DISCUSSION PAPER SERIES

DP17124

Trade-related Food Policies in a More Volatile Climate and Trade Environment

Kym Anderson

INTERNATIONAL TRADE AND REGIONAL ECONOMICS

CEPR

ISSN 0265-8003

Trade-related Food Policies in a More Volatile Climate and Trade Environment

Kym Anderson

Discussion Paper DP17124
Published 19 March 2022
Submitted 18 March 2022

Centre for Economic Policy Research
33 Great Sutton Street, London EC1V 0DX, UK
Tel: +44 (0)20 7183 8801
www.cepr.org

Trade-related Food Policies in a More Volatile Climate and Trade Environment

Abstract

Providing affordable access to enough healthy and safe food for an ever-more-affluent and growing world population has become more challenging in the face of climate change, rising income inequality and a more uncertain global trade environment. Agriculture is expected to contribute more to global food and nutrition security, but is under pressure in both high-income and developing countries to do so more sustainably and inclusively. This paper reviews the roles of trade-related food policies in this changing setting. It begins by revisiting the case for keeping food markets open to international trade, investment and technology transfer, and concludes that openness is even more important, especially for developing countries, as the climate becomes warmer and more volatile. It then summarizes trade-related food policy developments globally in the 50 years prior to the global financial crisis, and in the price-spike periods since then. The current situation is calling for more action – including from agriculture – to mitigate climate change and biodiversity loss. The scope for re-purposing food policies to better meet these demands is then assessed. It proposes some alternatives to current measures that could better achieve national societal objectives while simultaneously benefitting the rest of the world in terms of easing natural resource and environmental stresses and reducing national and global poverty, food and nutrition insecurity, and inequalities in income, wealth and health. The review summarizes the policy lessons learnt to date and concludes by noting areas where further research could facilitate such transformations in food policies.

JEL Classification: N/A

Keywords: Uncertain international trade environment, Virtues of liberal food trade, Re-purposing food policies

Kym Anderson - kym.anderson@adelaide.edu.au
Adelaide University and CEPR

Acknowledgements
This paper was prepared as background to the 16th Elmhirst Lecture, presented in the opening plenary session of the 31st International Conference of Agricultural Economists, (virtual), 17-31 August 2021. The author is grateful for very helpful comments from three referees. Forthcoming in Elsevier's journal Food Policy.

Trade-related Food Policies in a More Volatile Climate and Trade Environment

Kym Anderson
School of Economics and Public Policy, University of Adelaide, Adelaide and
Arndt-Cordon Department of Economics, Australian National University, Canberra
kym.anderson@adelaide.edu.au

March 2022

Corresponding author:
Professor Kym Anderson
School of Economics and Public Policy
University of Adelaide
Adelaide SA 5005, Australia
Phone +61 8 8313 4712
kym.anderson@adelaide.edu.au

This paper was prepared as background to the 16th Elmhirst Lecture, presented in the opening plenary session of the 31st International Conference of Agricultural Economists, (virtual), 17-31 August 2021. The author is grateful for very helpful comments from three referees. Forthcoming in Elsevier's journal *Food Policy*.

Trade-related Food Policies in a More Volatile Climate and Trade Environment

Abstract

Providing affordable access to enough healthy and safe food for an ever-more-affluent and growing world population has become more challenging in the face of climate change, rising income inequality and a more uncertain global trade environment. Agriculture is expected to contribute more to global food and nutrition security, but is under pressure in both high-income and developing countries to do so more sustainably and inclusively. This paper reviews the roles of trade-related food policies in this changing setting. It begins by revisiting the case for keeping food markets open to international trade, investment and technology transfer, and concludes that openness is even more important, especially for developing countries, as the climate becomes warmer and more volatile. It then summarizes trade-related food policy developments globally in the 50 years prior to the global financial crisis, and in the price-spike periods since then. The current situation is calling for more action – including from agriculture – to mitigate climate change and biodiversity loss. The scope for re-purposing food policies to better meet these demands is then assessed. It proposes some alternatives to current measures that could better achieve national societal objectives while simultaneously benefitting the rest of the world in terms of easing natural resource and environmental stresses and reducing national and global poverty, food and nutrition insecurity, and inequalities in income, wealth and health. The review summarizes the policy lessons learnt to date and concludes by noting areas where further research could facilitate such transformations in food policies.

Keywords: Uncertain international trade environment; Virtues of liberal food trade; Re-purposing food policies

Trade-related Food Policies in a More Volatile Climate and Trade Environment

1. Introduction

Food policies over the past dozen or so years have come under numerous strains. After a steady rise in the first few years of this century, real international food prices spiked up in 2007-08 during the global financial crisis (GFC). They rose again in 2011-12, and then in 2021-22 they rose once more and to a height not seen since 1974-75. Meanwhile, the United States unilaterally started a series of tariff 'wars' during the Donald Trump presidency (2017-20) triggering retaliation – especially from China – that affected the trade of numerous farm products.[1] In early 2020 the COVID-19 pandemic hit the world, causing border closures, lockdowns and thus major logistical disruptions to the international movement of most goods including food, and to the temporary international movement of seasonal farm laborers. Overlaying these short-term shocks have been long-term concerns with climate change and biodiversity loss, both of which adversely affect agriculture – and to which agriculture is itself a significant contributor. China's rapid economic growth has brought opportunities for food-exporting countries, but its greater assertiveness recently under President Xi Jinping is adding new challenges. These developments, plus perceived rises in income and wealth inequality in numerous countries, are contributing to more market and policy uncertainty (Figure 1). They are also leading to the election of more populist political leaders – with trade-protectionist inclinations to appease anti-globalization groups – than have been seen for several decades (Funke, Schularick and Trebesch 2021).

[insert Figure 1 around here]

This paper reviews the roles of food policies that affect global food systems in this changing global environment, particularly those that affect international trade (because they thereby have major impacts on farm product and factor prices). It begins by revisiting the case for keeping food markets open to international trade, investment and technology transfer. It then summarizes trade-related food policy developments globally in the 50 years prior to the GFC (Section 3), and in the price-spike periods since then (Section 4). COVID-19 has caused a considerable rise in the number of poor and malnourished people in the world (FAO et al. 2021), making it more difficult to meet the UN's Sustainable Development Goals of eradicating extreme poverty and hunger by 2030. The current situation is calling for renewed progress on that front, and for more action on climate change and biodiversity loss to help preserve the global commons, as well as less soil and water degradation and more space in intensive livestock facilities. Section 5 explores the scope for re-purposing food subsidies and trade policies to better meet these latest demands on policymakers. It suggests that some of the available alternative food policy measures for achieving national societal objectives can simultaneously benefit the rest of the world with less disruptions to trade. Those global benefits include easing natural resource and environmental stresses while reducing national and global poverty, food and nutrition insecurity, and inequalities in income, wealth and health. The final section summarizes the policy lessons learnt to date and notes areas where further research could facilitate such transformations in food policies.

[1] See, e.g., Carter and Steinbach (2020), Feenstra and Hong (2021) and Grant et al. (2021). Phase I of the 2020 US-China Trade Agreement (USCTA) did reverse some of the lost farm trade but by no more than would have resulted without the trade war, according to Bown (2022); and many of those unilateral actions by the US have continued into the Biden presidency that began in January 2021.

2. Why have open food markets?

When food markets are opened to international trade, the gains from intra-national production specialization and market exchange are multiplied. Those gains from trade can come from exchange when domestic preferences differ from those in the rest of the world, but also from production specialization when relative factor endowments or technologies differ and economies of scale are present, from within-year intra-industry trade when seasons differ, from the greater range of qualities and varieties of each good on offer, and from increased competition from abroad driving down monopolistic pricing domestically (although see Curzi et al. 2021). The gains from production specialization are increasing as global value chains increase in importance. And since openness expands the scope for raising the variety, style and quality ranges of products available to consumers (Costinot and Rodriguez-Clare 2014, Gouel and Jean 2021, Gaigné and Gouel 2022), it can contribute to diet diversity and food safety and quality, the demands for which rise with per capita income.

The smaller a country, the greater its gains from openness (Limao and Xu 2021). This is because without it there is less scope for specialization in production to exploit economies of scale, more scope for monopolistic pricing, and less likelihood that a weather shock to crops in one part of the country will be countered by an offsetting shock in the rest of the country. Even if nearby countries suffer a similar weather shock, more-distant countries are less likely to do so at the same time. For that reason, openness to the world is becoming more important because of climate change: weather shocks are becoming greater and more frequent everywhere, and global warming is altering the comparative advantage of farmers, harming those in the tropics most (see Jägermeyr et al. 2021 and the many citations therein).

These standard gains-from-trade arguments have been called into question at various times, including recently by Roberts and Lamp (2021) who contrast five alternative views to what they call the establishment narrative. But most criticisms have been shown by welfare economists to be unfounded, because there are superior domestic policy measures for dealing more efficiently and equitably with the concerns raised by those critics (Bhagwati 1971 and 2004, Ch. 13 of Corden 1997). So long as complementary first-best domestic policies are in place for encouraging accumulation of various forms of capital (natural, human, knowledge, financial, physical), for providing public goods, and for offsetting local environmental and other externalities and risks, trade openness will be welfare-maximizing for any economy unable to influence its international terms of trade.

These arguments apply also to countries with an element of monopoly power in the international marketplace, because that power cannot easily be exploited by taxing the country's trade if other countries can retaliate (Johnson 1953-4). The General Agreement on Tariffs and Trade (GATT) and now the World Trade Organization (WTO) were designed at the outset to minimize such trade tax 'wars' via their most-favored-nation and reciprocity Articles, and by the WTO's dispute settlement mechanism that limits infringement retaliation to no more than a proportionate response. With these institutions in place, even large economies are incentivised to not exploit their market power, to the great benefit of smaller economies and the world as a whole (Bagwell and Staiger 1999 and 2002, Felbermayr et al. 2020, Staiger 2022). This applies to agriculture as much as to other products (Grant and Boys 2013).

Unfortunately, the reversion of the US and China under Presidents Trump and Xi to bilateral economic coercion has shrunk global trade in agricultural (and other) products (Carter and Steinbach 2020, Grant et al. 2021). The US took this action against China out of frustration with not only a bilateral trade imbalance, but also with what it claims to be China's non-compliance with WTO rules and agreements and inadequate outcomes via multilateral processes under WTO (Mattoo and Staiger 2020). The recent prevention by the

US of a renewal of judges for the WTO's Appellate Body has added to global trade uncertainty, by stalling the WTO dispute settlement mechanism (Johnson 2019). These elements of trade and policy uncertainty have been exacerbated by the COVID-19 epidemic, which has led some firms to re-shore previously off-shored activities in manufacturing (Antràs et al. 2022, Baldwin and Freeman 2021).[2]

In the past it has often been claimed that taxing trade is necessary for a low-income country because that is its lowest-cost way of raising essential government revenue. As countries develop, though, the capacity of the state to rely more on consumption and income taxes than on trade taxes gradually improves (Besley and Persson 2011, Besley, Dann and Persson 2021). Arezki, Dama and Rota-Graziosi (2021) find that liberalization alters the tax structure toward a greater reliance on indirect taxes relative to direct ones, and that economies with value added taxes in place prior to liberalization see less-negative effects on tax revenues from trade reform. Moreover, countries with the weakest tax-raising capacity can begin trade liberalization by replacing an import tariff with a consumption tax of the same magnitude which, even if collected only at the border, would raise the same revenue as a tariff. Any subsequent imposition of that new tax on domestically produced goods and services, if/when such a sector emerges, would then provide an additional source of tax revenue for the treasury.

A further reason for openness this century is the vastly increased scope to separate in time and space the various productive tasks along each product's value chain, thanks to the information and communication technology (ICT) revolution. Firms are increasingly able to take advantage of factor cost differences across countries for specific tasks without having to sacrifice gains from product specialization or move the whole of their production operation offshore where the risks of intellectual property theft may be greater. This includes trade in services, which goes alongside and facilitates trade in most goods (Liu et al. 2021), including both unprocessed and processed farm products (OECD 2021b).

There is an important exception to the above gains-from-trade arguments, however. It has to do with environmental externalities and how they – and policy responses to them – can spill over to other countries and the global commons. International transport is a gross – but not necessarily a net – contributor to global pollution. Generally its direct damage is small, but it can contribute also indirectly by facilitating the relocation of pollutive production and consumption (Cristea et al. 2013). Whether the damage from greater transportation when importing food is more or less than the pollution from producing that food abroad instead of locally is an empirical question. In the 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, undermining the 'eat local' rhetoric.

In some cases, removing current trade barriers and subsidies could itself improve the global environment (Anderson and McKibbin 2000, Shapiro 2021, Laborde et al. 2021), but in other cases expanding trade of products whose consumption or production is pollutive may cause environmental damage that costs more than the gains from expanding trade. An important influence on the environmental/resource outcome of opening is the extent to which property rights are attached to renewable resources and how well markets for them or their services operate in each jurisdiction, as for example with forests (Ferreira 2004), water

[2] This re-shoring has been less of an issue with food products because they have been less involved in global value chains than other goods (World Bank 2021c, p. 28). Also, trade flows have not been disrupted by COVID as much for food as for other goods (Arita et al. 2022). However, COVID's disruption to the temporary international movement of seasonal workers for harvesting horticultural crops has been challenging for farmers in numerous high-wage countries.

(Debaere 2014, Ringler, Perez and Xie 2021) and fisheries (Erhardt 2018). Another influence is how heavily environmental pollution is taxed or otherwise regulated in each nation. Those policy measures alter the international competitiveness of domestic firms, the extent to which each nation's environmental damage spills over to the rest of the world, and thereby global pollution. Copeland, Shapiro and Taylor (2021) provide a thorough survey of these and related issues, including the effects of trade openness on national environmental policies and international environmental agreements and the latter's possible linkages with international trade agreements.[3]

In addition to the above comparative static arguments, openness to trade has the additional benefit of boosting innovation and an economy's growth rate (Estevadeordal and Taylor 2013, Akcigit and Melitz 2021, Melitz and Redding 2021, Aghion, Antonin and Brunel 2021). Greater openness to international financial markets adds further stimulus to investment. (By contrast, back-tracking on trade reform has a negative impact on foreign investment.) The latest surge of globalization has been spurred also by the technology 'lending' that is involved in off-shoring a rising proportion of production processes (Baldwin 2016).

More-open economies also tend to be more innovative insofar as that involves greater trade in intellectual capital. That is, international trade and investment liberalization can lead not just to a larger capital stock and a one-off increase in productivity but also to higher rates of capital accumulation and productivity growth in the reforming economy (Alcalá and Ciccone 2004), thanks to the way reform energizes entrepreneurs to be more innovative including through creative destruction of low-productivity firms by the most-productive firms (Feenstra 2018, Aghion, Antonin and Brunel 2021).

In the case of food markets, innovation can be accelerated by interactions between domestic and international R&D providers. New agricultural technologies and improved genes in seeds and breeding animals come from investments by both the private and public sectors (Fuglie et al. 2020). Their uneven generation, adoption and international transfer across the world and across species have altered agricultural comparative advantages of countries and commodities non-trivially. Such investments have yielded extremely high estimated rates of return, even after great scrutiny of the methodologies used for measuring them (Rao, Hurley and Pardey 2019). Those high returns suggest agrifood R&D underinvestment by both high-income and developing countries, especially as the estimated returns do not include health benefits such as reduced infant mortality for poor rural households.

Dynamic welfare gains from trade can occur even in countries that specialize in non-innovative, low-technology sectors, provided those sectors are open to trade. They occur not from production but via consumption: innovation in high-tech sectors in the rest of the world lowers the price of those sectors' output and thus improves the international terms of trade of the less-innovative food-importing countries. This is a specific example of the more-general point that open economies benefit from the growth of other open economies with complementary trade specialization via the effect the latter has on the international terms of trade. Lewis (1981) made this point in arguing that developing countries, as exporters of

[3] Going forward, trade measures such as carbon border tax adjustments may be imposed by the European Union and some other countries (Martin 2021), ostensibly to entice their trading partner countries to sign an international abatement agreement on greenhouse gas (GHG) emissions. Should that not alter the number of signatories, however, it may serve as little more than an anti-trade protectionist measure benefitting local producers at the expense of producers abroad. Cattle and sheep producers in the rest of the world, and consumers of beef, sheepmeat and milk products in the protective countries, would be especially harmed if methane emissions were included in the scheme, unless new technologies come on stream and are adopted to reduce the methane emissions of ruminants.

primary products and importers of most manufactured goods, had gained from the post-war growth of advanced industrial economies up to 1973.

