Food price volatility and domestic stabilization policies in developing countries[*]

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Abstract

When food prices spike in countries with large numbers of poor people, hunger and malnutrition are very likely to result in the absence of public intervention. For governments, this is also a case of political survival. Government actions often take the form of direct interventions in the market to stabilize food prices, which goes against most international advice to rely on safety nets and world trade. Despite the limitations of food price stabilization policies, they are widespread in developing countries. This paper attempts to untangle the elements of this policy conundrum. Price stabilization policies arise as a result of international and domestic coordination problems. At the individual country level, it is in the national interest of many countries to adjust trade policies to take advantage of the world market in order to achieve domestic price stability. When countercyclical trade policies become widespread, the result is a thinner and less reliable world market, which further decreases the appeal of *laissez-faire*. A similar vicious circle operates in the domestic market: without effective policies to protect the poor, such as safety nets, food market liberalization lacks credibility and makes private actors reluctant to intervene, which in turn forces government to step in. The current policy challenge lies in designing policies that will build trust in world markets and increase trust between public and private agents.

Keywords: agricultural trade policy, food security, price volatility, storage.

JEL classification: F13, I38, Q11, Q17, Q18.

1 Introduction

In early 2009, Manmohan Singh was reelected as Prime Minister of India following a successful election campaign in which he emphasized his success in protecting his country from the outcomes of the 2007/08 world food crisis. While world rice prices increased by 160% between June 2007 and June 2008, in India this increase was only 7.9% (World Bank 2010). In 2007, when the world rice price increase was accelerating, the Indian government was already aware of and concerned about the high world price of wheat, which would have made large wheat imports very costly. To secure domestic grain availability, in October 2007, India banned non-Basmati rice exports. The ban was soon relaxed and a minimum export price above the Indian export parity price was imposed, which had to be increased regularly as world prices were rising.[1]

The Haitian government was less successful in its attempts to weather the crisis. Haiti imports 82% of its rice consumption, and in April 2008, after an annual increase of 81% in the price for imported rice, the Haitian president, acknowledging his helplessness, was reported to have said to protesters: "come get me at the palace and I will demonstrate with you."[2] The Haitian prime minister was soon voted out and decisions were taken to subsidize the price of rice. Many countries experienced food riots that threatened the stability of their governments but the situations in Haiti and India illustrate that public intervention in a period of high food prices is a matter of political survival in countries with large poor populations. Governments have to be "seen to be doing something" (Poulton et al. 2006). Inaction is not an option. But without appropriate preparation for such situations and pressed by emergencies, many countries rely on costly policies, such as universal food subsidies, or beggar-thy-neighbor policies, such as trade policy adjustments. The food crisis has increased the consciousness of many governments of the unreliability of world markets,[3] and that the stable food prices experienced in the previous decades must not be taken for granted. Anecdotal evidence and experience of what happened following the 1973/74 crisis would suggest that the recent crisis could trigger a wave of new stabilization policies relying on storage and self-sufficiency.

However, these developments would go against the recommendations made since the 1980s by academics and policy analysts that direct market intervention should be avoided, people should be assisted to cope with risks by their governments through the use of safety nets or the development of market-based risk management instruments, agriculture should be supported through investment in long-run productivity growth, and trade and private storage

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[1] For more on Indian rice policies see Slayton (2009), World Bank (2010) and Timmer (2010).

[2] *New York Times*, April 18, 2008, "Across Globe, Empty Bellies Bring Rising Anger".

[3] The recent global "land rush", which is strongly driven by net food importing countries (Arezki, Deininger, and Selod 2011), is a good illustration of this new distrust in world markets.

should be relied on to compensate for supply shortfalls (World Bank 2006).[4] The food crisis has led many researchers and experts to question the dominant approach (Timmer 2012; Galtier 2009; Abbott 2012a; HLPE 2011; Oxfam 2011). The dominant approach has attracted criticism because safety nets have proved complex to use in times of crisis, market-based risk management instruments have not yet been successfully developed, and the countries that were relying on the world market for their imports were the ones that suffered the most during the crisis. Indeed the countries that weathered the food crisis best were those countries with very interventionist policies related to both trade and storage, such as China and India. Despite international recommendations, stabilization policies are widespread in most developing and emerging countries. For example, Demeke, Pangrazio, and Maetz (2009), based on information obtained from 81 countries, show that 68 of them used trade policy measures during the 2007/08 food crisis, and 35 released public stocks at subsidized prices.

The present paper attempts to make sense of this divide between policy advice and practice. Drawing on the theoretical literature and on accounts of policy responses to price volatility, this paper tries to answer the following questions: What are the justifications for domestic stabilization policies? Following the food crisis, is the policy framework put forward by international organizations still relevant, or should countries rely more on price-stabilization policies? And if so, what type of price stabilization?

The liberal paradigm is facing reasonable criticism. Why should food importing countries trust a world market that is susceptible to sudden spikes and can even disappear if major exporters close their borders? In our view, the weakness of the dominant approach to a large extent is related to the fact that it requires countries to trust each other and to adopt the same cooperative policies. Indeed, the impact of domestic policies on stability of world prices is negative in the case of countercyclical trade measures and potentially positive in the case of storage policies. Those policies also are interdependent in the sense that the each country's domestic policy choices might affect the policy choices of its trade partners. Because domestic stabilization policies can be rationalized as the outcome of a non-cooperative equilibrium in which countries coordinate through a vicious circle of negative feedbacks, their reform faces considerable challenges.

Coordination on a non-cooperative equilibrium and distrust among agents are not just international problems; they apply also to the domestic sphere, where in many countries public intervention crowds out private agents because of political uncertainty, and regulations limiting profit from arbitrage (Wright and Williams 1982a; Tschirley and Jayne 2010). The caution of private agents confirms government's belief that it must step in to ensure basic storage and trade, deterring even more a normal market behavior. This mechanism implies that any

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[4] A framework labeled "best practice" by Timmer (2010) and Abbott (2012a), and "optimum strategy" by Galtier (2009).

reform of domestic policies toward fewer market interventions must also deal with the issue of building domestic trust.

This paper explains the various aspects of this policy conundrum. Section 2 provides a summary of the motivations for stabilizing food prices. It focuses on the potential efficiency costs of price instability and shows that there are still significant uncertainties regarding these costs. The standard assessments that rely on assumption of market incompleteness and the expected utility framework lead to small welfare costs and hence challenge the usefulness of public intervention. In contrast, recent research highlights the potential costs of food price spikes to poor households. Section 3 draws on the theoretical and applied literature on price stabilization policies to discuss the design and the effects of stabilization policies concentrating on storage and trade policies, and the alternative of safety nets. In Section 4, we explore what can be learned from historical stabilization policies and their effects. Section 5 presents some policy implications of this discussion and concludes the paper.

2 Motivations for stabilizing food prices

This section analyzes the cost of food price instability, the reasons why public intervention might be defensible, and the reasons why it is justifiable in practice. It focuses mostly on justifications for intervention that are independent of the underlying causes of price volatility. Sections 3 and 4 discuss justifications for intervention that arise endogenously from the existence of other interventions and that have a feedback effect on price volatility. This applies, for example, to the cases of trade policies abroad and lack of commitment not to intervene but in these two cases the reasons to intervene in the first place are those discussed in the present section. There is a third category of justifications: situations where the market failure justifying intervention is also one of the causes of food price volatility. This can occur if price volatility is the result of expectations errors (see Section 2.4) or if private storage is different from its competitive level. Those last causes have attracted limited attention in the literature and thus are not reviewed in this paper.

2.1 Incomplete markets and standard assessments of the costs of price instability

The assumption that risk markets are incomplete is used frequently to justify public intervention in volatile commodity markets (Newbery and Stiglitz 1981; Innes 1990). Although this assumption may be reasonable, the extent of markets' incompleteness is a difficult empirical issue; therefore, for convenience, assessments of the welfare cost of price instability generally assume that the markets for risk management are missing.

In this paper, the standard assessment of the welfare effect of price instability is considered to be the method that emerged in the 1980s to measure the cost of instability using the

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expected utility framework. This approach superseded the earlier Marshallian surplus analysis, which is described in Wright (2001).

2.1.1 Consumers

Under the expected utility hypothesis, Turnovsky, Shalit, and Schmitz (1980) analyze the welfare change for consumers from price stabilization at its arithmetic mean, and represent it by an equivalent variation measure approximated to the second order by:

$$[\gamma(\eta - \rho) - \alpha]\gamma \frac{\Delta\sigma_P^2}{2} , \tag{1}$$

where α and η are the price and the income elasticities of demand; $\Delta\sigma_P^2$ is the reduction in the square of the coefficient of variation of price; and γ and ρ are the commodity budget share and the relative risk aversion parameters at mean price. This measure implicitly assumes that consumers are unable to insure against price volatility, to store grain, or to save.

If we ignore variations in the marginal utility of income (the term $\gamma(\eta - \rho)$), this welfare measure is necessarily negative with a downward sloping demand curve. In this case, it reduces to a surplus measure, and with a downward-sloping demand curve, surplus gains from low prices more than compensate for losses at high prices (Waugh 1944). Table 1 presents the welfare measure in equation (1) for various parameter values. For low budget shares, $\gamma = 0.01$, or in the absence of income effects, $\eta = \rho = 0$, the welfare change is close to a surplus measure, and the consumer suffers from stabilization. This implies that stabilization at the mean price is detrimental to consumers from developed countries, since a low share of their budget goes on food staples. However, because of this low budget share, the welfare losses would be relatively innocuous since they do not exceed -0.032% of income when 1% of income is devoted to a staple.

[Table 1 about here.]

Risk aversion can compensate for the risk-loving component associated with a downward sloping demand curve, and make stabilization beneficial only if budget share and risk aversion are sufficiently high. With high risk aversion ($\rho = 4$) and high budget share ($\gamma = 30\%$), gains do not exceed 0.7% and 1.5% of income for coefficients of variation of price of 20% and 30% (a range of volatility typical of the real prices on world food markets, Gilbert and Morgan 2010). While a food budget share of 50%—60% is common in low-income countries (Seale, Regmi, and Bernstein 2003), expenditure on one staple reaches 30% only for the poor population subgroups, and this level is less likely in countries where consumption of stables is diversified, such as in Eastern Africa where staples consumption is divided among maize, wheat, rice, and cassava (Tschirley and Jayne 2010).

There are many variants of the welfare measure represented by equation (1). Newbery and Stiglitz (1981, p. 123) propose a measure that accounts for price and income risk, and

their correlation. Wright and Williams (1988a) note that in reality commodity policies achieve price stabilization by stabilizing quantities not prices, hence welfare change should be assessed with respect to stabilization at the mean quantity. This measure demonstrates the importance of demand curvatures in welfare gains. If the demand function is non-linear, stabilizing quantities consumed at their mean affects the mean price, which in turns affects welfare change. Although this may lead to welfare changes very different from equation (1), the difference concerns the incidence of the policy, i.e. the repartition of gains between consumers and producers, rather than efficiency (we return to this issue in Section 3.4). Nocetti and Smith (2011) extend the analysis to a situation where consumers can save. None of these works is able to challenge the initial finding of only small welfare changes from price stabilization.

In addition, in this framework, the welfare costs presented above should be considered upper bounds. All possibilities of risk-coping strategies have been assumed away. For example, consumers cannot save. And the welfare changes are calculated by comparing welfare under price instability with welfare when prices are stabilized at their means. This ideal stabilization is not feasible (Townsend 1977), and feasible stabilization policies are costly.

