

Food price volatility and domestic stabilization policies in developing countries^{*}

Christophe Gouel[†]

July 19, 2012

Abstract

When food price spikes in countries with large numbers of poor people public intervention is essential to alleviate hunger and malnutrition. For governments, it is a matter also of political survival. These actions often take the form of direct intervention in the market to stabilize food prices, such as storage or trade policies, which goes against most international advice to rely on safety nets and world trade. Despite their limitations food price stabilization policies are widespread in developing countries. This paper attempts to explain the elements of this policy conundrum. These policies arise as a result of international and domestic coordination problems. At the individual country level, it is in the interests 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 decreases the appeal of laissez-faire even further. A similar vicious circle operates in the domestic market: without effective policies to protect the poor, such as safety nets, food markets 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 market and increase trust between public and private agents.

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

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

^{*} I would like to thank Mathilde Douillet for helpful comments. This research was generously supported by the Knowledge for Change (KCP) Trust Fund. The views expressed here are the sole responsibility of the author and do not reflect those of the World Bank.

[†] INRA, The World Bank and CEPII (christophe.gouel@agroparistech.fr)

1 Introduction

In early 2009, Manmohan Singh was reelected as Prime Minister of India following a successful election campaign in which he emphasized his ability to protect 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 Indian export parity price was imposed, which had to be regularly increased 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% of the import price of 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 prime minister was soon voted out and decisions were taken to subsidize the price of rice. Many other countries experienced food riots that threatened the stability of their governments. But the situations in Haiti and India illustrate that public intervention in 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

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

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

³ The recent global "land rush", which is strongly driven 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 call into question the dominant approach (Timmer 2010a; Galtier 2009; Abbott 2012a; HLPE 2011). The dominant approach has drawn 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 have been the rice exporting Asian countries, such as China and India, which have very interventionist policies related to both trade and storage. However, 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 the recent crisis, 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 instead on price-stabilization policies?

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 to trade? To our view, the weakness of the dominant approach has to do to a large extent with the fact that it requires countries to trust each other and to adopt the same cooperative policies. Indeed, domestic policies impact world prices stability, negatively in the case of countercyclical trade measures and potentially positively in the case of storage policies. Those policies are also interdependent in the sense that the domestic policy choice of each country 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 is facing considerable challenges.

The coordination on a non-cooperative equilibrium and the distrust between agents are not just an international problem; they apply to the domestic sphere too 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 cautiousness of private agents confirms government that it has to step in if it wants basic

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

storage and trade to be done, deterring even more a normal market behavior. This mechanism implies that any reform of domestic policies toward fewer market interventions has also to deal with 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 the market incompleteness assumption and the expected utility framework lead to small welfare costs and hence they challenge the usefulness of public intervention. Recent research highlights, on the contrary, the potential cost of food price spikes for 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 see 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 mostly focuses on justifications for intervention that are independent of the underlying causes of price volatility. Sections 3 and 4 will discuss justifications for intervention that arise endogenously from the existence of other interventions and that have a feedback effect on price volatility. This is, for example, the case of trade policies abroad and of 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: the situations where the market failure justifying intervention is also one of the causes of food price volatility. It can occur if the price volatility were resulting from expectations errors or if private storage were different from its competitive level. Those last causes have attracted limited attention in the literature and thus will not be reviewed in this paper.

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

Public intervention in volatile commodity markets is frequently justified by the assumption that risk markets are incomplete (Newbery and Stiglitz 1981; Innes 1990). Although such an assumption is reasonable, the extent to which markets are incomplete is a difficult empirical issue, and for convenience, assessments of the welfare cost of price instability generally assume that the markets for risk management are missing. Thus, the costs presented below should be considered upper bounds. They are overestimated also because they are calculated by comparing welfare under price instability with welfare when prices are stabilized at their

mean. This ideal stabilization is not feasible (Townsend 1977), and feasible stabilization policies are costly.

What is referred to here as the standard assessment of the welfare effect of price instability is the method that emerged in the 1980s to measure the cost of instability using the 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, the welfare change for consumer from price stabilization at its arithmetic mean can be represented by an equivalent variation measure and approximated to the second order by (Turnovsky, Shalit, and Schmitz 1980):

$$[\gamma(\eta - \rho) - \alpha]D(\bar{P}, Y)\bar{P}\frac{\Delta\sigma_P^2}{2}, \quad (1)$$

where $\alpha < 0$ and η stand for the price and income elasticities of demand; $D(\bar{P}, Y)$ is demand at the mean price, \bar{P} ; $\Delta\sigma_P^2 < 0$ 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 parameter. This measure implicitly assumes that consumers are unable to insure against price volatility, to store grains or to save.

If we ignore variations in the marginal utility of income (the term $\gamma(\eta - \rho)$), this welfare measure is necessarily negative. 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. Consumer welfare would suffer from stabilization. In Table 1, this situation corresponds to $\gamma = 0.01$ or $\eta = \rho = 0$ and is characterized by small welfare changes from stabilization. It implies that stabilization at the mean price would be detrimental to consumers from developed countries, since a low share of their budgets goes to food staples.

[Table 1 about here.]

Risk aversion can compensate for this risk-loving component, and make stabilization beneficial only if budget share and risk aversion are sufficiently high. With high risk aversion (4) and high budget share (30%), gains do not exceed 0.7% and 1.5% of income for coefficients of variation of price of 20% and 30%. While a food budget share of 50—60% is common in low-income country (Seale, Regmi, and Bernstein 2003), the expenditures on one staple reach 30% only for the poor population subgroups, and is less likely to be reached in countries where staples consumption is diversified, such as in Eastern Africa where staples consumption is divided between 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 accounting 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 mean quantity. This measure demonstrates the importance of demand curvature in welfare gains. When demand function is non-linear, stabilizing quantities consumed at their mean affect the mean price, which in turns affects welfare change. Although it 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 small welfare change from price stabilization.

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 prevails, these production and consumption decisions tend to be non-separable (de Janvry and Sadoulet 2006). This has decisive implication 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 determines the effect of price fluctuations is the size 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 much. Net sellers, however, are likely to prefer price stability since it helps to stabilize a large share of their income. 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 be potentially regressive.

For producers, the consequences of price instability that are most discussed are not the welfare but the behavioral consequences; the argument being that instability leads to production level lower than if price was stabilized at its expected value (Sandmo 1971). Because producers have to commit resources before uncertainty is resolved, they decrease their production level 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 of the 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 underproduce. 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 an illustration of this behavior (Barrett 1996).