Whatever the degree of openness between national economies, an additional global dynamic gain can come from lowering uncertainty in the trade environment. One of the great benefits of the WTO has been that its member states agree to legally bind their import tariffs such that traders can be confident that they will pay no more than that ceiling rate, or otherwise have the right to be compensated (Francois and Martin 2004). China's accession to the WTO at the end of 2001 also reduced uncertainty in global trade for both China and its trading partners (Handley and Limão 2017). Unfortunately the recent rise in policy uncertainty (Figure 1) is eroding this former gain from increasing openness, at least temporarily (Davis 2018, Handley, Kamal and Monarch 2020).

Econometric evidence regarding the impact of trade reform on economic growth were critiqued in a survey by Rodríguez and Rodrik (2001). In the two decades since then, researchers have tried to overcome the various methodological problems that plagued earlier studies. A new survey by Irwin (2019) finds trade reforms to have had a consistent positive impact on economic growth on average, although the effect is not uniform across countries.

One reason for that unevenness of impact is that gains from opening an economy are greater if that opening is extended beyond goods to tradable services (Borchert et al. 2020, Liu et al. 2021), and if accompanied by a freeing up of domestic markets for land, water, labor, finance and non-tradable services, and of the market for foreign currency exchange (Atkin and Khandelwal 2020). If a country's currency is flexible such that its real exchange rate can move freely in response to international price or domestic market shocks (or a trade reform), producer and consumer incentives will adjust promptly to the new market conditions in a way that smooths the adjustments required and continues to maximize national economic welfare. And if a low-income country's trade reform is accompanied by (or preferably preceded by) the introduction of indirect taxes, the government's optimal level of tax revenue need not be compromised by reduced trade taxation.

Despite all the above benefits, critics of openness and globalization have raised various concerns (e.g., Stiglitz 2017, Helpman 2018, Rodrik 2020), and have pointed to the need to address them seriously if populist contenders are to be kept from reversing past trade liberalizations. The main concerns have to do with income, wealth and health distributional consequences, plus environmental outcomes (Roberts and Lamp 2021).

The current globalization wave has seen a massive decline in the incidence of global poverty (Ravallion 2016 and 2020, Atkinson 2019), and also ill-health (Deaton 2013). Another consequence is a great reduction in inequality of incomes across countries (Milanovic 2016). Yet much has been made of the rise of income and wealth inequality *within* countries during the current globalization wave (Goldberg and Pavcnik 2007, Stiglitz 2012, Bourguignon 2015, Zucman 2019, Case and Deaton 2021, Collier at al. 2021), and the lack of improvement in self-assessed well-being or happiness (Layard 2020), notwithstanding the simultaneous massive declines in absolute poverty and ill-health nationally and globally. Empirical evidence vindicates the Corden (1997, pp. 72-76) notion of a conservative social welfare function in revealing that governments choose policies that help to avert losses for significant groups from exogenous shocks (Freund and Özden 2008, Tovar 2009), including from food price shocks (Meyimdjui and Combes 2021).

Regarding poverty, evidence surveyed by Ravallion (2006, 2016) suggests aggregate economic growth differences have been largely responsible for the differences in poverty alleviation across regions. Initiatives that boost economic growth are therefore likely to be helpful in the fight against poverty, and trade liberalization is one such initiative. But liberalizations of trade barriers also alter relative product prices domestically and in international markets, which in turn affect factor prices. Hence their net effect on poverty and

income inequality depends also on the way those price changes affect poor households' expenditure and their earnings net of remittances. If the consumer and producer price changes (whether due to own-country reforms and/or those of other countries) are pro-poor, then they will tend to reinforce any positive growth effects of trade reform on the poor. Simulation studies show that reforms to the food and agricultural policies of high-income countries could provide a major source of developing country gains from trade reform. Such reform would boost the demand for unskilled labor and for farm products produced in poor countries. Since more than two-thirds of the world's poor live in rural areas (World Bank 2021a), and since many poor rural households are net sellers of farm labor and/or food, one would expect such reforms to reduce the number in absolute poverty.[4]

In summary, openness to agricultural trade is likely to bring gains not just in efficiency terms but also in terms of reducing income inequality and especially poverty, malnutrition and ill-health, and through contributing to diet diversity and food safety and quality. Whether it would reduce or add to national and global environmental damage and biodiversity loss is a separate empirical question. It was rudimentarily addressed three decades ago in a study that concluded the removal of food output and input price and trade distortions would likely reduce global environmental damage and chemical residues in food (Anderson 1992). A recent study focusing on the removal of agricultural subsidies and market price supports in 54 high- and middle-income countries found, however, that it would have only a minor impact on GHG emissions (Laborde et al. 2021).[5] Another new study that focused on agricultural trade's impact on land systems found very heterogeneous environmental effects across regions and commodities (Kastner et al. 2021). Both came to a similar conclusion to that in the survey by Baylis, Heckelei and Hertel (2021), namely, that far more empirical research is needed by economists and ecologists to get a more comprehensive view of the effects of food and agricultural trade – and of trade reform – on various environmental indicators. This point is taken up in the final section of the present review.

3. How open were food markets pre-GFC?

During the globalization wave preceding World War I, international trade was hugely liberalized. It began for farm products with the repeal of Britain's Corn Laws in 1846, which benefitted the rest of the world as much as Britain due to its influence on their international terms of trade (Irwin and Chepeliev 2021). Then 1860 saw the signing of the Cobden-Chevalier Treaty that liberalized trade between Britain and France. That bilateral treaty's most-favored-nation (MFN) clause required any agreed cut in the tariff on each item in the bilateral trade to be applied also to their imports from other countries. It also meant that every European country that subsequently signed a bilateral trade treaty with either Britain or France (and most had done so by 1867) signed onto MFN. The systemic effect of that 1860

[4] A set of analyses reported in Anderson, Cockburn, and Martin (2011), in which global and national CGE model results are carefully combined with household income and expenditure survey data for nearly a dozen developing countries, tests this hypothesis. It finds strong support for it in most of the country case studies considered, even though those estimates use comparative static models and so underestimate the gains because they do not include the poverty-reducing dynamic effects on economic growth of such reforms. A broader study of 163 countries since the 1960s finds market-oriented reforms were positively correlated with income shares of low-income citizens (Gründler, Potrafke and Wochner 2020); but it also shows that low-income citizens are less likely to support market-oriented reforms than high-income citizens, suggesting they misperceive the prospective benefits from such reforms.

[5] Part of the reason for Laborde et al. (2021) finding market access restrictions to have only a minor impact on GHG emissions is that those barriers not only encourage local production but also discourage local consumption in the protecting country, with the latter being sometimes more damaging to the environment than the former.

Anglo-French accord was thus of much greater significance than its importance to either country alone, as it led to a network of treaties that lowered hugely the average level of import tariff protection. During the years from 1860 to 1913 the world thereby enjoyed relative serenity in terms of international trade and monetary relations. Even though economic growth then was proceeding at less than half the post-World War II pace, it was very rapid by previous standards, as was international trade growth.

However, when many of the European trade treaties were reaching their expiry date (nearly fifty of them were to expire in the first half of the 1890s), economic difficulties were making their renegotiation contentious. Once tariff wars ensued, the threat of retaliation – which had served as a deterrent to raising tariffs – became less of a constraint on trade liberalization reversal. Even though MFN was retained, relations were strained by the absence of bindings on tariffs (to prevent backsliding), of constraints on non-tariff trade-distorting measures, and of legal means to resolve disputes. Furthermore, the unwillingness of America or others to adopt the unconditional MFN principle meant the sustainability of the European commercial policy achievements of that period was far from certain. Indeed, the bilateral treaty regime ended abruptly with the outbreak of World War I in 1914 (Bairoch 1989).

Following that war, efforts to restore liberal trade centred on international conferences. However, despite the rhetoric in support of open markets, those meetings did not lead to renewed trade treaties with binding commitments to openness based on MFN. With no country willing or able to replace Britain as the hegemon, there was trade policy anarchy (Kindleberger 1989). When low agricultural prices and then economic recession 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, Jacks and Novy 2020). The volume of world trade shrunk by one-quarter between 1929 and 1932, and its value fell by two-fifths.

Over the entire inter-war period both agricultural and other merchandise trade grew hardly at all. According to Federico (2005, page 22-29), world exports of both agricultural and non-agricultural goods declined by 0.8% per year between 1925 and 1938, and real prices of farm products in international markets slumped following their highs during World War I – initially from oversupply and then from increases in trade barriers (see Findlay and O'Rourke 2007, pp. 447-48 and references cited therein). That decline in international prices of primary products nudged Prebisch (1950) and Singer (1950) to advise developing country governments to encourage industrialization relative to primary production, the impact of which took decades to erode (Irwin 2021).

The first attempts to reverse the growth in protection were discriminatory, benefitting Europe's colonies at the expense of other trading partners. Thus between 1929 and 1938 the share of imports from colonies rose from 30 to 42% for Britain, from 12% to 27% for France, and from 20% to 41% for Japan (Anderson and Norheim 1993). 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 and hence a return to MFN irrelevant unless and until 'tariffication' of those barriers occurred. For agriculture that took until the World Trade Organization came into being in 1995.

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. After much negotiation, an Interim Commission of the International Trade Organization was established and its General Agreement on Tariffs and Trade (GATT) was signed in 1947 by 23 trading countries. At that

time, those 12 high-income and 11 developing countries 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.

The last of those negotiations, the Uruguay Round (1986-94), culminated in numerous agreements to further reduce trade barriers over the subsequent decade. Two of those agreements involved, for the first time, a serious attempt to liberalize agricultural trade and discipline sanitary and phytosanitary (SPS) trade measures. Another agreement involved the replacement of the Interim Commission of the ITO by a new World Trade Organization (WTO) in January 1995, the membership of which now involves 164 countries/customs territories that account for more than 97% of world trade. By the end of the implementation of the Uruguay Round, the extent to which different farm products were imported or exported still varied enormously across countries and products (Table 1). Even though differential trade costs would explain part of that variance across products, it nonetheless suggests there may still be plenty more scope for further liberalization in the 21st century.

[insert Table 1 around here]

There were three reasons why agricultural trade grew much less rapidly than trade in other goods in the 20th century. Two reasons were structural, but a third has to do with policies. The first structural reason is the fall in agriculture's share of global GDP, thanks to rapid farm productivity growth confronting low price and income elasticities of food demand (Anderson and Ponnusamy 2022): that GDP share is now only 3%, down from more than 50% not much earlier than 1900. The second structural reason is the recent fragmentation of industrial production into ever-more processes and the associated rapid expansion in the number of international links in their global value chains (Antràs 2016, Baldwin 2016, Sposi 2019). Global value chains have grown for farm products too, but at a much slower pace than for manufactured goods and for intra-national food trade (Reardon and Minten 2021, World Bank 2021c, p. 28). That is reflected in the global shares of exports as a percentage of sectoral GDP, which rose from 67% to 102% for manufacturing while hardly changing (a slight fall from 11% to 10%) for agriculture during 1997-2007, after which both sectors' shares have flat-lined with the stalling of global trade growth (based on WDI data by the World Bank 2021a).

The third contributor to relatively slow farm trade growth has to do with trade-restricting policies. The lack of strong GATT disciplines on agriculture's trade-related policies allowed two separate developments in farm policies between the 1950s and the 1980s: agricultural protection growth in high-income countries (especially Japan and the European Community), and agricultural export taxation in low-income countries.[6] Nearly all of the assistance to Japanese and European farmers in that period was due to restrictions on imports of farm products. But assistance then rose markedly in the early 1980s, generating a surplus that was being disposed of with the help of export subsidies and which triggered a North Atlantic food export subsidy "war" (Bagwell and Staiger 2001).

Meanwhile, developing countries had been heavily discriminating against their farmers. A major World Bank study of 18 developing countries by Krueger, Schiff, and Valdés (1988) shows that the depression of incentives facing developing-country farmers from the 1960s to the mid-1980s had been due partly to various forms of agricultural price

[6] The political economy forces behind those separate policy developments are surveyed in Anderson (2010b), Anderson, Rausser and Swinnen 2013 and Swinnen 2018).

and trade policies, including subsidies to food imports as well as taxes on farm exports, and partly to developing countries' nonagricultural policies that hurt their farmers indirectly. The two key indirect measures were manufacturing protectionism (which attracts resources from agriculture to the industrial sector) and overvalued exchange rates (which attract resources to sectors producing nontradables, most notably services).

A more-comprehensive World Bank study two decades later (Anderson 2009, 2010a) covers 45 developing countries but also 13 European transition economies as well as 24 high-income countries, and it covers all foods plus key raw materials such as fibres. Its results reveal that there have been substantial reductions in distortions to agricultural incentives in both high-income and developing countries over the past three decades (Figure 2). This is also clear from three decades of producer support estimates by the OECD (2021a):[7] the nominal rate of agricultural protection for the 36 OECD member countries (mostly high-income economies) fell from 46% in 1986-88 to 26% in 2000-02 and 9% in 2018-20. However, for 12 (mostly large middle-income) emerging economies, the OECD estimates that their nominal rate of agricultural protection rose on average from 1% in 2000-02 to 4% in 2018-20.

[insert Figure 2 around here]

Those recent estimates also reveal that the reform process is far from complete. First, the average progress has not been uniform across countries and regions, particularly among developing countries: an average relative rate of assistance to farmers (RRA) for that group of close to zero hides the fact that some in that group of countries have RRAs well above zero and others less than zero. That is, some developing countries have "overshot" in the sense that they have transitioned from having an average RRA that was negative to one that is positive, rather than stopping at the welfare-maximizing rate for a small economy of zero. Second, even if a country has a zero RRA, that may be because the nominal rates of assistance (NRA) for its agricultural sector is the same as the weighted average of that for its other goods-producing (most notably manufacturing) sectors, both of which may be positive and thus attracting resources from non-tradable parts of the services sector. Third, many countries still have within their agricultural sector a wide dispersion in NRAs for different farm industries. In particular, virtually all countries – including key exporters of farm products – have a strong anti-trade bias in the structure of assistance within their agricultural sector (Table 3 in Anderson 2010a). Global resource use is further distorted by the trade-restrictiveness of service sector policies, which are more severe than those for goods and which raise input costs in goods production (OECD 2020a).

More specifically, while the average NRA for exporters in developing countries has been negative throughout (but coming back from -50% in the 1960s and 1970s to almost 0% in 2000-10), the NRA for import-competing farmers in developing countries has fluctuated around a trend rate that has risen from 10% to 30% (and it even reached 40% in the years of low international prices in the mid-1980s). That anti-trade bias is further confirmed in Figure 3, which shows the while average import tariffs have come down over the past 25 years, they are still higher for agriculture than manufacturing and the agricultural average for DCs is well above that for HICs. And non-tariff measures restricting both exports and imports are far more prevalent for farm products than for those from mining or manufacturing (Figure 4 in WTO 2021). Furthermore, there are still some countries that directly discriminate against the more-competitive parts of their farm sector, both in Africa (Pernechele, Balié and Ghins 2018) and in Asia (notably India and Vietnam – see those two countries' PSE estimates in OECD 2021a). All this suggests that export-focused farmers in many developing countries

[7] The OECD's NRA is defined as PSE/(1-PSE/100) where its PSE is more comprehensive than that estimated by the World Bank study: the latter is based just on domestic to border price ratios and so is closer to the OECD's NRP.

are still discriminated against in two respects: (1) by the anti-trade structure of assistance within their own agricultural sectors, and (2) by the protection from imports that remains for farmers in other – especially developing – countries and thus limits both South-North and South-South trade.

[insert Figure 3 around here]

The RRA estimates shed light on something that had perplexed agricultural trade analysts for some time: why did self-sufficiency in farm products fall so little in China in the decades following its opening up despite the very strong growth in production and exports of manufactures in China? A non-trivial contributor has been the gradual removal of agricultural disincentives, which encouraged farm output growth even as China's international competitiveness in manufacturing was strengthening (Huang et al. 2009). China transitioned from negative to positive assistance to farmers far faster than an average developing country, and almost as fast as its Northeast Asian neighbors did in earlier decades at similar levels of real per capita incomes. That helped to ensure China remained food self-sufficient during the first two decades of reform; but agricultural self-sufficiency is now declining and is projected to continue to do so over the next decade under current policies (Anderson 2018). Net imports of farm products declined until the early 1990s, but have been growing since then (Figure 4) – although more than half of those net imports are accounted for by just soybeans and now also maize for animal feed and cotton for the country's massive textile industry.

