^t)/(100+NRAnonag^t)−1], where NRAag^t and NRAnonag^t, respectively, are the nominal rates of assistance (NRAs) for the tradable segments of the agricultural and non-agricultural goods sectors. The NRA is the percentage by which gross returns to producers in a sector are raised because of government sectoral or trade policies.

Source: Anderson and Nelgen (2013) to 2011 updated using nominal rates of protection from www.ag-incentives.org (accessed January 2019).

Table 1: Agricultural nominal rates of assistance by country, 1986-88, 2001-03, 2017-19 and 2020 (%, weighted average using value of production without assistance as weights)

	1986-88	**2001-03**	**2017-19**	**2020**
Norway	247	238	145	104
Switzerland	328	196	95	108
Korea	165	95	86	91
Japan	135	111	71	69
Philippines[a]	na	23	37	37
Indonesia[a]	na	10	30	25
UK	na	na	26	26
European Union	63	43	24	24
Turkey	29	33	22	24
US	26	21	13	12
Colombia[a]	na	28	14	15
China[a]	na	7	16	14
Mexico[a]	na	31	11	11
Russian Federation[a]	na	12	12	7
Canada	53	23	9	11
Kazakhstan	na	3	5	3
Costa Rica	na	8	6	8
Australia	11	4	3	2
South Africa[a]	na	8	4	3
Ukraine[a]	na	1	1	1

	1986-88	2001-03	2017-19	2020
Chile[a]	na	6	3	3
Brazil[a]	na	8	2	1
New Zealand	12	1	1	1
India[a]	na	-5	-5	-7
Viet Nam[a]	na	8	-6	-6
Argentina[a]	na	-13	-17	-16

[a] In the 1986-88 column, the estimates for developing countries are for 1985-89 and the estimates for Russia and Ukraine are for 1992-95, all from Anderson (2009).

Source: Compiled from OECD (2021) and Anderson (2009).

Table 2: Component shares of agriculture's PSE, by country, 2019 (%)

	Output support (A)	Input support (B)	Payments based on current production (C)	Payments based on non-current production (D+E)	Payments for environment services and resource conservation (F)	Other payments (G)	TOTAL
Argentina	101	-1	0	0	0	0	100
Australia	0	55	23	21	1	0	100
Brazil	3	92	5	0	0	0	100
Canada	46	12	35	6	0	1	100
Chile	2	92	6	0	0	0	100
China	67	10	15	7	1	0	100
Colombia	90	10	0	0	0	0	100
Costa Rica	92	8	0	0	0	0	100
EU28	19	14	26	27[a]	14[a]	0	100
India	276	-145	0	-29	0	-2	100
Indonesia	89	11	0	0	0	0	100
Japan	85	3	5	7	0	0	100
Kazakhstan	-7	102	5	0	0	0	100
Korea	91	3	3	4	0	0	100
Mexico	56	22	1	9	12	0	100
New Zealand	86	14	0	0	0	0	100
Norway	51	6	31	11	0	0	100
Philippines	97	3	0	0	0	0	100

Russian Fed	50	33	10	0	0	8	100
South Africa	70	29	1	0	0	0	100
Switzerland	46	2	17	20	12	4	100
Turkey	77	9	13	0	0	0	100
UK	25	12	10	47	1	5	100
Ukraine	67	12	21	0	0	0	100
US	21	17	46	12	4	0	100
Viet Nam	113	-11	-2	0	0	0	100

[a] The EU's Greening Payments (PHNR12) in E have been shifted to F.

Source: Compiled from OECD (2021).

Table 3: Elasticities of real incomes of farmers and industrial capitalists to changes in the prices of their products in a poor agrarian economy and a rich industrial economy

	Poor agrarian economy		Rich industrial economy	
Elasticity with respect to the price of:	Farmers	Industrial capitalists	Farmers	Industrial capitalists
Farm products	0.4	-4.0	2.3	-0.3
Manufactures	-0.2	4.5	-2.0	0.4

Source: Anderson (1995).