Among the many strategies of 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 food price volatility has received since 2007 and the major public interventions it has promoted. 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) follows 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).

These food riots are an indication that high food prices create severe hardship for people and it is unlikely that periods of low food prices would 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 consumption goods that are not a necessity; but food is different for 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 or 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).

For most people it will be no surprise that, for consumers, the main problem associated with food prices is the risk of upward price spikes and not price volatility *per se*. However, economists have devoted much more attention to the latter than to the former. Although we have evidence of the cost of upward price spikes, they are more difficult to express with the rigor that characterizes the expected utility framework described above.

This is not to imply that we should worry only about upward price spikes – and policy makers do not. Anderson and Nelgen (2012a, Table 6) show that policymakers adjust trade policies by the same magnitude in response to upward or downward price spikes. The prevention of downward price spikes is likely to arise from a concern for producer welfare. Regarding 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 under 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 what is the real cost of volatility. This discussion is informative also for policy design by focusing on the most important justifications for public

intervention.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 standards 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 to 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 justifications 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 without even 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 such intervention scale. 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.

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 that 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. It means that price stabilization policies, at best, are 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 like 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 rules-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 cost of instability and this argument has been used to support price stabilization policies (Boussard et al. 2006). However, this approach presents many theoretical inconsistencies and is not supported by empirical evidence (Gouel 2012).

A related issue is the ongoing debate over 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 do not represent adequately the supply and demand equilibrium. Today there is no clear theoretical justification behind the potential impact of financialization. Irwin and Sanders (2012) propose 3 plausible justifications: (i) lack of liquidity that would have prevented the absorption of the large order flow of index funds; (ii) index investors are noise traders; and (iii) their development makes more difficult for other traders distinguishing 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 on the contrary to 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 storage policy

In this section, we will focus on broad issues related to storage policy design. We will neglect, 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 are related more to their political economy than to any lack of theoretical understanding, even if a theoretical design of second-best 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. Stocks accumulate when supply is larger than needs, 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.

Increasing stock levels beyond competitive levels is the basis of any storage policy. There are many ways to achieve it, but it should first be noted that increasing stock levels is costly. If private storers are already arbitraging the difference between current and expected prices,

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

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 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 even 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 Section 2, is how policy makers want to alter price distribution? As already emphasized, in almost all cases 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 the price variance. In this case, Gouel (2011) 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 close 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 to prevent 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 not as efficient as private storage, this crowding out will increase the costs of the policy much beyond the additional storage it requires. Another issue is that, because of crowding out, such a policy may inhibit the development of a private marketing system making a 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 not motivated only 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 seasonali-

ty of agriculture production, it is reasonable to think that an optimal public storage policy in practice 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, it could also be achieved by giving appropriate incentives to private storers. Gouel (2011) shows that the gains from a public storage rule can be reached simply by giving storers a subsidy proportionally 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 US, 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 2011). 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 may 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 2011). Although there is no formal analysis of a price band designed for preventing 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. However, until now, simulation studies have found that the wider the band, the costlier the policy (Miranda and Helmberger 1988; Williams and Wright 1991; Gouel 2011).

Whatever are the bounds, price band policies share 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 to the stock level, which greatly improves the behavior of a price band (Gouel 2011). 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).

That a price band means buying low and selling high does not imply that this policy is fiscally profitable. It could do so, 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 reduce the cost of the policy. The latter is not so: 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 received comparatively much more attention than second-best storage policies. In particular around 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 other 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 optimal trade policy for a small open economy is not free trade. It 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 were not primarily concerned 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 risk-sharing. Food security concerns would probably strengthen even further 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 the works that display interventionist trade policies is that they consider small-open countries. If this kind of policies can make perfect sense for a single country, extending this conclusion to the whole world would lead to a fallacy of composition. When globally used 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 generalization, first, results in their ineffectiveness. 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 an illusion of a successful policy when domestic price is compared to world price. Second, not all countries apply such policies, and those that do may face budgetary constraints which limit their policy adjustments. These countries that refrain from using trade policies or that are constrained in their adjustments will suffer from the worldwide use of trade policies.

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 have only 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 al-

low large tariff adjustments (Bouët and Laborde 2010). Export subsidies are allowed for 25 WTO members and are subject to commitments. 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 with 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 few things 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 it is 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 trade costs, as long as countries are not trading continuously, trade cannot completely smooth away idiosyncratic shocks since spatial arbitrage is costly. Hence storage plays a different role with trade costs. It serves both to smooth the aggregate shocks, and there is a part of the idiosyncratic shocks that cannot be smoothed by trade. But, except when trade costs are so large that they prevent trade, the respective ideal roles 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 an efficient storage is more about world risk than national risk.

That the main role of stocks is to smooth aggregate world shocks does not imply that the location of 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 a 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 the domestic price in an autarkic country because of 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 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. So it leads to asymmetric price stabilization by reducing the occurrence of low more 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 reduces a lot 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 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 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 by 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, and also other moments. If we assume that agents are sufficiently risk averse, they may enjoy welfare gains from a reduced variance in prices, and we may expect aggregate efficiency gains for the economy. However, changes in the mean price will lead to transfers between consumers and producers that potentially will exceed for some groups the efficiency gains obtained from a reduced risk. The direction of the transfers between agents will be determined mainly by changes to the mean price and there are good reasons to expect stabilization policies will affect the mean price.

Stabilization may affect the mean price in both directions, and it is difficult to propose general results on the incidence of stabilization policies because several parameters affect it. 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 the 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 1988).

3.4.1 Static incidence

Here we focus on static transfers, that is, 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 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 when this is not the objective, stabilizing quantities is practically more convenient 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 leads to a lower 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, with these potentially larger efficiency costs incidence 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. 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 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 existing literature on incidence, however, may be an incomplete guide on this issue, as it relies on 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 pol-

icy 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 temporary higher. We have explained above that a stabilization policy, in the long-run may lead to a price distribution with a lower mean, thus potentially hurting producers' welfare. Because these long-run lower prices are discounted with respect to short-run high prices, producers may actually enjoy a storage policy. This is the important conclusion in Miranda and Helmberger (1988) and Wright and Williams (1988) 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 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 2011).

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 alternatives. 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 critic).