2.1.2 Peasants and rural households

In poor countries, it is common for rural households to engage in agricultural production for their own consumption. And in the context of rural poor markets where market failures prevail, these production and consumption decisions tend to be non-separable (De Janvry and Sadoulet 2006). This has decisive implications for the effect of price uncertainty on welfare. Barrett (1996) and Myers (2006) propose expressions similar to equation (1) to assess the welfare cost of food price volatility in this case. For peasant households what is crucial to determine the effect of price fluctuations is the size and the sign of their marketed surplus. For households that are net food buyers, it does not change much from the effects described above for consumers. Affluent consumers are unlikely to suffer from price fluctuations, and may even prefer them. Poor consumers, who spend a large share of their budget on a commodity and are quite risk averse, are more likely to suffer from price fluctuations, but not overly so. However, net sellers are likely to prefer price stability since it helps to stabilize a large share of their income because they have to take their productive decisions before uncertainty is resolved. Poor producers with a limited marketed surplus are unlikely to experience large welfare gains, contrary to affluent producers. The larger the producer and the marketed surplus, the greater the preference for stability. So stabilization gains will accrue mostly to affluent producers, and potentially will be regressive.

For producers, the consequences of price instability most often discussed are the behavioral not the welfare consequences; the argument being that instability leads to production levels lower than if prices were stabilized at their expected values (Sandmo 1971). Because

producers have to commit resources before uncertainty is resolved, they decrease their production levels to decrease their risk exposure. In poor countries however, there are arguments and evidence against this behavior (Fafchamps 2003, Ch. 6). If we account for the lack of formal markets for some inputs, such as labor and land, and if we account also for the survival risk created by underproduction under price risk, households may not systematically under produce. For example, households that are food insecure and risk averse are likely to overproduce to ensure their food intake, and the inverse farm size-productivity relationship could be seen as illustrative of this behavior (Barrett 1996).

Among the many strategies used by the poor to cope with risk, the choice between commercial and subsistence farming is noteworthy. Due to limited market integration, food prices in rural regions can be very volatile. When faced with the choice of allocating land and labor between a food crop and a non-consumed cash crop, in a context of price instability poor farmers may allocate a larger share of resources to the food crop than if food prices were stable, as insurance against consumption price uncertainty (Fafchamps 1992). Consequently, food price instability may hinder the transition towards more market-oriented specialization, and some risk-coping strategies could actually hinder development.

2.2 Price volatility or downward and upward price risks?

The standard assessment of the welfare cost of food price volatility, which relies on the expected utility framework and the assumption of incomplete markets, leads to provocative results. It suggests that, in most cases, the cost to consumers is small if not negative. The only people who can expect significant gains from price stabilization are the producers – and especially affluent producers, which would make price stabilization where most benefits accrue to the most well off, highly regressive. This welfare assessment implies that governments should avoid price stabilization policies and focus resources on policies that promote increased food productivity (a conclusion similar to Lucas, 2003, in macroeconomics, for whom the small cost of business-cycle fluctuations seems to go against active stabilization policies). This conclusion conflicts with the attention paid to food price volatility since 2007, and the decades of major public interventions it has prompted. On this, Barrett and Bellemare (2011) propose a provocative argument: food price volatility does not matter; high food prices do matter. They show that civil unrest is correlated not to food price volatility but to food price spikes. Bellemare (2011) builds on this idea and instruments the food price index with natural disasters to demonstrate that high food prices are the cause of political unrest (see also Arezki and Brückner 2011).

Food riots are an indication that high food prices create severe hardship for people and it is unlikely that periods of low food prices will compensate for these events as postulated by the standard framework in which there is symmetry between high and low food prices. A symmetric welfare effect of high and low prices is understandable for affluent consumers or

for non-essential consumption goods; but the situation is different for food and poor households. When the price of a staple food increases, poor households search to protect their caloric intake. They reduce their dietary diversity, even to the extent of consuming more of a more expensive staple (Giffen good behavior), because it is still the cheapest way to obtain calories (D'Souza and Jolliffe 2012). This reduction in food diversity implies a shift from nutrient-rich food to cheaper and more caloric food, which can have lasting consequences for vulnerable populations with high nutrient requirements, such as young children or pregnant mothers (Brinkman et al. 2010).

These costs are clearly asymmetric, they cannot be compensated for by periods of low prices but they are also dynamic. Nutrition in childhood affects education outcomes, cognitive skills, and adult economic achievement (Glewwe, Jacoby, and King 2001; Hoddinott et al. 2008). In addition, as households struggle to protect their food intake, they are forced to reduce other expenses such as child schooling and health related expenditure (Jacoby and Skoufias 1997). If periods of high prices prevent human capital accumulation, it means that, in addition to static welfare losses, they generate dynamic welfare losses that compound over time and may matter much more in the assessment of welfare cost than static losses (Myers 2006).

This is not to imply that we should worry only about upward price spikes – and policy makers do not do so. Anderson and Nelgen (2012a, Table 6) show that policy makers adjust trade policies in response to upward or downward price spikes by the same magnitude. The prevention of downward price spikes is likely to arise from a concern for producer welfare. In the case of the cost of price volatility for producers, is the concern more about price volatility or about downward price spikes? Volatility is definitely a concern for producers. Price volatility can induce large swings in realized profit, and therefore in the marginal utility of income. It also can affect production decisions, since resources have to be committed before prices and yields are known. However, it is true that within the standard framework there is symmetry between low and high prices, whereas low price periods are clearly different for producers because they increase the threat of default (Leathers and Chavas 1986). In a creative destruction approach the default of some firms allows the elimination of the least productive firms but in a context of price volatility it may just be that firms default due to the absence of a perfectly contingent market. Although price volatility is a concern for producers, it could be argued that for them downward price spikes are at least an equivalent concern.

This distinction between price volatility and downward and upward price spikes could be considered merely rhetorical, because these spikes are the two components of volatility – you cannot have one without the other. But this discussion raises the point that standard welfare measures may not be able to capture the real cost of volatility. This discussion is informative also for policy design by focusing on the most important justifications for public interven-

tion.[5] Although development economics research demonstrates that food security and related coping strategies to preserve it are likely to be more important for welfare assessments than standard measures of welfare change under expected utility, they do not provide any monetary assessments. To allocate resources to their most profitable use, we would like to deal with the marginal cost of stabilization policies and their marginal benefits. At the present time this is not possible, and even in the future is likely to be difficult. Contrary to infrastructure spending which has tangible outcomes, the benefits from price stabilization are intangible and depend heavily on households' coping strategies. They depend on improvements in health, nutrition, schooling, child labor, and savings. As Grosh et al. (2008, Ch. 3) note in relation to measuring the benefits of spending on safety nets, many economists believe that such a measure is not feasible. And even if it were, it would remain an academic exercise and a function of many behavioral assumptions and hypotheses about the future state of the economy.

In the absence of more precise conclusions about the welfare cost of price instability, in what follows we assume that, at least in poor countries, the difficulty of coping with high food prices creates large and potentially irreversible welfare losses.

2.3 Political economy and redistribution

Previous discussions have focused on market failures as justification for food price stabilization policies; but market failures are not necessary for socially unacceptable outcomes to emerge. Even with complete and well-functioning markets, price booms can result in dire poverty and starvation for the poorest. These are not socially desirable outcomes, and a free market will not prevent them. So given the large distributive effects at stake, public intervention would be likely to emerge even without the market failures mentioned above.

Anderson et al. (2010) remind us that public support for agriculture increases with national per capita income and its importance is greater when a country's agricultural comparative advantage is weaker. It is unlikely to emerge from any market failure, but it represents the increasing role of farm lobbies as countries develop. This political economy motivation for stabilization policies is especially strong in developed countries where it is difficult to find compelling market failures to justify this scale of intervention. It is probably also present in some developing countries – and increasing with economic growth. For example, the way the minimum support price can be increased in India without any consideration for plentiful public stocks and further utilization of these stocks, is a good indication of the influence of farmers in the policy process.

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[5] One example of this framework applied to policy design is Giordani, Rocha, and Ruta (2012). They assume agents are loss averse: they value losses more than gains. Consumers experience losses when prices exceed some reference price, and vice versa for producers. It is consistent also with the contradictory injunctions from non-governmental and international organizations, for which food prices are always either too low or too high (Swinnen and Squicciarini 2012).

Other justifications for such public interventions have been discussed (see, e.g., Rashid, Cummings, and Gulati 2007, for the Asian case), such as lack of transport and communication infrastructures, and limited foreign currency reserves which reduce the ability of a country to import food. Although valid 40 years ago, these justifications have lost some traction. In Section 4 we discuss two common and still relevant justifications for stabilization: lack of private storage, and limited reliability of world markets. The problem is that these justifications are self-fulfilling. They arise from a vicious circle around public intervention and agents' behavior.

2.4   Stabilization policies as second-best interventions

The reasons for intervention outlined above do not imply that the price distribution is suboptimal. They state that agents have difficulties to cope with price shocks but not that price shocks are evidence of market failure. In this framework, price stabilization policies are, at best, second-best policies. The first-best policy would be to provide insurance/futures markets but their behavior could be mimicked through safety nets that would provide countercyclical transfers.

This is true if we believe that price instability is driven by supply and demand shocks, and mediated by the optimal reactions of rational agents. There is an alternative vision: price dynamics is not optimal because it is driven by expectations errors as in a cobweb. This is not a new idea, and has not gained ground in discussions of stabilization policies (see Gouel 2012, for a survey of the debate). This approach assumes that agents – or at least some agents in a model with heterogeneous expectations (Brock and Hommes 1997) – will base their decisions on rule-of-thumb expectations, implying that they will make systematic forecasting errors and not allocate resources according to their expected scarcity. In this case, price volatility arises endogenously from market behavior. It implies potentially large welfare costs of instability and this argument has been used to support price stabilization policies (Boussard et al. 2006). However this approach involves many theoretical inconsistencies and is not supported by the empirical evidence (Gouel 2012).

A related issue is the ongoing debate on the role of the recent financialization of commodity markets in the food crisis. This debate is more empirical than theoretical but proof of a positive link between increased speculation and commodity price volatility could be interpreted as evidence that the introduction of new agents may have influenced prices so that they inadequately represent the supply and demand equilibrium. Currently there is no clear theoretical justification behind the potential impact of financialization. Irwin and Sanders (2012) propose three plausible justifications: (i) lack of liquidity which would have prevented the absorption of the large order flow of index funds; (ii) index investors being noise traders; and (iii) the development of index investors makes it more difficult for other traders to distinguish signals from noise. In any case, it could be seen as supporting a cobweb-like conclusion that

prices do not reflect the equilibrium in which all agents take informed decisions. However, with a few exceptions (e.g., von Braun and Torero 2009), the belief that speculation played an important role in the price spike has not led people to conclude that governments should intervene to stabilize markets but rather that they should introduce rules that would make speculation less destabilizing.

3   Lessons from the theory of price stabilization policies

We need to make an artificial distinction between the theoretical literature and the lessons drawn from experience because empirical analysis of commodity markets is at an early stage – at least in terms of its ability to match structural models with the data.[6] This section presents theoretical and applied results for price stabilization policies. They are drawn from models that represent commodity markets in which policies are introduced. For applied models, they are calibrated to represent the economies of interest and to simulate price dynamics similar to those observed.

3.1   Theory of buffer-stock policy

In this section, we focus on broad issues related to the design of storage policy for price stabilization. We do not consider, for example, issues such as how to account for price trends, or how storage for inter-annual stabilization interacts with intra-annual storage. These are not simple issues but as we show in Section 4, the practical difficulties related to storage policies come more from their political economy than from any lack of theoretical understanding, even though a theoretical design of second-best storage policies presents significant unresolved challenges.

