Supporting farmers and consumers under food price uncertainty: the role of price support policies

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Abstract: *This research work follows the recent trend in most African countries in introducing (or strengthening) price support programs for selected cereals. Under this background, this study examines the impact of a potential implementation of a minimum support price MSP) policy on cereals in Ethiopia. To that end, positive and negative productivity shocks were considered under alternative producer and consumer pricing policies backed-up by public storage services. The quantitative analysis show that the effectiveness of price policies and government intervention in the commodity market depends on the nature of the productivity changes. Producer price floors are effective only when there are productivity gains which would ultimately decrease producer prices, suggesting the productivity enhancing role of this policy option. Also, producer price support works against consumers as prices of target commodities could not fall anymore beyond the level dictated by the support program. On the other hand, price ceiling on commodities is effective only when there are productivity losses since consumer prices tend to increase. Consumer price support policies help urban households since they slightly dampen increases in consumer prices and declines in incomes to these households. However, rural households lose more welfare mainly due to further losses in incomes as the control in consumer prices limit the increase in producer prices for cereals. The price policy of keeping producers prices of cereals within a 5% floor does not effectively affect the economy since producer prices tend to increase significantly if productivity is falling by the simulated levels due to exogenous shocks, such as extreme weather conditions.*

Key words: *minimum price support, price stabilization, storage, agriculture, CGE*

1. Introduction

In most developing countries, levels and trends of agricultural prices are important since they determine farm incomes and cost-of-living of consumers. These prices are more volatile than the prices of non-agricultural commodities (Peng, 1991; Demeke *et al.*, 2012), and this affects the risk perception of and incentives for producers. Consumers in developing countries are also highly exposed to movements of prices of agricultural and food commodities since a considerable proportion of the population in these economies are poor, allocating a significant part of their incomes on food. To protect producers and consumers, governments implement several policy options, which could sometimes be conflicting. Some of the producer support policies include price incentives to farmers, trade restrictions on imports, development of irrigation infrastructure, technical support, and extension services (Balisacan and Ravago, 2003). Governments also support consumers by restricting exports of principal food commodities, importing and distributing subsidized cereals, and reducing taxes on food commodities apart from direct cash transfers in some cases. Some of these interventions demand well operating institutional bodies. For example, the effective operation of a price stabilization policy requires government purchases and sales of commodities at predetermined price floors and ceilings. While consumer support programs are common in most developing countries (Mariano and Giesecke, 2014; Gouel and Jean, 2012) with varying level of success, producer support policies are more restricted to input subsidies and infrastructural development.[1] Direct producer price support have also been implemented in few emerging economies such as India (Parikh *et al*., 2003; Parikh and Singh, 2007), Indonesia (Robinson and El-Said, 1997; Timmer, 1996), and Chile (Holland *et al*., 2003; Bagwell and Sykes, 2004) where governments guarantee producers that farm-gate prices they receive for their outputs do not fall below some minimum levels, i.e., practicing a minimum support price (MSP) policy.

The high price volatility in the international and domestic markets in recent periods, coupled with continued food insecurity, appears to motivate some renewed interests on price support programs from countries in Africa (Demeke *et al.*, 2014; Bryan, 2013). Although sometimes not at regular basis and at large quantity, state-controlled marketing parastatals in Kenya (Kamau *et. al*., 2012), Malawi (Ricker-Gilbert *et al*., 2013), Nigeria (Olomola, 2013), and Zambia (Bryan, 2013) implement MSP scheme for maize. Likewise, the Ethiopian government is also considering introducing MSP for selected cereals (Minot and Rashid, 2013) principally to support staple grain producers, and is considering the potential sectoral, economy-wide and distributional implications of such interventions. Some West African countries such as Côte d'Ivoire and Benin already have operating MSP schemes for cash crops such as cocoa and cotton (Ecobank, 2013).

However, there is a lack of consensus on whether governments in poor countries should intervene to stabilize agricultural and food prices (Gouel, 2013), leading to continued research on the likely effects of such interventions on agricultural production and agents

[1] This is typically so in Africa where governments most frequently attempted to support consumers without taking into account the negative impacts on producers (Demeke *et al*., 2012).

welfare. These kinds of price and stockholding interventions on a specific sector can have far reaching economy-wide implications as the effects can spread over the whole economy (Femenia, 2010), and in such situations computable general equilibrium (CGE) modelling has long been recommended (Newbery and Stiglitz, 1981). Hence, to examine the implications of alternative agricultural and food pricing policies tied to storage programs on producers, consumers, and the macro-economy of Ethiopia, this study adapts a CGE model that accounts for the inter-sectoral interactions, price determination, and income distribution mechanism explaining a semi-subsistence developing economy. This work is closely related to studies of commodity price stabilization schemes such as Robinson and El-Said (1997), who analyze rice price policies in Indonesia, and Parikh *et al.* (2003), who examined the growth and welfare consequences of rise in MSP in India. However, unlike these studies which consider commodity specific shocks, the model followed here i) consider productivity shocks on the agricultural sector because agriculture in most developing economies is multiproduct activity; ii) accounts for and endogenizes the cost of running storage services which could influence the success of such a program, and iii) examines a wide range and combination of producer and consumer price support policies. Also, unlike Robinson and El-Said (1997), the model and the database used for this study explicitly accounts production for home consumption, the accounting of which is seen to affect policy outcomes (Aragie and McDonald, 2014).

Once the model and the data are set, the following simulations are run to study the effects of cereal price stabilization and storage policies on the Ethiopian economy when positive and negative productivity shocks occur in the agricultural sector: i) producer prices of cereals are not allowed to fall by more than 5.0% of the base level and no price support to consumers; and ii) producer prices for cereals are restricted no to fall by more than 5.0% from the base levels, and consumer prices of cereals are restricted not to increase by more than 5.0%. These scenarios provide rich information on economic consequences of mix of possible price policies. Simulation results show that the effectiveness of the price policies and government interventions in the commodity market depends on the trends of agricultural productivity in the economy. While producer price floors are effective when there are productivity gains, consumer price ceilings are effective in a context of productivity losses. Producer price support policies work in favor of producers and against consumers when there are productivity gains thereby avoiding further declines in producer prices and consumer prices. On the other hand, price ceilings on commodities work against producers and in favor of consumers by damping further increases in producer and consumer prices. The magnitude of intervention by the government in the commodity market grows proportionately as the agricultural sector faces strong positive or negative shocks.

The remaining part of the paper is organized as follows. Section 2 introduces the data and the model used for the study, section 3 provides the simulation design, section 4 discusses model results, and the final section concludes.

2. Data and Model Features

2.1. Data

A 2010 social accounting matrix (SAM) for Ethiopia is used to calibrate a model with MSP backed up by a government parastatal doing public storage and grain trade activities. A detailed description of the SAM can be found in Aragie (2014). In addition to providing well disaggregated commodity, activity, factor, and household accounts, the SAM has several salient features: i) it splits commodities into own account and marketed counterparts, and ii) it incorporates households as producing units in the activities account separating them from activities by incorporated non-household enterprises thereby properly reflecting the consumption and production structures of semi-subsistence economies. The SAM includes 39 commodity types, of which 15 are home production for home consumption, with corresponding number of marketed counterparts, and 9 are solely supplied by the market such as public services and industrial goods. There is extensive representation of the activity account owing to the fact that households are now explicitly recognized in the SAM as producing units. As a result the SAM includes 57 activities of which 35 are multiproduct household activities, while 12 are purely non-agricultural. There are also 35 representative household groups where each regional state in the country is represented by rural, other urban and big urban household groups. Rural households are further classified by four agro-ecological zones: moisture sufficient and drought prone highlands, and moisture sufficient and drought prone lowlands. In addition, there are a total of 88 factors where about two-third are labor types classified into five skill types for each administrative region of the country. Apart from these relevant extensions, the SAM also has other institutional accounts including accounts for enterprises, the government, investment-saving and the rest of the world (RoW).

