



Does food aid have disincentive effects on local production? A general equilibrium perspective on food aid in Ethiopia

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Abstract

This paper examined impacts of food aid on domestic food production employing a computable general equilibrium modelling technique and using data from Ethiopia. The simulation experiments have shown that food aid has unambiguous disincentive effects on domestic food production. The removal of food aid caused a modest increase in food prices but this stimulated food production. Employment and income generation effects of the latter outweighed the adverse effect of the former. Consequently, the removal of food aid led to improvements in aggregate household welfare. Contrary to some concerns in the food aid literature that any reduction in food aid would hurt the poor, the simulation experiments suggested that actually poor rural households and urban wage earners are the ones who benefit most in absence of food aid but entrepreneurs are more likely to encounter a marginal welfare decline. We have distinguished between in-kind food aid and cash equivalent transfers in order to isolate the disincentives that in-kind transfers would make to domestic production from those that are related to household purchasing power problem. The expansionary effect of removing food aid becomes significantly larger when it is accompanied by cash equivalent payments because the latter would provide demand side stimulus to agriculture while the removal of in-kind transfers would stimulate supply side, with the supply and demand side effects reinforcing each other. In our modelling framework, the only adverse effect would be a modest deterioration in the external current account, because the expansionary effects of food aid would cause imports to rise but exports to fall.

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Introduction

There has been a growing need to explain the role of food aid in alleviating poverty in less developed countries. Many researchers have critically examined associations between the level of food aid and rising level of poverty in the recipient countries. Although food aid has been a heavily researched topic, most studies have assessed only one aspect of the transfer such as: food aid's impact on domestic agricultural production (Schultz, 1960); domestic price (Gabre-Madhin et al., 2003; Barrett, 2003; Barrett et al., 1999), factor supply (Barrett and Clay, 2003; von Braun et al., 1999; Holden et al., 2003; Bezuneh et al., 1988) relative efficiency of in-kind food aid and cash payments (Sen, 1986; Coate, 1989; Basu, 1996; Faminow, 1995); and whether or not food aid reaches target households (Clay et al., 1999; Jayne et al., 2001).

The impact of food aid on domestic economy in the recipient country are mostly analysed in a partial equilibrium context. However, the existence and importance of system-wide effects of food aid are widely acknowledged in the literature. In spite of some attempts at developing some analytical frameworks tracing general equilibrium effects of food aid as early as 1980s (Bhagwati, 1985), general equilibrium analysis has rarely been applied to food aid issues. This is despite the fact that there has been vastly increased application of computable general equilibrium (CGE) on a wide range of policy analysis in LDCs in recent years. Few existing CGE applications on this subject so far have generally focused more on assessment of general food aid requirements (Wobst, 2001; Fontana et al., 2005) or specific food aid targeting (Arndt and Tarp, 2001) than disincentive of food aid on domestic food production and the feed-back effects of this on the rest of the economy.

This paper would make a modest attempt to fill this gap in the literature. We concentrate on the disincentive of food aid on food production in Ethiopia and employ a computable general equilibrium modelling approach, relying on a social accounting matrix and associated database created recently for Ethiopia through a project sponsored by the World Bank. More specifically, the general equilibrium analysis focuses on differential impacts of in-kind transfers and cash equivalent payments. It is found that cash payment is by far the most effective form of aid because it simulates domestic production, factor employment and household welfare.

The paper is structured as follows. The first section provides an overview of food aid to Ethiopia. The second section highlights key features of the CGE model developed for this study with a focus on the specification of food aid. Section Simulation results are discussed the third section. Concluding remarks are made in a final section.

Overview of food aid in Ethiopia

Ethiopia is one of the least-developed countries in the world; predominantly an agrarian economy with about 85% of the population living in rural areas. Subsistence agriculture is the mainstay of the Ethiopian economy accounting for about 42% in 2003 of the

GDP and nearly 90% of the export trade. The industrial sector, including mining and energy, contributes only 10.7% to the GDP. About 44% of the population live below the poverty line (World Bank, 2004). A subsistence economy that heavily relies on rain-fed agricultural production means significant variations in food production. Consequently, the socio-economic and agro-ecological imbalances and instabilities have caused recurrent drought and famine in Ethiopia for much of its recent history. Such dramatic events have led to frequent appeals for emergency food aid and a continuous inflow of food aid.

Composition and share of food aid in food supply

The volume of food aid donated to Ethiopia was about 760 thousand metric tons per year during 1993 to 2003 (FAO, 2005). A substantial proportion (over 80% in bad years) of food aid being used for emergency relief purposes (Dercon and Krishnan, 2003). Jayne et al. (2001) and Clay et al. (1999) estimate that cereals donated to the country represent about 10% of national cereal production over this period. Cereals account for the bulk of food aid shipped to Ethiopia (93%), wheat constituting the largest share, about 80% of the total volume of food aid supplied between 1992 and 1995 (Clay et al., 2001).

On the ground that a substantially large proportion of food aid to Ethiopia has been cereals, analysts have most commonly measured the significance of food aid in terms of its ratio to total national cereal or grain production; in fact, total “grain production” is interchangeably used with “food production”. Clay et al. (1999, p. 397), justifies such an approach stating that “Conventional wisdom in Ethiopia is that grains constitute 80% of the average Ethiopian diet...”. It will be shown shortly that this is not necessarily be the case but it is useful to recognise that the insufficient attention paid to the significance of non-cereal food stuff in total food consumption in Ethiopia has serious repercussions in understanding extent of food insecurity and the significance of food aid in supplementing domestically available food without necessarily competing against it.