The importance of inter-annual storage in policy debate and in applied policies stems from its perceived ability to smooth quantitative shocks and from observation that a low-stock situation has been a necessary condition for price spikes since the 1960s (Gilbert 2011). Stocks accumulate when supply is larger than need, and are released in times of scarcity. This provides some price stabilization but only to the extent that stocks are available when prices rise. In competitive markets, storage can be profitable since it exploits the difference between low and high prices. Recognizing the existence of profit-oriented storers is crucial, because any food price policy will affect their incentives. A first consequence of their existence is that they provide some stability in the market even without public intervention (Wright and Williams 1982b). However, based on the discussion in Section 2, it is likely that private storers do not take account of some of the costs accruing to the population in times of very high or very low food prices. So, higher price stability, provided by more storage, could improve welfare.

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[6] This is changing though, and some studies present encouraging estimates of storage models (see, e.g., Cafiero et al. 2011).

Increasing stock levels beyond competitive levels is the basis of any storage policy aimed at achieving higher price stability. There are many ways to achieve it but it should be noted first that increasing stock levels is costly. If private storers are already arbitraging the difference between current and expected prices, any policy that increases storage beyond competitive levels will not cover its costs through market operations, and may even reduce profitability and thus amounts of private storage. As long as private markets are functioning properly – which may be assuming a lot in poor countries – any public policy aimed at increasing storage beyond competitive levels will be fiscally costly. This does not reduce the potential for storage policy to increase welfare but it should not be assumed from the start that a public storage policy will result in break-even because storers buy low and sell high. This may occur – and over several years – but by design public storage policy must be costly in order to exceed what is being done by private arbitrageurs.

An important question, linked to the discussion in the previous section, is how policy makers want to alter price distribution. As already emphasized, the literature generally retains that price stabilization policies are second-best policies, so it is likely that there is nothing wrong initially with the price distribution except that agents may find it difficult to cope with. If the problem is mostly one of risk aversion, equation (1) tells us that the cost of price volatility for consumers will decrease with a decrease in price variance. In this case, Gouel (forthcoming) shows that the optimal storage rule is very similar to the competitive storage rule (on second-best storage policies, see also Gardner 1979 and Newbery 1989). For low food availability, no stock is accumulated and all stocks are sold. When availability is superior to normal consumption, part of the excess is accumulated. The difference between the competitive and optimal storage rule is that under the optimal rule stock accumulation starts at lower food availability and the marginal propensity to store is always higher. The occurrence of low prices decreases because of the increased stock accumulation, and the higher mean stock level allows avoidance of more price spikes than under the competitive level. As a consequence, any public agency implementing such a rule would completely crowd out private storage since the reduced instability would not be enough to sustain the profitability of arbitrageurs. If public storage is less efficient than private storage, this crowding out will increase the costs of the policy well beyond the additional storage that it requires. Another issue arises because crowding out means that such a policy may inhibit the development of a private marketing system making future transition to a freer trade regime more difficult.

There are reasons to expect incomplete crowding out. This will be the case if private storage is motivated not just by speculation or if it has some structural differences from public storage. Wright and Williams (1982b) and Williams and Wright (1991, Ch. 15) touch on this by analyzing the management of strategic petroleum reserves. Two features explain the coexistence of both public and private stocks: in the first study, private storers are assumed to receive a convenience yield from the holding of stocks, implying that they hold stock even if the

apparent return is negative; in the second study, they suppose that public stock is not held at the same location as private stock – for example, private stocks may be located closer to the market – so that private storers face a different price instability, which may sustain their activity. For these reasons, and because private storers hold stocks to smooth the natural seasonality of agriculture production, it is reasonable to think that, in practice, an optimal public storage policy would not completely crowd out private storage. But there will be very little scope for private storage to obey a speculative motive in the presence of welfare-maximizing public storage.

Since an optimal storage rule designed to address issues of risk aversion is similar to a competitive storage rule, optimal storage could also be achieved by giving appropriate incentives to private storers. Gouel (forthcoming) shows that the gains from a public storage rule can be reached simply by giving storers a subsidy proportional to the stored quantities. This policy has the advantage of avoiding the involvement of government in grain marketing and decentralizing the policy to private agents. Subsidies have been used to stimulate private storage in Latin American countries and in the U.S., but often in the less efficient form of interest-rate subsidies (Gardner and López 1996).

In policy discussions a more frequent option than a storage rule that would be close to a competitive rule is a price band. Price bands can be justified on two grounds. One is that an optimal storage policy can be complex to design and to explain to private agents, and may not be robust to uncertainties, so relying on a simple storage rule may be a good way to reap some of the benefits from stability without too many complications (Gardner 1979; Gouel forthcoming). The other is the idea that price instability is not the most important problem. What concerns agents are very high or very low prices, and while normal price instability can be smoothed by private storers, government should intervene to prevent extreme prices. These justifications can lead to opposite recommendations with respect to lower and upper bounds. In the former case, the optimal price band is a price peg, a policy where the lower and upper bounds are identical, with an intervention price close to the steady state (Gouel forthcoming). Although there is no formal analysis of a price band designed to prevent extremes, the intuition is that this case would call for a wide price band, which would limit interventions to serious shortages or surpluses and permit private sector intervention between bounds (World Bank 2012). However, simulation studies so far find that the wider the band, the costlier is the policy (Miranda and Helmberger 1988; Williams and Wright 1991; Gouel forthcoming).

Whatever the bounds, price band policies have some common features. Contrary to common expectations that prices will fluctuate between bounds, they spend a lot of time at the bounds, challenging them (Williams and Wright 1991, Ch. 14). A price band is also very different from a competitive storage rule. Because of the commitment to defend a lower bound, the marginal propensity to store at high food availability is equal to 1, while competitive

storers have a marginal propensity to store that increases with availability but stays below unity. So when the floor price is reached, stock accumulation is much higher under a price band than what would be achieved by competitive storers. Because of this high marginal propensity to store, price bands can easily lead to over-accumulation and even explosive behavior (Miranda and Helmberger 1988; Williams and Wright 1991, Ch. 14) when the bounds are inappropriate. This can be prevented by fixing a limit on the stock level, which greatly improves the behavior of a price band (Gouel forthcoming). With such a policy, nothing is accumulated until the lower bound is reached, and since there is no intervention between the bounds, there may continue to be sufficient volatility to sustain private activity. With respect to private storage, a price band has ambiguous effects. Since it trims from the distribution prices above and below the bounds, it removes some of the incentives to store. On the other hand, public storage under a price band presents predictable public interventions that can be exploited strategically by private storers to make profit, and even subject it to speculative attacks (Salant 1983). This private speculative activity taking place along a price-band policy might be perceived negatively since it interacts strategically with the government program. Theoretically this intuition would be wrong. A price-band policy without private activity is more likely to generate welfare losses compared to a *laissez-faire* situation (Gouel forthcoming) since arbitrage possibilities continue to be available. A price-band policy can increase storage beyond competitive levels only with the help of speculators.

The need of private storers to make a price band welfare improving contrasts with the observation that countries implement buffer-stock policies partly because of their distrust of private markets. It contrasts also with the regulations on private activity that often accompany these policies, such as pan-territorial pricing, and restrictions on intranational or international trade.

That a price band means buying low and selling high does not imply that this policy is fiscally profitable. It might be without the intervention of private storers but as long as speculators are not prevented from seizing the profit opportunities – and they should not be since they provide valuable stabilization – public storage under a price band results in a loss. In particular, contrary to expectations and many policy recommendations, wide bands are very costly to defend. Common expectations are that wide bands ensure rare interventions and allow private storers to do their work, and that the large spread between buying and selling prices reduces the cost of the policy. This latter expectation does not hold: the high selling price will cover the purchasing costs but the large spread implies that the time between accumulation and release of grain may be long, creating large opportunity and storage costs.

3.2 Countercyclical trade policies

Second-best trade policies have received comparatively much more attention than second-best storage policies, particularly in relation to the issue of the non-optimality of free trade

under uncertainty which inspired a large literature in the 1970s and 1980s. The first formalization of this issue was achieved by Brainard and Cooper (1968). Based on a portfolio approach, they showed that diversification in a primary producing country decreases fluctuations in national income, which increases national welfare if the country is risk averse. Based on a comparable framework, including risk aversion in a context where productive choices are made before uncertainty is resolved, several papers challenge the idea of the optimality of free trade under uncertainty (Batra and Russell 1974; Turnovsky 1974; Anderson and Riley 1976).

Helpman and Razin (1978) point out that this result hinges crucially on the assumption of incomplete risk-sharing markets. They show that the main results of Ricardian and Heckscher-Ohlin theories of international trade, including the optimality of free trade, carry over to uncertain environments if risk can be shared appropriately. In their model, this is the case because the stock market allows households to diversify their capital, and cross-border trade in financial assets opens the possibility for international risk-sharing arrangements.

Helpman and Razin's seminal contributions clarify decisively the conditions underlying potential deviations from standard results and pave the way to numerous insightful elaborations. Yet as argued in Section 2, there is a variety of reasons why the conditions required for their results might not hold. For instance, in the case that households need to invest their capital in a particular activity without any possibility to diversify, to insure, or to trade the corresponding risk. In this context, which is plausible especially for rural households in developing countries, Eaton and Grossman (1985) show that the optimal trade policy for a small open economy is not free trade. The optimal policy is countercyclical and helps to redistribute resources between groups depending on the terms-of-trade shocks. In addition, this optimal policy entails, on average, an anti-trade bias. Similar conclusions emerge if market incompleteness is the result of lack of international trade in financial assets (Feenstra 1987). In a specific-factor model with risk-averse factor owners, Cassing, Hillman, and Long (1986) also show that a state-contingent tariff policy can increase the expected utility of all agents.

These works are not concerned primarily with food products and food security but they make the point that when other arrangements are not available, a departure from free trade may be motivated by domestic risk-sharing. Food security concerns would probably even further reinforce the rationales to redistribute resources from producers to consumers in times of food price spikes. With the exception of Newbery and Stiglitz (1984), a notable feature of work that supports interventionist trade policies is that it considers small-open countries. Although these kinds of policies may make perfect sense for a single country, extending this conclusion to the whole world would lead to a fallacy of composition. When applied globally and to the extent that countries have similar risk preferences, trade policies may not allow any risk sharing and may even be pro-cyclical. Martin and Anderson (2012) study the collective action problem that arises if countercyclical trade policies are generalized. Their generaliza-

tion, first, results in their being ineffective. Importers tax imports when the world price is low, and decrease tariffs or use import subsidies when the world price is high. Exporters do the opposite. They subsidize exports when world prices are low and restrict them in times of high world prices. These trade policies offset each other, which can leave domestic prices unchanged with respect to free trade and make the world price more volatile, giving the illusion of a successful policy when the domestic price is compared to the world price. Second, not all countries apply such policies or if they do they may face budgetary constraints limiting their adjustment. Those countries that refrain from using trade policies or that are constrained about adjustment to their interventions may suffer from the worldwide use of trade policies. The use of countercyclical trade policies, thus, results in a typical prisoner's dilemma.