[insert Figure 4 around here]

Prior to this century, taxes on and quantitative barriers to trade were the dominant instruments of inter-sectoral distortions to producer incentives in most countries. Over the past two decades, however, budgetary transfers to farmers have played an increasing role. Drawing on PSE estimates by the OECD (2021a), the GTAP modelling database suggests those US$ outlays almost doubled between 2004 and 2014 in the 54 countries (including 13 large emerging economies) monitored by the OECD – as did the emerging economies' share in that total, which rose from 22% to 42% (Anderson and Valenzuela 2021).

The overall PSE in US dollars for OECD countries has changed little since the late 1980s, while their average PSE in percentage terms has halved thanks to growth in the value of farm output. With the contribution of trade barriers falling relative to that from domestic supports, the distortion to consumer prices has dropped even more, from a tax equivalent of 41% to just 7% (OECD 2021a). That compares with a 4% average for the 13 large emerging economies the OECD also monitors. It means there are still restrictions on imports into those countries' food markets provided by agrifood policies that make food more expensive for consumers than it would be under free trade.

Nor are the switches from trade measures to domestic supports always welfare improving, even though that removes the consumer welfare cost of the trade measure. This can be because a domestic farm price support may be accompanied by a public storage program that is inefficiently managed pending a rise in the export price or its eventual transfer to domestic consumers (Anderson and Strutt 2014). It could also be because the price support is conditional on the farmer adopting a technology that may improve the environment but be much more costly than the default technology (Gautam et al. 2022).

As for public investments assisting the agricultural sector, an important component is agricultural R&D, which has had major influences on long-term trends in agricultural comparative advantages. Those investments fell between 2000-02 and 2018-20 from 1.1% to 0.8% of the gross unassisted value of production of the 54 countries monitored by the OECD (2021a), despite their very high rates of return (Rao, Hurley and Pardey 2019). Pardey et al. (2016) point to two important caveats though. One is that private investments in agricultural R&D have grown dramatically and now exceeds the rate of public investment (if food processing is included); the other is that developing countries, particularly Brazil, China and

India, are rapidly increasing their share of global investment in agricultural R&D (Pardey et al. 2015, Fuglie 2016).

Payments to farmers for resource conservation and providing environmental services have grown to become a significant contribution in Switzerland and the EU, but it shows up only a little in the US and Norway and is very minor or non-existent in all other countries For the OECD as a whole, it amounts to well under 2% of the gross value of agricultural production (OECD 2021a). Given that there are sometimes positive externalities associated with environmental services provided by farmers, these expenditures may be less than what is optimal from a national welfare or willingness-to-pay viewpoint.

Other forms of non-product-specific assistance to the farm sector included in the OECD's General Services Support Estimate (GSSE) are investments in rural infrastructure, in quarantine services, in public stockholding, and in marketing and promotion of farm products. For the 54 countries monitored by the OECD (2021a), the GSSE has added nearly one-quarter to the US$ value of the PSE over the first two decades of this century. That annual sum (PSE+GSSE) averaged $533 billion during 2018-20. If the import protection policies of all other developing economies were added, this sum would be 20% or so higher, according to the Gautam et al. (2022). How that might be re-purposed to better meet current social objectives is taken up following the next section, which examines the volatility of food policies when prices spike.

4. How did food policies change during recent international price spikes?

The growth in agricultural protection to the mid-1980s added to a R&D-induced downward trend in real international farm product prices following their peak during the Korean War in the early 1950s, with the developing countries' export taxes only partly offsetting that effect (Tyers and Anderson 1992). Those prices flat-lined for the final 15 years of the 20th century, before rising dramatically for a combination of demand, supply, and policy reasons including a surge in demand when global stocks were low (Wright 2011, Gouel 2012). One of the policy contributors was the emergence of biofuel subsidies and mandates in both the United States and the EU (de Gorter, Drabik and Just 2015), just at a time when fossil fuel prices were rising for a decade from 1998 (Figure 5).

[insert Figure 5 around here]

But policy responses to food price rises have exacerbated the situation, as Johnson (1975) pointed out with respect to the 1973-74 food price spike. Although agricultural trade policies were officially all converted to tariffs following the Uruguay Round, many of them were confined to bilateral sales constrained by tariff-rate quotas (TRQs) while legal bindings on otherwise-unconstrained out-of-quota tariffs were set well above previously applied rates, allowing considerable flexibility to adjust protection rates upwards without breaching the out-of-quota tariff limits imposed by those ceiling commitments to the WTO membership. That has allowed many countries' policymakers to seek to stabilize their domestic prices relative to world market prices by varying the protection or taxation rates applied to agricultural trade in the short run.

Such insulating behavior may make sense for a small individual country if no other countries reacted, but that thinking involves a fallacy of composition. This is most easily seen by considering a case where each country's price is linked to the world price and each country responds in the same way to an increase in world prices. If a tightening of world market conditions raises world prices by $10, and all exporters offset this by applying a $10 export tax while all importing countries lower their import duties by $10 for the same reason, the combined impact is a rise in world prices of $20 instead of $10. Thus domestic prices rise by the same $10 they would have risen in the absence of this collectively ineffective

intervention. This is similar to all people in a stadium standing up in the forlorn hope of getting a better view of the playing field.

The extent to which that type of impact occurred during the global financial crisis is shown by Martin and Anderson (2012) and Jensen and Anderson (2017) using annual data ,and by Giordani, Rocha and Ruta (2016) using monthly data. It also occurred following the food price spike in the early 1970s and the price slump in the mid-1980s (Anderson and Nelgen 2012). In those environments, only countries that insulate by more than the average have any hope of stabilizing their domestic prices using this strategy (Anderson, Martin, and Ivanic 2017). In practice, by becoming less integrated into the international grain market it is possible that domestic markets become *more* unstable in the medium term – as found for wheat in Russia and Ukraine (Götz, Glauben and Brümmer 2012) and for maize in Africa where imperfect implementation diverted trade into the informal sector (Porteous 2017).

Slumps in international prices can trigger the opposite government reaction, to protect domestic farmers from a drop in the price of their output. For food-importing countries that can be in the form of a higher tariff or quantitative import restriction, and for food-exporting countries in the form of export subsidies. The use of such measures in the mid-1980s by the EU and North America was one of the reasons the Cairns Group (made up of 15 non-subsidizing agricultural-exporting countries) insisted the Uruguay Round Agreement on Agriculture involve binding and phasing down both import tariffs and export subsidies.

Another important form of agricultural trade policy response for staple foods—frequently observed in Africa—focuses on actual or perceived shocks to agricultural supply. When domestic outputs of maize or other key staples are expected to be below normal levels, export restrictions are often imposed or state-traded imports are brought in. Such sporadic policy responses tend to destabilize many domestic and international markets, and frequently reduce food security by focusing on the availability of food rather than on the more economically relevant ability of vulnerable groups to access food (Sen 1981). A recent example is for maize in Zambia, which added to poverty because the poorest households were net sellers of maize (Koo, Mamun and Martin 2021).

These two reasons for governments to alter border restrictions (to insulate the domestic market from international price volatility, or to ensure enough supplies in the wake of a domestic production shortfall) are likely to be invoked more in future insofar as climate change adds to market instability.[8] That suggests there will be a greater need to extend WTO disciplines on import restrictions and export subsidies to cover also export restrictions in future, to avoid the futile 'standing-up-in-the-stadium' practice seen in 2008-11 or the export subsidy 'war' of the mid-1980s. Yet some developing countries continue to call for special safeguard measures that would allow them to use temporary import price- or quantity-triggered restrictions at their discretion, in spite of numerous analyses that suggest they will be ineffective ((Hertel, Martin and Leister 2010, Grant and Meilke 2011, Ivanic and Martin 2014, Thennakoon and Anderson 2015). More encouraging is the fact that the 30% upward spike in international food prices in 2021 (see Figure 5 above) triggered relatively few and shorter-lived food export restrictions compared with the 2008-12 period (Ch. 2 in IFPRI 2021).

5. How best to re-purpose food policies?

The hyper-globalization of the two decades around the new millennium, plus the global financial crash of 2008 and the 'slowbalization' that followed, China's re-emergence on the

[8] COVID-19 provided another example of governments altering border restrictions during a crisis, namely for vaccines and personal protective equipment for health care workers: import tariffs were suspended, and export restrictions including bans were put in place in 2020/21 (WTO 2021).

world stage, and the increases in income and wealth inequality in numerous nations have strengthened the swell of anti-globalization sentiment that began in the late 1990s (recall the 'Battle of Seattle' at the 1999 WTO Trade Ministerial meeting). Adding to these concerns are the digital revolution, climate change, biodiversity loss, and biosecurity/food safety and animal welfare issues. On top of that, the COVID-19 pandemic in 2020-22 has led to a considerable rise in the number of poor and malnourished people in the world (FAO et al. 2021), making it more difficult to meet the Millennium Development Goals of eradicating extreme poverty and hunger by 2030. One consequence has been a rise in the number of populist national political leaders (Funke, Schularick and Trebesch 2021), some of whom have withdrawn their nation from multilateralism and imposed 'temporary' protectionist import tariffs and other trade sanctions, adding substantially to global market and policy uncertainty in general, and costly trade policy uncertainty in particular (Handley and Limão 2022, Mattoo and Staiger 2020).

Even though globalization and trade opening are often blamed for increased disruption to and uncertainty in markets, much is due to on-going structural changes that accompany economic growth and to which new technologies and innovations are major contributors. Yet key societal concerns are based on assumed impacts of trade on such things as inequality of income, wealth and health, unemployment, poverty, and damage to the natural environment and its resources. The COVID-19 pandemic has added to inequalities and reduced interest in cross-border activities.

If trade *per se* is not the main reason for these disliked social outcomes, then a trade policy instrument is unlikely to be the first-best response and might even worsen the situation (Bhagwati 1971, Corden 1997). Thanks to the ICT revolution this is becoming increasingly true even in low-income countries where traditionally policy options other than trade restrictions have been more limited (but on price stabilization issues see Gouel 2014 and Gouel and Jean 2016). Even so, 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 for the global commons grow.

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.

5.1 Start with lowering agricultural trade barriers

It would help greatly if WTO members could resolve multilaterally to lower trade barriers first. That is because market price supports are still the dominant form of assistance to farmers globally: even though they have declined in importance relative to more-direct support measures over the past two decades (OECD 2021a), they contributed 93% of the global welfare cost of all agricultural price and trade policies in 2001 (Anderson, Martin and Valenzuela 2006) and still contributed around 90% two decades later (Anderson et al. 2022).

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. But should that prove elusive, and should bilateral or regional preferential trade agreements (PTAs) continue to deliver few cuts to agricultural subsidies and tariffs (Bureau, Houssein and Jean, 2019), reliance in the meantime will need to be mostly on unilateral actions.

As argued in Section 2 above, unilaterally lowering 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 not only the backbone to long-term human progress (Norberg 2020), it is also the best national insurance against unexpected shocks to markets. That applies not just to goods and services trade but also to migration, finance, foreign currency exchange, foreign direct and portfolio investments, technologies and ideas. The long-term decline in costs of trading internationally, and the consequent strengthening of global value chains, 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.

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.[9] The more countries that do so, the less volatile will be international food prices.

5.2 Ensure optimal national environmental policies are in place

As for dealing with natural resource and environmental issues, the best option for national governments 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 for those likely to be otherwise left behind by forthcoming technologies (Acemoglu 2021, Colantone, Ottaviano and Stanig 2021).

Specifically, to reduce the risk of back-tracking on the trade reforms of recent decades and 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 – including meeting expectations and agreed obligations to contribute to global public goods such as mitigating climate change and biodiversity loss. 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.

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

The national economic welfare gains from trade opening are 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 Care needed in paying farmers for contributing to society's 'non-economic' goals

[9] Costinot, Donaldson and Smith (2016) suggest production changes more than trade will be crucial as climates change, but more-recent research by Gouel and Laborde (2021) concludes that trade openness also will be an important way to deal with volatility in yields.

Needless to say, farmers would desire compensation if current subsidies and import protection were removed. More than that, in the 1990s in some high-income countries it was argued that agricultural protection and subsidies were warranted because farmers contributed to 'non-economic' objectives of society. The claim was that agricultural production was 'multifunctional' in that it provided positive externalities and public goods for which farmers were not being paid directly. Examples pointed to included food security, environmental protection, and the economic viability of rural areas. Such claims did not stand up well to scrutiny, however, as they ignored negative externalities from farming (and farm input subsidies) and there were more-efficient and more WTO-consistent instruments for achieving those social objectives than measures that support farm prices and reduce trade (Anderson 2000).

For example, for those countries becoming more food import-dependent as their comparative advantages move away from agriculture, slowing that process by raising food import barriers worsens rather than improves their national food security and nutrition, since it raises food consumer prices and thus reduces economic access to food for the vast majority of households who are net buyers of food. And protecting net sellers of farm products from import competition is a very inequitable way of assisting farmers, in that it helps such farmers in proportion to their marketed output and thus boosts the incomes of the biggest/least-needy farmers most. It also boosts landowners' wealth in proportion to the size of their holding (Ciaian et al. 2021).

5.5 Boost public investments in rural infrastructure, R&D, education and health

A far more efficient way to assist today's farmers to compensate 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. That would provide the human capital needed for farm families to become more resilient as farmers, or to more-easily take up more lucrative non-farm activities.

5.6 Support the poorest households with direct fiscal transfers

If the above public investments were not enough to assist the poorest farm households adjust to short-run fluctuations and long-run market trends, a generic social safety net e-payment such as conditional targeted income supplements could be provided. They could be used in extreme situations as and when producer prices temporarily slump or crops fail, as well as to encourage structural adjustment out of farming. They could also be used to assist the poorest net buyers of food when prices temporarily spike upwards. In such situations that could lower the number falling below the poverty line. The widespread use of e-banking now makes fiscal transfers to individuals possible at little administrative cost, even to poor isolated households in low-income countries (Demirgüç-Kunt et al. 2018).

5.7 Encourage 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 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 abroad (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). Some scientists have cautioned that the scientific basis for such payments is often not sound, so they 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), with their inadequate design and implementation hampering their success to date (Wunder et al. 2020).

5.8 Reduce restrictions on international technology transfers

How might lowering restrictions on international technology transfers impact malnutrition and hunger, and diet diversity and quality? Hunger and undernutrition in particular could be eased greatly, if slowly, by trade in agricultural technologies, in particular newly bred varieties of staple food crops. The introduction of high-yielding dwarf wheat and rice varieties during the Green Revolution that began in Asia in the 1960s is a previous case in point, whereby producers and consumers shared the huge benefits in terms of higher farm profits and lower consumer prices for cereals (Gollin, Hansen and Wingender 2021).

Now there is the possibility of breeding crop varieties that are not only less costly to grow sustainably (Qaim 2020) but are also biofortified in the sense they contain vitamin and mineral supplements. One of the most promising is so-called golden rice. Consumers in many poor countries suffer from chronic vitamin A deficiency that can lead to blindness, weakened immune systems, and increased morbidity and mortality for children as well as for pregnant and lactating women. Golden rice has been genetically engineered to contain a higher level of beta-carotene in the endosperm of the grain and thereby provide a vitamin A supplement. However, there continues to be a reluctance in many countries to import both genetically modified (GM) seeds for local production and GM foods for local consumption (Anderson, Jackson and Nielsen 2005). While that reluctance persists, conventionally bred biofortified crops can and do offer an alternative pathway (see www.harvestplus.org), although that is necessarily slower at producing novel varieties than is possible using GM or gene editing biotechnologies.

GM crops can also be bred to help mitigate climate change. 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 (Kovak, Blaustein-Reito and Qaim 2022). Were there to be more economic incentives for breeders to target that objective, the latest genetic engineering technologies could speed that type of contribution to climate change mitigation.