In the model (described below) the MSP program is linked with public storage operations. Most studies (such as Storm, 1994; Robinson and El-Said, 1997; Parikh *et al*., 2003) examined public or private storage operations without incorporating an estimate of the cost of running such interventions. In this study, we account for administrative and operating costs associated with storage by incorporating, in the SAM, an activity that produces a commodity called storage services. Price of this activity is used to approximate the per-unit operation cost of running storage facilities. A similar approach is followed by Femenia (2010).

An extract from Sharma (2012) for the case of India, a country with long history of MSP policy, shows that administrative expenses, transit losses, and storage losses respectively account 10.1, 1.1, and 0.8% of distribution costs of food grains administered under the MSP program, where distribution costs themselves constitute about 16.0-17.0% of total economic costs of grains in the public warehouses. This implies that these three particular cost components (administrative expenses, transit losses, and storage losses) account to about 2.0% of total value of stocks.[2] This estimate is used to determine the per-unit quantity of storage cost when introducing a storage service activity in the SAM and later in the simulations. Explicitly speaking, the new storage service activity is introduced in the SAM

[2] It can be seen that administrative expenses, transit losses, and storage losses equal to 1.7, 0.2, and 0.1% of total value of grain stocks, respectively.

such that it is about 2.0% of the base level of public stocks. Costs of storage services are then entirely covered by the government, i.e., storage services are public goods the unit prices of which are determined endogenously in the model. This new activity is assumed to use labor and non-agricultural capital as value added inputs and transport services as intermediates. Labor income is assumed to be distributed equally across skilled and unskilled non-agricultural labor in all administrative regions. The same is for return to non-agricultural capital.

Apart from the storage cost associated with the baseline (average) level of stock of cereals in the warehouses, sales and purchase activities by the government from farmers at any time through the year/period involve extra storage related operation costs. These costs are assumed to proportionately change with the volume of government purchase and sales transactions, and are included in the total government commodity (storage service) consumption. The same rate of 2.0% is assumed per unit of cereal purchases and sales.

An initial level of public storage need to be assumed for couple of reasons: i) this makes it possible to define a band within which the level of public storage can oscillate, and ii) the introduction of a storage service activity in the SAM as discussed above implies some positive level of storage service production. Hence, for the base period, we assume an amount equal to 5.0% of total domestic production of marketed cereals as the baseline level of stock. While this will be considered as the 'normal' level of cereals stocks within a period, economic conditions could force the government to undergo through times of stocking and di-stocking deviating the stock level from its 'normal' amount. A constraint within which shock levels can deviate is also imposed as discussed shortly.

2.2. Main model features

As pointed out by Newbery and Stiglitz (1981) and followed by Robinson and El-Said (1997), Parikh *et al.* (2003), and Femenia (2010), price support policies and stocktaking behaviors are best dealt with CGE framework. This is because price changes as a result of such policies can, to some degree, propagate to other sectors of the economy. These operations could also have budgetary and tax implications that could affect the whole economy. As a result, a variant of CGE model called STAGE (McDonald, 2007) is used for this study. A variant of STAGE modified by Aragie (2014) is particularly used to incorporate MSP policies and public stockholding behavior in the model. This model (Aragie, 2014) has some innovative features on how commodity consumption and factor allocation decisions are modelled; this is typically due to the incorporation of home production for home consumption under non-separability assumption in the database discussed above. These modifications were desirable to better portray the production and consumption systems in peasant economies such as Ethiopia.

Production follows multi-level nested structure where household and non-household enterprises aim at maximizing profit. All activities are generally assumed to use nested constant elasticity of substitution (CES) technology, but different activities may have different values of substitution elasticity. Specifically, the production nesting structure in the

STAGE model discussed in McDonald (2007) is modified to account for the production nesting structure considered appropriate for the kind of economies this study focuses on. Note that labor use by household enterprises for producing for own consumption is constrained by the household's own labor endowment and this condition is imposed in the labor market equilibrium condition.

Consumers' behavior is defined by a two-stage consumption nesting such that households demand for commodities can reflect the source of commodities as defined in the SAM as database for the study. At the bottom of the consumption nest is a CES demand system where pair of notionally identical home produced and marketed commodities are combined to provide aggregate consumption of the commodity. Consumers decide on the optimal combination of these two types of commodities based on their relative prices subject to the imperfect substitution elasticity defined effectively as part of the CES function. The choice of CES at this stage of the nest does the purpose as semi-subsistence households will not be worried about the source of the commodities (i.e., home produced *teff* or marketed *teff*) in fulfilling their subsistence levels of consumption. At the top of the nest, consumers maximize their utility from the consumption of a set of combined commodities (from the lower nest) subject to their budget constraints and the linear expenditure demand systems (LES) derived from Stone-Geary utility function. LES demand systems split subsistence consumption, which is still a dominant phenomenon in low-income countries, from discretionary consumption where the amount of household budget on discretionary demand is a residual component of total household consumption budget and committed expenditure on subsistence demand. The subsistence and discretionary consumption expenditure is decided over the composite of own account and market commodities generated in the lower nest of the consumption tree.

Price support and storage policies by the government are introduced in the model following Robinson and El-Said (1997) and using complementarity problems (inequalities). The first set of equations relate to producer and consumer price support programs. Producer prices *(PXC)* are not allowed to fall below a certain level set by *dpxctar(c)* [2.1] where *pxctar(c)*, measured as a proportion of base producer prices, defines the level over which prices can fluctuate.[3] Hence, [2.1] introduces a policy tool to maintain producer prices floors for commodity *c*, such as a set of selected cereals. Different level of *dpxctar* can be assured depending on the extent to which the government wants to see producer prices oscillate. In the simulations, producer prices of cereals are allowed to change by 5.0% over the base level of producer prices for these commodities.

$$PXC(c) - pxctar(c) + dpxctar(c) = G = 0 \qquad [2.1]$$

It is possible that governments also target to stabilize consumer prices for these commodities as cereals account a considerable proportion of consumption expenditures in most developing countries. Equation [2.2] describes policy tool to maintain a ceiling on consumer price *(PQD(c))* of a composite good. This is done by exogenously imposing a ceiling *dpqdtar(c)*

[3] For model calibration purposes, *pxctar(c)* is set at the base level of producer prices (PXC).

defined as a proportion of the base level of the consumer price for that commodity. Similarly, *pqdtar(c)* is a parameter that defines the base level of consumer price, and *dpqdtar(c)* can take any feasible value but assigned value of 5.0% for simulation purposes.

$$pqdtar(c) + dpqdtar(c) - PQD(c) = G = 0 \qquad [2.2]$$

The producer and consumer price floor and ceiling, respectively, are maintained through an effective intervention by the government in the domestic and international commodity markets; the second set of equations related to this. The government is assumed to achieve such market stabilization roles using a public enterprise that trades and stores strategic grains, such as EGTE in Ethiopia, FRA in Tanzania, or BULOG in Indonesia. Taking the actions of EGTE of Ethiopia, equation [2.3] defines EGTE's stocks $(EGTE\underline{STK}(c))$ as a sum of its initial stocks *(stk0(c))* and net of its domestic and international trade activities within a period. As explained above, *stk0(c)* is assumed to equal to 5.0% of total domestic production of marketed cereals. EGTE can participate in the domestic market by purchasing $(EGTE\underline{P}(c))$ and selling $(EGTE\underline{S}(c))$ grains depending on the governments pricing policy and state of the domestic demand and supply. It can involve in imports $(EGTE\underline{M}(c))$ when there are shortages and exports $(EGTE\underline{E}(c))$ when there are surpluses in the domestic market.