In reality, adjustments to trade policies are constrained by bilateral and multilateral trade agreements but the scope for adjustment is nevertheless quite large. When instituting export restrictions on foodstuffs World Trade Organization (WTO) members only have to give consideration to the effects on importing members, and provide notification. Import tariffs are constrained by their bound levels, but bound levels for agricultural products are high and allow large tariff adjustments (Bouët and Laborde 2010). Export subsidies are allowed for 25 WTO members and are subject to commitments but all developing countries can use them to cover marketing and transport costs. Variable levies which adjust the levy on imports to defend domestic price targets were banned by the Uruguay Round Agreement on Agriculture. However, discretionary tariff adjustments are allowed as long as tariff rates stay below their bound levels, and have been used often over the last 40 years (Anderson and Nelgen 2012a).

3.3 Combining trade and storage policies

Most results for storage policies are derived in closed economy settings or under the implicit assumption that the model represents the whole world. We know much less about how to implement storage policies in an open economy. For example, we know very little about the interactions between price-band policies and trade. This is a very important issue because, despite the widespread pursuit of self-sufficiency, most countries engage in cereal trade and trade strongly affects storage decisions.

There are a few theoretical relations between trade and storage under free trade that are important to understand in order to consider the effect of combined storage and trade policies. For each country, shocks to yields can be decomposed into an aggregate component, deviation of world yield from its mean allocated to each country according to its land share, and an idiosyncratic component, which is the difference between realized domestic yields and their aggregate components. In a world without trade costs and trade policies, trade would perfectly alleviate the idiosyncratic components since by construction they sum to zero. All countries would share the same price, determined by the aggregate shock to world yield and existing stocks, and stocks would help to reduce the volatility caused by the aggregate shocks. With

16

trade costs, as long as countries are not trading continuously, trade cannot completely smooth away idiosyncratic shocks since spatial arbitrage is costly. Hence storage with trade costs plays a different role. It contributes to smoothing both the aggregate shocks and the part of idiosyncratic shocks that cannot be smoothed by trade. But except when trade costs are so large that they prevent trade, the respective ideal contributions of trade and storage in smoothing shocks in a *laissez-faire* world are for trade to smooth idiosyncratic shocks and for stocks to smooth aggregate shocks. Because of these respective functions, the use of trade and storage policies as national policies to smooth domestic prices appears problematic. Trade policies will reduce the global smoothing of idiosyncratic shocks which free trade allows, and efficient storage is more about world risk than national risk.

That the main contribution of stocks is to smooth aggregate world shocks does not imply that the location of the stocks is indifferent. Because of trade costs, it is not. Storing grains entails many costs, including the opportunity cost of the money that has to be spent immediately to reap future benefits. Importing grains with the objective of speculating implies paying opportunity costs over trade costs, since trade costs have to be paid immediately. The consequence is that in an importing country, storers should not import based on a speculative motive but only for proximate consumption. Speculative storage should be confined to exporting countries (Williams and Wright 1991). This does not mean that there are no reasons to store in importing countries. Shipping takes time, which justifies some stockholding by an importing country (Coleman 2009), however this does not modify the previous argument that, in general, arbitrageurs should prefer storing the commodity closer to its production to reduce interest costs.

However this is a worldwide perspective. With respect to a single country, trade is not always a blessing. It can help reduce volatility, because world price volatility can be expected to be lower than domestic price volatility in an autarkic country thanks to the smoothing of idiosyncratic shocks. Trade helps also to alleviate a limit of storage, its non-negativity. Storage, whether public or private, cannot prevent all price spikes because stocks occasionally are exhausted, but trade gives access to a supply source that is less likely to be exhausted. On the other hand, because of bad weather events or strong demand abroad, the world price can spike despite adequate domestic supply, and a country will face high prices that are unrelated to its domestic conditions. This opens the way to the numerous trade interventions we observe. It may be tempting to exploit the world market when it serves the interests of a country, and to withdraw from it when scarcity prevails abroad.

To analyze the interaction between trade and storage policy, we consider first the situation of a country close to self-sufficiency, which is the best suited to having a storage policy with some independence from the world market. Gouel and Jean (2012) analyze this situation by considering the optimal design of a food price stabilization policy in a small open economy

that is normally self-sufficient. Based on this assumption, the domestic price evolves between export- and import-parity prices, and when it is not connected to the world market any changes in stock levels affect the domestic price. The implications of increasing domestic price stability through storage or through trade policy are different. Storage policy on its own is not effective at preventing high prices because periods of price spikes occur when a country is very likely to be connected to the world market, through exports or imports. Storage could prevent spikes from domestic scarcity but stock release would need to be sufficiently high to completely crowd out imports. However, storage policy alleviates low prices by increasing stock accumulation and so leads to asymmetric price stabilization by reducing the occurrence more of low than high prices, which increases the mean price. This has consequences for trade. The increased stock levels reduce imports and increase exports.

In this setting, a countercyclical trade policy is much more efficient than a storage policy to stabilize prices. In particular, it reduces the occurrence of high prices by using export restrictions and import subsidies. Because trade policy reduces price volatility and the occurrence of price spikes, it reduces the incentives of private storers, and storage decreases by 20% in the simulations. Stabilization is more efficiently achieved by combining trade and storage policies since trade policy limits the "leakage" of storage policy to the world market and is efficient in preventing high prices, while storage is better at preventing low prices. Export restrictions are an essential component of this policy: not using them hugely reduces the potential gains and allows more of the effect of world price spikes to be transmitted to the market.

A country need not be self-sufficient to have an active and effective storage policy. For example, Larson et al. (2012) analyze the possibility of defending a price ceiling on wheat with public storage to alleviate very high prices (i.e., the last decile of the distribution), for Middle East and North African (MENA) countries. The MENA countries are very dependent on wheat imports (for 40% of their consumption), and wheat represents a very high share of national caloric intake. A storage policy is shown to be effective for reducing the frequency of price spikes for MENA but also for the rest of the world, since MENA countries are always connected to the world market because of their large import needs. It leads also to some international crowding out. Without public policy, speculative storage should be absent in MENA countries because they are consistently importing. A public storage policy in MENA reduces private storage in the rest of the world since it decreases price volatility by preventing high prices and by decreasing episodes of low prices through stock accumulation. This crowding out tends to be costly, because as noted above it means that storage is undertaken in a less efficient location so interest costs have to be paid on top of transport costs.

Although many of the results for storage policies in closed economies hold for open economies, in the latter case there is a fundamental difference, which is the possibility of

leakage of the policy to the world market. As long as a country is not well insulated by trade policies from world price variations, it has to displace trade volumes to be able to stabilize domestic prices through storage. This can be costly. If trade is not crowded out, the additional storage mostly helps to stabilize the world market. Price stabilization policies, even if individually rational for each country, create serious collective action problems. Public storage policies that could have positive international spillovers are of limited interest domestically if not flanked by trade policies to countries that are not isolated from the world market. On the other hand, trade policies have negative spillovers because they provide stabilization for a country at the expense of its trade partners. This can be linked to a previous point that in an open economy storage should be more about dealing with aggregate world shocks and trade should be more concerned with idiosyncratic shocks. A storage policy without an accompanying trade policy increases world stability by providing more smoothing of aggregate shocks. However, a trade policy will prevent the smoothing of idiosyncratic shocks. It should be apparent from this that it is not possible for an open economy to stabilize its domestic food prices without affecting its partners. Whether they are affected negatively or positively depends on the mix of trade and storage policies applied.

3.4   Large redistributive effects

Since the work of Newbery and Stiglitz (1981), a recurrent criticism of stabilization policies is that they generate redistribution between consumers and producers more than efficiency gains. Indeed, stabilizing prices through storage or trade policies can affect agents' welfare in convoluted and counterintuitive ways. This is because it is difficult if not impossible to reduce price variance without changing the mean as well as other moments. If we assume that agents are sufficiently risk averse, they may enjoy welfare gains from a reduced variance in prices, and we can expect aggregate efficiency gains for the economy. However, changes in the mean price will lead to transfers between consumers and producers that for some groups will potentially exceed the efficiency gains obtained from a reduced risk. The direction of the transfers between agents will be determined mainly by changes in the mean price and there are good reasons to expect stabilization policies to affect the mean price.

Stabilization may affect the mean price in both directions, and it is difficult to propose general results for the incidence of stabilization policies because it is influenced by several parameters. For example, the incidence identified for long-run results can be reversed when dynamics is accounted for and long-run welfare changes are discounted. Welfare gains can be reversed depending on the hypotheses made about the nature of the shocks: multiplicative or additive, related to the demand curvature or the values of the elasticities. Since incidence is so dependent on setting, we describe some general mechanisms that affect the distribution of gains among agents (for more details on the incidence of price stabilization policies, see Wright 1979; Wright and Williams 1988b).

3.4.1 Static incidence

Here we focus on static transfers, those that arise from a static model or from the stationary regime of a dynamic model. The mean price around which a policy stabilizes domestic prices depends on the details of the policy, but some general conclusions about this mean price can be drawn by considering how price instability affects demand and supply behavior.

The curvature of the demand function is a crucial element driving how stabilization policies affect the mean price. In many policies, the real objective is to stabilize food consumption not prices, and even if this is not the objective, stabilizing quantities is more convenient in practice since prices are the endogenous result of market equilibrium whereas it is possible to affect quantities through storage. If we focus on demand and neglect the supply reaction, a mean-quantity-preserving contraction will maintain the mean price constant if the demand function is linear. If demand is convex, a mean-quantity-preserving contraction (spread) leads to a lower (higher) mean price because the convexity implies that prices react more to changes in high consumption levels than to changes in low consumption levels.

Supply reaction also matters for assessing incidence. The welfare of producers changes because of the new price distribution but also they react to this distribution by changing their supply. Let us consider a situation à la Sandmo (1971) in which producers are risk averse and produce less when faced with stochastic prices than in a certain environment, and complete the market by introducing futures which allow producers to hedge their price risk with the result that they will produce more. This is individually profitable. Each producer, by securing its selling price on the futures market, is able to commit more resources and enjoy more benefits. However, this can be collectively self-defeating. Increased production by all farmers results in a price distribution with a lower mean, which may decrease producers' welfare for inelastic demand and elastic supply (Myers 1988; Lence 2009). In the absence of other market failures, completing the market increases economic efficiency and generates aggregate welfare gains but with no guarantee that risk-averse agents will benefit.

That incidence results might be dominated by mean price changes is a consequence of the low valuation of risk in expected utility models. Surplus measures dominate welfare assessments and efficiency gains are dwarfed by transfers. However, we have argued that price instability creates costs that are not well accounted for, and the low values obtained from the expected utility framework are difficult to reconcile with the social unrest and endless public intervention in these markets. We cannot ignore the possibility that these potentially larger efficiency costs incidence mean that results could be dominated less by mean price changes and more by a decrease in extreme events. The dominance of transfers over efficiency gains is a reason for Newbery and Stiglitz's (1981) skepticism about stabilization policies. This reasoning, which has become very influential and is the basis of many subsequent works, depends crucially on the way welfare gains are assessed. But even if there are good reasons to

expect higher efficiency gains than previously assumed, these gains will not be evenly spread in society and these policies will probably have large redistributive effects. In a world where agents are heterogeneous, some will gain a little from price stabilization or from reductions in extreme price events; some, because they are poorer or because they are highly specialized producers, will benefit a lot; and some may be indifferent to instability but will be affected by any mean price change. Since stabilization policies are untargeted policies, they affect all agents indifferently and it is very likely that to achieve the underlying efficiency gains, they will generate transfers. The literature on incidence, however, may be an incomplete guide to this issue since it assumes extremely low efficiency gains.