In order to compare the structure of domestic food production with that of food aid, we use data from “food balance table”, obtained from FAO statistical database. This provides a complete picture of food supply including both domestic production and food aid in a unified framework and hence enabling one to undertake a reasonable comparison. Fig. 1 below is constructed by bringing annual food balance tables for Ethiopia for the period 1993–2002. In order to show the relative importance of cereals and non-cereals in compositions of both domestic production and food aid, the data is categorised into three main groups: wheat, cereals, and non-cereals. The ratio of each of these categories from total food consumed during the corresponding year is computed to indicate its relative importance in the total food demand and supply during a given year. This ratio would give a more realistic picture of shortfalls from total need than the ratio of food aid to production in each category.

Fig. 1 displays food balance for Ethiopia by source of supply and category of food items during 1993–2002. It is constructed from FAO food balance tables for the period. Panel (a) presents the ratio of the three categories of food aid from aggregate food consumption. For each food group (i.e., wheat, cereal, and non-cereal) the corresponding bar stands for the ratio of each food aid category in total food consumed in Ethiopia during that year. The bar labelled “total” measures the proportion of food aid in aggre-

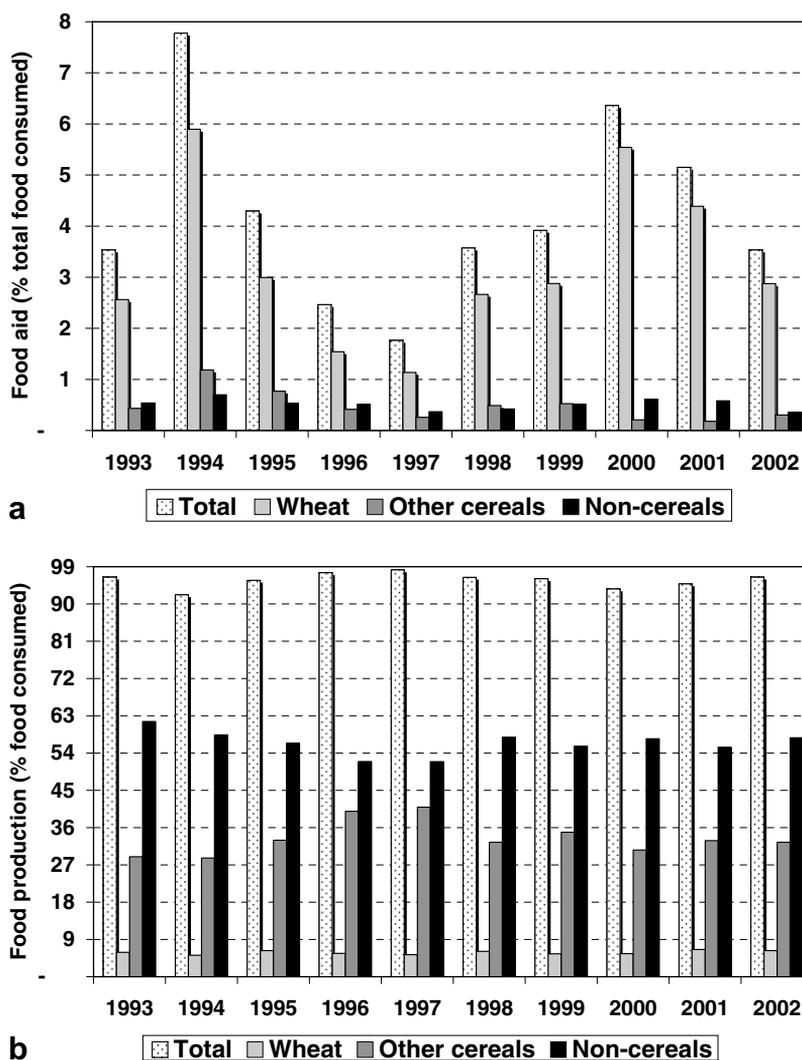


Fig. 1. Food balance for Ethiopia, by source of supply and category of food items, 1993–2002. Panel (a): Structure of food aid. Panel (b): Structure of domestic food production.

gate food consumption. For instance, the tallest bar for 1994 indicates the highest food aid ratio during the period under discussion, when food aid accounted for about 7.8% of total consumption and wheat accounts for much of this proportion. The composition of food aid remained more or less the same during the period but the proportion of food aid in total domestic food consumption varied considerably from year to year. The smallest ratio of food aid was in 1997, a particularly good year, when food deficit was only 1.8% of the total required level of consumption, near self-sufficiency in food production during that year. On average, food aid accounted for about 4.2% during

the period under discussion.¹ Wheat accounted for the largest proportion (3.3% of food supply and 75 % of food aid) per year, while the corresponding figures for other cereals and other food stuff was 0.48% and 0.51% of food consumption (12% and 13% total food aid), respectively.

Panel (b) shows domestic food production as a ratio of total food consumed for the same years and categories as in panel (a). If we compare the two panels, it becomes clear that there are contrasting patterns between the two sources of food supply. Contrary to Clay and others' claim that cereals constitute 80% of food consumption in Ethiopia, the FAO food balance estimates indicate that this proportion is only 44% domestic food consumption. The remaining proportion is accounted for by non-cereals such as *enset* (a perennial crop commonly referred to as 'false banana' tree), root crops, and livestock products. It is important to note that wheat consumption represents only 6% of total food consumed in Ethiopia, although it constitutes a bulk of food aid.