$$EGTE\underline{STK}(c) = stko(c) + EGTE\underline{P}(c) - EGTE\underline{S}(c) + EGTE\underline{M}(c) - EGTE\underline{E}(c) \qquad [2.3]$$

Equations [2.4] and [2.5] are inequalities setting EGTE's upper and lower bounds, respectively, of stocks by commodity type as defined in [2.3]. *dstk(c)* is the target band on stocks by commodity *c* and specified as a proportion of *stk0(c)*. A 5.0% band is assumed as the baseline level of target band, which is altered later to undertake sensitivity analysis of changes in producer and consumer prices and government's stockholding behavior to alternative degree of variations in storage levels.

$$stk0(c) + dstk(c) = G = EGTE\underline{STK}(c) \qquad [2.4]$$

$$EGTE\underline{STK}(c) = G = stk0(c) - dstk(c) \qquad [2.5]$$

If producer prices for cereals fall below the price floor, EGTE purchases as much from domestic producers at the price floor thereby maintaining producer prices at the level that satisfies the inequality in [2.1]. For example, if the government sets the target producer price band to zero, i.e., *dpxctar(c) = 0*, it is assuring that, after a certain shock, farmers are getting a price at least equal to the base level. Similarly, if domestic and international conditions derive consumer prices above the price ceiling level, the government, through EGTE, imports and sales in the domestic market thereby maintaining prices at their price ceiling as explained by the constraint in [2.2]. However, EGTE is not going to do it without capacity constraints, and there is usually a limit to the extent to which it can intervene in the market by stocking and de-stocking. This is determined by the relationships in [2.3]-[2.5]. Typically, when EGTE runs into a period of consumer price stabilization, stock levels could be low and hit the lower limit. In this case, EGTE will experience stock accumulation by buying from domestic or international sources. When stocks accumulate and hit the upper limit, such as due to active grain purchases from farmers to keep producer prices at least at a target level, EGTE will engage in selling (domestic and export).

The sale and purchase of grains by EGTE, both in the domestic and international markets have connotations to the government demand for commodities, government expenditure, and the overall external balance through international purchases and sales of cereals. Equation [2.6] depicts government demand for commodities *(QGD(c))* as a fixed share of spending on commodities (*qgdconst(c))* plus the net of EGTE's trade interventions (purchases and sales). *QGDADJ* is government consumption adjustment factor. Unlike Robinson and El-Said (1997) that do not account for such costs, net (domestic) trade interventions by EGTE are scaled up by a level of distribution cost which is a function of sales/purchases activities. The distribution cost is determined by a per-unit cost *(distcost(c))* which is assumed to be 2.0% of transactions as explained earlier. Costs associated with storage services are already included as part of commodity consumption (storage service demand) by the government in *qgdconst(c)*.

$$\begin{aligned} QGD(c) = {} & QGDADJ * qgdconst(c) + (EGTE\underline{P}(c) - EGTE\underline{S}(c)) \\ & + EGTE\underline{P}(c) * distconst(c) + EGTE\underline{S}(c) * distconst(c) \end{aligned} \qquad [2.6]$$

EGTE's external activities (in the form of imports and exports) are incorporated in equation [2.7], which defines the government's total expenditures *(EG)*. While *ER* is the exchange rate, *PWM* and *PWE* are world prices of imports and exports, respectively. *ctar* is a set of commodities for which the price target is set.[4]

$$\begin{aligned} EG = {} & SUM(c, QGD(c) * PQD(c)) + net\ transfers \\ & + SUM(ctar, EGTE\underline{M}(ctar) * ER * PWM(ctar)) \\ & - SUM(ctar, EGTE\underline{E}(ctar) * ER * PWE(ctar)) \end{aligned} \qquad [2.7]$$

The net of EGTE's external activities (exports less imports) is also included in the external balance computation for the country.

3. Policy Experiments

In this study, we focus on price and storage policies on cereal production and consumption in Ethiopia, although the framework discussed above can be used for any developing country consistent with the behavioral assumptions incorporated in the model. Policy analysis on the impacts of alternative price and storage policies requires specification of a benchmark and changing policy regimes (Parikh *et al.*, 2003). To facilitate comparison of states with and without a certain price and storage policy change, benchmark/reference scenarios are first generated. The benchmark/reference scenarios, **SIM0**, are baseline scenarios where productivity shocks are introduced, but there are no price support policies in place. Two types of productivity shocks are assumed as benchmark scenarios: i) increase and (ii) decrease in productivity of the agricultural sector against which the implications of price support policies are evaluated. This is different from the way Robinson and El-Said (1997) examined price

[4] *ctar* for this study includes major cereals, particularly barley, maize, sorghum, and wheat.

support policies in Indonesia where the authors restrict productivity shocks only to rice. Activities in most rural economies are multiproduct that shocks affect products jointly. The productivity shocks are simulated by altering the productivity/shift parameter in the CES production function at a stage where intermediate inputs are combined with factors. The shocks can be interpreted as changes due to climate or technology, and the time period of analysis is short run where government policies and other exogenous accounts are more predictable.

Each of these baseline scenarios, which are assumed consistent with new market ‘equilibriums’ after the economy adjusts to the shocks, are first run. Later, two more scenarios (**SIM1 and SIM2**) with alternative price strategies are examined under each productivity shock, and compared with the appropriate baseline scenario and against each other. Under **SIM1**, the government, through EGTE, is assumed to stabilize producer prices, but does not provide price support to consumers. In **SIM2,** EGTE considers stabilizing both producer and consumer prices (see below).

- **SIM0**: Baseline scenarios where productivity shocks are introduced, but there are no price support policies;
- **SIM1**: Producer prices of cereals are not allowed to fall by more than 5.0% of the base levels and no price support to consumers;
- **SIM2**: Producer prices for cereals are restricted not to fall by more than 5.0% from the base levels, and consumer prices of cereals are restricted not to increase by more than 5.0%.

Following Robinson and El-Said (1997), productivity changes (in both directions) of 5, 10, 15, 20, and 25% are considered. The nature of EGTE intervention depends on the direction and level of changes in producer and consumer prices as productivity is altered. For example, as productivity improves by 5.0-25.0%, producer prices will tend to decrease. As producer prices hit the price floor set, EGTE will intervene by purchasing from farmers as much to maintain the price floor. The government may not need to intervene on consumer prices in such situations since excess supply could keep consumer prices below the price ceiling band.

For model result sensitivity test purposes, we also run additional set of simulations with more flexible band on cereal stock change. The 5.0% band in stock change is relaxed to 10.0%, thereby allowing EGTE to intervene much strongly by stocking and de-stocking in response to economic conditions. This will allow examine how selected economic indicators change in relation to the cases where the 5.0% band on stock changes is imposed. We could also consider increasing the baseline stock level from the base level of 5.0% of marketed cereal production. However, knowing that maintaining a bigger level of stocks as requirement would cost the government a lot of money, EGTE will rather choose to allow for larger variations in stock levels within a period. Thus, we choose to consider wider variations in stock levels for sensitivity analysis.

4. Simulation Results

4.1. Positive productivity shocks with MSP

SIM1: Producer prices of cereals are not allowed to fall by more than 5% of the base level and no price support to consumers.