3.4.2 Dynamic incidence

Stabilization policies are inherently dynamic, which means that their incidence should not be assessed only on the long-run equilibrium. It is important also to account for the way welfare gains are affected in the transition to this equilibrium. A public storage policy usually aims at stabilizing prices by accumulating stocks beyond competitive levels. So a storage policy begins with a transitory phase of stock accumulation before reaching its long-run behavior. Since stock purchases are higher than they would without intervention, prices will be temporarily higher. We explained above that a stabilization policy in the long-run may lead to a price distribution with a lower mean, either because of supply reaction or of demand convexity, thus potentially hurting producers' welfare. Because these long-run lower prices are discounted with respect to short-run high prices caused by stock accumulation, producers may actually enjoy a storage policy. This is the important conclusion in Miranda and Helmberger (1988) and Wright and Williams (1988b) that the actual incidence of market-stabilizing policies is often dominated by what occurs in the transitory phase. The importance of transitional dynamics implies also that initial conditions matter a lot: it is not the same to start a policy when availability is high or low.

The other crucial point that affects the dynamic incidence of policies is capitalization. Agricultural production requires the use of a fixed factor, land. To the extent that other inputs are supplied elastically, the value of land is likely to include the effect of agricultural policies, potentially depriving farmers of welfare gains. Since the market value of farmland reflects the expected benefits tied to its operation and how much people are willing to pay to benefit from the insurance provided by farm programs, this value will increase with the introduction of policies that increase revenue or decrease revenue risk. Thus, the main beneficiaries of such a policy will be the owners of the farmland at the time the policy is implemented. In reality, the pass-through from policy benefits to land market values is not complete, but capitalization still allocates much of the gain to the current land owner (Kirwan 2009; Goodwin, Mishra, and Ortalo-Magné 2012).

3.5 The alternative of safety nets

This paper is not concerned directly with safety nets, but a presentation of stabilization policies would not be complete without some discussion of what often is considered to be their alternative. In the context of the failure of the international commodity agreements (Gilbert 1996) and the high cost and mixed record of domestic stabilization policies, the main policy recommendation in the 1980s and 1990s was that countries should rely more on market-based risk management instruments and safety nets (Varangis, Larson, and Anderson 2002; World Bank 2006; or Timmer 1989 for a critique).

Market-based risk management instruments are supposed to provide farmers, traders, food agencies, and even individuals with access to instruments that allow the sharing of price and weather risks and the smoothing of income fluctuations. Put simply, these instruments should help to complete markets. On the other hand, safety nets are supposed to help the poor and vulnerable cope with shocks. Safety nets are non-contributory targeted transfers, whose function is to provide assistance to the poor and to prevent destitution following shocks (Grosh et al. 2008). They exist in various forms such as cash transfers, food stamps, in-kind transfers, and food-for-work and cash-for-work programs. With respect to food price risk, they complement market-based risk management instruments by providing some insurance to the poor who have a limited access to formal coping mechanisms.

This is theoretically appealing since the case for public intervention is based not on excessive volatility, but on people's lack of capacity to deal with this risk. So countercyclical safety nets should bring us closer to the first best than could price stabilization policies. And even should this not be the case, as long as safety nets provide cash or infra-marginal in-kind transfers, they are unlikely to generate large efficiency losses. Also safety nets can be complementary even to stabilization policies. The source of food price fluctuations, weather events or demand shocks, can destabilize incomes. Hence the release of food from public stocks may not be enough to protect the purchasing power of the poor (Sen 1981; Alderman and Haque 2006) and safety nets would be a necessary complement to stabilization policies. In-kind safety nets can also be considered complements to storage policies because they provide a natural way to dispose of grains when stocks need to be rotated, although open-market sales would permit stock rotation without the logistical hurdle of a system of ration-shops.

The use of countercyclical safety nets is not straightforward. Most of the time, safety nets are not designed to fulfill an insurance function, but rather to reduce poverty and help raise people above the poverty level. This income transfer function is easier and better known than the insurance function. For example, the administration of countercyclical safety nets is challenging, because resources tend to be pro-cyclical; they are more available in good than in bad times. This is especially true for safety nets providing in-kind transfers since grain procurement is cheaper when harvests are good and prices are low. So using safety nets as insurance

presents some hurdles (Alderman and Haque 2006). One of these is the ability to scale safety nets up or down, depending on needs. In addition to administrative capabilities, this requires flexible financing. Targeting should also be dynamic. Food price shocks deteriorate the situation of the already-poor net food buyers and also may push into poverty people who initially were not poor enough to be covered by the safety net.

Safety nets are often presented as a good policy alternative to price stabilization policies, because they are targeted, they do not attempt to manipulate food prices, and they do not destabilize world markets. However, these transfers could create pecuniary externalities at world level. Through cash or through in-kind transfers, safety nets protect the purchasing power of the poor from increased food prices and help them maintain their food consumption. If applied, they will reduce the exportable surplus of an exporting country and increase the excess demand of an importing country. So safety nets create pecuniary externalities for other countries by increasing domestic demand for food, and in this respect do not differ much from countercyclical trade policies (Do, Levchenko, and Ravallion 2013), which try to secure local food supply and have been heavily criticized for fueling food crises. Safety nets, however, are advocated as good policy practice. In Section 4, we show that the practical use of these policies creates crucial differences: trade policies tend to over-react to upward price shocks, for example with countries banning exports and accumulating stocks in the midst of the food crisis, while safety nets under-react (Grosh et al. 2011) – probably because of the aforementioned difficulties to adjust them in times of crisis.

4   Lessons from historical experience

This section looks at the effectiveness and limitations of some examples of past food policies. Unfortunately, since statistical evidence on their effects is still limited, it focuses on narratives of stabilization policy successes and failures. As a consequence, even though we can highlight cases where trade and storage policies have been extremely costly or cases where interventions have not led to poverty reduction, or reduced hunger and malnutrition, these interventions cannot be compared to a benchmark situation; there is no counterfactual.

4.1   Safety nets during the recent food crises

Have safety nets protected the poor during the recent food crisis? Although most countries already had some kind of safety net in place, these measures were not always appropriate to protect against rising food prices. And since safety nets are difficult to develop in the timeframe of a food crisis, countries without preexisting and adequate programs have tended to rely on untargeted and distortive policies, such as universal food subsidies or trade policies, import tariff decreases, import subsidies, and export restrictions. The situation is by nature highly heterogeneous among countries. For example, in North African countries, the coverage provided by targeted safety nets is very limited and targeting often inadequate (World Bank

2009). These countries rely much more on general subsidies on flour, sugar, and cooking oil. As a result, in 2007/08, the overall policy response was to increase subsidies and reduce tariffs. Existing staple food subsidies proved difficult to reform because they are an essential part of the social order.

Grosh et al. (2011) provide a picture of safety-net readiness for food price volatility and its recent evolution. They provide detailed analysis of 13 low-income countries that faced high food price increases. They show that even in countries relatively well prepared coverage was only partially adequate. To be able to react in time, countries relied on existing safety nets most of which were based on static targeting because their original purpose was income transfer. However, the crisis increased interest in safety nets, and Grosh et al. (2011) found that the countries they studied were better prepared in 2011 than in 2008 with many projects launched and extended since that time.

Despite these difficulties, where safety nets were in place they played a crucial role in protecting the poor from food price increases (Demeke, Pangrazio, and Maetz 2009; Grosh et al. 2011). In the Latin American countries, the benefits of conditional cash transfer (CCT) programs were increased (Brazil, Mexico). Many countries scaled up school feeding programs to deter parents from removing their children from school (e.g., Haiti, Madagascar, Philippines). Other interventions included increasing subsidies in public distribution systems (e.g., Bangladesh and India), and raising wage rates in public work programs (Ethiopia).

An important lesson from the use of safety nets in the food crisis is that even countries with large safety net systems used complementary price stabilization policies. In Jamaica and Mexico, despite existing and well-considered CCT programs, the first reaction was not to scale up these programs but to rely on untargeted price subsidies. Their CCT programs were used as a second step (Grosh et al. 2011). Price stabilization in India, pursued through an export ban on non-Basmati rice and wheat, was so effective (real price of foodgrains increased by 4.7% in 2007/08 compared to 2006/07) that it caused partial redundancy of adjustments to existing safety nets, although food subsidies increased by 32% in the period (World Bank 2010).

This use of price stabilization policies in a context of existing safety nets may be related to the difficulties involved in scaling up and targeting this protection (Alderman and Haque 2006; Grosh et al. 2011) but may be due also to two other considerations. For countries close to self-sufficiency, such as India, it might be fiscally less costly to ban exports than to increase transfers. In addition, well targeted safety nets leave a large share of the middle class unprotected. Since international trade agreements do not seriously constrain the use of export restrictions on food, the political cost of their use is low compared to the political gains obtained from protecting the middle class not covered by social protection policies. Governments are rewarded for such actions. As noted by Timmer (2010), the Indian Prime Minister

and the Indonesian President were reelected in 2009 after campaigns that emphasized their ability to limit the impact of the food crisis on their countries.

In sum, in countries with already well-established safety nets, they have proved useful for protecting the poor from high food prices. Following the 2007/08 crisis many new projects are in development and are benefiting from technological improvements. For example, the United Nations World Food Programme is moving to a logic of food assistance agencies and is helping countries develop safety nets using cash and voucher transfers, relying on smart-cards and cell phones (Omamo, Gentilini, and Sandström 2010). But there are some real difficulties: a dynamic targeting is proving difficult; good administrative capacities are important to achieve policy adjustments at short notice; and the political economy is not always favorable to such reforms (e.g., in the Middle East and North Africa where reform of universal food subsidies has proved difficult). Nevertheless these problems are no greater than those faced by governments when they try to stabilize prices – as we see below.

4.2 The problems faced by buffer-stock policies

4.2.1 Weak selling provisions of national storage policies

As explained above, the incidence of storage policies is inherently dynamic. Producers may enjoy a market-stabilizing policy not because of its long-run properties – potentially detrimental to them when demand function is convex – but because of the initial accumulation phase that pushes prices to high levels. It also means that, once the first accumulation is achieved, farmers may lobby to delay stock selling, push for further stock accumulation, or for disposal through export subsidies. This occurred in many situations where the rule governing public stock accumulation was defined much more precisely than the rule governing stock release.

India offers a snapshot of this behavior. In the introduction we described how well India weathered the 2007/08 food crisis. This was due to its countercyclical trade policies, and particularly its export ban. However, Indian storage policy has probably little to do with this success. Since the end of the 1960s Indian food policy has achieved some of its objectives: no famine, domestic price stability, and self-sufficiency in major cereals. Public intervention dominates Indian foodgrain markets. Farmers benefit from a minimum support price through which 58% of the rice and wheat marketed surplus is channeled to public stocks. Public stocks are used to supply in-kind safety nets and to stabilize markets. Finally, various laws restrict private involvement in grain markets, such as limitations to inter-state and international trade, and anti-hoarding laws.

The recent management of Indian public stocks would suggest that these interventions are very costly and that better outcomes could be expected with the same public funding. Because of political pressures and to maintain the farmers' incentives to supply public stocks in peri-

ods of rising world prices, government rapidly raised minimum support prices in the 1990s and in the second half of the 2000s, which led to increased procurement. Although stock accumulation increased, stock releases did not keep up (see Figure 1). An important share of stocks is used to supply ration shops and other in-kind safety nets. But to limit fiscal costs, the public distribution of subsidized food was not adjusted to accord with stock levels. There is no rule to dispose of remaining stocks, which are supposed to help stabilize the market through discretionary releases. The large stocks accumulated were reduced in the early 2000s through subsidized exports; a policy difficult to rationalize in a country with more than 200 million undernourished people. It is difficult also to rationalize the stock accumulation during the 2007/08 crisis. While cereal prices were reaching very high levels on the world market, Indian rice stocks were increasing (as Dorosh, 2009, notes this had a large opportunity cost: 2 to 3 million tons of rice exported at $300/ton – a conservative estimate – would have represented $600 to $900 million in export revenues). Similarly, in 2009/10 India suffered from a severe dry monsoon and rice production decreased from 99 million tons from 2008/09 to 89 million tons. This was accompanied by a reduction in consumption of 5.6 million tons but a stock increase of 1.5 million tons (USDA 2012). From these anecdotes, it is unclear how much Indian storage policy is countercyclical and is helping market stabilization, given that stock release does not seem to follow high prices and stock accumulation persists during high price episodes.