Market-based risk management instruments are supposed to provide farmers, traders, food agencies, and even individuals with access to instruments that allow to share price and weather risks and smooth 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, food-for-work, or 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 a lack of people capacity to deal with this risk. So countercyclical safety nets should bring us closer to the first best than price stabilization policies could. 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 without difficulties. 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, but also may push into poverty people who initially were not poor enough to be covered by the safety net.

3.5.1 Market effects of safety nets

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, to the extent that they concern a large population with respect to a market, they affect price setting. The price effects can go in both directions depending on the type of transfer: cash or in-kind (see, e.g., Cunha, Giorgi, and Jayachandran 2011). The size of the pecuniary externality depends on how much supply is elastic, and so on how much the market under consideration is integrated into a larger market. It means that, despite safety nets being direct and targeted transfers, they affect people not involved in the transfer. For example, local producers will be adversely affected by in-kind transfers but will benefit from cash transfers. We have short-run evidence of this price effect (Cunha, Giorgi, and

Jayachandran 2011). However, we would expect more limited long-run impacts as the market and expectations adjust to the presence of safety nets.

These transfers could also 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 and Ravallion 2012), 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 the next section, 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 policies' 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 nets in place, they were not always appropriate to answer the stake of rising food prices. And since safety nets are very difficult to develop in the timeframe of a food crisis, countries without preexisting and adequate programs have been forced to rely on untargeted and distortive policies, such as universal food subsidies or trade policies, decrease in import tariffs, import subsidies and export restrictions. The situation is by nature highly heterogeneous between countries. For example, in North African countries, the coverage provided by targeted safety nets is very limited with often inadequate targeting (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. The 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 analyze in detail the case 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 more 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 (Demekle, 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), 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 nets 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 (price of foodgrains increased by 4.7% in 2007/08 compared to 2006/07) that it made partly redundant the adjustment of 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 may be fiscally less costly to ban exports than to increase transfers. In addition, well targeted safety nets will 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 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 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 universal food subsidies have proved difficult to reform). Nevertheless, these problems are no greater than those faced by governments when they try stabilize prices as we see below.

4.2 The problems faced by storage policies

4.2.1 Weak selling provisions of national buffer stock 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 or for further stock accumulation. 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 exports 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 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, 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 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. From these anecdotes, it is unclear how much Indian storage policy is counter-cyclical and is helping market stabilization, given that stock release does not seem to follow high prices.

[Figure 1 about here]

The story of the Australian Wool Corporation is also exemplary 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 half of all the wool offered for sale, for storage. 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 a year's production, and the debt represented 60% to 90% of one year's sales.

4.2.2 Storage in International Commodity Agreements (ICAs)

We can get more insights about the practice of storage policies by considering the history of ICAs. Because these agreements involve many consuming and producing countries, interventions were required to be more transparent and less discretionary than what is possible for a sovereign country. In addition, beyond anecdotes, it is difficult to assess the effectiveness of a storage policy in 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 United Nations auspices and concerned cocoa, coffee, rubber, sugar and tin. They are treaties between producing and consuming countries. They defined regulations of international trade and storage to achieve remunerative and stabilized prices. Although there are still active ICAs, 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). For some ICAs, the main objective was to prevent very low prices, not to stabilize them. In this respect, the international coffee and sugar agreements relied on export controls, not buffer stock. Storage was nonetheless playing a crucial role as exports are easier to control through domestic storage than through supply restriction when supply is very inelastic in the short run. The three other agreements relied explicitly on buffer stock. They were all based on bandwidth rules. The buffer stock manager had to defend a ceiling and floor price by stock sales and purchases.

From the history of ICAs with stockholding provisions, we can draw the following lessons. It was possible to sustain intervention for a long time (28 years for the tin agreements) because the price targets were regularly adjusted. When based on a bandwidth rule, storage policies require regular adjustments to account for structural changes (e.g., production costs and consumer tastes). This raises several issues. First, it may be conceptually complex. Because of the intervention, a representative free-trade price on which to base adjustment may be lacking. Second, these adjustments bring 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 its ceiling price was always below market price. In the early 1980s, the third cocoa agreement did not fare better. It exhausted its financial resources in its first three months by trying to defend an unrealistically high floor price, which remained above market price for most of the time of the agreement. Third, when the price targets are set in line with the economic fundamentals, the policy may have limited effects if it accommodates too well the price changes. This was the situation of 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. Because of the large bands, the interventions have been 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 by being relatively innocuous.

The commodities concerned by ICAs were traded on organized futures markets as is the case for most grains. This raises issues about interaction with speculators as in Salant (1983) who argues theoretically that the coexistence of public stock and private arbitrageurs create the possibility of speculative attacks on the stabilization schemes. In practice, it was scarcely a concern, except at the end of the international tin agreements (ITAs) in 1985 (Anderson and Gilbert 1988). Speculators did not lead directly to the collapse of the ITA, however. During

more than 20 years, the ITAs successfully managed to defend the floor price using both buffer stock and export control. Following the important price increase of the late 1970s, the bands were adjusted to represent the prevailing prices, but the market was turning in the early 1980s to a situation of excess supply. In this context, the international tin council (ITC) accumulated large stocks to defend the floor. When it faced its legal storage constraint, the ITC engaged in futures trades to support prices. But then, when facing 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, a word of caution has to be repeated. The absence of adequate counterfactuals prevents definitive conclusions to be drawn from these experiences and opens the way to personal interpretations. It is less so for safety nets, which can be evaluated through random assignments. For trade policies, a lot of data is available and counterfactual models, although imperfect, can be built to simulate the counterfactual. For storage, however, data related to stock levels are of poor quality and models are not rich enough 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 high Indian government officials (Basu 2010) recognize that welfare could be improved by a better foodgrain policy. From our previous description, Indian storage policy could be improved by adopting 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 be 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 case of supply short-fall?

The history of storage in Australia and India summarized above – but also in Europe where butter mountains and wine lake were accumulated – show that storage policies because of their ability to temporarily raise prices are highly susceptible to be captured by farm lobbies. A related issue is that these domestic storage policies lacked clear rules and may even have pursued multiple and contradictory objectives. The confusion was between prevention of low prices and decrease of price volatility. The former objective was always seriously defended, but the lack of precise selling price made the latter less achievable. The failures of the wool and tin stabilization programs demonstrate also that one of the most important market effects of such programs can be their collapse, since the stocks accumulated under explosive intervention rules may depress the market for a long time. These limitations could suggest that

better outcomes could be achieved with more rules-based policies, perhaps delegated to independent organizations.