Impact on commodity prices:

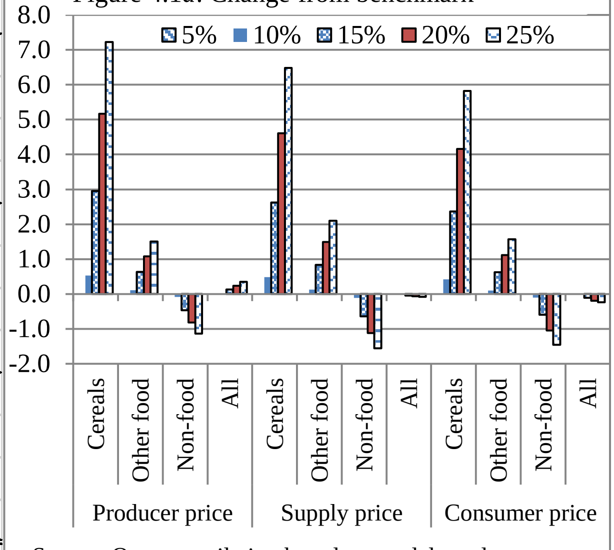
Discussions are in comparison to the benchmark (**SIM0**) scenario. Changes in producer price under **SIM1** are markedly lower than changes under the benchmark scenario. Decline in producer price of cereals remain fixed at 5.0% (Table 4.1*a*) once the price decline hit the floor (when productivity declines by 10.0%). Like the benchmark response without MSP policy, supply prices of composite cereals decline, but the declines tend to cease to be tied to the magnitude of shocks once the MSP start to materialize, i.e., when productivity increases by 10.0% or more (Figure 4.1*a*). Declines in supply prices of cereals under the current scenario are lower by 0.5-6.4 percentage points as productivity increases by 10.0-25.0% compared to the benchmark scenario of no price policy. On the other hand, composite supply prices of other food, non-food and all commodities are markedly lower than changes without the MSP policy. Consumer prices follow developments in supply prices. Unlike the benchmark scenario where only the productivity shock is considered, consumer prices for cereals decline at a lower rate once change in producer prices hit the price floor target.

Table 4.1*a* : Impact of increase in productivity on commodity prices

		5%	10%	15%	20%	25%
Producer price	Cereals	-2.89	-5.00	-5.00	-5.00	-5.00
	Other food	-1.81	-3.30	-4.22	-5.06	-5.82
	Non-food	1.50	2.74	3.54	4.25	4.88
	All	-0.27	-0.55	-0.77	-1.01	-1.27
Supply price	Cereals	-2.42	-4.20	-4.15	-4.11	-4.07
	Other food	-2.17	-4.01	-5.13	-6.14	-7.07
	Non-food	1.95	3.59	4.63	5.57	6.42
	All	0.30	0.50	0.61	0.67	0.70
Consumer price	Cereals	-2.06	-3.55	-3.39	-3.26	-3.15
	Other food	-1.87	-3.47	-4.52	-5.47	-6.35
	Non-food	1.84	3.39	4.36	5.24	6.04
	All	0.41	0.71	0.86	0.96	1.03

Source: Own compilation based on model results

Figure 4.1*a*: Change from benchmark



Source: Own compilation based on model results

Impact on commodity quantity:

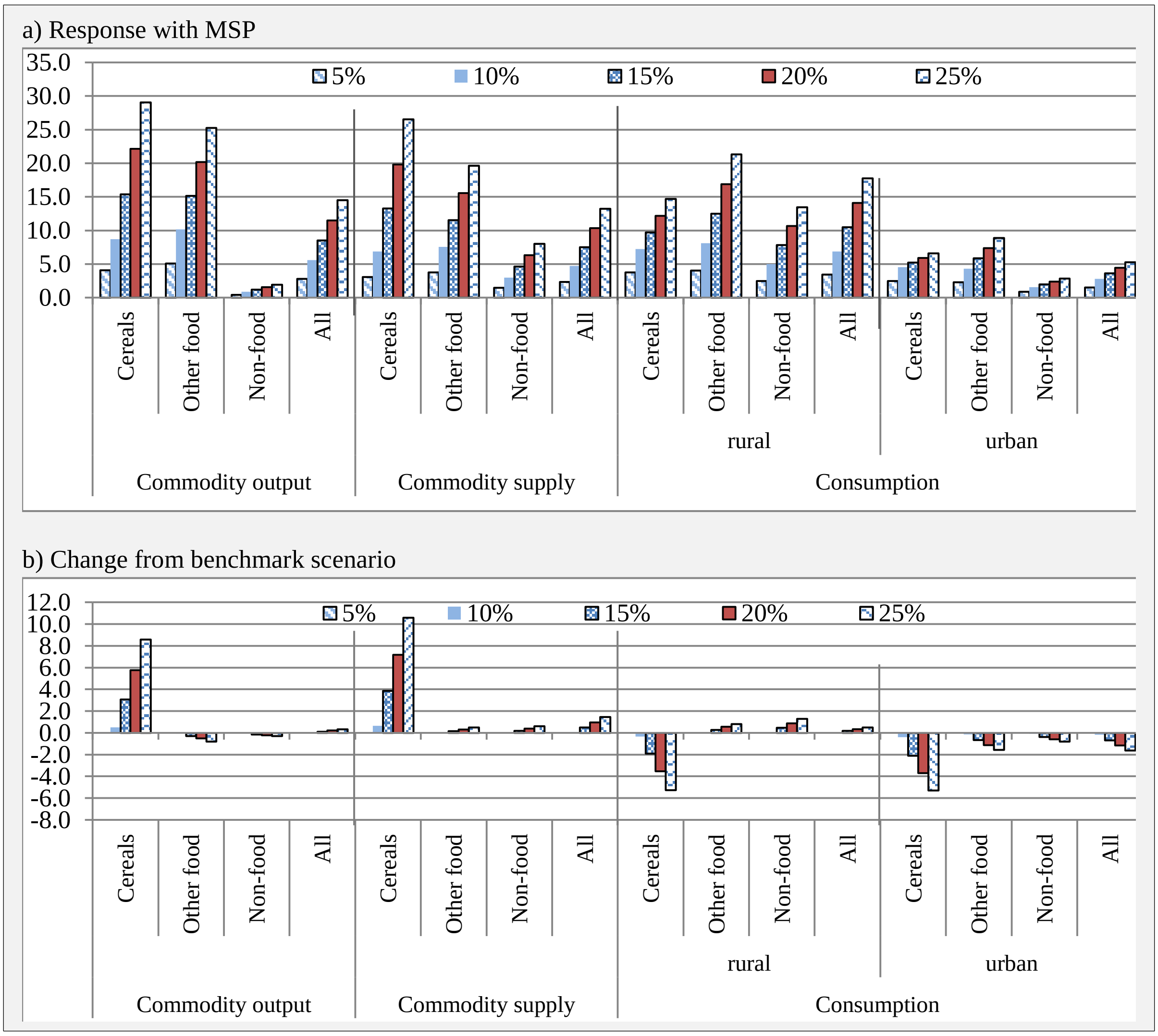
When productivity increase by 10.0% or more, change in cereal production deviates from the baseline scenario,[5] and increases by a higher percent compared to **SIM0**. Specifically, production of cereals increase by 0.5-8.6 percentage points more than the changes under

[5] Baseline scenario is the state of the economy before the productivity shock is implemented, while the benchmark scenario (SIM0) is the new equilibrium after the productivity shock has been introduced but before the MSP policy is implemented.

SIM0 when productivity increases by 10.0-25.0%. However, the production of other food, non-food and all commodities under this scenario tend to respond by a marginally lower rate than the benchmark scenario where only the productivity shock was implemented.