Unfortunately, trade in technologies to national agricultural researchers via the CGIAR (Consultative Group on International Agricultural Research) has been slowed by a decline in investments in that Group of more than one-fifth between 2015 and 2019 – despite a benefit-cost ratio from past investments in CGIAR research of more than 10:1 for developing countries (Alston, Pardey and Rao 2021), and despite new opportunities also for public-private partnerships in such research as food supply chains become more sophisticated with the continuing growth of supermarkets and spread of digital technologies (Fuglie et al. 2020). Hopefully the recent reorganization to create a more-integrated ‘One CGIAR’ will reverse that decline in its funding.

5.9 Policy measures to directly influence consumer malnutrition

What about food policy changes to boost consumers' nutrition and health? The dietary transitions that occur with income growth and urbanization are substantial (Masters, Finaret and Block 2022). They are influenced also from the supply side by transport and infrastructure improvements that lower costs of trading fresh food, and by productivity growth along the food value chain right through to retail supermarkets. Yet despite the rapid penetration of fresh fruit and vegetable consumption in both rural and urban areas of low- and middle-income countries, undernutrition and obesity continue to coexist as major health concerns in those countries (Reardon et al. 2021).

Both types of malnutrition, as well as micronutrient deficiencies, can be influenced by government policies. Specific taxes on ingredients such as sugar and low-quality oils are being introduced in numerous countries (Calcott 2021). Other interventions include labelling regulations, restrictions on advertising and marketing of unhealthy products such as sugar-sweetened beverages, and nutritional education programs, e.g. for mothers and school children. Interventions that simultaneously target both undernutrition and obesity could be expanded, because of the common drivers of these often-coexistent forms of malnutrition (Hawkes et al. 2020).

6. Lessons learnt, and areas for further research

Much has been learnt from past research and policy analysis that has contributed to beneficial policy reforms, but for the world's food systems to be more-appropriately transformed there is plenty of scope for further research by economists, especially as part of multidisciplinary teams.

6.1 Lessons learnt

First and foremost, the value of keeping national economies open to international trade in farm (and other) products, and of avoiding subsidies aimed at preventing the decline of the agricultural sector, has been taken on board by many governments since the 1980s. That has reversed the long-run agricultural protection growth trend of high-income countries, and it has almost ended the heavy taxation of agricultural exports in developing countries. However, it has not yet forestalled the transition from taxing to supporting farmers relative to producers of other tradables in a few large emerging economies, so advocacy efforts are still needed there.

Second, the welfare economics of distortions has been successfully drawn on to discredit the most audacious of claims for assistance to compensate for farmers' claimed 'multifuntionality' (the side-provision of services helping to meet society's 'non-economic' objectives in the form of positive externalities and public goods, for which farmers were not being paid directly). Those claims have morphed into a much more nuanced striving for payments for ecosystem services and the preservation or better utilization of natural capital. That in turn is stimulating research focused on optimal policies and institutions to help transform national and global food systems.

Third, to assist the poorest farm households adjust to short-run fluctuations and long-run market trends, or the poorest net buyers of food when prices temporarily spike upwards, a generic social safety net e-payment such as a conditional targeted income supplement has been shown to be far more efficient and equitable than altering food price – and much more likely to reduce the number falling below the poverty line. Such fiscal transfers to individuals are now possible at little administrative cost even in low-income countries, thanks to the ICT revolution in banking.

Fourth, economic policy analysis following the food price slump of the mid-1980s and the food price crisis during the GFC has contributed to our understanding of the high cost of both export subsidies (as in the mid-1980s) and export restraints (as in the 2008 price hike) on the countries imposing them and their exacerbating impact on international price volatility. More than that, research following the 2008 food price spike exposed the futility of many countries using trade measures to avoid transmitting such international price spikes to their domestic market. That lesson seems to have been taken on board by most countries during the latest (2020-21) international food price spike.

6.2 Areas for further research

The task of national governments to satisfy many objectives simultaneously when reviewing their food policies have become more complex in recent times. That is true whether or not global public good efforts lead to new multilateral agreements on climate change, biodiversity and the like that require changes to national policies. For developing countries, pressures for food-related policy changes are being added to their attempts to reach by 2030 the United Nations' Sustainable Development Goals (SDGs).

The conventional wisdom is that a similar number of policy instruments is needed if those multiple objectives are to be met efficiently (Tinbergen 1952). The complexity of finding optimal levels of intervention for numerous policy instruments multiplies greatly as the number of objectives and hence instruments rises; and the welfare cost of deviating from the most appropriate instruments or their optimal intervention levels is becoming ever-more difficult to assess. This is shown by Drupp et al. (2021) to be the case even when focusing on just two objectives, in their case the environment and inequality.

All this suggests the need for more-sophisticated analyses of policy options for governments to consider. It is thus encouraging that methodologies for solving this multiple-objectives problem are being developed and appear to be tractable (Martin, Ivanic and Mamun 2021, Bellanger et al. 2021). Those new methodologies can be and now are beginning to be used also to encourage governments to re-purpose farmer assistance policies away from welfare-reducing and environmentally damaging agricultural price supports and towards measures designed to enhance the natural environment and improve human health.

6.2.1 Carbon abatement and border tax adjustments

Many such environmental measures, like those being demanded of livestock producers by animal welfare groups, are likely to add to producer costs when implemented. In so far as trading partners do not impose similarly costly new measures, competitiveness issues arise and potentially could trigger demands for compensating border tax adjustments. Already the EU is planning to introduce a carbon border adjustment tax on imports from countries with a tax equivalent on GHG emissions that is considered lower than that imposed in the EU (EC 2021). This could have the positive environmental effect of encouraging other countries to impose such taxes. However, the potential economic cost of such measures may be considerable, particularly for GHG-emitting foreign producers of exportables, and especially for developing countries with much lower environmental standards (Ch. 13 of Corden 1997, Mattoo et al. 2012, Martin 2021). The incidence of such a border tax will depend on the design, coverage and implementation of the legislation, opening up much scope for more analysis of this type of policy.

6.2.2 The economics of re-purposing farm-support policies to transform food systems

A new study suggests that while replacing current farm-support measures with more-efficient ones would reduce standard distortionary costs, that alone would not make a big improvement in the global environment, assuming none of the benefits from such

liberalization are invested in initiatives to improve the natural environment (Laborde et al. 2021). Policies therefore will need also to tilt towards environment-enhancing measures if they are to have that effect.

Further research is needed to assist the search for politically, administratively and fiscally feasible solutions. New efforts to that end include analyses of incentives to encourage the adoption of more-sustainable agricultural practices (Piñeiro et al. 2020), of enhanced investments in climate- and nutrition-sensitive agricultural technologies, of more direct re-distributions of purchasing power to the poorest households as and when needed, and of boosts to consumer information that will nudge households towards a healthier diet[10] based on food ingredients that are also less damaging to the environment (Gautam et al. 2022, Huang and Zhang 2021, Mamun, Martin and Tokgoz 2021, Searchinger et al. 2021).

6.2.3 Broader country coverage of food price distottions

A mundane but necessary step in improving on these modelling efforts is to have sound representations of current policies in the various models. The annual PSE and CSE monitoring and evaluation by the OECD (2021a) continues to be the main resource for high-income and key emerging countries, but it is being supplemented for other developing countries at www.ag-incentives.org only with nominal rates of import protection. More resources need to be found in international organizations to deepen that effort among developing (especially low-income) countries, and to broaden it to include a fuller range of non-tariff measures such as regulatory policies behind national borders. The latter are possibly bigger trade barriers than tariffs today. But it is challenging to estimate their extent and effects, so more progress is needed in this research area (Beghin, Maertens and Swinnen 2015, Francois and Hoekman 2019).

6.2.4 The political economy of re-purposing farm-support policies to transform food systems

Policy-focused research and empirical open-economy analysis by economists can assist governments more, and have more-lasting impacts, the better analysts understand from the outset the political economy forces at work both domestically and abroad (Swinnen 2018, Grossman and Helpman 2021). Long-standing agricultural and other policies that distort markets persist not because of the economic illiteracy of policymakers but as a consequence of asymmetries in political power and costs of collective action between those groups gaining and those losing from a measure (Anderson 1995, Zingales 2020). It is a recognition of those political forces that is driving analysts, including Gautam et al. (2022) and the FAO, UNDP and UNEP (2021), as they look for ways to re-purpose farm-support measures such that the well-being of a broader range of groups in the rest of the society is improved without reducing greatly the welfare of (at last the poorer) currently supported farmers.

6.2.5 Projecting the effects of climate change on agriculture

Most of the key topics/questions that cry out to be addressed better by analysts are complicated and overlapping. That is, they involve trade-offs that require interactions between different groups in society, different professions, and various bureaucracies all with different priorities. For example, economists projecting the effects of climate change on

[10] The Lancet Commission (Willett et al. 2019) sought to provide an ideal diet capable of sustaining health and protecting the environment, but it did not assess its affordability. A first attempt to do the latter found its cost exceeded the household per capita income for at least 1.6 billion of the world's poorest people, and is 60% above the minimum cost of nutrient adequacy (Hirvonen et al. 2020). Apart from affordability, the ideal diet differs by age group (for example, Headey, Hirvonen and Hoddinott (2018) suggest animal-sourced foods may be very beneficial in early childhood), and the demographics of high-income countries are very different from those of developing countries.

agriculture begin by using a global multi-sector economywide model that has a baseline in which climate change is assumed not to happen. That projection needs to be compared with one in which climate change does occur to some specified degree, without and then with various greenhouse gases being taxed in some countries from specified periods, then with GHG emission permits being traded internationally, then with the European Union and perhaps other countries imposing a carbon border tax adjustment on certain imported products, and then with other countries imposing GHG emission taxes in lieu of paying carbon border taxes to the EU or other countries.

6.2.6 Devising schemes involving payments for ecosystem services

Much more research is needed also to improve on schemes involving payments for ecosystem services. Börner et al. (2017) find that positive incentives (rather than disincentives such as taxes, sanctions and legal regulations) work only if very well designed, and that their environmental impacts so far have tended to be small at best and usually just local or sub-national, as are their social impacts. Sustainability standards also have had only a modest impact so far (Meemken et al. 2021).

6.2.7 Projecting effects of reforms on poverty, nutrition, food security, health and gender

Another example of a future complex research area involves empirical analysis of the effects of trade reforms on poverty, nutrition, food security, health and gender.[11] What the analyst assumes about whether/how fiscal policies are to be adjusted as part of the reform will matter in such analyses. So too will any re-instrumentation of the measures to be removed (e.g., introducing a producer subsidy or an income supplement in place of an import tariff), and any efforts to nudge consumers away from products that add directly to obesity (e.g., sugar-rich beverages) or indirectly to greenhouse gas emissions (e.g. methane and nitrous oxide from cattle) via the production of beef.

The capacity of economists to project global production, consumption and international trade in agricultural and other products has improved enormously since 1990, particularly with the set of global economywide computable general equilibrium (CGE) models. Examples using GTAP-type models include Chateau et al. (2015) and Bekkers et al. (2021). As well, the OECD and FAO join forces each year to project the world's agricultural commodity markets one decade hence (OECD/FAO 2021), while IFPRI has now linked its very detailed IMPACT model of global agricultural product markets and associated input and factor markets (Robinson et al. 2015), to a global CGE model (Willenbockel et al. 2018). The more extensive of these types of models are capable of estimating income inequality and poverty consequences of projections and shocks, by region and by type of household, and also basic resource and environmental consequences including GHG emissions. Other social consequences also are now able to come into focus, helped by regulatory impact assessments becoming standard in advanced economies (OECD 2020b, Kauffmann and Saffirio 2021).[12] Since the degrees of market and policy uncertainty around trend projections have grown considerably in recent years, systematic sensitivity analysis will need to be far more common in future modelling efforts.

[11] Only recently has attention begun to focus on its unequal impact of trade on gender (Bøler, Javorcik and Ulltveit-Moc 2015 and 2018, Shepherd and Stone 2017, Brussevich 2018, Gurevich, Riker and Tsigas 2020, World Bank and WTO 2020, and OECD 2021d).

[12] A few countries are going beyond standard GDP/GNI measurement to capture a broader concept of well-being based on the science of psychology. See, e.g., Durand (2018, 2019), Stiglitz, Fitoussi and Durand (2018a,b), Layard (2006, 2020) and OECD (2020c). National life satisfaction scores are more closely correlated with the national Pillars of Prosperity Indexes generated by Besley, Dann and Persson (2021) than with GNIs.

The natural resource and environmental impacts of modelled projections and shocks continue to improve, but much scope remains for analyses becoming more comprehensive. This is especially important when numerous sectors are involved. Bellanger et al. (2021) point out that when the focus is on a single sector and user group, remedies can include Pigouvian restraints, or small group controls following Ostrom (1990, 2009), or bargaining across users (Coase 1960). However, more-difficult natural resource management problems involve competing uses of a resource or of multiple resources across numerous sectors. Such cross-sectoral externalities impede equal attainment of each conservation objective, especially if they fall under several jurisdictions. Bellanger et al. (2021) provide a four-level institutional analysis following Williamson (1996, 2000): social embeddedness, institutional environment, governance and resource allocation. That is able to illustrate the sources of potential conflict, the costs of addressing them, and the potential for resolutions via exchanges. It includes transaction costs associated with property rights, the costs of lobbying, implementing and enforcing government regulation, and the costs of scaling up from small-group controls when resource problems involve multiple sectors and heterogeneous populations.

6.2.8 Valuing capital to include investment recursively in projections

To operationalize such complexities in analyses using national and global multi-sector economywide models, a prior step is to better value capital beyond physical capital, and to include investment in a recursive way in projections. McKibbin and Wilcoxon (1999) have included financial capital and investment in their G-Cubed Model, which informs their modelling of climate change (see, e.g., McKibbin et al. 2020 and Fernando, Liu and McKibbin 2021) and allows them also to assess monetary policy (McKibbin et al. 2020). But better specifications also of human, natural and social capital are needed to capture environmental and social outcomes more comprehensively. The OECD (2020c) is gradually contributing in that direction in its national accounting, for example by subtracting net depreciation of the total capital stock from GDP each year, while UNEP (2019) is improving global estimates of natural capital. Lange, Wodon and Carey (2018) have conveniently assembled a time series of those various capital stocks up to 2014,[13] which has now been extended (World Bank 2021b). A new database on food system contributions to GHG emissions also has been recently published (Crippa et al. 2021).

6.2.9 Estimating nutrition and health impacts in projections

Another issue that could be better incorporated into national and global sectoral and economywide models involves the impacts of modelled projections and shocks, and of policy changes, on nutrition and health. Specific taxes on unhealthy ingredients such as sugar and low-quality oils can be included in and analysed using economic models (Calcott 2021). More difficult to model are such things as labelling regulations, restrictions on advertising and marketing of sugar-sweetened or alcoholic beverages, and nutritional education programs. Even in OECD countries though, better data are needed to help improve policy analyses of and responses to these interventions (Placzek 2021, Deconinck et al. 2021).

6.2.10 Estimating innovations required to meet SDGs by 2030

With less than a decade to the target date, projecting the costs involved to achieve the UN's SDGs is needed to focus the attention of government and international agencies. A beginning has been made regarding the innovations required for sustainable agricultural intensification

[13] Incidentally, UNEP (2019) found that between 1992 and 2014 the global natural capital stock per capita declined by nearly 40% while the per capita stock of physical capital doubled and that of human capital rose by one-eighth.

to meet several SDGs (Laborde, Parent and Smaller 2020, Baldos, Fuglie and Hertel 2020, Rosegrant 2021), but more such studies will be needed as the decade progresses.

6.2.11 Endogenizing political economy realities in simulation models

Finally, some progress has been made in endogenizing political economy realities in simulation models (building on the work surveyed in Anderson 2010b, Anderson, Rausser and Swinnen 2013 and Swinnen 2018), but much more could be done to ensure policy options being analysed for developing countries with limited state capacity include ones that are realistic politically, administratively and fiscally (Birner 2021). Even with sound and shared multi-disciplinary evidence-based policy analyses to hand that expose the winners and losers of major policy options, and even if no vested interests captured the political process, remaining frictions may need to be resolved because of differences in values held by different groups within each society (Besley, Dann and Persson 2021, OECD 2021c).[14]

Transparency and inclusiveness in policy debates, and possibly compensation for losers (adjustment assistance) and long transition periods will need to be among the strategies adopted by politicians and international negotiators as they seek to resolve remaining differences within countries and in fora such as the WTO.