[Figure 1 about here]

The story of the Australian Wool Corporation is also exemplary of this mechanism because its failure was the result of its direct management by wool producers (see Bardsley 1994 for the whole story). Australia stabilized the price of wool successfully through the 1970s and 1980s. The Wool Reserve Price Scheme, funded by a tax on production, defended a floor price set annually by government after consultation with the industry. However, there was no selling provision. Beyond stock purchase, stock management was discretionary. In 1987 management was handed over to the wool industry, which immediately increased the floor price by 70%. Supply increased accordingly, but the high prices deterred demand, which turned to cotton and synthetic fibers. At the end of the 1980s the Wool Corporation bought for storage half of all the wool offered for sale. The high stock accumulation soon exhausted the funding coming from the tax on production and further accumulations were financed by borrowing against the wool stockpile. However, this did not lead the industry to decrease the floor price. The industry was facing skewed incentives: large gains from selling high current production versus limited future losses from the Corporation because the industry was liable for the equity but not for the outstanding debts. In 1991 the Australian Government suspended the scheme. The remaining stockpile was close to one year's production and the debt represented between 60% and 90% of one year's sales.

4.2.2 Storage in International Commodity Agreements (ICAs)

We can get more insight into the practice of storage policies by considering the history of ICAs. Because these agreements involve many consuming and producing countries, interventions were required to allow more transparency and less discretion than is possible for a sovereign country. In addition, another interest of these global policies is that, beyond anecdote, it is difficult to assess the effectiveness of a storage policy for stabilizing prices in a single country since storage policies are often associated with trade policies, whose effects are likely to be very important.

ICAs with provisions for market control emerged in the postwar period under the auspices of the United Nations and concerned cocoa, coffee, rubber, sugar and tin. They were treaties between producing and consuming countries. They defined regulation on international trade and storage to achieve remunerative and stable prices. Although some ICAs are still active, they no longer include "economic clauses" and their role is to facilitate intergovernmental consultations and market transparency (for a detailed description of market interventions under ICAs, see Gilbert 1996; 2011). The primary objective of some ICAs was to prevent very low prices rather than to stabilize prices. In this respect, the international coffee and sugar agreements relied on export controls, not buffer stock. Nonetheless storage played a crucial role; when supply is very inelastic in the short run, control of exports is easier through domestic storage than through supply restriction. The agreements on cocoa, rubber, and tin relied explicitly on buffer stocks. All were based on bandwidth rules. The buffer-stock managers had to defend ceiling and floor prices by stock sales and purchases.

The history of ICAs with stockholding provisions provides the following lessons. Intervention was possible over a long time (28 years for the tin agreements) because the price targets were regularly adjusted. Storage policies based on a bandwidth rule require regular adjustments to account for structural changes (e.g., production costs and consumer tastes). This raises several issues. First, it can be conceptually complex. The existence of the intervention can mean that a representative free-trade price on which to base adjustment is lacking. Second, these successive adjustments inflame each time the inherent conflict between producing and consuming countries about the right price level. For example, the cocoa agreements were unsuccessful in the 1970s because the ceiling price was always below the market price. In the early 1980s, the third cocoa agreement fared no better. Its financial resources were exhausted in the first three months by attempts to defend an unrealistically high floor price, which remained above the market price for most of the life of the agreement. Third, when price targets are set in line with economic fundamentals, the policy may have limited effects if it accommodates the price changes too well. This was the situation for the international natural rubber agreements. These agreements allowed large bands, with a ceiling price 28.6% above the reference price and a floor price 25.2% below it. The large bands meant that interventions were

limited. The agreements were successful in preventing the price from falling below the floor, but not in preventing prices above the ceiling. Gilbert (1996) argues that natural rubber agreements lasted two decades precisely because they were relatively innocuous.

Some of the commodities covered by ICAs were traded on organized futures markets, as is the case for most grains. This raises issues about interaction with speculators; Salant (1983) argues theoretically that the coexistence of public stock and private arbitrageurs create the possibility for speculative attacks on the stabilization scheme. In practice, this was scarcely a concern except at the end of the international tin agreements (ITA) in 1985 (Anderson and Gilbert 1988). Speculators' activities did not lead directly to the collapse of the ITA, however. During more than 20 years, the ITAs managed successfully to defend the floor price using both buffer stock and export control. Following the important price increase in the late 1970s, the bands were adjusted to represent the prevailing prices but in the early 1980s the market was turning to a situation of excess supply resulting in the International Tin Council (ITC) accumulating large stocks to defend the floor. When it faced its legal storage constraint, the ITC engage in futures trades to support prices. But then faced with the threat of short sales that would have led to huge losses, the buffer-stock manager engaged in a massive market corner which ended with a market collapse when the ITC ran out of liquidity.

4.2.3   Lessons from public storage experiences

Before drawing lessons from these experiences of public storage, we again emphasize the need for caution. The absence of adequate counterfactuals prevents derivation of definitive conclusions from these experiences and opens the way to personal interpretations. This applies less to conclusions about safety nets which can be evaluated through random assignments. For trade policies, there are a lot of available data, and counterfactual models, although imperfect, can be built to simulate the counterfactual. For storage, however, data on stock levels are poor quality and the models not sufficiently rich to represent the complexity of actual food markets. For example, we described above several issues related to public storage management in India. Despite its many flaws, Indian food policy has managed to prevent a major food crisis over the last 40 years and has weathered large production shocks that significantly reduced domestic supply (with five supply shortfalls exceeding 10%). But even senior Indian government officials (Basu 2010) recognize that welfare could be improved by a better foodgrain policy. The previous description shows that Indian storage policy could be improved by clearer release rules and a less pro-cyclical behavior. However, making a judgment about the alternative to *laissez-faire* is more difficult. Would private storers have done the job? Would they have been willing to undertake sufficient inter-annual storage for India to deal with a 10% production decrease? Would India have been able to procure cereals on the world market in the case of supply shortfall?

The histories of storage in Australia and India summarized above show that storage policies because of their ability to temporarily raise prices are highly susceptible to being captured by farm lobbies. But other experiences of storage policies such as the European ones that resulted in butter mountains and a wine lake could tell the same story. This political economy issue was illustrated by the fact that these domestic storage policies lacked clear rules and may even have pursued multiple and contradictory objectives. The confusion was between preventing low prices and reducing price volatility. The former objective was always seriously defended but the lack of precise selling prices made the latter less achievable. The failures of the wool and tin stabilization programs demonstrate also that, when these programs are poorly designed, one of their most important market effects may be their collapse, since the stocks accumulated under explosive intervention rules can depress the market for a long time. These limitations might suggest that better outcomes would be achieved through more rules-based storage policies, delegated perhaps to independent organizations.

The story of ICAs, which relied on clear rules and were delegated, proves this intuition wrong. From his study of ICAs, Gilbert (1996; 2011) does not conclude that price stabilization policies are infeasible and bound to break down, but that they involve problems likely to threaten their long-run stability. These problems revolve around the issue of reference price and bandwidth updating, which is both conceptually complex and politically challenging since it reveals the inherent conflict between producing and consuming countries over schemes that have obvious large costs but unclear benefits. In addition, where such schemes proved effective this was more in relation to preventing low prices than stabilizing prices.

4.3   The apparent effectiveness of trade policies

In the past buffer-stock policies were quite widespread. The end of ICAs, successive reductions in Europe of direct market support, and structural adjustments in many developing countries have resulted in these policies being used much less since the early 1990s. Many countries continue to maintain stocks for emergencies or food-based safety nets but less so to achieve stabilization. This does not apply to countercyclical trade policies which are widespread. In the countries surveyed by Demeke, Pangrazio, and Maetz (2009), trade policy adjustments, whether tariff reductions or export restrictions, were the most commonly adopted policy measures during the 2007/08 food crisis (in 68 out of 81 countries). Their use is not restricted to crisis situations. Anderson and Nelgen (2012a) analyze a panel of 75 countries that account for 90% of global agriculture and show that these adjustements occur equally at low and high prices, in importing and exporting countries, and in developing and high-income countries.

Unlike storage policies, which occasionally have been procyclical, trade policies are fairly consistently countercyclical. Tariffs increase when the world price is low and decrease when it is high. Exporting countries tend to restrict exports during price spikes and to promote them

29

during price downturns. The data show that trade policy measures are negatively correlated with deviations in the international price from its trend (Anderson and Nelgen 2012a, Table 1). Among the developed countries, an archetypical example of such an adjustment is the European Common Agricultural Policy (CAP). To promote domestic agricultural production, the CAP stabilized the prices of several commodities and guaranteed a minimum price to farmers enabled by public storage with the help of trade policies. In the case of wheat, trade policies were crucial since Europe was a net importer of wheat until the end of the 1970s and an exporter thereafter. Figure 2 illustrates the protection granted to French wheat producers based on border adjustments and the countercyclical nature of these adjustments with respect to border price. As an importer, France's domestic prices were prevented from going below the intervention price through the use of variable levies or duties that adjusted automatically to the world market price in order to protect the intervention price. When world prices spiked in 1973/74, Europe used export taxes to limit domestic price increases (negative rate of assistance). When Europe became a net wheat exporter, variable levies were no longer sufficient to prevent low prices and Europe had to rely on export subsidies. Recent CAP reforms, by decreasing wheat intervention prices, have reduced the need for border protection. Price stability in the European market has never been complete because the policy was mostly aimed at protecting producers from downward price spikes but only a limited share of the world price movements was transmitted.

[Figure 2 about here]

By using similar trade policies to those applied in Europe, many countries achieved some isolation from the global market. On average, in their sample Anderson and Nelgen (2012a) find short-run price transmission elasticity from world to domestic price close to 0.5. This imperfect transmission likely comes from trade policies. The elasticity is 0.72 for soybean, which is known to be heavily traded (more than 30% of production is traded according to USDA (2012), against less than 8% and 20% for rice and wheat) and for which the rate of protection is not significantly correlated to the world price unlike other commodities (Anderson and Nelgen 2012a, Table 1). As a comparison, the short-run elasticities for rice and wheat are 0.52 and 0.47.

These trade policy adjustments did not always translate into a more stable domestic market. For example, Anderson and Nelgen (2012a, Table 9) find that in African countries domestic agricultural prices on average are more unstable than border prices. They suggest that this may be caused by poor policy timing. It could also be that export restrictions are difficult to enforce in countries with porous borders, which applies to many African countries. In this situation, export restrictions raise transaction costs and informal trade flows but do not always decrease trade (Staatz et al. 2008). Another reason could be that discretionary interventions create uncertainty which hinders private traders' activities. This effect is confirmed

by Chapoto and Jayne (2009) who show that in Eastern and Southern Africa the most interventionist countries tend to end up with more volatile and uncertain prices than the other countries (see also Porteous 2012, on the destabilizing effect of trade policies in Africa).