Due to the production enhancing effect of the MSP policy on cereals, supply of these commodities tend to increase considerably when the producer price support policy is implemented compared to the response under the positive productivity shock alone. However, this effect is only restricted to productivity gains of 10% and above (see part *b* in Figure 4.1*b*) since the price policy start to materialize in supporting cereal producers. However, the price support policy prevents consumer prices of cereals from falling as much (see Figure 4.1*a*), limiting the surge in consumption of these crops. This is so for both rural and urban households. Consumption of other food, non-food and all commodity types increase by higher rates under **SIM1** compared to **SIM0** for rural households as households start to look for cheaper options. For urban households, consumption of other food, non-food and all commodities increase by a lesser degree under **SIM1** compared with **SIM0** as their incomes tend to increase by a lesser degree (see Figure 4.1.*c*).

Figure 4.1*b*: Impact of increase in productivity on commodity quantity



Source: Own compilation based on model results

Impact on household income and welfare:

The 5% price band caused economic adjustment that resulted in strong increase in incomes of rural households compared to the benchmark scenario (**SIM0)** (Table 4.1*b*). Incomes of moisture sufficient households remain to grow by a stronger magnitude in response to the productivity gains compared to their drought prone counterparts (Figure 4.1*c*). However, incomes of urban households increase by a lower rate compared to **SIM0** as productivity grows by 10.0% and more. The same pattern is apparent for changes in consumption expenditures, but expenditures change by marginally lower rates than income once the government starts to intervene using the MSP policy since savings have to be mobilized from households to finance the increasing government expenditure.

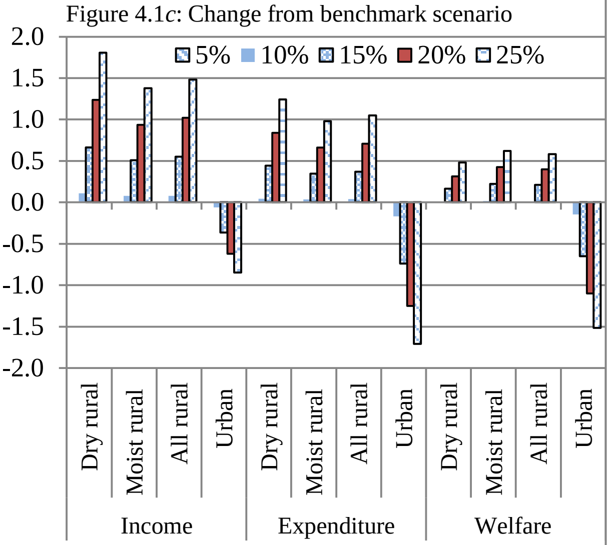
Change in welfare summarizes the price, income, and expenditure changes. While rural households tend to become better off under **SIM1** vis-à-vis **SIM0**, welfare of urban households improve by a lesser degree compared to **SIM0** since the producer price support on cereals prevent urban households from enjoying further increase in incomes and further declines in consumer prices of cereals.

Table 4.1*b* : Impact of increase in productivity on household income and welfare (%)

		5%	10%	15%	20%	25%
Income	Dry rural	2.58	5.29	8.48	11.70	14.95
	Moist rural	3.02	6.13	9.59	13.08	16.57
	All rural	2.90	5.90	9.29	12.70	16.12
	Urban	1.94	3.68	5.06	6.40	7.70
Expenditure	Dry rural	2.59	5.23	8.23	11.24	14.27
	Moist rural	3.03	6.10	9.43	12.77	16.11
	All rural	2.91	5.87	9.11	12.36	15.62
	Urban	1.97	3.60	4.70	5.73	6.73
Welfare	Dry rural	3.24	6.52	9.96	13.43	16.93
	Moist rural	3.35	6.73	10.32	13.92	17.54
	All rural	3.32	6.67	10.22	13.79	17.37
	Urban	1.48	2.72	3.53	4.33	5.12

Source: Own compilation based on model results

Figure 4.1*c*: Change from benchmark scenario



Source: Own compilation based on model results

Impact on EGTE operations:

EGTE starts to involve in the grain market when agricultural productivity increases by 10% from its current levels as this gain in productivity could otherwise force producer prices of cereals to decline by more than 5%. Once the producer price floor is reached, the government, through EGTE, starts to buy from farmers and sale in the export market. Table 4.1*c* shows that grain stocks can only increase by a maximum of 5.0% as this is the capacity constraint introduced in the analysis. How price and quantity outcomes will deviate with alternative stockholding capacity is treated in section 4.2. It can be noted from the result that the volume of interventions in the form of purchases and sales are lower in value terms as the expansion in production declined. Note that total purchases from farmers sum up to exports and change in stock from the base. EGTE is not participating in domestic sales and imports as it has no consumers' price stabilization objective now.

Table 4.1*c*: Impact of increase in productivity on EGTE operations (in '00 million units)

	Base	5%	10%	15%	20%	25%
EGTE<u>P</u>						
Cereals	0.00	0.00	0.43	2.44	4.50	6.60
Growth (%)	-	-	*+inf*	*+inf*	*+inf*	*+inf*
EGTE<u>S</u>						
Cereals	0.00	0.00	0.00	0.00	0.00	0.00
Growth (%)	-	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
EGTE<u>E</u>						
Cereals	0.00	0.00	0.32	2.33	4.39	6.49
Growth (%)	-	-	*+inf*	*+inf*	*+inf*	*+inf*
EGTE<u>M</u>						
Cereals	0.00	0.00	0.00	0.00	0.00	0.00
Growth (%)	-	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
EGTE<u>STK</u>						
Cereals	2.28	2.28	2.39	2.39	2.39	2.39
Growth (%)	-	*0.00*	*5.00*	*5.00*	*5.00*	*5.00*

Source: Own compilation based on model results

<u>*SIM2: Producer prices for cereals are restricted not to fall by more than 5% from the base levels, and consumer prices of cereals are restricted not to increase by more than 5%.*</u>

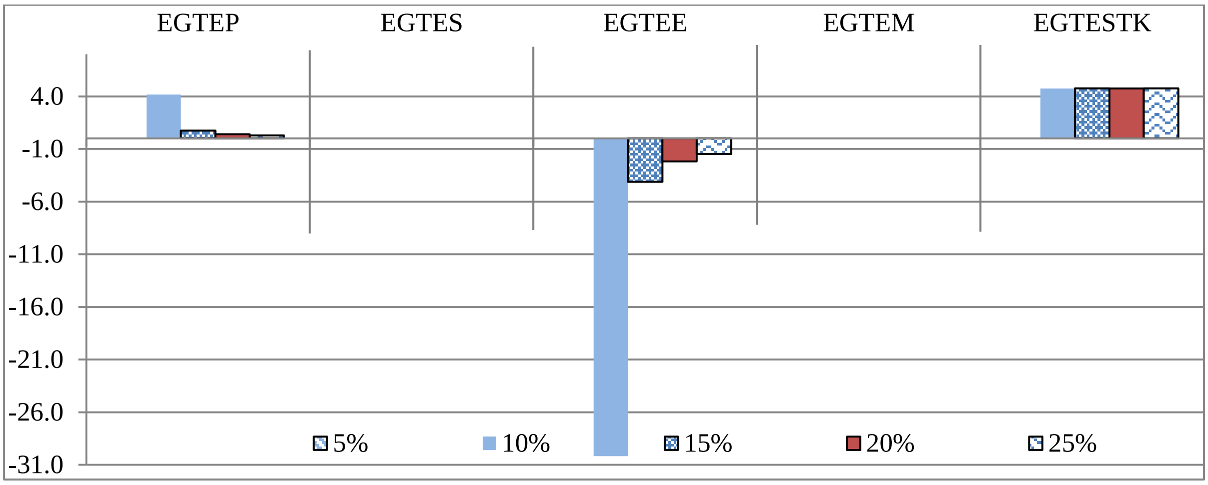
Changes in commodity prices, commodity quantity, household income and welfare, and operations of EGTE, when a 5% band on both producer and consumer prices is introduced (**SIM2**), are identical with changes in these variables under **SIM1.** This is because producer prices are restricted not to decrease by more than 5.0% from the base levels in both cases, and *consumer prices could not reach to the price ceiling level set* in the model. Under the cases of a 5.0% band on producer prices of cereals and 5.0-25.0% improvements in agricultural productivity, consumer prices of cereals can only decline (see Table 4.1*a*). Hence, the comparison between **SIM1** and **SIM0** holds for **SIM2** and **SIM0**.