The disincentive hypothesis and its applications to food aid in Ethiopia

There are considerable dissimilarities between the compositions of food aid and domestic food supply, as shown in Fig. 1. Critically, although wheat constitutes a substantially large proportion of food aid, about 80%, it accounts for only a small proportion of total food production and consumption in Ethiopia, on average about 6% during 1993–2002. The contrasting feature between the composition of food aid and domestic food supply has serious implications to understand whether or not food aid has disincentive effects on Ethiopian agriculture.

A number of studies have recently revisited the disincentive hypothesis using data from Ethiopian household surveys. They employed similar methods typically econometric analysis and arriving at more or less similar conclusion that food aid has no disincentive effect on domestic food production (Abdulai et al., forthcoming; Levinsohn and McMillan, 2004). In an article entitled "Does International Food Aid Harm the Poor?" Levinsohn and McMillan (2004) employed a partial equilibrium analysis, deriving supply and demand functions for wheat. Their analysis proceeded as follows:

...we find that the price of wheat would be \$295 per metric tonne in the absence of food aid compared with an average observed price of \$193 per metric tonne in 1999. We also find that the price increase would lead to an increase in producer surplus of around 125 million US dollars and a reduction in consumer surplus of around 159 million US dollars. Overall, the increase in the price of wheat leads to a net welfare loss of approximately 34 million US dollars. There were roughly 12 million households in Ethiopia in 1999 of which 4.3 million reported spending money on wheat and 0.8 million reported earning income from wheat. Therefore, *on average*, the loss in consumer surplus works out to roughly 37 US dollars per household per year for households that consume wheat and the gain in producer surplus works out to

¹ This figure is less than half of the 10% deficit we have quoted earlier for it is widely reported in the food aid literature on Ethiopia. The reason for this difference is that some how it has become a tradition among researchers on food aid to Ethiopia to express food aid as a ratio of domestic production rather than as a ratio of the required level of consumption. We believe that a realistic indicator of national food deficit and hence food aid requirement is given by the ratio of food aid to total consumption requirement.

roughly 157 US dollars per household per year for households that sell wheat. In Ethiopia, where the poverty line is roughly 1057 Birr (\$132), these effects are quite large... There are more buyers than sellers of wheat. This is important because it means that at all levels of living standards, more households will benefit from food aid (a reduction in wheat prices) than will be hurt (p. 22).

It is not surprising that the authors chose to confine their analysis to wheat because this commodity constitutes a bulk of food aid. However, the conclusion that emerged from their analysis seems to be rather hasty on several grounds.

First, the price effect of removing food aid was estimated using arbitrarily chosen elasticity parameters. The authors used own-price supply and supply elasticity of 0.45 and -0.6 borrowed from Soledad Bos (2003) and Regmi et al. (2001), respectively. Critically, these estimates were made for *cereals* yet the authors chose to apply them to *wheat*. However, Regmi et al. (2001) have clearly stated that own-price elasticity values increase considerably, most particularly in low-income countries, as one disaggregates larger commodity groups such as cereals to a particular food crop such as wheat. They say that: “It is possible for the lowest income groups of countries, price changes may result in substitution among food within a particular group. For example, when the price of rice increases, poorer consumers may choose to consume corn or sorghum...” (p. 20). If the price of wheat increases, say because of food aid being abolished, then Ethiopian households would have ample choice as they can shift their consumption to other cereals like teff, by far the most popular cereal among Ethiopian households. This means that a relatively larger parameter would give lower price increases if food aid was removed and hence lower welfare loss to consumers.

Second, it could be argued that there is an oversight related to cross-price elasticity of demand. The authors asserted that only net-sellers of wheat, which they estimate at 12% of households, would be hurt by the continued supply of food aid. However, it is reasonable to expect that households who get wheat for free via food aid would shift their consumption away from other cereals (teff, maize, and sorghum). Consequently, the adverse effect would be felt by producers of these substitute products with the extent of negative effects in each case depending on the closeness of their substitutability for wheat.

Third, in-kind food aid is expected to have some impacts on the structure of farming activity of rural households, particularly in the context of subsistence farming. If a certain group of rural households are net-buyers of a particular cereal like wheat, then in all probability one can only assume that they must have produced and sold some other cereal (teff, maize or sorghum) or other agricultural products. Thus, if net-buyers of wheat are provided with freely distributed wheat, this is expected to have implications for their decision to engage in other farming activities, by cutting back on producing for market. Abdulai et al. (forthcoming) and Hoddinott (2003) used Ethiopian data to examine labour supply effects of food aid. Their results were mixed, which were summarised as follows:

All negative effects of food aid disappeared, with two *exceptions*. Food aid received a year ago reduced the likelihood of growing enset [a perennial crop, that constitutes a substantial proportion of Ethiopian household diet in Southern and South-western regions] but by a trivial amount. And while contemporaneous access to food aid reduced time spent on permanent and non-permanent crops, the magnitude of these

effects was offset by the increased amount of labour on off-farm labour that food aid receipt induced (Hoddinott, 2003, p.2). [Emphasis and description in the bracket added]

Most importantly, whilst the disincentive hypothesis is mostly concerned with what happens to agricultural production and hence labour supply to agriculture, Hoddinott (2003) seem to insist counting on any food aid related off-farm employment activities such as food-for-work type public projects to disprove the disincentive hypothesis. In our view, if food aid induces farming households to get increasingly engaged in off-farm activities, then this would rather support the disincentive hypothesis than disprove it.

The CGE model

Overview

Computable general equilibrium models have gained popularity in developing countries as powerful methodological tools for policy analysis in various fields of economics. Wobst (2001) and Dervis et al. (1982) provide interesting summaries of CGE applications in LDCs. Arndt and Tarp (2001, p.108) observe that “despite vastly increased capacity to conduct applied or computable general equilibrium (CGE) analysis in recent years, relatively little CGE analysis has been conducted on food aid issues”. Those that have been applied on food aid and its impacts on a recipient developing countries have mostly focussed on demand side impacts such as assessment of food aid requirements (Wobst, 2001; Riaz, 1992; Sadoulet de Janvry, 1992) and impacts of different distribution schemes (Arndt and Tarp, 2001).