The story of ICAs, which were relying on clearer rules and was 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 breakdown, but that they involve problems likely to threaten their long-run stability. It revolves around the issue of the updating of the reference price and bandwidth, 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, if these schemes have been effective, it was much more at preventing low prices than at stabilizing prices. It was part of their purpose to support some cartel pricing, but the failure to prevent high prices is also a normal feature of storage policy: there is no instrument at the world level to deal with price increase when buffer stock is exhausted.

4.3 The apparent effectiveness of trade policies

Buffer stock policies were quite widespread. The end of ICAs, the successive reductions in Europe of direct market support and the structural adjustments in many developing countries have meant that these policies have been used much less since the early 1990s. Many countries continue to maintain stocks for emergencies or food-based safety nets, but fewer are aimed at 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 reduction or export restriction, were the most commonly adopted policy measures during the 2007/08 food crisis (in 68 countries over 81). Their use is not restricted to crisis situations. Anderson and Nelgen (2012), for a panel of 75 countries that account for 90% of global agriculture, show that these adjustments occur equally at low and high prices, in importing and exporting countries, and developing and high-income countries.

Unlike storage policies, which occasionally have been procyclical, trade policies are more 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 during price downturns. The data show that measures of trade policies are negatively correlated with a deviation in the international price from its trend (Anderson and Nelgen 2012a, Table 1). Among developed countries, an archetypical example of such an adjustment has been 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 how countercyclical these adjustments are with respect to

border price. As an importer, 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 increase (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, reduced the need for border protection. During this period, price stability in the European market was not 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 were able to achieve some isolation from the global market. In average, in their sample Anderson and Nelgen (2012a) find a 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, PSD (2012), against less than 8% and 20% for rice and wheat) and for which the rate of protection is not significantly correlated to world price contrary to other commodities (Anderson and Nelgen 2012a, Table 1). As a comparison, the short-run elasticities are 0.52 and 0.47 for rice and wheat. These trade policies adjustments did not always translate into a more stable domestic market. For example, African countries ended up with more unstable domestic than border prices (Anderson and Nelgen 2012a, Table 9). Anderson and Nelgen (2012a) suggest that it may be caused by poor policy timing, and we cannot exclude either that it is linked to the uncertainty created by discretionary interventions (see below for examples). However, in developing Asian countries, agricultural prices have been 30% more stable than border prices. For some (Dawe 2001; Timmer 2010b), this Asian success at price stabilization frequently serves 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 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 2010b). 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 world market becomes thinner and more

unstable (Martin and Anderson 2012). 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 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.

We have a few statistical illustrations of the consequence of a smaller market on instability. Jacks et al. (2011) use years of war as natural experiments to show that since 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 the volatility in yield 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 burden much larger shocks.

[Table 2 about here]

4.4 Mixed outcomes from experiences of liberalization

From the foregoing, it would seem that the cost of stabilization or at least storage policies would make greater liberalization profitable. However, the issue is not so straightforward. It is true that real policies crowd out private activity because stabilization policies reduce the benefits from private arbitrage, but potential policies can have the same effect, since the expectation of public involvement in the market in times of crisis reduces the benefits from arbitrage as well as creates 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 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 emerged in several countries as we show below.

The case of Eastern and Southern Africa are the most frequently analyzed. 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, the government maintains comprehensive regulation of trade through the issue 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 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 can be observed in India where regulation prevents hoarding, regional and international trade. This would make reform in India problematic. The question is what is the better option for a

food security objective between large-scale, inefficient intervention and incomplete reform, which results in poor consumers experiencing prices that are far above the import parity price.

Bangladesh, like India and Pakistan, has 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). This policy has been a success. 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 world market, when the other countries are less committed to liberal policies.

5 Conclusions and policy implications

From this literature review, we have shown that the negative conclusions drawn by economists in relation to price stabilization policies should not be viewed as a consequence of neglect of the welfare cost of food price instability. Although economists may find it tricky to assess these costs, the suspicion surrounding price stabilization policies has mainly to do with the difficulty to design a stabilization policy that would not adversely affect trade partners or hinder market development, and the fact that, historically, storage policies have been costly, and successful stabilization policies have relied heavily on trade policies exploiting the world market to achieve domestic objectives. These policies thus lead to a typical prisoner's dilemma where the world market is being trapped in a non-cooperative equilibrium. As long as this equilibrium prevails, it makes sense for countries to pursue individually domestic price stability, even though collectively this is self-defeating.

In the introduction we 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 our review of past experiences and the literature, our view is 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 from existing experiences it appears that good management of price stabilization policies is no less challenging. What is probably the most important problem of this liberal approach is that it may not be attainable, because markets are interdependent, and reliance on a world market requires its existence.

To us, the alternative is not appealing. Our review of some buffer stock policies shows they have a bad track record. They have often hindered the development of a private marketing system by crowding out private arbitrageurs. They have been captured by farmers' lobbies resulting in weak selling provision and over-accumulation in order to artificially maintain high prices. Independently of these problems, a buffer stock policy requires some isolation from world market to stabilize domestic price, so it needs to be backed by an adequate trade policy. Adjusting trade policy has been shown to be effective both for isolating from the world market and shifting abroad the burden of adjustments (e.g., the European policy of variable levy and export subsidy). Hence trade policy, more than buffer stocks, is the instrument that effectively stabilized domestic prices in many countries, but it is also the one that imposes the greatest cost on the focal country's partners.

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 most of the 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 2011, p 14; 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, our judgment is that the two crucial policy and research questions are (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) accounting for the present situation, what policies that would not worsen the situation economists can advise to countries wanting to protect their population from food price instability. Related to both questions, we present below some policy 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 2010b). Following the collapse of the rice market in 1972/73 and their scramble for affordable rice imports, countries such as India and Indonesia have 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 the 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 interest of every country for all large shocks. Thus, the countries that are the most in a position 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 cooperation, 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 it.