4.2. Sensitivity analysis to stock band level: positive productivity shocks

In this section, we examine how selected economic indicators behave in relation to the result with a 5.0% band on stock change when a more flexible band is established on the stock level. As explained in section 4, we establish a 10.0% variation in the level of cereal stocks. This implies that EGTE can intervene by selling larger quantities of cereals (when prices increase) from its warehouses than assumed so far (considered for now as the base level), and can purchase from domestic markets, store and export in greater quantities when producer prices fall due to gains in productivity. Sensitivity of model results to an alternative band for stock change is undertaken by comparing differences in results in terms of interventions by EGTE under the case of a 5.0% floor on producer prices and 5.0% ceiling on consumer prices, i.e., **SIM2**.[6] The relaxation of the band for cereal stocks has no strong impacts on most variables, except some government accounts, mainly government expenditure on commodities and government saving. It can also be concluded that price and quantity variables are more sensitive to price targets than the level at which the government allows stocks to vary.

With regard to EGTE's participation in the cereal trade, with increased flexibility in the size of cereal stocks, EGTE tend to slightly increase its purchases from farmers in periods of surplus production compared to the case under a 5.0% variation in stocks as the current assumption allows it to expand its stocks by 10.0% over the 'normal'/base level. As Figure 4.2 shows, purchases increase by 4.2% as agricultural productivity increases by 10.0%. This change in local purchases gradually declines as the productivity shock increases since the requirement for further purchases gradually declines. However, these increases in domestic purchases are not translated to exports since EGTE can now expand its stock by a greater level over the base. Specifically, exports of cereals by EGTE rather decline by up to 30.2% compared to the case of restricted variation in stocks as agricultural productivity is simulated to increase by 10.0%. However, this decline in EGTE's exports quickly reduced to 4.1% when productivity increases by 15.0%. The increased level of cereal purchases from domestic market is fully shipped to EGTE's stocks as stocks increase by 4.7% compared to the case under a 5.0% variation in stock levels.

Figure 4.2: Comparison of impacts on EGTE interventions of alternative stock bands



Source: Own compilation based on model results

The new level of stock-change band increased overall government expenditure by 0.3 percentage points, irrespective of the level of productivity shocks, due to increased level of net-purchases, cereal transaction costs, and declines in net-exports (see equation [2.6] and [2.7] on how these affect government expenditure). As a result, the increase in government saving declined by about 1.9 percentage points compared to the case of 5.0% cereal stock band.

[6] This scenario is chosen because we suppose that the government may find it politically right to support both consumers and producers.

4.3. Negative cereal productivity shocks with MSP

SIM1: Producer prices of cereals are not allowed to fall by more than 5% of the base levels and no price support to consumers.

The benchmark simulation indicates that declines in productivity would push producer prices up. Producer support price policies will not be required in such situations as long as prices are increasing by more than the price floor determined by the MSP policy. Hence, there are no differences in changes in prices, quantities, incomes, and welfare changes between the **SIM1** and benchmark scenarios (**SIM0**) as there is no need for MSP policy since producer prices of cereals increase by more than 5%. As a result, there is no active involvement by EGTE in the commodity market.

SIM2: Producer prices for cereals are restricted not to fall by more than 5% from the base levels, and consumer prices of cereals are restricted not to increase by more than 5%.

Impact on commodity prices:

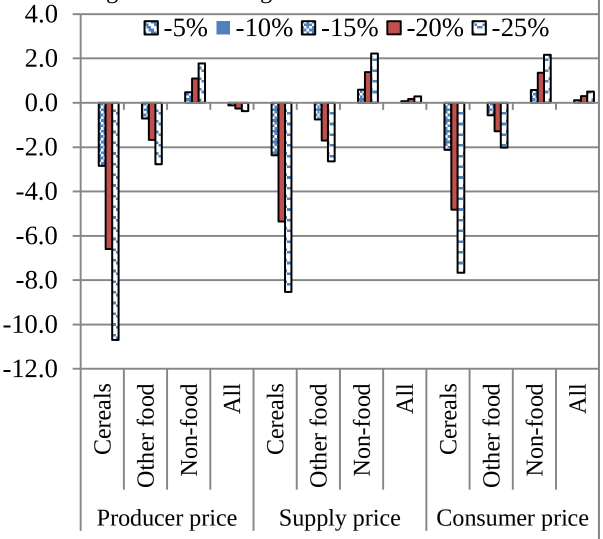
Changes in commodity prices under a price policy of 5.0% band on both producer and consumer prices of cereals (in Table 4.3*a*) are identical with changes in commodity prices without price interventions (**SIM0**) when agricultural productivity contracts by 5-10%. Once productivity start to decline by 15.0% or more, however, the MSP policy affects commodity price changes. Producer prices change by a reduced rate, in both directions and the decline is stronger for cereals (Figure 4.3*a*). Producer prices for cereals increase by 2.9 percentage points lower rate than the case without a corresponding consumer price support policy, and the gap increases proportionately with the magnitudes of the productivity decline. This shows the level of the return lost by cereal producers if the government implements controls on consumer prices when the economy is affected by domestic production shock.

Supply prices also fare in a similar fashion as changes in producer prices when one compares **SIM2** with **SIM0**. While consumer prices for other food commodities increase by lower rates, these prices for non-food and all commodity types decline by reduced rates. Interestingly, consumer prices of cereals increase by a maximum of 5.0% (see Table 4.3*a*) when productivity declines by 15.0% and more, which is at least 2.0 percentage points lower than the case under **SIM0**. The fixed 5.0% increase on consumer prices of cereals, irrespective of the magnitude of productivity shocks, is due to the impact of the price ceiling imposed by the government and assured by EGTE's interventions. In spite of this, composite price of all commodities decline by a lower rate now than under **SIM0** since cereals take only about 20% of total food consumption, and because non-food prices decline by 8.8% under **SIM2** vis-à-vis the 10.1% decline under **SIM0**.

Table 4.3*a* : Impact of increase in productivity on commodity prices						
		-5%	-10%	-15%	-20%	-25%
Producer price	Cereals	3.18	6.70	7.76	8.35	9.10
	Other food	2.05	4.39	6.39	8.58	11.21
	Non-food	-1.69	-3.62	-5.36	-7.28	-9.54
	All	0.22	0.38	0.35	0.20	-0.06
Supply price	Cereals	2.61	5.42	6.08	6.31	6.56
	Other food	2.38	5.02	7.19	9.49	12.18
	Non-food	-2.18	-4.64	-6.83	-9.20	-11.97
	All	-0.40	-0.91	-1.51	-2.24	-3.16
Consumer price	Cereals	2.21	4.58	5.00	5.00	5.00
	Other food	2.05	4.31	6.23	8.28	10.64
	Non-food	-2.07	-4.42	-6.51	-8.78	-11.45
	All	-0.52	-1.18	-1.88	-2.71	-3.75