While no amount of compensation would satisfy some groups with extreme values, these processes may be able to reduce at least some opposition to policy reforms that improve economic welfare, human health and the natural environment. That will require more-savvy use of communication channels though: in their survey of the political economy of populism, Guriev and Papaioannou (2021) find the impact of the internet and social media appear to favor populists far more than mainstream political leaders. More research is thus needed on how to more-persuasively communicate the virtues of welfare-improving policies, including the proposed re-purposing of food policies to better meet multiple objectives – not just economic but also social, environmental and cultural and not just nationally but hopefully also globally.

References

Acemoglu, D. (2021), "Harms of AI", NBER Working Paper 29247, Cambridge MA, September.

Aghion, P., C. Antonin and S. Brunel (2021), *The Power of Creative Destruction: Economic Upheaval and the Wealth of Nations,* Cambridge MA: Harvard University Press.

Akcigit, U. and M.J. Melitz (2021), "International Trade and Innovation", NBER Working Paper 29661, Cambridge MA, December. Forthcoming in G. Gopinath, E. Helpman and K. Rogoff (eds.), *Handbook of International Economics,* Amsterdam: Elsevier.

Alcalá, F. and A. Ciccone (2004), "Trade and Productivity", *Quarterly Journal of Economics* 119(2): 613-46, May.

Alston, J.M., P.G. Pardey and X. Rao (2021), "Payoffs to a Half-Century of CGIAR Research", *American Journal of Agricultural Economics* (forthcoming; early view 22 August at https://doi.org/10.1111/ajae.12255).

Anderson, K. (1992), "Effects on the Environment and Welfare of Liberalising World Trade: The Cases of Coal and Food", Ch. 8 (pp. 145-72) in *The Greening of World Trade Issues,* edited by K. Anderson and R. Blackhurst, Ann Arbor: University of Michigan Press.

[14] Differences in values affect a large array of food issues, over and above the factual gap between perception and reality (Paalberg 2020).

Anderson, K. (1995), "Lobbying Incentives and the Pattern of Protection in Rich and Poor Countries", *Economic Development and Cultural Change* 43(2): 401-23, January.

Anderson, K. (2000), "Agriculture's 'Multifunctionality' and the WTO", *Australian Journal of Agricultural and Resource Economics* 44(3): 475-94, September.

Anderson, K. (2009), *Distortions to Agricultural Incentives: A Global Perspective 1955–2007*, New York: Palgrave Macmillan; Washington DC: World Bank.

Anderson, K. (2010a), "Krueger/Schiff/Valdés Revisited: Agricultural Price and Trade Policy Reform in Developing Countries Since 1960", *Applied Economic Perspectives and Policy* 32(2): 195-231, Summer.

Anderson, K. (ed.) (2010b), *The Political Economy of Agricultural Price Distortions*, Cambridge and New York: Cambridge University Press.

Anderson, K. (2018), "From Taxing to Subsidizing Farmers in China Post-1978", *China Agricultural Economic Review* 10(1): 36-47.

Anderson, K., J. Cockburn, and W. Martin (2011), "Would Freeing Up World Trade Reduce Poverty and Inequality? The Vexed Role of Agricultural Distortions", *The World Economy* 34 (4): 487-515.

Anderson, K., E. Corong, A. Strutt and E. Valenzuela (2022), "The Relative Importance of Global Agricultural Subsidies and Tariffs, Revisited", Paper presented at the 66th Annual Conference of the Australasian Agricultural and Resource Economics Society, 7-11 February.

Anderson, K., L.A. Jackson and C.P. Nielsen (2005), "GM Rice Adoption: Implications for Welfare and Poverty Alleviation", *Journal of Economic Integration* 20(4): 771–88.

Anderson, K., W. Martin, and M. Ivanic (2017), "Food Price Changes, Domestic Price Insulation and Poverty (When All Policy Makers Want to be Above-Average)", pp. 181–92 in *Agriculture and Rural Development in a Transforming World*, edited by P. Pingali and G. Feder, London: Routledge.

Anderson, K., W. Martin and E. Valenzuela (2006), "The Relative Importance of Global Agricultural Subsidies and Market Access", *World Trade Review* 5(3): 357-376, November.

Anderson, K. and W. McKibbin (2000), "Reducing Coal Subsidies and Trade Barriers: Their Contribution to Greenhouse Gas Abatement", *Environment and Development Economics* 5(4): 457-81, October.

Anderson, K. and S. Nelgen (2012), "Trade Barrier Volatility and Agricultural Price Stabilization", *World Development* 40(1): 36-48, January

Anderson, K. and S. Nelgen (2013), "Updated National and Global Estimates of Distortions to Agricultural Incentives, 1955 to 2011", Database at www.worldbank.org/agdistortions.

Anderson, K. and H. Norheim (1993), "From Imperial to Regional Trade Preferences: Its Effect on Europe's Intra- and Extra-regional Trade", *Weltwirtschaftliches Archiv* 129(1): 78-102.

Anderson, K. and S. Ponnusamy (2022), "Structural Transformation Away from Agriculture: The Role of Trade", ANU Working Paper in Trade and Development 2022/02, February.

Anderson, K., G. Rausser and J.F.M. Swinnen (2013), "Political Economy of Public Policies: Insights from Distortions to Agricultural and Food Markets", *Journal of Economic Literature* 51(2): 423-77, June.

Anderson, K. and A. Strutt (2014), "Food Security Policy Options for China: Lessons from Other Countries", *Food Policy* 49(1): 50-58, December.

Anderson, K. and E. Valenzuela (2021), "What Impact are Subsidies and Trade Barriers Abroad Having on Australasian and Brazilian Agriculture?" *Australian Journal of Agricultural and Resource Economics* 65(2): 265-90, April.

Antràs, P. (2016), *Global Production: Firms, Contracts, and Trade Structure*, Princeton NJ: Princeton University Press.

Antràs, P., T. Fort, A. Gutiérrez and F. Tintelnot. (2022), "Trade Policy and Global Sourcing: A Rationale for Tariff Escalation". NBER Working Paper. Cambridge MA (forthcoming).

Arita, S., J. Grant, S. Sydow and J.Beckman (2022), "Has Global Agricultural Trade Been Resilient Under Coronavirus (COVID-19)? Findings from an Econometric Assessment of 2020 ", *Food Policy* 107: 102204, February.

Arezki, R., A.A. Dama and G. Rota-Graziosi (2021), "Revisiting the Relationship between Trade Liberalization and Taxation", CESifo Working Paper No. 9244, Munich, August.

Atkin, D. and A.K. Khandelwal (2020), "How Distortions Alter the Impacts of International Trade in Developing Countries", *Annual Review of Economics* 12: 213-38.

Atkinson, A.B. (2019), *Measuring Poverty Around the World*, Princeton NJ: Princeton University Press.

Avetisyan M., T.W. Hertel and G. Sampson (2014), "Is Local Food More Environmentally Friendly? The GHG Emissions Impacts of Consuming Imported Versus Domestically Produced Food", *Environmental and Resource Economics* 58(3): 415-62, July.

Bagwell, K. and R.W. Staiger (1999), "An Economic Theory of GATT", *American Economic Review* 89(1): 215–48.

Bagwell, K. and R.W. Staiger (2001), "Strategic Trade, Competitive Industries and Agricultural Trade Disputes", *Economics and Politics* 13(2): 113-28, July.

Bagwell, K. and R.W. Staiger (2002), *The Economics of the World Trading System*, Cambridge MA: MIT Press.

Bairoch, P. (1989), "European Trade Policy, 1815–1914", Ch. 1 in *The Cambridge Economic History of Europe, Volume VIII: The Industrial Economies*, Cambridge and New York: Cambridge University Press.

Baker, S.R., N. Bloom and S.J. Davis (2016), "Measuring Economic Policy Uncertainty", *Quarterly Journal of Economics* 131(4): 1596-1636, November.

Baldos, U.L.C., K.O. Fuglie and T.W. Hertel (2020), "The Research Cost of Adapting Agriculture to Climate Change: A Global Analysis to 2050", *Agricultural Economics* 51(2): 207-20.

Baldwin, R. (2016), *The Great Convergence: Information Technology and the New Globalization*, Cambridge MA and London: Harvard University Press.

Baldwin, R. and R. Freeman (2021), "Risks and Global Supply Chains: What We Know and What We Need to Know", NBER Working Papers 29444, Cambridge MA,

Baylis, K., T. Heckelei and T.W. Hertel (2021), "Agricultural Trade and Environmental Sustainability", *Annual Review of Resource Economics* 13: 379-401, October.

Beghin, J.C., M. Maertens and J.F.M. Swinnen (2015), "Nontariff Measures and Standards in Trade and Global Value Chains", *Annual Review of Resource Economics* 7: 425-50.

Bekkers, E., E. Corong, J. Métivier and D. Orlov (2021), "Global Trade Patterns in 2050 and its Drivers", Paper presented at the 24th Annual Conference on Global Economic Analysis, West Lafayette IN, June.

Bellanger, M., R. Fonner, D.S. Holland, G.D. Libecap, D.W. Lipton, P. Scemama, C. Speir and O. Thebaud (2021), "Cross-Sectoral Externalities Related to Natural Resources and Ecosystem Services", NBER Working Paper 28480, Cambridge MA, February.

Besley, T., C. Dann and T. Persson (2021), "Pillars of Prosperity: A Ten-year Update", CEPR Discussion Paper 16256, London, June.

Besley, T. and T. Persson (2011), *Pillars of Prosperity: The Political Economics of Development Clusters*, Princeton NJ: Princeton University Press.

Bhagwati, J.N. (1971), "The Generalized Theory of Distortions and Welfare", in *Trade, Balance of Payments and Growth*, edited by J.N. Bhagwati et al., Amsterdam: North-Holland.

Bhagwati, J.N. (2004), *In Defense of Globalization,* London and New York: Oxford University Press.

Birner, R. (2021), "Analyzing the Political Economy of Agricultural Policy and Public Expenditure Reforms", mimeo, University of Hohenheim, June.

Bøler, E.A., B. Javorcik and K.H. Ulltveit-Moe (2015), *Globalization: A Woman's Best Friend? Exporters and the Gender Wage Gap,* CEP Discussion Paper No 1358, June 2015, Centre for Economic Performance, London School of Economics.

Bøler, E.A., B. Javorcik and K.H. Ulltveit-Moe (2018), "Working Across Time Zones: Exporters and the Gender Wage Gap", *Journal of International Economics* 111: 122-33, March.

Borchert, I., J. Magdaleine, J.A. Marchetti and A. Mattoo (2020), "The Evolution of Services Trade Policy Since the Great Recession", Policy Research Working Paper 9265, World Bank, Washington DC, June.

Börner, J., K. Baylis, E. Corbera, D. Ezzine-de-Blas, J. Honey-Rosés, U.M. Persson and S. Wunder (2017), "The Effectiveness of Payments for Environmental Services", *World Development* 96: 359-74.

Bourguignon, F. (2015), *The Globalization of Inequality,* Princeton NJ: Princeton University Press.

Bown, C.P. (2022), "China Bought None of the Extra $200billion of US Exports in Trump's Trade Deal", PIIE Educational Resources, Washington DC: Peterson Institute for International Economics, accessed 8 February at https://www.piie.com/sites/default/files/documents/bown-china-us-exports-trade-deal-2022-02.pdf

Brussevich, M. (2018), "Does Trade Liberalization Narrow the Gender Wage Gap? The Role of Sectoral Mobility," *European Economic Review* 109: 305-33, October.

Bureau, J.-C., G. Houssein and S. Jean (2019), "Competing Liberalizations: Tariffs and Trade in the Twenty-fisrt Century", *Review of World Economics* 155(4): 707-53.

Cahill, C. and S. Tangermann (with L. Brink, S. Fan, J. Glauber, A. Gonzalez, T. Groser, A. Gulati, J. Hewitt, A. Hoda, A. Matthews and G. Valles Galmes) (2021), "New Pathways for Progress in Multilateral Trade Negotiations in Agriculture", May.

Calcott, P. (2021), "Regulating Ingredients in Sin Goods", *American Journal of Agricultural Economics* (forthcoming).

Carter, C.A. and S. Steinbach (2020), "The Impact of Retaliatory Tariffs on Agricultural and Food Trade", NBER Working Paper 27147, Cambridge MA, May.

Case, A. and A. Deaton (2021), "The Great Divide: Education, Despair and Death", NBER Working Paper 29241, Cambridge MA, September.

Chateau, J., L. Fontagné, J. Fouré, Å. Johansson and E. Olaberría (2015), "Trade Patterns in the 2060 World Economy", *OECD Journal: Economic Studies* 2015(1): 67-101.

Ciaian, P., E. Baldoni, D.A. Kancs, and D. Drabik (2021), "The Capitalization of Agricultural Subsidies into Land Prices", *Annual Review of Resource Economics* 13: 14.1–14.22.

Coase, R.H. (1960), "The Problem of Social Cost", *Journal of Law and Economics* 3: 1-44.

Colantone, I., G. Ottaviano and P. Stanig (2021), "The Backlash of Globalization", CEPR Discussion Paper 16521, London, September. Forthcoming in the *Handbook of*

International Economics, Volume V, edited by G. Gopinath, E. Helpman and K. Rogoff, Amsterdam: Elsevier.

Collier, P., D. Coyle, C. Mayer, and M. Wolf (2021), **"**Capitalism: What has Gone Wrong, What Needs to Change, and How it Can Be Fixed**",** *Oxford Review of Economic Policy* 37(4): 637–49, Winter.

Copeland, B.R., J.S. Shapiro and M.S. Taylor (2021), "Globalization and the Environment", NBER Working Paper 28797, Cambridge MA, May. Forthcoming in the *Handbook of International Economics, Volume V*, edited by G. Gopinath, E. Helpman and K. Rogoff, Amsterdam: Elsevier.

Corden, W.M. (1997), *Trade Policy and Economics Welfare* (Second Edition), Oxford: Clarendon Press.

Costinot, A., D. Donaldson and C. Smith (2016), "Evolving Comparative Advantage and the Impact of Climate Change in Agricultural Markets: Evidence from 1.7 Million Fields Around the World", *Journal of Political Economy* 124(1): 205-48, February.

Costinot, A. and A. Rodriguez-Clare (2014), "Trade Theory with Numbers: Quantifying the Consequences of Globalization", Ch. 4 (pp. 197-261) in the *Handbook of International Economics, Volume IV*, edited by G. Gopinath, E. Helpman and K. Rogoff, Amsterdam: Elsevier.

Crippa, M., F. Solazzo, D. Guizzardi, F. Monforti-Ferrario, F.N. Tubiello and A.J.N.F. Leip (2021), "Food Systems are Responsible for a Third of Global Anthropogenic GHG Emissions", *Nature Food* 2(3): 198-209, March 8.

Cristea, A.D., D. Hummels, L. Puzzello and M.G. Avetisyan (2013), "Trade and the Greenhouse Gas Emissions from International Freight Transport", *Journal of Environmental Economics and Management* 65(1): 153-73.

Curzi, D., M. Garrone and A. Olper (2021), "Import Competition and Firm Markups in the Food Industry", *American Journal of Agricultural Economics* 103(4): 1433-53, August.

Davis, S.J. (2018), "Trump's Trade-Policy Uncertainty Deters Investment", November 14 blog at https://www.chicagobooth.edu/review/trumps-trade-policy-uncertainty-deters-investment, accessed 14 February 2022.

Deaton, A. (2013), *The Great Escape: Health, Wealth, and the Origins of Inequality*, Princeton NJ: Princeton University Press.

Debaere, P. (2014), "The Global Economics of Water: Is Water a Source of Comparative Advantage?" *American Economic Journal: Applied Economics* 6(2): 32-48.

Deconinck, K., C. Giner, L.A. Jackson and L. Toyama (2021), "Overcoming Evidence Gaps on Food Systems", OECD Food, Agriculture and Fisheries Paper No.163, Paris, July.

de Gorter, H., D. Drabik and D.R. Just (2015), *The Economics of Biofuel Production: Impacts on Price Volatility in Grain and Oilseed Markets*, London and New York: Palgrave Macmillan.