Whether or not food aid has depressing effects on domestic production has not yet been examined using CGE application. However, a CGE model is a suitable instrument to analyse the effects of exogenous shocks such as drought and famine related in-kind food aid that cause not only changes to consumption levels but also supply side impacts. In this context, if supply conditions are non-passive, or if we shift our attention to supply effects, then we require a modelling approach that fully captures adverse impacts on the supply side. Moreover, since they are built upon the input–output basic data, CGE models are capable of accommodating inter-sectoral linkages in a theory-consistent manner; dealing with the endogeneity of relative prices (and therefore competitiveness) and quantities as all markets equilibrate simultaneously.

The formulation of the model applied in this study closely follows the theoretical structure of a standard CGE model (Hosoe and Hashimoto, 2004; Lofgren et al., 2002; Gelan, 2002). Logren et al. (2002) provides detailed descriptions of the theoretical structure and algebraic formulations of system of equations for such standard CGE applications. This study benefits from a social accounting matrix database recently constructed by the World Bank.² World Bank (2005) provides a conceptual basis for this macroeconomic modelling framework that has placed emphasis on food aid and its potential impacts on domestic production. Taffesse and Ferede (2004) discuss the structure of a social accounting matrix

² A collection of background papers for this macroeconomic modelling project as well as a detailed database, including the social accounting matrix are available on the World Bank website: <http://siteresources.worldbank.org/INTETHIOPIA/Resources/PREM>.

for 2000 as a base year, constructed by the World Bank modelling project.³ The structure of the model we have formulated is shown in [Appendix I](#); where details of activity and commodity disaggregations; household types; and functional forms employed at different levels of aggregation. Here we limit our discussion to highlighting key features of the model. Three most important aspects in specifications of CGE models applied to food aid and its effects are discussed separately in the subsequent sections. These are the importance of transport and trade margins in food production and distribution; the role of subsistence consumption; and the treatment of food aid in model specification.

Transport and trade margins

EU (2002) stated that Ethiopia has one of the least-developed road networks in the world and the lowest road density in Africa with only twenty per cent of the land area being located within a ten km range of an all-weather road. [Dinka and Gelan \(2005\)](#) established important links between road accessibility and food security challenges in Ethiopia. [Gebre-Madhin \(2001, pp. 83–84\)](#) reported that in the Ethiopian grain marketing “transaction costs are a significant share of the total set of costs, including physical marketing costs, representing 19% of total costs. However, traders in surplus and deficit markets diverge considerably, with transaction costs taking a higher share in the deficit markets, possibly because of the greater risk of commitment failure in purchasing grain of unknown quality. Thus, transaction costs might be more significant in trader’s choice to use brokers in the case of distant purchases”.

In the recently constructed Ethiopian SAM, on which this CGE model is based, there were particularly large trade and transport margins in primary agricultural sector. About 61% of total trade and transport margins generated in the economy during that year were incorporated to agricultural prices while 45% of this was added to food prices. For every one Ethiopian birr worth agricultural produce sold directly to a consumer, 13 cents was trade and transport margin. Given these details provided by the SAM, the marketing margins are carefully accounted for through the price formations for different markets. For instance, the purchasers’ price of a particular commodity, c , is specified as: $PD_c = PS_c(1 + tx_c) + \sum_{c'} PQ_{c'} ts_{c'c}$; where $ts_{c'c}$ denotes transaction services of commodity c' used per unit of commodity c ; $PQ_{c'}$ is price of transaction service c' ; tx is sales tax; PD is purchasers’ price; and PS is producer price. Although ts enter the price formation in fixed proportions, PQ and related variables for trade and transport services producing activities are endogenous in this model. In this model, the transport and trade margins are specified following [Logren et al. \(2002\)](#).

The importance of marketing costs in explaining Ethiopia’s food crisis can by no means be overemphasised. Although the condition of food crisis in Ethiopia has frequently caught attention of the international community for much of the last three decades, donor agencies and policy-makers have only just begun to recognise policy implications of spatial mismatches between production and consumption patterns. This has given rise to a perverse situation whereby chronic food shortage in some regions and food surplus in others have co-existed in the same country. For instance, a report by [UN-EU \(2002\)](#) stated that,

³ The model was implemented using a GAMS (General Equilibrium Modelling Systems) programming language. The full set of model equations both in Algebraic and GAMS formats are available upon request.

many farmers in the western regions of the country have experienced bankruptcy following the dramatic falls in the price of grain during recent years. Favorable rains in the central and western highlands led to a higher than average harvest, market prices plunged by as much as eighty per cent. Consequently, many farmers were unable to recover the cost of the seed and fertiliser, often purchased with loans attracting heavy interest payments.

It is straightforward that much of such an anomaly is explained by the existence of extremely high trade and transport costs in the Ethiopian food distribution system. High transport and trade margins means large divergences between the price paid at the source of supply, the farm gate, and the price paid by the final consumer. According to [Arndt and Tarp \(2001, pp. 109–110\)](#) “high market costs reflect: large distances between production and consumption centers, poor infrastructure, high costs of capital which result in high costs of holding inventories, and high risks associated with trading activities combined with limited opportunities for diversification”.