Source: Own compilation based on model results

Figure 4.3*a*: Change from benchmark scenario



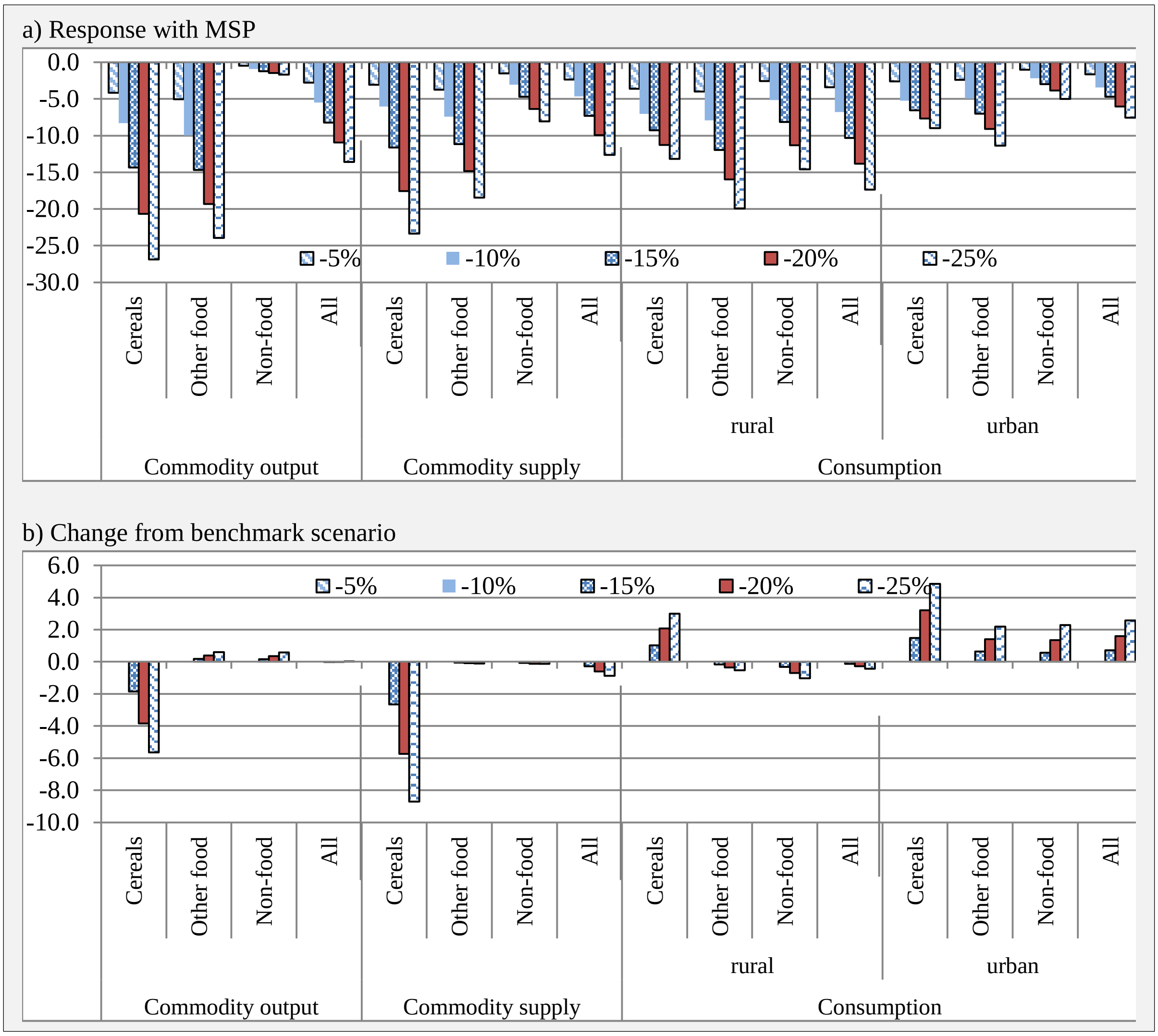
Source: Own compilation based on model results

Impact on commodity quantity:

Compared to the outcome without consumer price support, the production of cereals decline by a higher rate as the ceiling on consumer prices is materialized (Figure 4.3*b*). The consumer price support causes cereal production to decline by 14.4% when productivity contracted by 15.0%, compared to the 12.5% change without the consumer price support policy. On the other hand, the production of other food and non-food commodities decline by marginally lower rates under **SIM2**. The slower decline in production of non-food commodities is due to the relatively smaller decline in their producer prices under **SIM2**, while the slower decline in production of other food commodities is due to the improvement in their relative producer prices against cereals.

Although imports increased from the base level, the strong decline in domestic supply of cereals caused overall supply of cereals to reduce further under **SIM2**. Also, unlike the change in production, supply of other food and non-food commodities decline strongly under **SIM2** because of a lesser increase in imports of other food and a stronger decline in imports of non-food commodities. Despite a stronger decline in composite supply of cereals, the introduction of consumer price ceiling on these commodities works in favor of consumers and reduced the decline in consumption of cereals for both rural and urban households compared with the no price support scenario. However, while consumption of other groups of commodities further decline for rural households, consumption of these groups of commodities decline by smaller levels than **SIM0** for urban households.

Figure 4.3*b*: Impact of increase in productivity on commodity quantity



Source: Own compilation based on model results

Impact on household income and welfare:

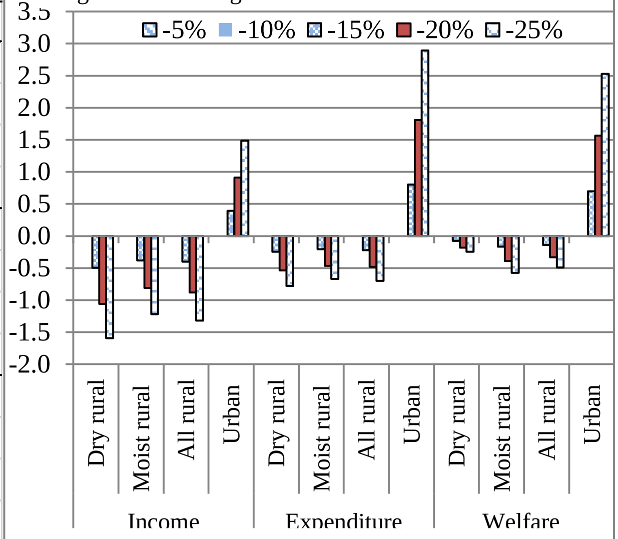
The imposition of consumer price ceiling on cereals in the face of productivity loss and producer price support makes rural households worse-off by higher levels in terms of income, expenditures, and welfare changes (Table 4.3*b*). Specifically, the loss in income, expenditures, and welfare of rural households increased by 0.9-1.3, 0.2-0.7, and 0.3-0.5 percentage points (Figure 4.3*c*), respectively, compared to the case of no price policy intervention of any kind or without consumer price support as productivity declines by 15.0-25.0%. Of rural households, moisture sufficient households remain the main losers in incomes, expenditure, and welfare, where the welfare loss ranges between 10.1 and 18.7% when agricultural productivity declines between 15.0 and 25.0%. However, preventing consumer prices of cereals from increasing by more than 5.0% benefits urban households as declines in their incomes, expenditures, and welfare slightly drop for these households. Urban households face declines in welfare loss by 1.6–2.5 percentage points due to the intervention as productivity declines by 15.0-25.0%. Welfare loss moves inversely with the level of urbanization since income source and consumption composition differ as one moves from rural to highly urbanized areas.