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 EU and the USA. 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 the accession negotiations (Crosby 2008). The consolidated levels can be decreased gradually, at each negotiation round. This allows importing countries to predict more accurately extents of policy adjustments. These trade policies for food security are more difficult regulate than export subsidies, however. Export restrictions have usually 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 of high-income countries contributed much less to the 2007/08 price spike than in 1973/74 (Anderson and Nelgen 2012b). They reduced their 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 poli-

cies in the US and in the EU. In 2009 maize used for ethanol production in the US represented 12% of maize world production. Vegetable oil use for biodiesel in the EU 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 tank 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 crisis will continue to be a challenge but lessons have been learned from the 2007/08 experience. This will not ensure that countries with more safety nets will avoid price stabilization policies altogether. As we observed in the 2007/08 food crisis, even countries with large safety nets systems (e.g., India) used stabilization policies and are planning to increase storage facilities. However, 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 be rightly 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.

As countercyclical trade policy interventions are unlikely to decrease soon, it should not be excluded that storage policies may have their role to play in a transition towards a less interventionist policy environment. Likely not as buffer stocks, which proved difficult to manage, but as emergency stocks (see, e.g., Wright and Cafiero 2011 for a discussion of their relevance for MENA countries). If the topic of buffer stock policies has been researched a lot, it is less so of emergency stocks (i.e., stocks allowing to meet situations when there are short-run physical constraints on production and import preventing them from supplying needs). However, their implementation raises many issues such as the interaction between private and public storage, the cost of long-run grain storage and how it would compare to alternative policies, and the design of appropriate storage rules. On the first point, for example, it is worth noting that the accumulation of public stocks, even without a price stabilization objective, may affect private storage because the additional demand for public stocks will push prices up, deterring private storage. Studies related to the management of strategic petroleum reserves and their disposal in case of supply disruption or embargo emerged in the 1980s and could inspire research on emergency grain stocks. The institutions that manage these stocks could also be a source of inspiration. For example, the International Energy Agency, com-

posed mostly of net oil importers, coordinates the releases of emergency stocks between member countries in order to address to potential free-rider problems related to stock releases in an open market.

References

- Abbott, Philip C. 2012a. Stabilisation Policies in Developing Countries after the 2007-08 Food Crisis. In *Agricultural policies for poverty reduction*, ed. J Brooks, 109-168. Paris: OECD Publishing.
- . 2012b. “Export Restrictions as Stabilization Responses to Food Crisis.” *American Journal of Agricultural Economics* 94 (2): 428-434.
- Ahmed, Raisuddin, Steven Haggblade, and Tawfiq-e-Elahi Chowdhury, eds. 2000. *Out of the Shadow of Famine: Evolving Food Markets and Food Policy in Bangladesh*. Baltimore: The Johns Hopkins University Press for IFPRI.
- Alderman, Harold, and Trina Haque. 2006. “Countercyclical Safety Nets for the Poor and Vulnerable.” *Food Policy* 31 (4) (August): 372-383.
- Anderson, James E, and John G Riley. 1976. “International Trade with Fluctuating Prices.” *International Economic Review* 17 (1): 76-97.
- Anderson, Kym, Johanna Croser, Damiano Sandri, and Ernesto Valenzuela. 2010. Agricultural Distortion Patterns Since the 1950s: What Needs Explaining? In *The Political Economy of Agricultural Price Distortions*, ed. Kym Anderson, 25-80. New York: Cambridge University Press.
- Anderson, Kym, and Signe Nelgen. 2012a. “Trade Barrier Volatility and Agricultural Price Stabilization.” *World Development* 40 (1): 36-48.
- . 2012b. “Agricultural Trade Distortions During the Global Financial Crisis.” *Oxford Review of Economic Policy* 28.
- . 2012c. Updated National and Global Estimates of Distortions to Agricultural Incentives, 1955 to 2010.
- Anderson, Ronald W, and Christopher L Gilbert. 1988. “Commodity Agreements and Commodity Markets: Lessons From Tin.” *The Economic Journal* 98 (389): 1-15.
- Arezki, Rabah, and Markus Brückner. 2011. *Food Prices and Political Instability*. March.
- Arezki, Rabah, Klaus Deininger, and Harris Selod. 2011. *What drives the global “land rush”?* October.
- Bagwell, Kyle, and Robert W Staiger. 1990. “A Theory of Managed Trade.” *The American Economic Review* 80 (4): 779-795.

- Bardsley, Peter. 1994. "The Collapse of the Australian Wool Reserve Price Scheme." *The Economic Journal* 104 (426): 1087-1105.
- Barrett, Christopher B. 1996. "On price risk and the inverse farm size-productivity relationship." *Journal of Development Economics* 51 (2) (December): 193-215.
- Barrett, Christopher B, and Marc F Bellemare. 2011. "Why Food Price Volatility Doesn't Matter: Policymakers Should Focus on Bringing Costs Down." *Foreign Affairs* July 12.
- Basu, Kaushik. 2010. *The Economics of Foodgrain Management in India*. September.
- Batra, Raveendra N, and William R Russell. 1974. "Gains from Trade Under Uncertainty." *The American Economic Review* 64 (6): 1040-1048.
- Bellemare, Marc F. 2011. Rising food prices, food price volatility, and political unrest. June.
- Boussard, Jean-Marc, Françoise Gerard, Marie Gabrielle Piketty, Mourad Ayouz, and Tancred Voituriez. 2006. "Endogenous risk and long run effects of liberalization in a global analysis framework." *Economic Modelling* 23 (3) (May): 457-475.
- Bouët, Antoine, and David Laborde. 2010. "Assessing the potential cost of a failed Doha Round." *World Trade Review* 9 (02): 319-351.
- Brainard, William C, and Richard N Cooper. 1968. "Uncertainty and Diversification in International Trade." *Food Research Institute Studies* 8: 257-285.
- von Braun, Joachim, and Maximo Torero. 2009. *Implementing Physical and Virtual Food Reserves to Protect the Poor and Prevent Market Failure*. February.
- Brinkman, Henk-Jan, Saskia de Pee, Issa Sanogo, Ludovic Subran, and Martin W Bloem. 2010. "High Food Prices and the Global Financial Crisis Have Reduced Access to Nutritious Food and Worsened Nutritional Status and Health." *The Journal of Nutrition* 140 (1): 153S-161S.
- Brock, William A, and Cars H Hommes. 1997. "A Rational Route to Randomness." *Econometrica* 65 (5) (September): 1059-1096.
- Cafiero, Carlo, Eugenio S A Bobenrieth, Juan R A Bobenrieth, and Brian D Wright. 2011. "The Empirical Relevance of the Competitive Storage Model." *Journal of Econometrics* 162 (1) (May): 44-54.
- Cassing, J H, A L Hillman, and N V Long. 1986. "Risk Aversion, Terms of Trade Uncertainty and Social-Consensus Trade Policy." *Oxford Economic Papers* 38 (2): 234-242.
- Coleman, Andrew. 2009. "Storage, Slow Transport, and the Law of One Price: Theory with Evidence from Nineteenth-Century U.S. Corn Markets." *Review of Economics and Statistics* 91 (2) (May): 332-350.
- Crosby, Daniel. 2008. "WTO Legal Status and Evolving Practice of Export Taxes." *Bridges* 12 (5): 3-4.