Subsistence consumption

If farm gate prices and consumer prices diverge significantly because of high marketing margins, then this would have implications for food production and consumption. [Arndt and Tarp \(2001, p. 110\)](#) observe that “rather than sell at a low price and purchase at a high price, households, particularly rural agricultural households, can opt to consume at least some of what they produce. In this manner, marketing margins are avoided.” This means a large wedge between producer and purchaser prices would inevitably create disincentive to produce for market, i.e., high marketing costs encourage subsistence production but discourage production of marketable food surplus. In the case of Ethiopia, [Gebre-Madhin \(2001, p.82\)](#) estimates that “a relatively low share of domestic production is marketed, 28% in a good harvest year such as 1995/96, and an even lower share goes through private marketing channels, only 18% of total production. Thus, the scope for increasing the scope of market participation both in volume and in value-added remains high.” In this circumstance, food aid would simply encourage production for subsistence and reduce production of marketable surplus even further, making this situation worse over time.

In CGE applications, the most appropriate functional form to specify subsistence consumption is the linear expenditure system (LES). In this formulation, the initial task is to estimate the subsistence level of consumption. Then the cost of minimum consumption, savings, taxes, and transfers are deducted from household income to obtain supernumerary income, which is the amount of income left after all necessary expenditures are met. The supernumerary income is then allocated across all marketed commodities according to the share parameters. [Powell et al. \(2002\)](#) derived a simplified algebraic relationship between the variables; and [de Janvry and Sadoulet \(2002\)](#) provided the necessary elasticity parameters for estimating the subsistence consumption level. These are presented in [Appendix II](#).

Treatment of food aid in model specification

In many CGE applications, food aid enters the model via the composite commodity balance equation. [Wobst \(2001\)](#) and [Arndt and Tarp \(2001\)](#), for instance, employed the following relationships:

$$QS^* + QFA = QFD \quad (1)$$

Variables QS^* and QFD are, respectively, domestic supply and final demand, the latter includes household, government and investment consumptions and exports. It is important to explain three interrelated points underlying Eq. (1). First, it is assumed that food aid arrives only after crop failures caused by a drought or a natural disaster. In order to compensate for losses resulting from such natural disasters, food aid for domestic markets is modelled as “a complementary market supply through an exogenous commodity injection” (Wobst, 2001, p. 74). This means that output after harvest failure, QS^* , plus food aid, QFA , would restore commodity supply in the domestic market to the level of a normal year, QS . Consequently, domestic consumption would remain unaffected at the level before the crop failure, QFD . A modelling trick commonly employed to simulate harvest failure is to reduce efficiency parameter for food crop production in such a way that output would be reduced by the estimated amount of decline in food production.

Eq. (1) simply specifies food aid requirements after food crisis caused by a natural disaster. However, it does not seem to capture the essence of a range of crucial issues discussed in the food aid literature. Firstly, there is a widely held view that food aid to developing countries does not necessarily reflect extents of imbalances between demand and supply in the domestic food markets but rather the situation of grain prices in the world market (Lowder, 2004; Webb, 2005). The most obvious cases are programme food aid and project food aid. If this is the case, then it would not be always necessary to apply the efficiency shock to the production function to reduce output to estimate food aid requirements. Secondly, the notion of ‘tied food aid’ has received a good deal of attention in that in-kind food aid rules out any other option, including purchases from local sources (especially when food deficit and surplus regions exist in the same country or in a neighbouring country). Thirdly, a specification of food aid in CGE models should pay attention to disincentives that tied food aid causes to domestic food production. This requires distinguishing between in-kind donations and cash payments that enhances purchasing power of households. We bring these different strands of the literature in a single framework and formulate an alternative framework for entry of food aid in a general equilibrium model specification:

$$QS + QFA = QFD^* + CA \quad (2)$$

$CA (=QFA)$ stands for cash equivalent payments to households, so that household consumption would remain at the normal year level QFD which is equal to QFD^* plus CA (or QFA). In contrast to Eq. (1), domestic output in Eq. (2) is not necessarily a depressed level as food is assumed to be available either in the local, regional or national markets but purchasing power of households might have been reduced to less than normal level because of drought and crop failure in certain localities. In this circumstance, in-kind food aid could be understood as an additional quantity of grains to commodity market and hence increasing food supply (left hand side of Eq. (2)). For accounting purposes, to maintain the equality between the two sides of the equation, tied food aid could be registered as “double accounting entry”, in-kind food aid being added to commodity balance and then cash equivalent payments as transfer payments to households so that they would be able to buy the exact amount of grain added to the national market through in-kind food aid. Thus, given $QFD = QFD^* + CA$, a generalised form of food aid specification in a CGE model could be formulated as follows:

$$QS = QFD - QFA \quad (2')$$

Eq. (2') determines total domestic demand for domestic output as a difference between total domestic food consumption less food aid. The crucial point is that elimination of tied food aid would mean that $QFA = 0$ but QFD would remain at normal level due to cash payments and hence this would simulate domestic production and hence QS would increase. However, in-kind food aid inevitably reduces demand for domestic food output.

It is important to note that the specification of food aid discussed above represents a fundamental departure from standard CGE application. Existing CGE models employ the Armington assumption to aggregate imported and domestic products. Critically, this implies that food aid is an imperfect substitute to domestically produced food. Imperfect substitution suggests a notion of “non-competitiveness”, which effectively leads one to believe that food aid may not be competitive to domestic food output. However, in this model, the food aid is specified as a “competitive import” or a “perfect substitute”. This means that food aid reduces domestic demand for domestic products.⁴ As far as we are aware, the notion of “competitive imports” has not specifically been applied to food aid but it has been commonly employed in the structuralist CGE tradition (Taylor, 1993; and Taylor, 1983).