Demirgüç-Kunt, A., L. Klapper, D. Singer, S. Ansar and J. Hess (2018), *The Global Findex Database 2017: Measuring Financial Inclusion and the Fintech Revolution*, Washington DC: World Bank.

Drupp, M.A., U. Kornek, J. Meya and L. Sager (2021), "Inequality and the Environment: The Economics of a Two-Headed Hydra", CESifo Working Paper No. 9447, December.

Durand, M. (2018), "Countries' Experiences with Well-Being and Happiness Metrics", Ch. 8 in *Global Happiness Policy Report 2018*, New York: UN's Sustainable Development Solutions Network.

Durand, M. (2019), "Adopting a Well-Being Approach in Central Government: Policy Mechanisms and Practical Tools", Ch. 8 in *Global Happiness and Wellbeing Policy Report 2019*, New York: UN's Sustainable Development Solutions Network.

EC (2021), "Proposal for a Regulation of the European Parliament and of the Council Establishing a Carbon Border Adjustment Mechanism", COM(2021) 564 Final, Brussels: European Commission, 14 July.

Erhardt, T. (2018), "Does International Trade Cause Overfishing?" *Journal of the Association of Environmental and Resource Economists* 5(4): 695|-711.

Estevadeordal, A. and A.M. Taylor (2013), "Is the Washington Consensus Dead? Growth, Openness, and the Great Liberalization, 1970s–2000s", *Review of Economics and Statistics* 95(5): 1669-90, December.

Fan, S., D. Headey, C. Rue and T. Thomas (2021), "Food Systems for Human and Planetary Health: Economic Perspectives and Challenges", *Annual Review of Resource Economics* 13: 131-56.

FAO (2021), FAOSTAT, Rome: Food and Agriculture Organization of the United Nations, accessed 21 April at www.faostat.org.

FAO, IFAD, UNICEF, WFP and WHO (2021), *The State of Food Security and Nutrition in the World 2021*, Rome: Food and Agriculture Organization of the United Nations.

FAO, UNDP and UNEP (2021), *A Multi-Billion-Dollar Opportunity: Repurposing Agricultural Support to Transform Food Systems*, Rome: FAO, UNDP and UNEP.

Federico. G. (2005), *Feeding the World: An Economic History of Agriculture, 1800-2000*, Princeton NJ: Princeton University Press.

Feenstra, R.C. (2018), "Alternative Sources of Gains from International Trade: Variety, Creative Destruction, and Markups", *Journal of Economic Perspectives* 32 (2): 25–46.

Feenstra, R.C. and C. Hong (2021), "China's Import Demand for Agricultural Products: The Impact of the Phase One Trade Agreement", *Review of International Economics* 30(1): 345-68, February.

Felbermayr, G., M. Larch, E. Yalein and Y.V. Yotov (2020), "On the Heterogeneous Trade and Welfare Effects of GATT/WTO Membership", CESifo Working Paper No. 8555, University of Munich, September.

Fernando, R., W. Liu and W.J. McKibbin (2021), "Global Economic Impacts of Climate Shocks, Climate Policy and Changes in Climate Risk Assessment", CEPR Discussion Paper 16154, London, May.

Ferreira, S. (2004), "Deforestation, Property Rights and International Trade", *Land Economics* 80(2): 174-93.

Findlay, R. and K.H. O'Rourke (2007), *Power and Plenty: Trade, War, and the World Economy in the Second Millennium*, Princeton NJ: Princeton University Press.

Francois, J. and B. Hoekman (eds.) (2019), *Behind-the-Border Policies: Assessing and Addressing Non-Tariff Measures*, Cambridge: Cambridge University Press.

Francois, J. and W. Martin (2004), "Commercial Policy, Bindings and Market Access", *European Economic Review* 48: 665-79, June.

Freund, C. and C. Özden (2008), "Trade Policy and Loss Aversion", *American Economic Review* 98(4): 1675-91, September.

Fuglie, K. (2016), "The Growing Role of the Private Sector in Agricultural Research and Development World-wide", *Global Food Security* 10: 29–38.

Fuglie, K., M. Gautam, A. Goyal and W.F. Maloney (2020), *Harvesting Prosperity: Technology and Productivity Growth in Agriculture*, Washington DC: World Bank.

Funke, M., M. Schularick and C. Trebesch (2021), "Populist Leaders and the Economy", CEPR Discussion Paper 15405, London, January.

Gaigné, C. and C. Gouel (2022), "Trade in Agricultural and Food Products", Ch. in *Handbook of Agricultural Economics, Volume V*, edited by C. Barrett, and D, Just, Amsterdam: Elsevier (forthcoming).

Gautam, M., D. Laborde, A. Mamun, W. Martin, V. Piñeiro and R. Vos (2022), *Repurposing Agricultural Policies and Support: Options to Promote Sustainable Development*, World Bank Report No: AUS0002236, Washington DC: World Bank and IFPRI.

Giordani, P., N. Rocha and M. Ruta (2016), "Food Prices and the Multiplier Effect of Trade Policy", *Journal of International Economics* 101: 102-22, July.

Goldberg, P.K. and N. Pavcnik (2007), "Distributional Effects of Globalization in Developing Countries", *Journal of Economic Literature* 45(1): 39–82.

Gollin, D., C.W. Hansen and A. Wingender (2021), "Two Blades of Grass: The Impact of the Green Revolution", *Journal of Political Economy* 129(8): 2344-84, August.

Götz, L., T. Glauben and B. Brümmer (2013), "Wheat Export Restrictions and Domestic Market Effects in Russia and Ukraine During the Food Crisis", *Food Policy* 38: 214-26, August.

Gouel, C. (2012), "Agricultural Price Instability: A Survey of Competing Explanations and Remedies", *Journal of Economic Surveys* 26(1): 129-56.

Gouel, C. (2014), "Food Price Volatility and Domestic Stabilization Policies in Developing Countries", Ch. 7 (pp. 261-306) in *The Economics of Food Price Volatility***,** edited by J.-P. Chavas, D. Hummels and B.D. Wright, Chicago and London: University of Chicago Press for NBER.

Gouel, C. and S. Jean (2016), "Optimal Food Price Stabilization in a Small Open Developing Country", *World Bank Economic Review* 29(1):72-101.

Gouel, C. and S, Jean (2021), "Love of Variety and International Trade", CESifo Working Paper No. 9460, Munich, December.

Gouel, C. and D. Laborde (2021), "The Crucial Role of Domestic and International Market-Mediated Adaptation to Climate Change", *Journal of Environmental Economics and Management* 106: 102408, March.

Grant, J.H., S. Arita, C. Emlinger, R. Johansson and C. Xie (2021), "Agricultural Exports and Retaliatory Trade Actions: An Empirical Assessment of the 2018/2019 Trade Conflict", *Applied Economic Perspectives and Policy* 43(2): 619-40, June.

Grant, J.H. and K.A. Boys (2013), "Agricultural Trade and the GATT/WTO: Does Membership Make a Difference?" *American Journal of Agricultural Economics* 94(1): 1-24.

Grant, J. and K. Meilke (2011), "The Special Safeguard Mechanism: Previous Studies and Future Outlook", Ch. 7 (pp. 179-212) in W. Martin and A. Mattoo (eds.), *Unfinished Business? The WTO's Doha Agenda*, London: Centre for Economic Policy Research and Washington DC: World Bank.

Grossman, G.M. and E. Helpman (2021), "Identity Politics and Trade Policy", *Review of Economic Studies* 88(3): 1101-26, May.

Gründler, K., N. Potrafke and T. Wochner (2020), "Structural Reforms and Income Inequality: Who Benefits from Market-Oriented Reforms?", CESifo Working Paper No. 8042, Munich.

Gurevich, T., D. Riker and M. Tsigas (2020), "Trade Policy and Gender: Examination of Gender and Sector-Specific Outcomes", Presented during the 23rd Annual Conference on Global Economic Analysis (Virtual Conference), June 2020. www.gtap.agecon.purdue.edu/resources/download/9773.pdf

Guriev, S. and E. Papaioannou (2021), "The Political Economy of Populism," *Journal of Economic Literature* (forthcoming).

Handley, K., F. Kamal, and R. Monarch (2020). "Rising Imports Tariffs, Falling Export Growth: When Modern. Supply Chains Meet Old-Style Protectionism", NBER Working Paper 26611, Cambridge MA, revised August.

Handley, K. and N. Limão (2017), "Policy Uncertainty, Trade, and Welfare: Theory and Evidence for China and the United States", *American Economic Review* 107(9): 2731-83, September.

Handley, K. and N. Limão (2022), "Trade Policy Uncertainty", NBER Working Paper 29672, Cambridge MA, January.

Hawkes, C., M. Ruel, L. Salm, B. Sinclair and F. Branca (2020), "Double-duty Actions: Seizing Programme and Policy Opportunities to Address Malnutrition in all its Forms", *The Lancet* 395: 142-55.

Headey, D., K. Hirvonen and J. Hoddinott (2018), "Animal-Sourced Foods and Child Stunting", *American Journal of Agricultural Economics* 100: 1302−19.

Helpman, E. (2018), *Globalization and Inequality,* Cambridge MA: Harvard University Press.

Hertel, T., W. Martin and A. Leister (2010), "Potential Implications of a Special Safeguard Mechanism in the World Trade Organization: The Case of Wheat", *World Bank Economic Review* 24(2): 330–59.

Hirvonen, K., Y. Bai, D. Headey and W. Masters (2020), "Affordability of the EAT–Lancet Reference Diet: A Global Analysis", *The Lancet* 8: e59-e65, January.

Huang, J., Y. Liu, W. Martin and S. Rozelle (2009), "Changes in Trade and Domestic Distortions Affecting China's Agriculture", *Food Policy* 34: 407–416.

Huang, W. and C. Zhang (2021), "The Power of Social Pensions: Evidence from China's New Rural Pension Scheme", *American Economic Journal: Applied Economics* 13(2): 179-205.

Hynes, W., D.S. Jacks and K.H. O'Rourke (2012), "Commodity Market Disintegration in the Interwar Period", *European Review of Economic History* 16(2): 119-143.

IFPRI (2021), *Global Food Policy Report 2021,* Washington DC: International Food Policy Research Institute.

Irwin, D.A. (2019), "Does Trade Reform Promote Economic Growth? A Review of Recent Evidence", NBER Working Paper 25927, Cambridge MA, June.

Irwin, D.A. (2021), "The Rise and Fall of Import Substitution", *World Development* 139: 105306, March.

Irwin, D.A. and M.G. Chepeliev (2021), "The Economic Consequences of Sir Robert Peel: A Quantitative Assessment of the Repeal of the Corn Laws", *Economic Journal* (forthcoming, early view 10 April).

Ivanic, M. and W. Martin (2014), "Poverty impacts of the Volume-Based Special Safeguard Mechanism", *Australian Journal of Agricultural and Resource Economics* 58(4):607-21.

Jacks, D.S. and D. Novy (2020), "Trade Blocs and Trade Wars during the Interwar Period", *Asian Economic Policy Review* 15(1): 119–36.

Jägermeyr, J., C. Müller, A.C. Ruane, J. Elliott, J. Balkovic, O. Castillo, B. Faye, I. Foster, C. Folberth, J.A. Franke, K. Fuchs, J.R. Guarin, J. Heinke, G. Hoogenboom, T. Iizumi, A.K. Jain, D. Kelly, N. Khabarov, S. Lange, T.-S. Lin, W. Liu, O. Mialyk, S. Minoli, E.J. Moyer, M. Okada, M. Phillips, C. Porter, S.S. Rabin, C. Scheer, J.M. Schneider, J.F. Schyns, R. Skalsky, A. Smerald, T. Stella, H. Stephens, H. Webber, F. Zabel and C. Rosenzweig (2021), "Climate Impacts on Global Agriculture Emerge Earlier in New Generation of Climate and Crop Models", *Nature Food* 2**:** 873–85. https://doi.org/10.1038/s43016-021-00400-y

Jensen, H.G. and K. Anderson (2017), "Grain Price Spikes and Beggar-thy-neighbor Policy Responses: A Global CGE Analysis", *World Bank Economic Review* 31(1): 158-75, February.

Jensen, N. and C.B. Barrett (2017), "Agricultural Index Insurance for Development", *Applied Economic Perspectives and Policy* 39: 99–219.

Johnson, D.G. (1975), "World Agriculture, Commodity Policy, and Price Variability", *American Journal of Agricultural Economics* 57(5): 823–28, December.

Johnson, H.G. (1953-4), "Optimal Tariffs and Retaliation", *Review of Economic Studies* 21(2): 142-53.

Johnson, K. (2019), "How Trump May Finally Kill the WTO", December 9, Washington DC, accessed 14 February 2022 at https://foreignpolicy.com/2019/12/09/trump-may-kill-wto-finally-appellate-body-world-trade-organization

Kastner, T., A. Chaudhary, S. Gingrich, U.M. Persson, G. Bidoglio, G. Le Provost and F. Schwarzmüller (2021), "Global Agricultural Trade and Land System Sustainability: Implications for Ecosystem Carbon Storage, Biodiversity, and Human Nutrition", *One Earth* 4(10): 1425-43, October.

Kauffmann, C. and C. Saffirio (2021), *Good Regulatory Practices and Co-Operation in Trade Agreements: A Historical Perspective and Stocktaking,* OECD Regulatory Policy Working Papers No. 14, Paris.

Kindleberger, C.P. (1989), "Commercial Policy Between the Wars", in P. Mathias and S. Pollard (eds.), *The Cambridge Economic History of Europe, Vol. 8,* Cambridge and New York: Cambridge University Press.

Koo, J., A. Mamun and W. Martin (2021), "From Bad to Worse: Poverty Impacts of Food Availability Responses to Weather Shocks", *Agricultural Economics* 52(5): 833-47, September. Korinek, J., E. Moise and J. Tange (2021), "Trade and Gender: A Framework for Analysis", OECD Trade Policy Paper 246, Paris, March.

Kovak, E., D. Blaustein-Reito and M. Qaim (2022), "Genetically Modified Crops Support Climate Change Mitigation", *Trends in Plant Science,* 8 February. https://doi.org/10.1016/j.tplants.2022.01.004

Krueger, A.O., M. Schiff, and A. Valdés (1988), "Agricultural Incentives in Developing Countries: Measuring the Effect of Sectoral and Economy-wide Policies", *World Bank Economic Review* 2(3): 255–72.

Laborde, D., A. Mamun, W. Martin, V. Pineiro and R. Vos (2021), "Agricultural Subsidies and Global Greenhouse Gas Emissions", *Nature Communications* 12: 2601, May 10.

Laborde, D., M. Parent and C. Smaller (2020), *Ending Hunger, Increasing Incomes, and Protecting the Climate: What would it cost donors?* Winnipeg: International Institute for Sustainable Development and Washington DC: International Food Policy Research Institute.

Lange, G.-M., Q. Wodon and K. Carey (eds.) (2018), *The Changing Wealth of Nations 2018: Building a Sustainable Future,* Washington DC: World Bank.

Layard, R. (2006), "Happiness and Public Policy: A Challenge to the Profession", *Economic Journal* 116(510): C24-C33, March.

Layard, R. (2020), *Can We Be Happier? Evidence and Ethics,* London: Pelican Books.

Lewis, W.A. (1981), "Development Strategy in a Limping World Economy", pp. 12-26 of G. Johnson and A. Maunder (eds.), *Rural Change: The Challenge for Agricultural Economists*, London: Gower.

Limão, N. and Y. Zu (2021), "Size, Trade, Technology and the Division of Labor", NBER Working Paper 28969, Cambridge MA.

Liu, X, A. Mattoo, Z. Wang and S.-J. Wei (2021), "Services Development and Comparative Advantage in Manufacturing", *Journal of Development Economics* 144: 102438, May.

Mamun, A., W. Martin and S. Tokgoz (2021), "Reforming Agricultural Support for Improved Environmental Outcomes", *Applied Economic Perspectives and Policy* 43 (forthcoming, online from 10 January).

Martin, W. (2021), "Carbon Border Adjustment Mechanisms and Their Implications for Agriculture", Paper Presented at the (virtual) 31st International Conference of Agricultural Economists, 27 August.

Martin, W. and K. Anderson (2012), "Export Restrictions and Price Insulation During Commodity Price Booms", *American Journal of Agricultural Economics* 94 (2): 422–27.