Table 4: Subsidies and import tariffs in the updated GTAP Data Base, primary agriculture, processed foods, and non-ag&food goods, 2017 (%)

	Domestic subsidies, 2017[a]			Tariffs, 2017[b]			
Region	Primary agriculture	Processed foods	Total Ag&food	Primary agriculture	Processed foods	All Ag&food	Non-ag&food
HICs	10.7	0.2	3.3	3.1	6.2	5.1	1.3
DCs	3.7	0.6	2.0	7.1	7.8	7.5	3.6
WORLD	5.3	0.4	2.5	5.7	7.1	6.6	2.5

[a] Average subsidy to production (including total subsidy payments on outputs, intermediate inputs and primary factor inputs), weighted by the value of output at market prices.

[b] Average tariff weighted by imports at cif prices, excluding intra-EU trade.

Source: Authors' calculations from the adjusted GTAP v11p4 2017 Data Base.

Table 5: Simulated changes in real GDP from the elimination of domestic subsidies, import tariffs and export subsidies on all agricultural and food products, 2017 (US$ million and %)

Contributions	US$m change in real GDP[a]			% change in real GDP[a]		
from:	HICs	DCs	World	HICs	DCs	World
Domestic subsidies:						
Primary factors	*814*	*-503*	*311*	*0.00*	*0.00*	*0.00*
Intermediate inputs	*126*	*2,160*	*2,286*	*0.00*	*0.01*	*0.00*
Outputs	*359*	*162*	*521*	*0.00*	*0.00*	*0.00*
Total	1,298	1,819	3,118	0.00	0.01	0.00
Import tariffs	19,437	26,152	45,589	0.04	0.07	0.06
Export subsidies	-28	11	-16	0.00	0.00	0.00
TOTAL	**20,707**	**27,983**	**48,690**	**0.04**	**0.08**	**0.06**
HIC liberalization	18,716	1,931	20,646	0.04	0.01	0.03
DC liberalization	1,992	26,052	28,044	0.00	0.07	0.03

[a] The real GDP results in this table and in Tables 6 and 7 differ slightly from the welfare results reported in Anderson et al. (2023) in that they refer to real GDP rather than the equivalent variation in income.

Source: Authors' GTAP model simulation results.

Table 6: Distribution of changes in real GDP from regional and global elimination of domestic subsidies, import tariffs and export subsidies on agricultural and food products, 2001 and 2017 (%)

	Shares of effect in 2001 on:			Shares of effect in 2017 on:		
	HICs	DCs	World	HICs	DCs	World
HIC liberalization	61	12	73	38	4	42
DC liberalization	14	13	27	4	54	58
Global liberalization	75	25	100	42	58	100

Source: Authors' GTAP model simulation results as reported in Table 4 above and Table 4 of Anderson and Martin (2005).

Table 7: Shares of domestic subsidies, import tariffs and export subsidies in the regional and global GDP effects of full liberalization of agricultural and food policies, 2001 and 2017 (%)

	Shares of effect in 2001 on:			Shares of effect in 2017 on:		
	HICs	DCs	World	HICs	DCs	World
Domestic supports	5	4	5	6	7	6
Import tariffs	88	108	93	94	93	94
Export subsidies	7	-12	2	0	0	0
TOTAL	**100**	**100**	**100**	**100**	**100**	**100**

Source: Authors' GTAP model simulation results as reported in Table 4 above and Table 5 of Anderson and Martin (2005).

Table 8: Changes in real output of selected foods from the elimination of domestic subsidies, import tariffs and export subsidies on all agricultural and food products, 2017 (%)

	Beef and sheepmeat			Dairy products			Fruit and vegetables		
	contribution of:			contribution of:			contribution of:		
	Subsidies	Tariffs	Both	Subsidies	Tariffs	Both	Subsidies	Tariffs	Both
HICs	-2.2	-1.0	-3.2	-2.6	1.3	-1.3	-5.1	0.2	-4.9
DCs	0.0	0.8	0.8	0.4	-1.4	-0.9	0.6	-0.1	0.5
World	-0.9	0.1	-0.8	-1.2	0.0	-1.1	-0.4	-0.1	-0.4

Source: Authors' GTAP model simulation results.