Simulation results

The social accounting matrix for Ethiopia (2000), the baseline database for this study, indicates that total value of food aid was 944 million Ethiopian birr. This has two components: food aid freely distributed to households (68%) of the total amount and food aid given to households who supplied labour services to public works in drought affected regions, food-for-work projects, accounting for (32%) of the total amount. The simulation experiment is limited to removing the former, leaving the latter category intact.

Two separate simulation scenarios were conducted. Scenario 1 examines system-wide impacts of eliminating freely distributed food aid. This simulates the effect of abolishing food aid when this is implemented without any cash aid equivalent. In the context of the conceptual framework given in Eq. (2), this means that both elements of entries in the tied aid accounting framework become zero, i.e., $QFA = 0$ and $CA = 0$. Scenario 2 eliminates in-kind food aid and replaces it with its cash equivalent. This means that in-kind transfer of food is not allowed in this scenario ($QFA = 0$) but cash equivalent is transferred to households so that they can buy food from domestic markets (CA). Simulation results from these scenarios reveal crucial differences between in-kind food aid and its cash equivalent.

Commodity market effects

Table 1 below shows commodity market effects of removing in-kind food aid in the Ethiopian economy. Column 1 displays base year values computed from the social accounting matrix. The base value 1.15 against food crops, for instance, represents farm gate price which is held at unity plus a 15% trade and transport margin. Similarly, the base value of 15,772 represents the total value (in millions of Ethiopian birr) of food crop produced during the base year.

⁴ This follows the simple Keynesian macroeconomic model, $E = C + I + G + X - M$, where E , C , I , G , X , and M are aggregate expenditure, consumption, investment, exports, and imports.

Table 1
Commodity price and output effects

	Base value	Scenario 1	Scenario 2
<i>Commodity price effects:</i>			
Food crops	1.15	2.49	2.55
Traditional agricultural exports	1.14	−0.71	−0.61
Non-traditional agricultural exports	1.14	−4.17	−3.21
Other agricultural products	1.14	−7.52	−7.81
Agro-industrial products	1.27	−0.07	−0.16
Other industrial products	1.16	−0.16	−0.68
Public goods services	1.00	0.74	0.65
Other services	1.01	−0.22	−0.14
<i>Commodity output (million Eth birr):</i>			
Food crops	15,772	2.16	4.49
Traditional agricultural exports	13,826	−0.44	1.65
Non-traditional agricultural exports	2558	0.62	2.80
Other agricultural products	2804	1.62	3.91
Agro-industrial products	6737	−1.68	0.81
Other industrial products	15,845	−0.90	0.11
Public goods services	7203	−0.15	0.42
Other services	24,098	−0.83	−0.17

Focussing on the commodity price effects, we note that prices of food crops, the sector that received the policy shock, increases in both scenarios, by 2.49% in scenario 1 and by 2.55% in scenario 2. This confirms the widely reported concern in the food aid literature that removing in-kind food aid would cause an increase in food prices and hence this would result in welfare deterioration particularly for households who are net buyers of food (Barrett, 2003; Levinsohn and McMillan, 2004). However, our simulation results indicate that the increase in the prices of food does not necessarily cause a decline in aggregate welfare (see Table 4). Whilst the excess demand in the food grain market is likely to raise the price of food crops, the feed-back effect of the food aid shock would cause equilibrium prices of other commodities to decline in both scenarios by more or less similar percentage points. There is a marked difference in the price effects between agricultural products and non-agricultural commodities, with negligible price effects on the latter but significantly larger price effects on the former. Within agriculture, price increase happens only to the agricultural commodity that received the shock, the food crops, but other agricultural products experiencing adverse price effects. The rates of price changes reflect the share of the commodity in household consumption, the formulation of which follows the linear expenditure system with minimum level of consumption for each commodity group (see Eq. (A.1) in Appendix II).

If we shift our attention to commodity output effects of the exogenous shock, we observe that output of most commodity groups increase from the base period. This means that the removal of food aid would have expansionary effects on most agricultural and non-agricultural sectors under each scenario. Food crops output increase by 2.17% in scenario 1 and by 4.5% in scenario 2. The other agricultural sectors would mostly experience expansion even under scenario 1, even when no cash payment accompanies food aid withdrawal from the system. When cash equivalent payment replaces in-kind food aid, however, the rate of expansion becomes significantly large under scenario 2. Non-agricultural commodity out-

put encounter marginal declines under scenario 1 but the situation improves under scenario 2 with most of these sectors experiencing positive changes.

Factor market effects

Table 2 below summarises effects of removing food aid on Ethiopia's factor market. The first rows display factor price effects. In this simulation experiment all factor prices and quantities were allowed to vary with equilibrium values of each variable being determined by interactions between demand and supply, except for the price of capital which is not allowed to vary on the ground that Ethiopia's interest rate remains fixed in the short-to medium-run. We allow factor quantities (land, labour, capital) to vary freely, this could be justified because of the existence of considerably high unemployment rate and uncultivated land in Ethiopian. In the subsequent section, factor rigidity and restrictive factor substitution possibilities will be jointly imposed to examine the extent to which model results would vary from those we report in the main simulation experiment in this section.