- Cunha, Jesse M, Giacomo De Giorgi, and Seema Jayachandran. 2011. *The Price Effects of Cash Versus In-Kind Transfers*. September.
- Dawe, David. 2001. "How far down the path to free trade? The importance of rice price stabilization in developing Asia." *Food Policy* 26 (2) (April): 163-175.
- Demeke, Mulat, Guendalina Pangrazio, and Materne Maetz. 2009. Country responses to the food security crisis: Nature and preliminary implications of the policies pursued.
- Do, Quy-Toan, and Martin Ravallion. 2012. Coping with Food Price Shocks: Trade versus Social Protection Policies.
- Dorosh, Paul A. 2009. "Price stabilization, international trade and national cereal stocks: world price shocks and policy response in South Asia." *Food Security* 1 (2): 137-149.
- D'Souza, Anna, and Dean Jolliffe. 2012. "Rising Food Prices and Coping Strategies: Household-level Evidence from Afghanistan." *Journal of Development Studies* 48 (2): 282-299.
- Eaton, Jonathan, and Gene M Grossman. 1985. "Tariffs as Insurance: Optimal Commercial Policy When Domestic Markets Are Incomplete." *The Canadian Journal of Economics* 18 (2): 258-272.
- Fafchamps, Marcel. 1992. "Cash Crop Production, Food Price Volatility, and Rural Market Integration in the Third World." *American Journal of Agricultural Economics* 74 (1): 90-99.
- . 2003. *Rural Poverty, Risk and Development*. Edward Elgar Publishing.
- Feenstra, Robert C. 1987. "Incentive Compatible Trade Policies." *The Scandinavian Journal of Economics* 89 (3): 373-387.
- Galtier, Franck. 2009. *How to manage food price instability in developing countries?*
- Gardner, Bruce L. 1979. *Optimal Stockpiling of Grain*. Lexington, Mass.: Lexington Books.
- Gardner, Bruce L, and Ramón López. 1996. "The Inefficiency of Interest-Rate Subsidies in Commodity Price Stabilization." *American Journal of Agricultural Economics* 78 (3): 508-516.
- Gilbert, Christopher L. 1996. "International Commodity Agreements: An obituary notice." *World Development* 24 (1) (January): 1-19.
- . 2011. International commodity agreements and their current relevance for grains price stabilization. In *Safeguarding Food Security in Volatile Global Markets*, ed. Adam Prakash, 202-230. Rome: FAO.
- Giordani, Paolo E, Nadia Rocha, and Michele Ruta. 2012. Food Prices and the Multiplier Effect of Export Policy. April.

- Glewwe, Paul, Hanan G Jacoby, and Elizabeth M King. 2001. "Early childhood nutrition and academic achievement: a longitudinal analysis." *Journal of Public Economics* 81 (3): 345-368.
- Goodwin, Barry K, Ashok K Mishra, and François Ortalo-Magné. 2011. *The Buck Stops Where? The Distribution of Agricultural Subsidies*. January.
- Gouel, Christophe. 2011. Rules versus discretion in food storage policies.
- . 2012. "Agricultural Price Instability: A Survey of Competing Explanations and Remedies." *Journal of Economic Surveys* 26 (1): 129-156.
- Gouel, Christophe, and Sébastien Jean. 2012. *Optimal Food Price Stabilization in a Small Open Developing Country*.
- Grosh, Margaret, Colin Andrews, Rodrigo Quintana, and Claudia Rodriguez-Alas. 2011. *Assessing Safety Net Readiness in Response to Food Price Volatility*.
- Grosh, Margaret, Carlo del Ninno, Emil Tesliuc, and Azedine Ouerghi. 2008. *For Protection and Promotion: The Design and Implementation of Effective Safety Nets*. The World Bank.
- HLPE. 2011. *Price volatility and food security*. Rome.
- Helpman, Elhanan, and Assaf Razin. 1978. *A Theory of International Trade under Uncertainty*. New York: Academic Press.
- Hoddinott, John, John A Maluccio, Jere R Behrman, Rafael Flores, and Reynaldo Martorell. 2008. "Effect of a nutrition intervention during early childhood on economic productivity in Guatemalan adults." *The Lancet* 371 (9610) (February): 411-416.
- Innes, Robert. 1990. "Uncertainty, Incomplete Markets and Government Farm Programs." *Southern Economic Journal* 57 (1): 47-65.
- Irwin, Scott H, and Dwight R Sanders. 2012. "Testing the Masters Hypothesis in commodity futures markets." *Energy Economics* 34 (1): 256-269.
- Jacks, David S, Kevin H O'Rourke, and Jeffrey G Williamson. 2011. "Commodity Price Volatility and World Market Integration since 1700." *Review of Economics and Statistics* 93 (3): 800-813.
- Jacoby, Hanan G, and Emmanuel Skoufias. 1997. "Risk, Financial Markets, and Human Capital in a Developing Country." *The Review of Economic Studies* 64 (3) (July): 311-335.
- de Janvry, Alain, and Elisabeth Sadoulet. 2006. Progress in the modeling of rural households' behavior under market failures. In *Poverty, inequality and development: essays in honor of Erik Thorbecke*, ed. Alain de Janvry and Ravi Kanbur, 155-182. New York: Springer.