Table 4.3*b* : Impact of increase in productivity on household income and welfare (%)

		-5%	-10%	-15%	-20%	-25%
Income	Dry rural	-2.55	-5.08	-8.08	-11.14	-14.16
	Moist rural	-3.01	-6.02	-9.39	-12.82	-16.22
	All rural	-2.89	-5.76	-9.03	-12.37	-15.67
	Urban	-2.09	-4.37	-6.49	-8.75	-11.28
Expenditure	Dry rural	-2.59	-5.17	-8.02	-10.92	-13.81
	Moist rural	-3.04	-6.09	-9.36	-12.69	-16.02
	All rural	-2.92	-5.84	-9.00	-12.22	-15.43
	Urban	-2.16	-4.55	-6.42	-8.42	-10.73
Welfare	Dry rural	-3.23	-6.45	-9.74	-13.07	-16.38
	Moist rural	-3.33	-6.64	-10.11	-13.63	-17.14
	All rural	-3.30	-6.59	-10.01	-13.48	-16.93
	Urban	-1.60	-3.35	-4.58	-5.87	-7.35

Source: Own compilation based on model results

Figure 4.3*c*: Change from benchmark scenario



Source: Own compilation based on model results

Impact on EGTE operations:

Results from **SIM0** show that producer prices are above the price floor and there is no need for producer support intervention. However, consumer prices for cereals increase by more than 5.0% once agricultural productivity falls by 15.0% and more. Under the current scenario (**SIM2**), EGTE has to intervene to keep consumer prices for cereals at the level specified in the model, i.e., within a 5.0% ceiling. This is done by de-stocking, importing and selling of cereals in the domestic market by EGTE (Table 4.3*c*). Initially, EGTE starts to pump cereals to the domestic market from its stock, and it then imports once the stock level hits the minimum band. This is shown by the 5.0% decline in cereal stocks when agricultural productivity falls by 15.0% and more. Imports and sales increase almost proportionately as productivity continues declining. This increase in interventions by EGTE has considerable effects on government expenditure and the external balance.

Table 4.3*c*: Impact of decline in productivity on EGTE operations (in ’00 million units)

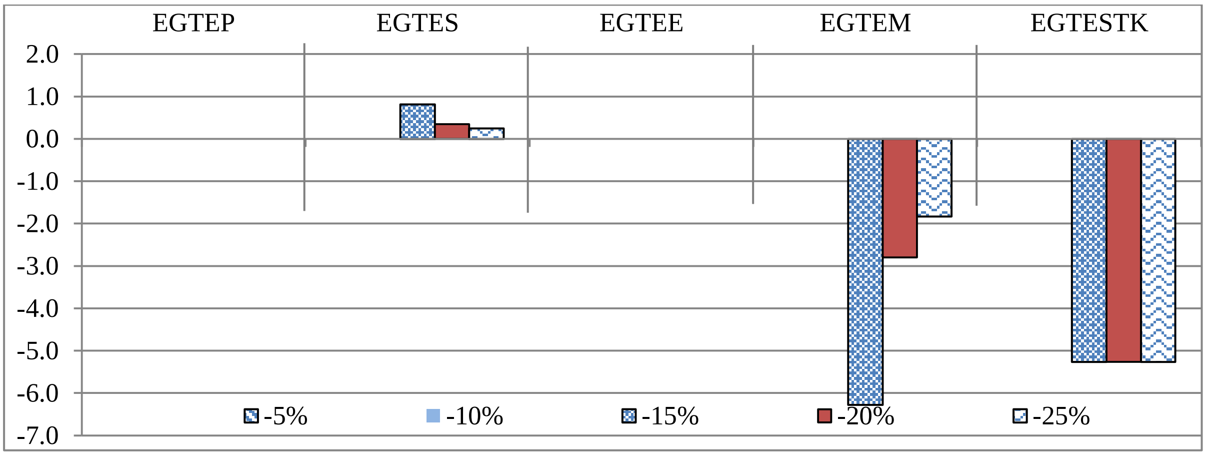
	Base	-5%	-10%	-15%	-20%	-25%
EGTEP						
Cereals	0.00	0.00	0.00	0.00	0.00	0.00
Growth (%)	-	-	-	-	-	-
EGTES						
Cereals	0.00	0.00	0.00	1.72	3.72	5.64
Growth (%)	-	-	-	*+inf*	*+inf*	*+inf*
EGTEE						
Cereals	0.00	0.00	0.00	0.00	0.00	0.00
Growth (%)	-	-	-	-	-	-
EGTEM						
Cereals	0.00	0.00	0.00	1.61	3.60	5.53
Growth (%)	-	-	-	*+inf*	*+inf*	*+inf*
EGTESTK						
Cereals	2.28	2.28	2.28	2.17	2.17	2.17
Growth (%)	-	*0.00*	*0.00*	*-5.00*	*-5.00*	*-5.00*

Source: Own compilation based on model results

4.4. Sensitivity analysis to stock band levels: negative productivity shocks

The change in stock band level does not affect most quantities and prices noticeably. The effect is restricted mainly on the roles of EGTE and some government accounts. It has been shown that declines in productivity would push consumer prices up, triggering the government stabilize consumer prices by importing and selling in domestic markets. The relaxation of the cereal stock floor is expected to allow EGTE de-stock by a larger amount and reduce the pressure on import requirements. Figure 4.4 below reflects this. As expected, cereal stock levels decline by 5.3% from the floor level of 2.2 under the bassline stock band level. As a result, EGTE was able to pump 0.8% more cereals to the domestic market under a 15.0% decline in productivity, for example, although the extra level of intervention (in percent) declines as the negative productivity shock increases. A more flexible stock level also helps to reduce cereal import requirement at any time in a period (say, a year) by 6.3% for a 15.0% decline in productivity as long as EGTE has a reasonable amount of initial stock.

Figure 4.4: Comparison of impacts on EGTE interventions of alternative stock bands



Source: Own compilation based on model results

Opposite to the case under productivity gains, the alternative level of cereal stock band would rather help cut down government expenditure by 0.3 percentage points more. This is mainly associated with declines in net-imports as the government was able to pump cereals from the stock compared to the scenario with a 5.0% stock band, reducing the need for imports. In addition, sales also increase, reducing net-purchases in the government account. As a result, declines in government savings reduce by about 1.8 percentage points in relation to the case under a 5.0% cereal stock band.

5. Summary and Conclusion

The high price volatility in the international and domestic markets in recent periods, coupled with continued food insecurity, appears to motivate some renewed interests on price support programs in Africa. This study examines the impact of the potential implementation of a minimum support price policy on cereals in Ethiopia. To that end, two productivity shocks and two pricing policies were examined. Increase and decrease in agricultural sector productivity by 5.0-25.0% are considered under the following pricing policy options: i) producer prices of cereals are not allowed to fall by more than 5.0% of the base levels and no price support to consumers; and ii) producer prices for cereals are restricted no to fall by more than 5.0% from the base levels, and consumer prices of cereals are restricted not to increase by more than 5.0%. These price policies are enforced using active public intervention in commodity markets.

The following summary can be drawn from simulation results on the above price and government storage policies. The effectiveness of the price policies and government intervention in the commodity market depends on the nature of the productivity shock. Producer price floors are effective only when there are productivity gains which would ultimately decrease producer prices. Also, producer price support works against consumers as prices of commodities for which the minimum support price is implemented could not fall anymore beyond the level dictated by the support program. The introduction of price ceiling together with price floor, when there are productivity gains, have no any role since consumer prices will not increase anyway. Under productivity gains, EGTE buys from domestic markets, accumulates stocks given the capacity limits, and exports the rest. Price ceiling on commodities (consumer price support policy) is effective only when there are productivity losses as consumer prices tend to increase. Consumer price support policies help urban households since they slightly dampen increases in consumer prices and declines in incomes to these households. On the other hand, rural households lose increasing level of welfare mainly due to further losses in incomes as the control in consumer prices limit the increase in producer prices for cereals. The producer price ceiling of keeping prices at least at the base level does not effectively affect the economy since producer prices tend to increase significantly under such productivity shocks. Under productivity losses, EGTE de-stocks and imports, and sales cereals into the domestic market.

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