In this circumstance, a positive stimulus to the agricultural sector does not necessarily cause an upward pressure on factor prices. The simulation results show that factor prices remain more or less unchanged at the base period level. Whilst price of capital remain unchanged (by assumption) price of labour (imputed price of family labour as well as wage labour) declines but only very slightly while imputed land rent rises marginally from the base year value. As we expect, the positive stimulus to the agricultural sector would have

Table 2
Employment and value-added effects

	Base value	Scenario 1	Scenario 2
<i>Factor prices:</i>			
Family labour	1.11	0.02	-0.04
Wage labour	1.90	-0.31	-0.56
Capital	0.33	0.00	0.00
Land	0.48	0.00	0.74
<i>Factor demand:</i>			
<i>Agriculture:</i>			
Family labour	17,621	1.14	4.34
Wage labour	2332	0.32	3.63
Capital	16,655	0.94	3.71
Land	12,011	2.08	1.42
<i>Non-agriculture:</i>			
Family labour	1303	-1.32	-0.25
Wage labour	3817	0.36	1.93
Capital	66,554	-0.89	-0.38
<i>Sectoral value-added (Million Eth birr)</i>			
Mixed farming	24,022	2.05	4.15
Livestock production	5624	-1.71	0.32
Small scale manufacturing	1650	-1.58	0.78
L&M scale agro-processing	1650	-1.66	1.00
L&M scale other manufacturing	901	-0.80	0.26
Other industries	244	-0.82	0.23
Services	20,559	-0.56	0.16
Total	68,158	0.11	1.63

a ripple effect; causing the quantity of factors employed in production to rise for most factors and in both scenarios. While agricultural land use increases modestly under both scenarios, family labour and wage labour increase by relatively large percentage points under scenario 2.

The lower part of Table 2 presents effects of the policy shock on aggregate value-added with details for the producing sectors. Total value-added, which represents income measure of GDP, increases in both scenarios. Under scenario 1, the positive GDP effect is entirely explained by the relatively large increase in mixed farming sub-sector of agriculture. Two main factors explain why mixed farming benefits from the policy change even with no cash equivalent payment to households. First, it has to be noted that mixed farming is the sector which produces most food crops, and is directly affected by food aid. With the removal of food aid, there would be excess demand in food market, and hence prices of food crops increase from the base period level, as indicated in Table 1. Consequently, this causes a positive stimulus to mixed farming sector, and hence employment and value-added to expansion. Second, in the base year database, the social accounting matrix, food crops constitute a considerably larger proportion in household consumption expenditure budget than any other commodity group. Given the LES, a functional form with a certain minimum consumption parameter for each commodity, this level is calibrated using the budget share parameter as key determining variable. Therefore, when the price of food crops increase but purchasing power of consumers is effectively reduced, households tend to shift demand away from most other commodities to food crop which has a relatively large budget share hence its contribution to household subsistence consumption is relatively high.

Under scenario 2, most sectors experience positive changes. Total value-added rises by 1.63% and this is largely explained by a relatively large increase in agricultural value-added, a rise by 4.15%. In this case, since food aid elimination is accompanied by cash equivalent payments, the food price effect of the policy shock would have minimal effect on sectoral expansion via household budget constraint. Incidentally, the fact that mixed farming experiences larger expansion under scenario 2 than scenario 1 indicates that the policy shock operating via household budget constraint affects all sectors including food crops.

Aggregate effects

Macroeconomic effects

Table 3 illustrates the macroeconomic effects of the shocks. Scenario 1 shows that reducing or removing food aid from the system would have an adverse macroeconomic effect. If food aid is eliminated without any cash equivalent payments to maintain purchasing power of households, then Ethiopia's gross domestic expenditure (GDP) would decline by 0.97% from the base period level and all components of domestic absorption would contract in this scenario.

The simulation results in scenario 2 reveal a crucial point that removal of food aid from the system could have relatively large expansionary effect on the Ethiopian economy as long as the removal of in-kind food aid is replaced by cash equivalent aid. As it was shown earlier, the removal of food aid stimulates domestic production while transfer payments to households maintains purchasing power of households. These effects would reinforce each

Table 3
Macroeconomic effects of food aid

	Base value (Million Eth birr)	Change from base value (%)	
		Scenario 1	Scenario 2
Consumption	43,728	-0.97	1.64
Government exp	7203	-0.15	0.42
Investment	19,473	-0.80	0.88
Exports	7307	-0.98	-3.76
Imports	15,330	-0.49	2.36
Real GDP	62,381	-0.94	0.45

other and have a multiplier effect on the domestic economy. Consequently, real GDP increases from the base period levels but only marginally. However, exports decline in both scenarios mainly because cash transfers to households would stimulate domestic demand and hence this would encourage production for domestic markets than for exports. Similarly, the removal of food aid would cause an increase in prices of agricultural products (Ethiopia's main exports) and hence demand for exports would fall. Apart from this adverse effect on the external sector via reduction of exports and increase of imports, the replacement of food aid by cash aid is expected to have an expansionary effect on the Ethiopian economy.

Welfare effects

Given that the consumer price index is the numeraire for this model, the aggregate effect of removing food aid on household or private consumption given in Table 1 above change by similar order of magnitude as the total welfare effect measured by equivalent variation (EV) in Table 4 below. Aggregate welfare declines under scenario 1 but it improves under scenario 2. Additionally, Table 4 reveals distributional effects across household groups. On the one hand, it is crucial to note that farm households experience negligible welfare loss under scenario 1 and the largest welfare gain under scenario 2, an increase by 1.91 from the base period. The reason is that food aid competes with domestic agricultural output and hence its removal would stimulate the agricultural sector under all scenarios (see sectoral details in Tables 1 and 2 above).