Martin, W., M. Ivanic and A. Mamun (2021), "Modeling Development Policies with Multiple Objectives", Invited Paper presented to the (virtual) 31st International Conference of Agricultural Economists, 27 August.

Masters, W.A., A.B. Finaret and S.A. Block (2022), "The Multiple Burdens of Malnutrition: Dietary Transition and Food System Transformation in Economic Development", Ch. 6 in the *Handbook of Agricultural Economics, Vol. 6*, edited by C.B. Barrett and D.R. Just, Amsterdam: Elsevier (forthcoming).

Mattoo, A. and R.W. Staiger (2020), "Trade Wars: What Do They Mean? Why Are They Happening Now? What Are the Costs?", *Economic Policy* 35(103): 561-84, July.

Mattoo, A., A. Subramanian, D. van der Mensbrugghe and J. He (2012), "Can Global De-Carbonization Inhibit Developing Country Industrialization?", *World Bank Economic Review* 26(2): 296–319.

McKibbin, W.J., A. Morris, P.J. Wilcoxen and A. Panton (2020), "Climate Change and Monetary Policy: Issues for Policy Design and Modelling," *Oxford Review of Economic Policy* 36: 579-603.

McKibbin, W.J. and P.J. Wilcoxen (1999), "The Theoretical and Empirical Structure of the G-Cubed Model", *Economic Modeling* 16: 123-48.

Meemken, E.-M., C.B. Barrett, H.C. Michelson, M. Qaim, T. Reardon and J. Sellare (2021), "Sustainability Standards in Global Agrifood Supply Chains", *Nature Food* https://www.nature.com/articles/s43016-021-00360-3

Melitz, M. and S.J. Redding (2021), "Trade and Innovation", NBER Working Paper 28945, Cambridge MA, June. Forthcoming in U. Akcigit and J. Van Reenen (eds.), *The Economics of Creative Destruction: Festschrift in Honor of Philippe Aghion and Peter Howitt*.

Meyimdjui, C. and J.-L. Combes (2021), "Food Price Shocks and Household Consumption in Developing Countries: The Role of Fiscal Policy", IMF Working Paper WP/2021/012, Washington DC.

Milanovic, B. (2016), *Global Inequality: A New Approach for the Age of Globalization*, Cambridge MA and London: Harvard University Press.

Naeem, S., Ingram, J.C., Varga, A., Agardy, T., Barten, P., Bennett, G., Bloomgarden, E., Bremer, L.L., Burkill, P., Cattau, M., Ching, C., Colby, M., Cook, D.C., Costanza, R., DeClerck, F., Freund, C., Gartner, T., Goldman-Benner, R., Gunderson, J., Jarrett, D., Kinzig, A.P., Kiss, A., Koontz, A., Kumar, P., Lasky, J.R., Masozera, M., Meyers, D., Milano, F., Naughton-Treves, L., Nichols, E., Olander, L., Olmsted, P., Perge, E., Perrings, C., Polasky, S., Potent, J., Prager, C, Quétier, F., Redford, K., Saterson, K., Thoumi, G., Vargas, M.T., Vickerman, S., Weisser, W., Wilkie, D. and Wunder, S. (2015), "Get the Science Right When Paying for Nature's Services", *Science* 347(6227): 1206-1207, 13 March. https://doi.org/10.1126/science.aaa1403

Norberg, J. (2020), *Open: The Story of Human Progress*, London: Atlantic Books.

OECD (2020a), *OECD Services Trade Restrictiveness Index: Policy Trends up to 2020*, Paris: OECD, January.

OECD (2020b), *Regulatory Impact Assessment: OECD's Best Practice Principles for Regulatory Policy*, Paris: OECD, February.
OECD (2020c), *How's Life? 2020: Measuring Well-being*, Paris: OECD. https://doi.org/10.1787/9870c393-en
OECD (2021a), *Producer and Consumer Support Estimates database*. Accessed 28 June 2021. https://www.oecd.org/agriculture/topics/agricultural-policy-monitoring-and-evaluation/
OECD (2021b), "Trade in Value Added", *OECD Statistics on Trade in Value Added* (database), https://doi.org/10.1787/data-00648-en (accessed on 4 August).
OECD (2021c), *Making Better Policies for Food Systems*, Paris: OECD, January.
OECD (2021d), *Trade and Gender: A Framework for Analysis*, OECD Trade Policy Paper No. 246, Paris, March.
OECD/FAO (2021), *OECD-FAO Agricultural Outlook 2021-2030*, Paris: OECD.
Ostrom, E. (1990), *Governing the Commons: The Evolution of Institutions for Collective Action*, Cambridge and New York: Cambridge University Press.
Ostrom, E. (2009), "A General Framework for Analyzing Sustainability of Social-Ecological Systems", *Science* 325(5939): 419-22.
Paarlberg, R. (2020), *Resetting the Table: Straight Talk About the Food We Grow and Eat*, New York: Alfred A. Knopf.
Pardey, P.G., C. Chan-Kang, J.M. Beddow and S.P. Dehmer (2015), "Long-Run and Global R&D Funding Trajectories: The U.S. Farm Bill in a Changing Context" *American Journal of Agricultural Economics* 97: 1312–23.
Pardey, P.G., C. Chan-Kang, S.P. Dehmer and J.M. Beddow (2016), "Agricultural R&D is on the Move", *Nature* 15 (537): 301-303, September.
Pernechele, V., J. Balié and L. Ghins (2018), *Agricultural Policy Incentives in Sub-Saharan Africa in the Past Decade (2005-2016): Monitoring and Analysing Food and Agricultural Policies*, Rome: Food and Agricultural Organization.
Placzek, O. (2021), "Socio-Economic and Demographic Aspects of Food Security and Nutrition", OECD Agriculture and Fisheries Paper No. 150, OECD, Paris.
Piñeiro, V., J. Arias, J. Dürr, P. Elverdin, A. Ibáñez, A. Kinengyere, C. Opazo, N Owoo, J. Page, S. Prager and M. Torero (2020), "A Scoping Review on Incentives for Adoption of Sustainable Agricultural Practices and their Outcomes", *Nature Sustainability* 3: 809–20.
Porteous, O. (2017), "Empirical Effects of Short-term Export Bans: The Case of African Maize", *Food Policy* 71: 17-26.
Prebisch, R. (1950), "The Economic Development of Latin America and Its Principal Problems", *Economic Bulletin for Latin America* 7: 1–12.
Qaim M. (2020), "Role of New Plant Breeding Technologies for Food Security and Sustainable Agricultural Development", *Applied Economic Perspectives and Policy* 42: 129–50.
Rao, X., T.M. Hurley and P.G. Pardey (2019), "Are Agricultural R&D Returns Declining and Development Dependent?", *World Development* 27-37, October.
Ravallion, M. (2006), "Looking Beyond Averages in the Trade and Poverty Debate", *World Development* 34(8): 1374-1392.
Ravallion, M. (2016), *The Economics of Poverty: History, Measurement and Policy*, London and New York: Oxford University Press.
Ravallion, M. (2020), "On Measuring Global Poverty", *Annual Review of Economics* 12: 167-88.
Reardon, T., B. Belton, L. Saweda, O. Liverpool-Tasie, L. Lu, C.S.R. Nuthalapati, T. Oyinkan and D. Zilberman (2021a), "E-commerce's Fast-tracking Diffusion and

Adaptation in Developing Countries", *Applied Economics Perspectives and Policy* (forthcoming).

Reardon, T. and B. Minten (2021), "Food Value Chain Transformation in Developing Regions", Ch. 12 (pp. 397-437) in Otsuka, K. and S. Fan (eds.), *Agricultural Development: New Perspectives in a Changing World*, Washington DC: International Food Policy Research Institute.

Ringler, C., N. Perez and H. Xia (2021), "The Role of Water in Supporting Food Security: Where we Are and Where We Need to Be", Ch. 20 in Otsuka, K. and S. Fan (eds.) (2021), *Agricultural Development: New Perspectives in a Changing World*, Washington DC: IFPRI.

Roberts, A. and N. Lamp (2021), *Six Faces of Globalization: Who Wins, Who Loses, and Why it Matters*, Cambridge MA: Harvard University Press.

Robinson, S., D. Mason-D'Croz, S. Islam, T.B. Sulser, R. Robertson, T. Zhu, A. Gueneau, G. Pitois and M. Rosegrant (2015), "The International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT) Model Description for Version 3", IFPRI Discussion Paper 01483, Washington DC, November.

Robles, M. (2021), "Agricultural Insurance for Development: Past, Present and Future", Ch. 17 in Otsuka, K. and S. Fan (eds.) (2021), *Agricultural Development: New Perspectives in a Changing World*, Washington DC: IFPRI.

Rodrigeuz, F. and D. Rodrik (2001), "Trade Policy and Economic Growth: A Skeptic's Guide to Cross-National Evidence", in B.S. Bernanke and K. Rogoff (eds.), *NBER Macroeconomics Annual 2000*, Cambridge MA: MIT Press.

Rodrik, D. **(**2020), "Why Does Globalization Fuel Populism? Economics, Culture, and the Rise of Right-Wing Populism", NBER Working Paper 27526, Cambridge MA.

Rosegrant, M. (2021), "Estimating the Global Investment Gap in Research and Innovation for Sustainable Agriculture Intensification in the Global South", Invited Paper presented at the (virtual) 31st International Conference of Agricultural Economists, 27 August. https://wle.cgiar.org/cosai/sites/default/files/images/CoSAI_Investment_Gap_Report_3.pdf

Searchinger, T.D., C. Malins, P. Dumas, D. Baldock, J. Glauber, T. Jayne, J. Huang and P. Marenya (2021), *Revising Public Agricultural Support to Mitigate Climate Change*, Washington DC: World Bank.

Sen, A. (1981), *Poverty and Famines.* London and New York: Oxford University Press.

Shapiro, J.S. (2021), "The Environmental Bias of Trade Policy", *Quarterly Journal of Economics* 136(2): 831-86.

Singer, H. (1950), "The Distribution of Gains between Investing and Borrowing Countries", *American Economic Review* 40(3): 473–85.

Shepherd, B. and S. Stone (2017), "Trade and Women", ADBI Working Paper 648, Tokyo.

Simone, T.E., D.M. Lambert, I. Cuvaca and N.S. Eash (2017), "Soil Carbon Sequestration, Carbon Markets, and Conservation Agriculture Practices: A Hypothetical Examination in Mozambique", *International Soil and Water Conservation Research* 5: 167–79.

Sposi, M., (2019), "Evolving Comparative Advantage, Sectoral Linkages, and Structural Change", *Journal of Monetary Economics* 103(C): 75-87.

Staiger, R.W. (2022), *A World Trading System for the 21st Century*, Cambridge MA: MIT Press (forthcoming in the Ohlin Lecture series). Selections from the book, with the same title, are available in NBER Working Paper 28947, June 2021.

Stiglitz, J.E. (2012), *The Price of Inequality*, London: Penguin.

Stiglitz, J.E. (2017), *Globalization and its Discontents Revisited*, London: Penguin.

Stiglitz, J., J. Fitoussi and M. Durand (2018a), *Beyond GDP: Measuring What Counts for Economic and Social Performance*, Paris: OECD https://dx.doi.org/10.1787/9789264307292-en.

Stiglitz, J., J. Fitoussi and M. Durand (eds.) (2018b), *For Good Measure: Advancing Research on Well-being Metrics Beyond GDP*, Paris: OECD. https://dx.doi.org/10.1787/9789264307278-en.

Swinnen, J. (2018), *The Political Economy of Agricultural and Food Policies,* London and New York: Palgrave Macmillan.

Thennakoon, J. and K. Anderson (2015), "Could the Proposed WTO Special Safeguard Mechanism Protect Farmers from Low International Prices?" *Food Policy* 50: 106–113.

Tinbergen, J. (1952), *On the Theory of Economic Policy*, Amsterdam: North-Holland.

Tovar, P. (2009), "The Effects of Loss Aversion on Trade Policy: Theory and Evidence", *Journal of International Economics* 78(1): 154–67.

Tyers, R., and K. Anderson (1992), *Disarray in World Food Markets: A Quantitative Assessment,* Cambridge and New York: Cambridge University Press.

UNEP (2019), *Inclusive Wealth Report 2018: Measuring Sustainability and Well-being,* Paris: UNESCO.

White, R.E., B. Davidson and R. Eckard (2021), "An Everyman's Guide for a Landholder to Participate in Soil Carbon Farming in Australia", Occasional Paper 21.01, Australian Farm Institute, Sydney, August. https://www.farminstitute.org.au/publication/a-landholders-guide-to-participate-in-soil-carbon-farming-in-australia/

Willenbockel, D., S. Robinson, D. Mason-D'Croz, M.W. Rosegrant, T.D.S. Sulser and N. Cenacchi (2018), *Dynamic Computable General Equilibrium Simulations in Support of Quantitative Foresight Modeling to Inform the CGIAR Research Portfolio: Linking the IMPACT and GLOBE models,* IFPRI Discussion Paper 1738, Washington DC: International Food Policy Research Institute.

Williamson, O.E. (1996), *The Mechanisms of Governance*, London and New York: Oxford University Press.

Williamson, O.E. (2000), "The New Institutional Economics: Taking Stock, Looking Ahead", *Journal of Economic Literature* 38(3): 595-613.

Willett, W., J. Rockström, B. Loken, M. Springmann et al. (2019), "Food in the Anthropocene: the EAT–*Lancet* Commission on Healthy Diets from Sustainable Food Systems", *The Lancet* 393: 447-92.

World Bank (2021a), *World Development Indicators,* accessed 22 April 2021 at https://datatopics.worldbank.org/world-development-indicators/

World Bank (2021b), *The Changing Wealth of Nations 2021: Managing Assets for the Future*, Washington DC: World Bank.

World Bank (2021c), *World Development Report 2020: Trading for Development in the Age of Global Value Chains,* Washington DC: World Bank.

World Bank and WTO (2020), *Women and Trade: The Role of Trade in Promoting Gender Equality,* Washington DC: World Bank and Geneva: World Trade Organization.

Wright, B.D. (2011), "The Economics of Grain Price Volatility", *Applied Economic Perspectives and Policy* 33(1): 32-58, Spring.

WTO (2021), *Tariff Profiles 2021,* Geneva: World Trade Organization.

Wunder, S., J. Börner, D. Ezzine-de-Blas, S. Feder and S. Pagiola (2020), "Payments for Environmental Services: Past Performance and Pending Potentials", *Annual Review of Resource Economics* 12: 209-34.

Zingales, L. (2020), "The Political Limits of Economists", *American Economic Review* 110(3): 375-82, May.

Zucman, G. (2019), "Global Wealth Inequalities", *Annual Review of Economics* 11: 109-38.

Table 1: Shares of domestic consumption imported and of domestic production exported, 27 major agricultural products,[a] 2000-03 (%)

	Africa	Asia	Latin America	European transition economies	High-income countries
% of consumption imported					
Grains[b]	17	9	22	11	27
Oilseeds[c]	2	51	27	6	62
Tropical crops[d]	13	18	12	42	42
Livestock products[e]	8	6	5	9	14
All 27 products	**13**	**14**	**12**	**11**	**19**
% of production exported					
Grains[b]	2	7	11	13	29
Oilseeds[c]	4	32	35	25	30
Tropical crops[d]	52[f]	38	45	32	47
Livestock products[e]	1	4	10	7	20
All 27 products	**16**	**22**	**19**	**11**	**24**

[a] Weighted averages across 82 countries, using consumption or production measured at undistorted prices as weights.