In developing Asian countries, trade policies have been more effective. Their domestic agricultural prices have been 30% more stable than border prices. For some (Dawe 2001; Timmer 2010), this Asian success at price stabilization is used frequently to illustrate what can be achieved by stabilization policies: securing good incentives for farmers' long-run investment and providing stable and affordable supply for poor consumers. However the Asian success in stabilizing prices is apparent only. Although Asian policy makers may have congratulated themselves on achieving domestic stability in an unstable world market, the world rice price does not represent global scarcity but only the extent to which these countries are willing to trade. It is widely acknowledged that the major cause of the 2007/08 rice price spike was the generalized use of restrictive trade policies by exporting countries (Timmer 2010). For each country taken individually, a countercyclical trade policy appears to work because its domestic price is less than the world price. However, for the countries collectively this policy is self-defeating as the world market becomes thinner and more unstable (Martin and Anderson 2012). In addition, these policies cannot be effective for all countries. Anderson, Ivanic, and Martin (2013), analyzing the combined effect of all policies, show that Bangladesh and Indonesia tried to insulate their domestic rice markets from the increase in world prices but their policy adjustments were not enough to offset the price-increasing implications of all other countries' collective adjustments. Their rice price did not increase as much as the world price but increased more than it would have done in the absence of worldwide insulation. Martin and Anderson (2012) compare this to the collective-action problem arising when a crowd stands up in a stadium to get a better view. Remaining seated is not an option because the view is obliterated, and standing up collectively is ineffective.

The extent to which these trade policy adjustments contribute to world price volatility through their terms-of-trade effects can be assessed by building models to represent the world food market and analyzing the counterfactual situation of a world without trade policy adjustments. This is obviously subject to many criticisms given the difficulties in estimating models that explain commodity price volatility (Cafiero et al. 2011). Anderson and Nelgen (2012b) provide such a back-of-the-envelope assessment using observed policy changes. For rice, the contribution is significant; they estimate that trade policy changes explain 40% of the 2006—08 rice price spike compared to 27% in 1972—74. It mattered also for wheat and maize where changes to trade barriers contributed respectively to 19% and 10% of the spike.

Beyond terms-of-trade effects, trade policies affect volatility by hindering risk sharing of yield shocks. There are a few statistical illustrations of the consequences of a smaller market on instability. Jacks et al. (2011) use years of war as a natural experiment to show that since

31

1700 commodity prices were more volatile when the world market was smaller. Persson (1999) reaches a similar conclusion for the case of early modern Europe. He shows that price volatility declined with falling trade costs and the reduced administrative barriers to trade. These results make sense given the limited volatility of world yield compared to domestic yield. Table 2 presents the coefficients of variation of yield of the three main cereals for ten large producing countries and for the world. There is no country where yield volatility is less than at world level. It is not uncommon for yield volatility in major producers to be twice as high as at world level. Given the smoothness of cereal yields at world level, it is hardly surprising that any measure that disturbs this smoothing of shocks will increase the volatility of global prices since the residual market will have to bear much larger shocks.

[Table 2 about here]

4.4 Mixed outcomes from experiences of liberalization

From the foregoing, it might seem that the cost of stabilization or the difficulty involved in managing storage policies would make greater liberalization profitable. However the issue is less straightforward. It is true that real policies crowd out private activity because stabilization policies reduce the benefits from private arbitrage, but potential interventions can have the same effect since the expectations of public involvement in the market in times of crisis reduce the benefits from arbitrage as well as creating a lot of uncertainty. This situation is analyzed theoretically in Wright and Williams (1982b). They show that if government is unable to commit to not intervening in times of shortage – in their case by imposing a price ceiling – private storers stock much less than under this commitment. The insufficiency of private stock levels implies that welfare can be improved through public stockpiling. This is not just a theoretical consideration; the configuration has emerged in several countries as we show below.

The case of Eastern and Southern Africa are the most frequently analyzed for the challenges related to reforming food policies. The countries in this region inherited from the colonial period food policies that relied on state marketing aimed at promoting settlers' production through cross-subsidies using taxes on African farmers' production (Jayne and Jones 1997). They involved many regulations including pan-seasonal and pan-territorial pricing, and restrictions on private grain movements. The new policies that were introduced at independence promoted smallholder agriculture but did not reduce state involvement. In the mid-1980s, the combination of mounting fiscal costs and structural adjustment programs in Africa pushed these countries toward liberalization of their food policies.

However, in most cases, liberalization has not been complete and several countries have maintained some state-owned grain trading enterprises, which although coexisting alongside private traders still play an important role in food policies. This is the case in Zambia where

the Food Reserve Agency manages food security stocks, and purchases substantial quantities, mostly maize (Tschirley and Jayne 2010). In addition, government maintains comprehensive regulation of trade through the issuing of export and import licenses. Since 2000, Zambia has experienced three periods of prices exceeding import parity prices, which at first sight might seem to be severe market failure but is not. These situations arose as a result of distrust between government and traders. In 2001/02, in the expectation of a supply shortfall, government announced large public, subsidized imports. Following this announcement, private traders abstained from importing. However, the public imports were delayed and prices soared. In 2002/03, faced with another potential crisis, government tried to involve the private sector in the import decision but limited the discussion to large commercial millers who produce expensive maize meals, excluding from discussion small-scale millers. Price again rose above the import parity price because of insufficient imports. In 2005/06, following forecasts of a poor maize harvest, government announced that the 15% tariff on maize would be waived. Private traders delayed their imports until the decision was implemented. The delay pushed prices above the import parity price. There are similar stories that could be told about the case of Malawi (Tschirley and Jayne 2010).

This lack of trust between private agents and government is problematic in some Eastern and Southern African countries because their food policy reforms are in midstream: they do not have real public stabilization policies but they do not trust private traders, which are reluctant to step in fearing erratic government intervention. This distrust is not reserved to Africa; it is observed in India where public regulation prevents hoarding, and regional and international trade. This makes reform of food policies in India and many other interventionist countries extremely challenging.

Bangladesh, like India and Pakistan, inherited from its colonial era food policies based on foodgrain procurement at minimum support prices to support farmers, public management of international trade, and stock policies aimed at stabilizing domestic prices and providing supply for public distribution systems. Bangladesh reformed its food policies in the early 1990s. The reforms involved trade liberalization, limitation of the role of public stocks to emergencies and targeted safety nets, and elimination of ration shops. Notably, the reforms were accompanied by measures meant to build private sector confidence in future limited public interventions: the absence of anti-hoarding regulation, dialogue between traders and government, low tariffs on grains (Dorosh 2009). When rice production was reduced in 1998 by severe flooding, the domestic price increase was limited by the import parity price and traders compensated for the production shortfall by imports. During the 2007/08 campaign, Bangladesh simultaneously suffered serious flooding, the effects of Cyclone Sidr, and the global food crisis. The same strategy was applied: private sector imports compensated for shortfalls despite reduced supply in a tightening world market; safety nets were scaled up (46% budget increase); and agricultural production was supported to ensure a good harvest from winter-

season rice. These measures limited food price inflation and the threat of a large-scale food crisis. However, the severity of the shocks and the need to import from the world market during the crisis led to a doubling of the rice price (World Bank 2010) and a worsening of food insecurity for many poor people. Bangladesh's food policy reforms have been praised as an important step toward a modern food market (Ahmed, Haggblade, and Chowdhury 2000), but the recent crisis has highlighted the difficulty to weather a perfect storm affecting both domestic production and the world market, when the other countries are less committed to liberal policies.

5   Conclusion

From this literature review, we have identified the reasons for the negative conclusions drawn by economists in relation to price stabilization policies. For some time, one of these reasons was related to the limited welfare gains arising from the expected utility framework. Although economists may have found it tricky to assess the welfare cost of food price instability, there is a suspicion that more stability could deliver significant gains, not least from additional political stability. However, the literature seems doubtful about the possibility that price stabilization policies could deliver such gains without the country involved or its partners having to pay a cost that is disproportionately high compared to the gains. This is explained, firstly by the difficulty to design a stabilization policy that would not adversely affect trade partners or hinder market development. A buffer-stock policy requires some isolation from the world market to stabilize the domestic price so it needs to be backed by adequate trade policy. Secondly, storage policies historically have been costly and have failed to deliver the expected stabilization, because they have been captured by farmers' lobbies resulting in weak selling provision and over-accumulation in order to maintain high prices artificially. Lastly, successful stabilization policies have relied heavily on trade policies exploiting the world market to achieve domestic objectives. Hence trade policy more than buffer stocks is the instrument that effectively stabilized domestic prices in many countries, but also imposes the greatest cost on the focal country's partners. Thus these policies lead to a typical prisoner's dilemma where the world market is trapped in a non-cooperative equilibrium. As long as this equilibrium prevails, it makes sense for countries individually to pursue domestic price stability through trade policies even though collectively this is self-defeating.

The introduction to this paper raised the question of whether the academically dominant approach of reliance on safety nets and world trade is still relevant or whether developing countries should rely on food price stabilization policies. Based on the reviews of past experiences and the literature, we believe that the food crisis has not changed the general perspective. Indeed, for most economists, a world where all countries rely on direct transfers to assist consumers and producers, where government refrains from changing the price distribution, and where trade smoothes production shocks globally would be close to the first best. It is true

that countercyclical safety nets have proved challenging, but experiences suggest that good management of price stabilization policies is no less difficult. What seems to be the most important problem in standard international advice is that it relies on the idea that all countries will adopt the same cooperative policies. As long as this is not the case, a country adopting a free-trade policy will act as a residual market that must absorb a disproportionate share of global volatility. In addition, reliance on a world market requires its existence at all times, which is not guaranteed if major exporters use export bans.

The apparent effectiveness of trade policies makes it difficult to break the vicious circle of non-cooperative policies. This problem of multiple equilibria could explain the different stances of economists on the issue of food price stabilization policies. On the one hand, international organizations should not be expected to advise countries about policies in which benefits will come at the expense of their partners. Their policy advice should be consistent – domestically and internationally. Their policy recommendations will focus naturally on the most cooperative outcome. On the other hand, some (e.g., Timmer 2013; Abbott 2012b, p 6), although acknowledging the benefits of a market with limited trade interventions, do not believe it is achievable in the present policy situation. Hence, in our judgment there are two crucial policy and research questions: (i) how we pass from the current non-cooperative equilibria in which countries, distrustful of the world market and of a private marketing system, apply insulating and stabilizing policies to a cooperative equilibrium that would allow a better sharing of risk; and (ii) taking account of the present situation, what policies that would not worsen the situation can economists recommend to countries wanting to protect their populations from food price instability. Related to both questions, below we offer some perspectives on the respective issues of trade policies, safety nets, and storage policies.

The current difficulties related to the rice market are in part a legacy of the 1972/73 crisis (Timmer 2010). Following the collapse of the rice market in 1972/73 and the scramble for affordable rice imports, countries such as India and Indonesia focused on greater self-sufficiency and developed policies to achieve it. Following the 2007/08 food crisis, were more countries to emulate these examples, this would reduce the rice market even further. Is it possible to curb the tendency to restrict trade further? The theoretical answer from the literature on self-enforcing trade agreements (e.g., Bagwell and Staiger 1990, for trade policies in a volatile environment) would be that as long as the discount rate is not too low a cooperative equilibrium can be sustained by threat of future punishment. However, even if the payoff from cooperation is collectively high, being sovereign, countries will accept to cooperate only if this is in their own self-interest. A consequence – and a standard feature of self-enforcing trade agreements – is that the first-best policy of free trade may not satisfy the interests of every country for all large shocks. Thus the countries that are best positioned to extract gains from non-cooperative policies may retain the right to some deviations from the first-best in a cooperative equilibrium in order to satisfy their participation constraints. So even under coop-

eration, to satisfy each country's national interest some deviations from free trade should be expected and countries relying on the world market for their food supply should account for these deviations.