- Jayne, T S, and Stephen Jones. 1997. "Food marketing and pricing policy in Eastern and Southern Africa: A survey." *World Development* 25 (9) (September): 1505-1527.
- Kirwan, Barrett E. 2009. "The Incidence of U.S. Agricultural Subsidies on Farmland Rental Rates." *Journal of Political Economy* 117 (1): 138-164.
- Larson, Donald F, Julian Lampietti, Christophe Gouel, Carlo Cafiero, and John Roberts. 2012. *Food security and storage in the Middle East and North Africa*. April.
- Leathers, Howard D, and Jean-Paul Chavas. 1986. "Farm Debt, Default, and Foreclosure: An Economic Rationale for Policy Action." *American Journal of Agricultural Economics* 68 (4): 828-837.
- Lence, Sergio H. 2009. "Do Futures Benefit Farmers?" *American Journal of Agricultural Economics* 91 (1): 154-167.
- Lucas Jr., Robert E. 2003. "Macroeconomic Priorities." *The American Economic Review* 93 (1): 1-14.
- Martin, Will, and Kym Anderson. 2012. "Export Restrictions and Price Insulation During Commodity Price Booms." *American Journal of Agricultural Economics* 94 (1): 422-427.
- Miranda, Mario J, and Peter G Helmerger. 1988. "The Effects of Commodity Price Stabilization Programs." *The American Economic Review* 78 (1): 46-58.
- Myers, Robert J. 1988. "The Value of Ideal Contingency Markets in Agriculture." *American Journal of Agricultural Economics* 70 (2) (May): 255-267.
- . 2006. "On the Costs of Food Price Fluctuations in Low-Income Countries." *Food Policy* 31 (4): 288-301.
- Newbery, David M G. 1989. "The Theory of Food Price Stabilisation." *The Economic Journal* 99 (398): 1065-1082.
- Newbery, David M G, and Joseph E Stiglitz. 1981. *The Theory of Commodity Price Stabilization: A Study in the Economics of Risk*. Oxford: Clarendon Press.
- . 1984. "Pareto Inferior Trade." *Review of Economic Studies* 51 (1) (January): 1-12.
- Nocetti, Diego, and William T Smith. 2011. "Price uncertainty, saving, and welfare." *Journal of Economic Dynamics and Control* 35 (7): 1139-1149.
- Omamo, Steven Were, Ugo Gentilini, and Susanna Sandström, eds. 2010. *Revolution: From Food Aid to Food Assistance. Innovations in Overcoming Hunger*. Rome, Italy: World Food Programme.
- Persson, Karl Gunnar. 1999. *Grain Markets in Europe, 1500-1900: Integration and Deregulation*. Cambridge: Cambridge University Press.

- Poulton, Colin, Jonathan Kydd, Steve Wiggins, and Andrew Dorward. 2006. "State Intervention for Food Price Stabilisation in Africa: Can It Work?" *Food Policy* 31 (4) (August): 342-356.
- Rashid, Shahidur, Ralph Cummings Jr., and Ashok Gulati. 2007. "Grain Marketing Parastatals in Asia: Results from Six Case Studies." *World Development* 35 (11) (November): 1872-1888.
- Salant, Stephen W. 1983. "The Vulnerability of Price Stabilization Schemes to Speculative Attack." *The Journal of Political Economy* 91 (1): 1-38.
- Sandmo, A. 1971. "On the Theory of the Competitive Firm Under Price Uncertainty." *The American Economic Review* 61 (1): 65-73.
- Seale Jr., James L, Anita Regmi, and Jason Bernstein. 2003. *International Evidence on Food Consumption Patterns*. October.
- Sen, Amartya Kumar. 1981. *Poverty and Famines: An Essay on Entitlement and Deprivation*. Oxford: Oxford University Press.
- Slayton, Tom. 2009. *Rice Crisis Forensics: How Asian Governments Carelessly Set the World Rice Market on Fire*. March.
- Swinnen, Johan, and Pasquamaría Squicciarini. 2012. "Mixed Messages on Prices and Food Security." *Science* 335 (6067): 405-406.
- Timmer, C Peter. 1989. "Food price policy: The rationale for government intervention." *Food Policy* 14 (1) (February): 17-27.
- . 2010a. "Behavioral dimensions of food security." *Proceedings of the National Academy of Sciences*.
- . 2010b. "Reflections on food crises past." *Food Policy* 35 (1) (February): 1-11.
- . 2011. *Managing Price Volatility: Approaches at the global, national, and household levels*. May.
- Townsend, Robert M. 1977. "The eventual failure of price fixing schemes." *Journal of Economic Theory* 14 (1) (February): 190-199.
- Tschirley, David L, and T S Jayne. 2010. "Exploring the Logic Behind Southern Africa's Food Crises." *World Development* 38 (1) (January): 76-87.
- Turnovsky, Stephen J. 1974. "Technological and Price Uncertainty in a Ricardian Model of International Trade." *The Review of Economic Studies* 41 (2): 201-217.
- Turnovsky, Stephen J, Haim Shalit, and Andrew Schmitz. 1980. "Consumer's Surplus, Price Instability, and Consumer Welfare." *Econometrica* 48 (1): 135-152.

- Varangis, Panos, Donald Larson, and Jack R Anderson. 2002. *Agricultural markets and risks - management of the latter, not the former*. February.
- WTO. 2004. WTO agriculture negotiations: The issues, and where we are now. December.
- Williams, Jeffrey C, and Brian D Wright. 1991. *Storage and Commodity Markets*. New York: Cambridge University Press.
- World Bank. 2006. *Managing Food Price Risks and Instability in an Environment of Market Liberalization*. Washington, DC: The World Bank.
- . 2009. *Improving Food Security in Arab Countries*. Washington, DC: The World Bank.
- . 2010. *Food price increases in South Asia: National responses and regional dimensions*. Washington, DC: The World Bank.
- Wright, Brian D. 1979. "The Effects of Ideal Production Stabilization: A Welfare Analysis under Rational Behavior." *The Journal of Political Economy* 87 (5): 1011-1033.
- . 2001. Storage and price stabilization. In *Marketing, Distribution and Consumers*, ed. Bruce L Gardner and Gordon C Rausser, 1B, part 2:817-861. Amsterdam: Elsevier.
- Wright, Brian D, and Carlo Cafiero. 2011. "Grain reserves and food security in the Middle East and North Africa." *Food Security* 3 (Supplement 1): 61-76.
- Wright, Brian D, and Jeffrey C Williams. 1982a. "The Roles of Public and Private Storage in Managing Oil Import Disruptions." *The Bell Journal of Economics* 13 (2): 341-353.
- . 1982b. "The Economic Role of Commodity Storage." *The Economic Journal* 92 (367): 596-614.
- . 1988a. "Measurement of Consumer Gains from Market Stabilization." *American Journal of Agricultural Economics* 70 (3): 616-627.
- . 1988b. "The Incidence of Market-Stabilising Price Support Schemes." *The Economic Journal* 98 (393): 1183-1198.