[b] Barley, cassava, maize, millet, oats, rice, sorghum, wheat

[c] Groundnuts, palm oil, sesame seed, soybean, sunflower seed

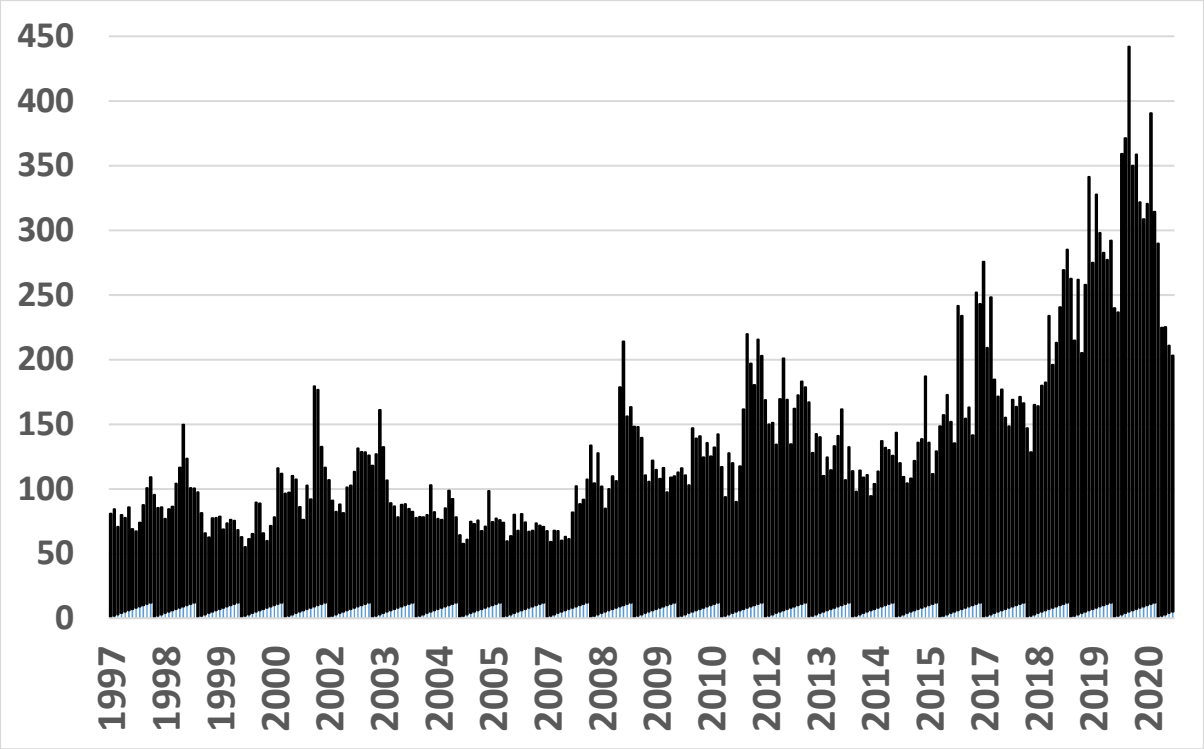
[d] Cocoa, coconut, coffee, cotton, rubber, sugar, tea

[e] Beef, eggs, milk, pig meat, poultry, sheep meat, wool

[f] Not including the cotton-exporting countries of Benin, Burkina Faso, Chad, Mali and Togo, most of whose cotton was exported.

Source: Anderson (2009, Table B.8), based on FAO commodity balance sheets.

Figure 1: Monthly index of global economic policy uncertainty,[a] January 1997 to May 2021

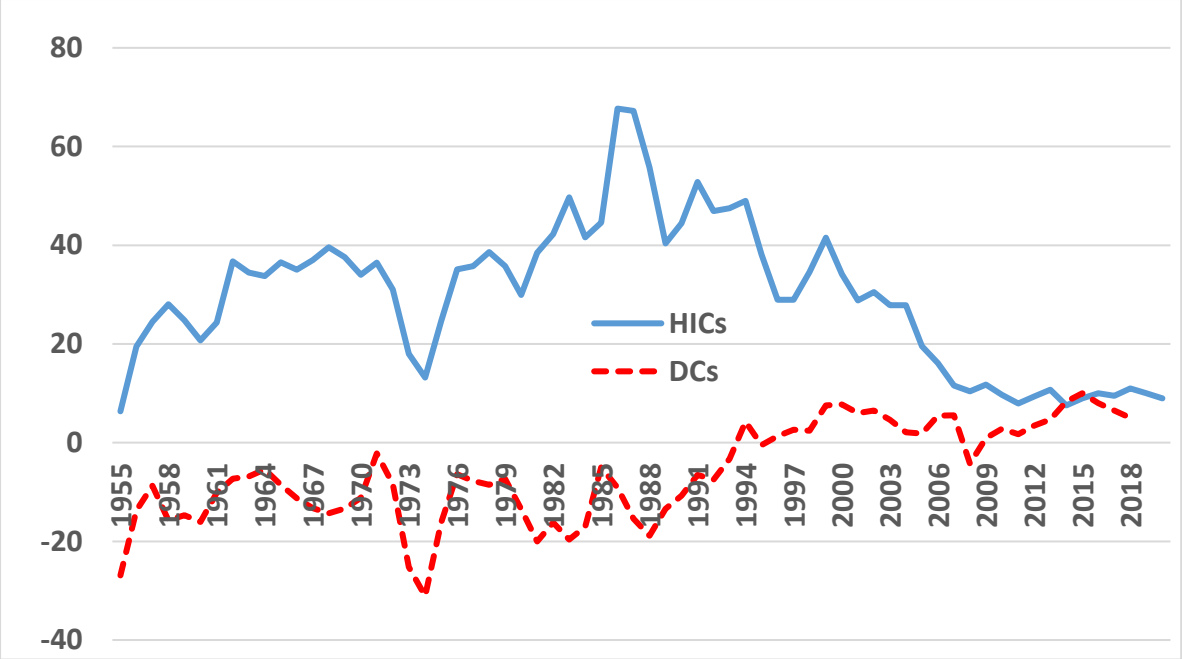


[a] Calculated as the GDP-weighted average of monthly EPU index values for US, Canada, Brazil, Chile, UK, Germany, Italy, Spain, France, Netherlands, Russia, India, China, South Korea, Japan, Ireland, Sweden, and Australia, using GDP data at PPP from the IMF's *World Economic Outlook* Database. Each national EPU Index is renormalized to a mean of 100 from 1997 to 2015 before calculating the Global EPU Index.

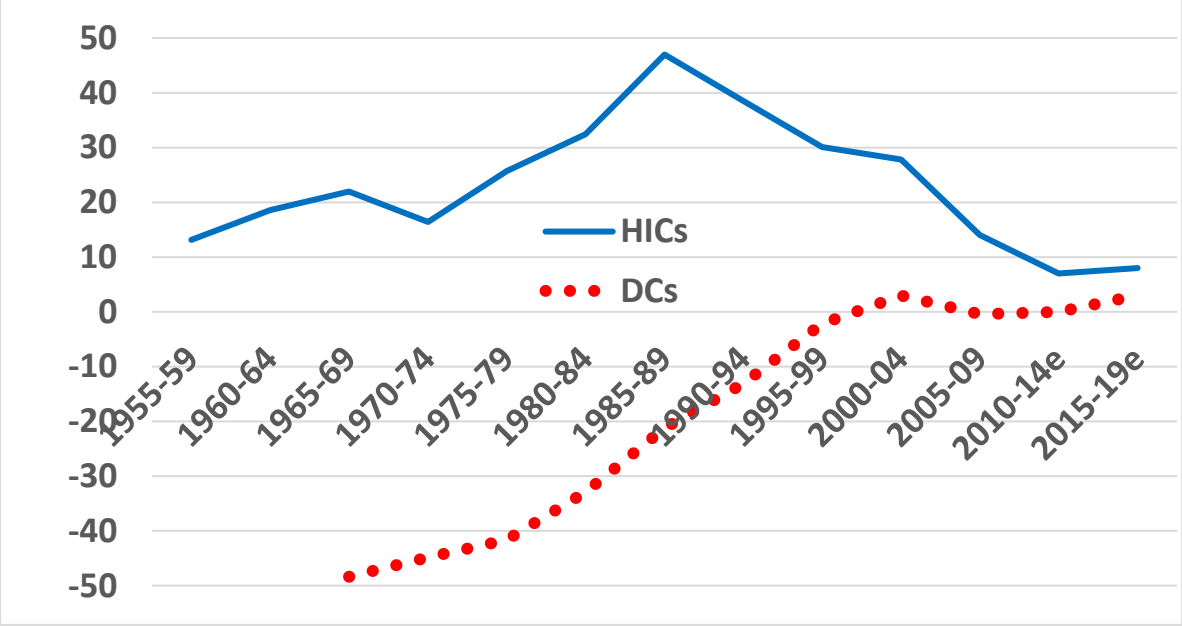
Source: www.policyuncertainty.com, based on methodology in Baker, Bloom and Davis (2016).

Figure 2: Nominal and relative rates of assistance to agriculture,[a] high-income (dotted line) and developing countries (solid line), 1955–2020 (%)

(a) Nominal rate of assistance to agriculture (annual)



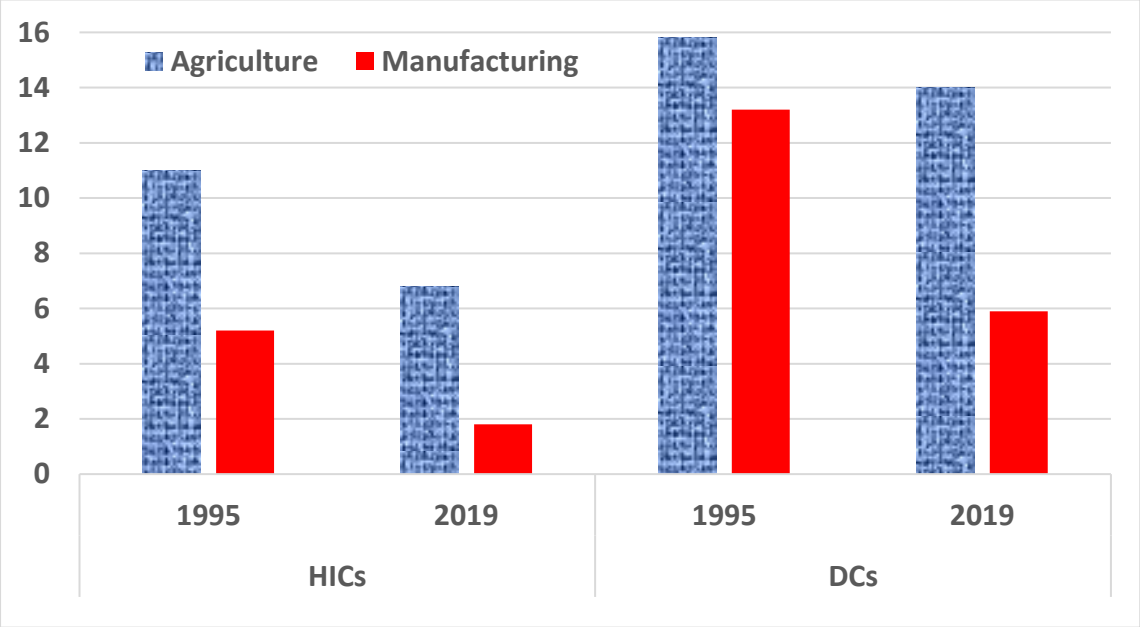
(b) Relative rate of assistance to agriculture vs non-agriculture[a] (5-year averages)



[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.

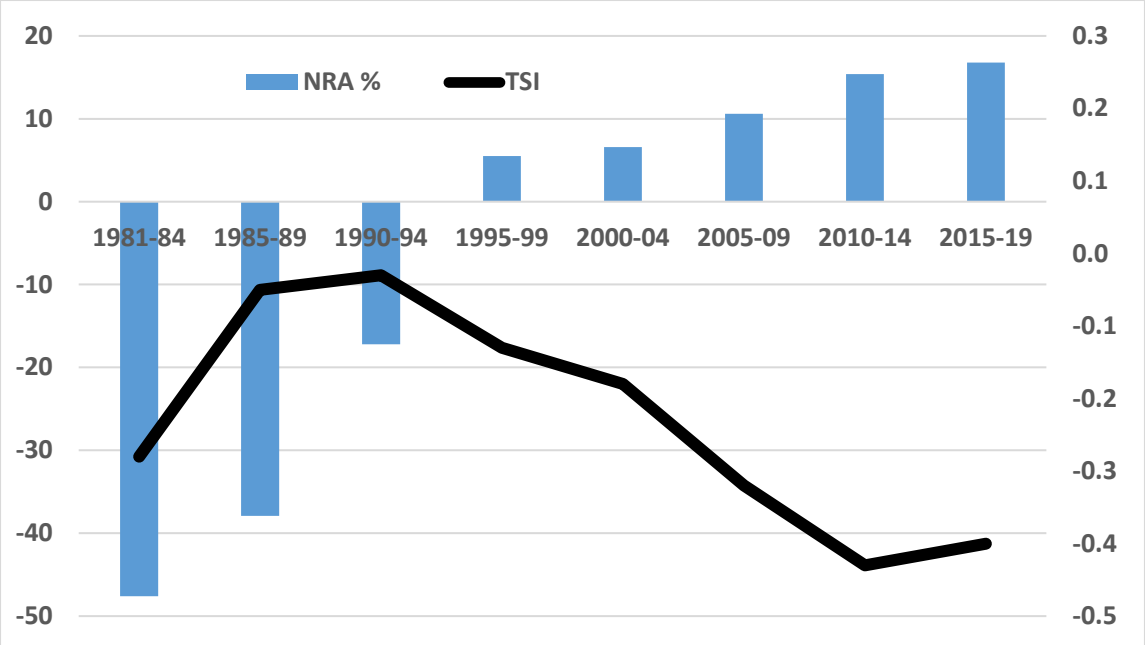
Source: Anderson and Nelgen (2013) to 2011 updated using nominal rates of protection from www.ag-incentives.org (accessed 9 November 2021) plus (for HICs in 2019 and 2020) OECD (2021a).

Figure 3: Average import tariffs protecting agriculture and manufacturing in high-income and and developing countries, 1995 and 2019 (%)



Source: WTO (2021).

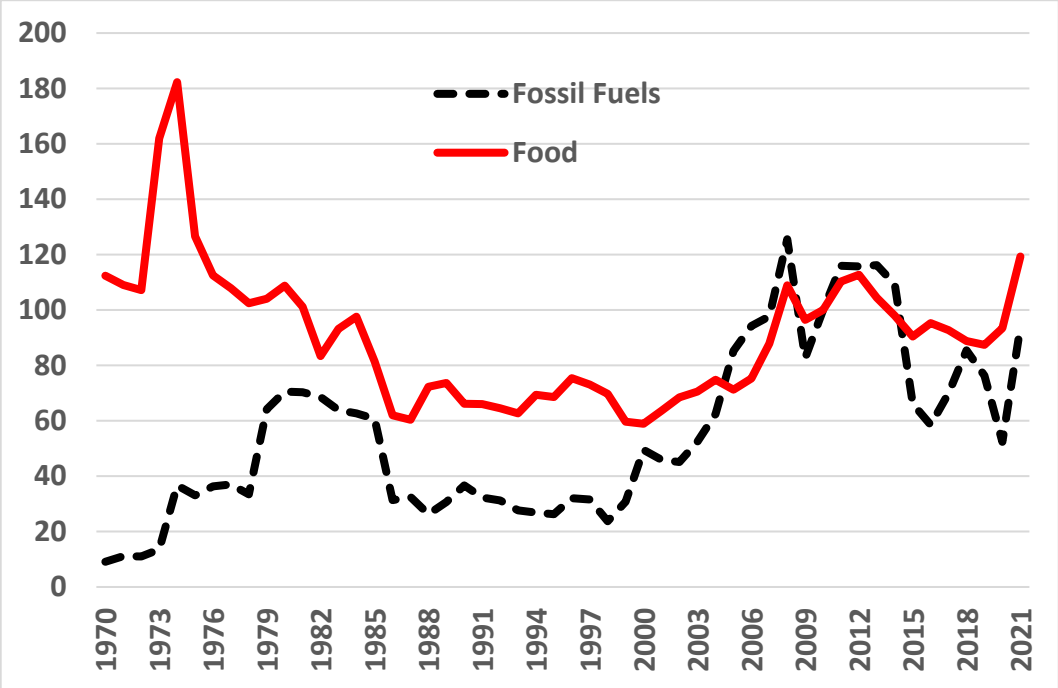
Figure 4: China's index of trade specialization in agricultural and food products[a] and nominal rate of assistance to farmers (%), 1981 to 2019



[a] The TSI is net exports as a ratio of exports+imports.

Source: Trade data from FAO (2021), NRAs from Huang et al. (2009) to 1994 and OECD (2021a) thereafter.

Figure 5: Real international prices of food and fossil fuel (energy raw materials) for developing countries, 1970 to 2021 (2010 = 100, based on real 2010 $US)



Source: World Bank, *Pink Sheets* (accessed 14 February 2022).