In practice, this type of coordination, even if incomplete, occurs mostly with the help of trade agreements or within the WTO, and the outlook for such agreements is not good. What is encouraging is that the Uruguay round negotiations brought discipline to a similar situation: the export subsidy escalation between the E.U. and the U.S. Export restrictions could be subject to the same discipline as tariffs and export subsidies: taxes, which must be consolidated, are allowable, but not quantitative restrictions – recently acceded WTO members have accepted similar disciplines during accession negotiations (Crosby 2008). The bound levels can be decreased gradually at each round of negotiations. This allows importing countries to predict more accurately the extents of policy adjustments. These trade policies for food security are more difficult to regulate than export subsidies, however. Export restrictions usually have a short life, and dispute settlements in the WTO take a long time, and are supposed to address existing policies. In addition, proposals to regulate export restrictions were rejected by many member countries at the beginning of the Doha Round negotiations (WTO 2004) and are unlikely to be accepted now. A positive point with respect to trade policies is that the policy changes in high-income countries contributed much less to the 2007/08 price spike than in 1973/74 (Anderson and Nelgen 2012b). They reduced some tariffs to limit domestic price increases but refrained from their previous action of using export taxes. Nevertheless the role of developed countries' policies in the recent food crisis should be acknowledged. It is true that these countries rely less on storage policies and time-varying trade policies, but recently the agricultural policies with the largest terms-of-trade effects are probably the biofuels policies in the U.S. and in the E.U. In 2009 maize used for ethanol production in the U.S. represented 12% of maize world production. Vegetable oil use for biodiesel in the E.U. represented 5% of world vegetable oil production. The ability of developing countries' trade policies to affect the quantities supplied to the world market is dwarfed by the effects of these biofuels policies. To ask developing countries to commit to liberal trade policies while calories are sucked towards developed countries' fuel tanks is asking a lot from them.

On safety nets, the outlook is encouraging. They are mushrooming and countries will be able to rely on them in the future in preference to stabilization policies. Adjusting them in times of food crises will continue to be a challenge but lessons have been learned from the 2007/08 experience. Safety nets are a necessary first step toward reforms; they are needed in order to build trust with private agents. As governments politically cannot afford to be perceived to be inactive during food crises, private storers should rightly be concerned by governments pretending to abandon all possibilities to address hunger in times of high prices. If appropriate and scalable safety nets have not been developed, governments will be forced to rely on costly policies such as universal subsidies, or self-defeating policies such as erratic

trade policy adjustments, that disincentivize private traders. A government commitment not to intervene directly on food prices is credible so long as government retains some options to protect the poor and vulnerable. So safety nets are essential to break non-cooperative interactions between private traders and governments. This will not ensure that countries with more safety nets will avoid price stabilization policies completely. As we observed in the 2007/08 food crisis, even countries with large safety net systems (e.g., India) used stabilization policies and are planning to increase storage facilities. Hence, an important research question would be to better understand this trade-off between stabilization policies and safety nets.

As countercyclical trade policy interventions are unlikely to decrease soon and the reliability of the world market is equally unlikely to increase, it should not be excluded that storage policies may still play a part in the policy mix in the future. While buffer-stock policies have proved difficult to manage and rarely delivered any additional stabilization, emergency stocks may appear to be a valuable alternative. Emergency stocks are stocks allowing to meet situations when there are short-run physical constraints on production and import preventing supply of needs. Although the topic of buffer-stock policies has been well researched, this is not the case for emergency stocks. The World Food Programme's (2011) feasibility study for the G20 on regional food reserves and the assessment of the Ethiopian Strategic Grain Reserve by Rashid and Lemma (2011) provide insights into the design of and the benefits that can be expected from emergency stocks. Research on emergency grain stocks could also be inspired by studies related to the management of strategic petroleum reserves and their disposal in the case of supply disruption or the embargo that emerged in the 1980s.

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Tables

Table 1. Ex-ante equivalent variation for a consumer from perfect price stabilization at mean price for various parameters (relative risk aversion, ρ, commodity budget share, γ, income elasticity, η, price elasticity, α, coefficient of variation of price, σ_P; welfare changes are calculated using equation (1) and expressed as percentage of income)

η	α	ρ:	0			2			4		
		γ:	0.01	0.15	0.3	0.01	0.15	0.3	0.01	0.15	0.3
Medium fluctuations ($\sigma_P = 20\%$)											
0	-0.1		-0.002	-0.030	-0.060	-0.002	0.060	0.300	-0.001	0.150	0.660
0.25	-0.1		-0.002	-0.041	-0.105	-0.002	0.049	0.255	-0.001	0.139	0.615
0.25	-0.4		-0.008	-0.131	-0.285	-0.008	-0.041	0.075	-0.007	0.049	0.435
0.5	-0.4		-0.008	-0.143	-0.330	-0.008	-0.053	0.030	-0.007	0.038	0.390
0.5	-0.7		-0.014	-0.233	-0.510	-0.014	-0.143	-0.150	-0.013	-0.053	0.210
Large fluctuations ($\sigma_P = 30\%$)											
0	-0.1		-0.005	-0.068	-0.135	-0.004	0.135	0.675	-0.003	0.338	1.485
0.25	-0.1		-0.005	-0.093	-0.236	-0.004	0.110	0.574	-0.003	0.312	1.384
0.25	-0.4		-0.018	-0.295	-0.641	-0.017	-0.093	0.169	-0.016	0.110	0.979
0.5	-0.4		-0.018	-0.321	-0.743	-0.017	-0.118	0.067	-0.016	0.084	0.878
0.5	-0.7		-0.032	-0.523	-1.148	-0.031	-0.321	-0.338	-0.030	-0.118	0.473

Table 2. Coefficient of variation of yield in the ten largest cereal producers and in the world, 1960—2012 (%)

	Maize	Rice	Wheat
Argentina	6.02	5.52	7.81
Bangladesh	--	2.32	8.56
Brazil	3.63	2.32	10.89
Canada	5.40	--	8.41
China	3.70	2.62	3.14
European Union (27)	7.35	5.74	4.27
Indonesia	3.97	2.93	--
India	4.95	3.64	2.97
Russia	21.04	6.31	12.33
United States	5.84	3.43	4.97
World	2.82	1.29	2.32

Source: Obtained after HP-filtering (smoothing parameter of 400) of original yield data from USDA (2012).
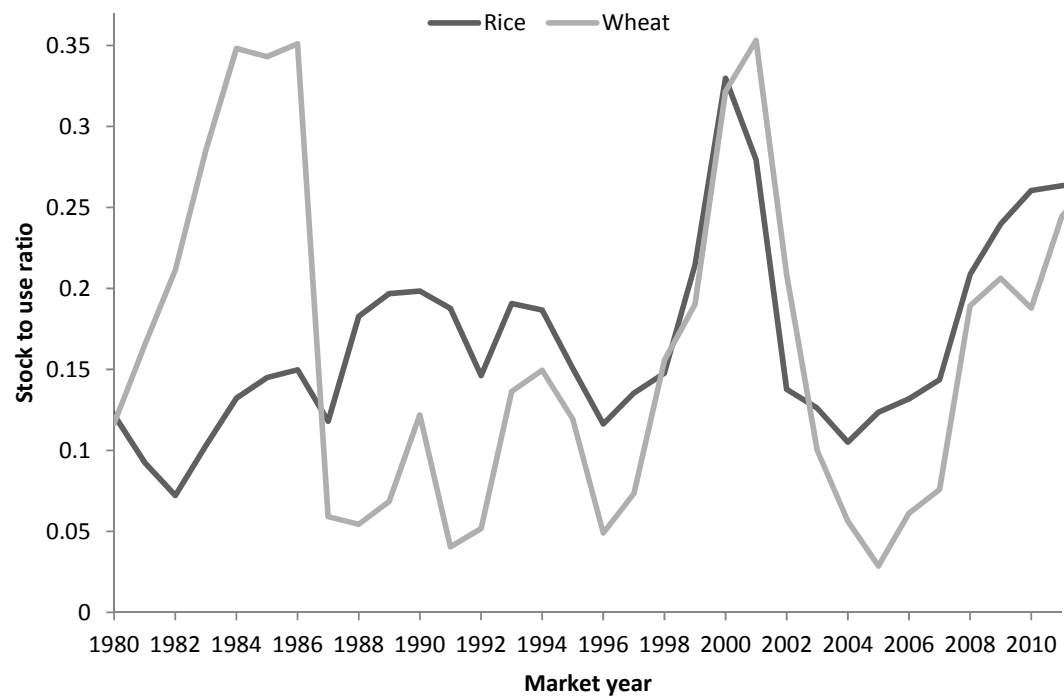
Figures

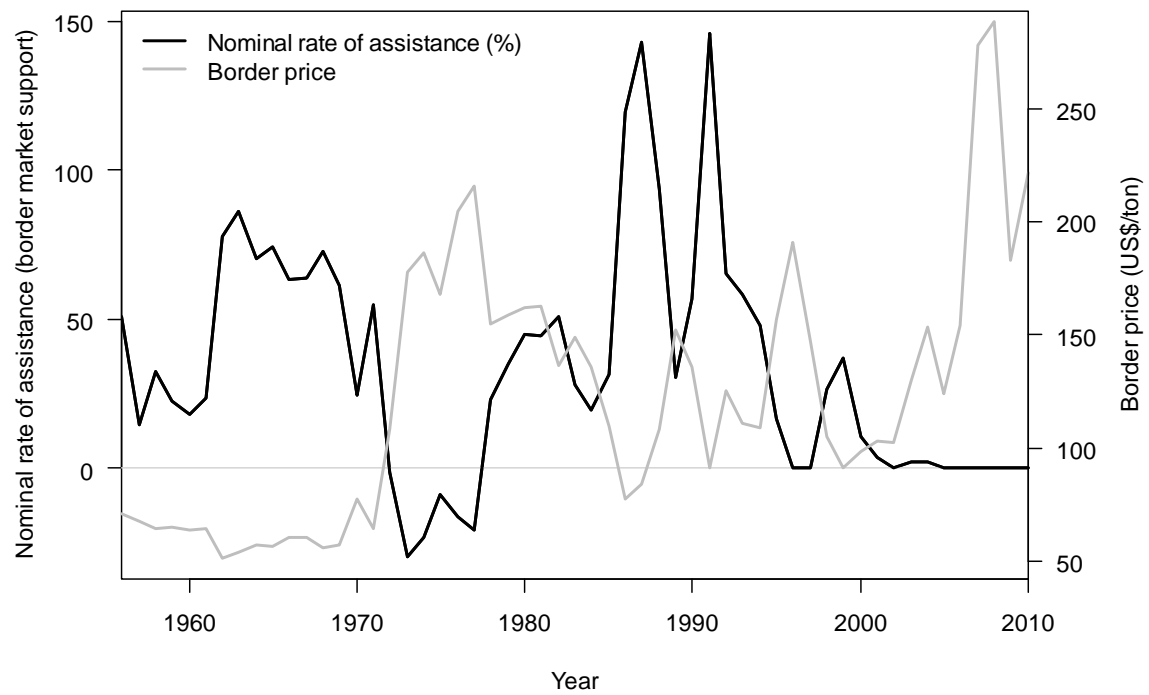**Figure 1. Wheat and rice stocks in India.** Source: USDA (2012).

Figure 2. Nominal rate of assistance and border price on French wheat market. Source: Anderson and Nelgen (2012c).