Tables

Table 1. Welfare change for a consumer from perfect stabilization at mean price (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
<i>Medium fluctuations ($\sigma_p = 0.2$)</i>											
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
<i>Large fluctuations ($\sigma_p = 0.3$)</i>											
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, PSD (2012), available on the Internet at <http://www.fas.usda.gov/psdonline/>.

Figures

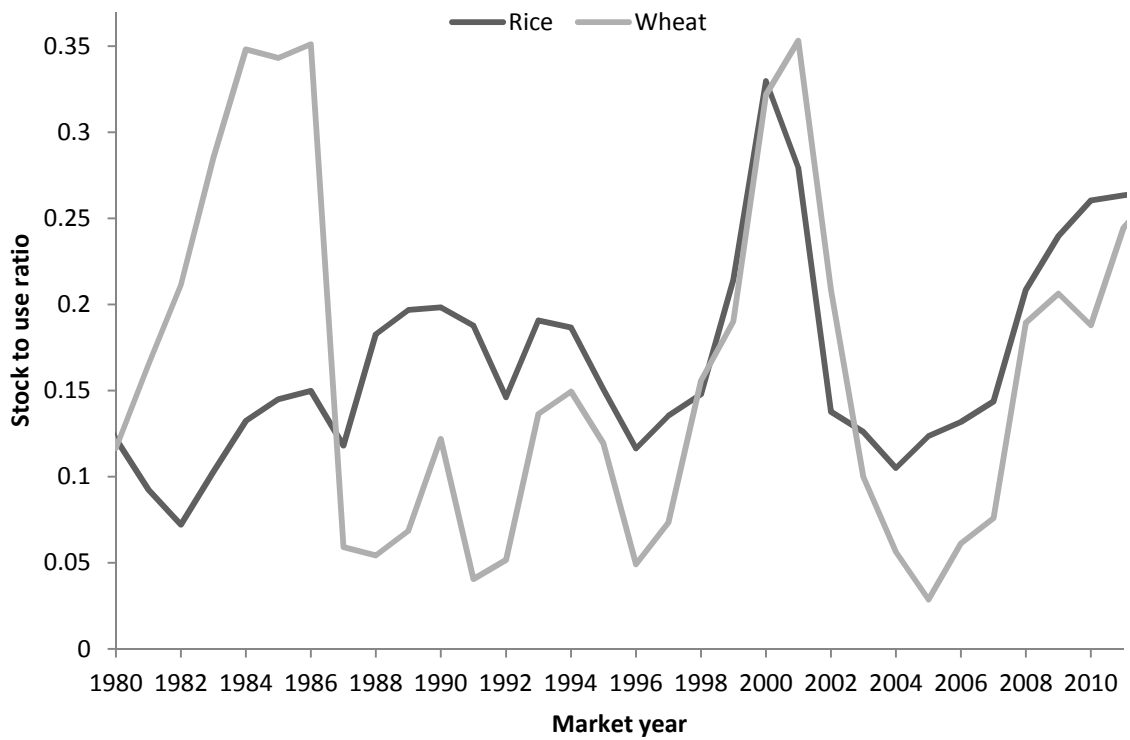


Figure 1. Wheat and rice stocks in India. Source: USDA, PSD (2012), available on the Internet at <http://www.fas.usda.gov/psdonline/>.

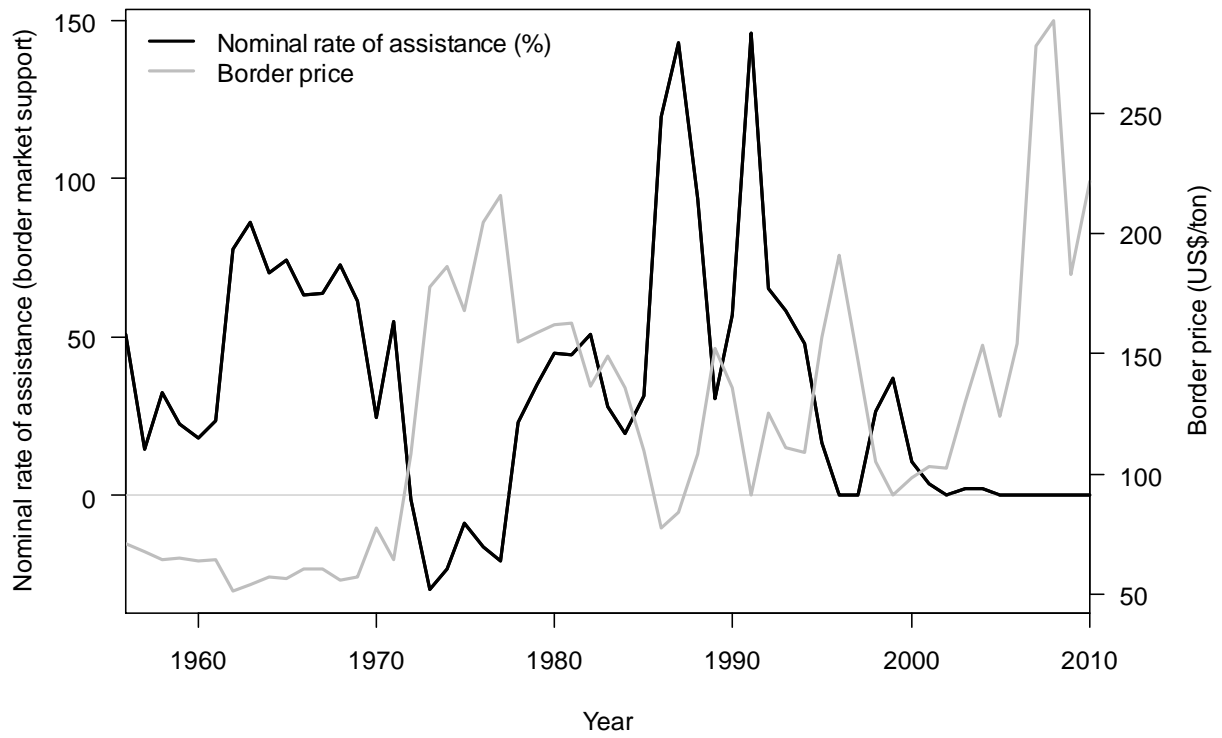


Figure 2. Nominal rate of assistance and border price on French wheat market. Source: Anderson and Nelgen (2012c).