On the other hand, contrary to the widely held view in the food aid literature, the simulation experiments indicate that it is entrepreneurs, not farming households, who benefit from the existence of food aid in the system mainly via effects on costs of production. Accordingly, entrepreneurs would not only experience the largest welfare decline under scenario 1 (a drop by 5.72%) but also encounter a marginal welfare loss under scenario 2 (a drop by 0.42%). Wage earners experience welfare deterioration only under scenario

Table 4
Equivalent variation on household consumption or change in household welfare

	Scenario 1	Scenario 2
Farm households	-0.09	1.91
Wage earners	-1.71	1.82
Entrepreneurs	-5.72	-0.42
Total	-0.98	1.64

1 (–1.71%) but their welfare improves in scenario 2 (1.82%). Welfare changes for the wage earner households group is mostly related to income generation because of the policy effect sectoral employment levels.

Whilst discussing the welfare implications of cash transfers, it is important to keep in mind the possibility of regional differences in food price increases. For instance, [Kebede \(2006\)](#) compared findings from Ethiopia's new Productive Safety Net Programme (PSNP) in two districts. The findings of this study indicated that if cash transfer programmes are to be successful, then they require a range of complementary measures which may include interventions to ensure the availability of food in local markets.

*Sensitivity analysis*⁵

The simulation results reported in the preceding sections were obtained by calibrating the model and replicating the base year SAM as well as supplementary data sets related to factor demand and supply. Additionally, exogenous elasticity parameters were utilised in the calibration process. It proves useful to examine the extent to which simulation results reported and discussed in the previous section would be sensitive to variations in sizes of the exogenous elasticity parameters. To that effect, we turn our attention to the sensitivity of key variables to changes in elasticity parameters used at the calibration stage. Four sets of CES and CET elasticity parameters⁶ were used to implement the model (see [Appendix I](#)). These were constant elasticity of factor substitution (σ_f); commodity output transformation (σ_c); and import aggregation also known as the Armington aggregation (σ_q).⁷

The simulation results would also depend on factor market assumptions, the degree to which factor supplies are allowed to vary in response to the exogenous policy shock. While reporting factor market effects of removing in-kind food aid, we discussed that the simulation experiments were undertaken by allowing factor supplies and prices to vary except for the price of capital. However, it is necessary to impose some degree of factor constraint and examine the extent to which this change would make model results to deviate from those reported earlier. Accordingly, we impose capital supply constraint, i.e., keeping capital stock at the baseline level but then allow price of capital to vary together with prices and quantities of other factors of production. In the Ethiopian condition, we believe that it is more realistic to assume scarcity of capital than that of labour or land.

Additionally, the model is implemented with sectoral efficiency parameters calibrated from the base year data and the simulation results reported earlier were obtained by holding this parameter values constant. In this section, we assume a 10% efficiency improvement in the transport services providing sectors and then implement this efficiency shock together with the food aid shock applied in the previous section.

⁵ The author is grateful to an anonymous referee who provided insightful comments and stimulated the discussion in this section.

⁶ CES and CET stand for “constant elasticity of substitution” and “constant elasticity of transformation”, respectively.

⁷ The other functional relationship displayed in [Appendix I](#) is related to “export transformation” (σ_t). However, in the base year database, i.e., the SAM, there was no export for “food crop”, the commodity category that is subjected to the policy shock in this study. Thus, there is no need to undertake sensitivity analysis varying this parameter.

Table 5
Sensitivity of simulation results to variations to substitution elasticity parameters

	% Change from base value	
	Food production	GDP effect
<i>Factor substitution (σ_f)</i>		
0.4	3.7570	0.8808
5.0	4.4926	1.6347
8.0	4.6268	1.7022
<i>Output transformation (σ_a)</i>		
0.4	4.3142	1.5314
2.0	4.4926	1.6347
4.0	4.5437	1.6591
<i>Import elasticity (σ_c)</i>		
0.4	4.4970	1.6366
2.0	4.4926	1.6347
4.0	4.4876	1.6324
10% improvement in transport services	9.2170	7.1511

Table 5 below displays a summary of sensitivity analysis, separately presented for three sets of elasticity parameters and efficiency parameters. We begin by varying elasticity parameters around the values implemented under the main simulation set-up for which results were reported under scenarios 1 and 2 in the preceding section. In each case, we vary parameter values from the main simulation, given in bold fonts. In the baseline database, the SAM, it was reported that food crops were produced by two agricultural sub-sectors, categorised as “peasant farming – highland mixed” and “peasant farming – lowland mixed” (see Appendix I).

For these sectors, the factor substitution parameter, σ_f , was held at 5.0 in the main simulation. Food production and aggregate GDP effects of replacing in-kind food aid with cash payments (reported under scenario 2 of the main simulation) were 4.49% and 1.63% increases respectively. When the parameter values were reduced to 0.4 for each food producing farming sectors, and holding their capital stocks at the baseline values at the same time, then the positive impact on food output and GDP become lower, 3.8% and 0.9%, respectively. This means that even when the model was constrained, limiting factor supply as well as factor substitution, the replacement of in-kind food aid with cash payment would still yield positive overall impacts indicated by increases in food production and aggregate GDP. Additionally, if we keep capital stock at the baseline value, but assume a better factor substitution possibility than the main simulation set-up, i.e., raising substitution elasticity value from 5.0 to 8.0, then as we expect, the expansionary effect of the policy shock becomes even larger than the main simulation results. Food production would increase by 4.6% while aggregate GDP would rise by 1.7%.

The commodity output transformation parameter measures the ease with which the farmers would be able to shift their activities toward food production in response to price incentives provided by the replacement of in-kind food aid by cash payments. The model was implemented with a value of 2.0 for this parameter in the main simulation. Reducing or raising the parameter value to 0.5 or 4.0 did not cause the impact of the policy shock on food production and aggregate GDP to vary from the main simulation result to any great extent. This result follows from our assumption related to factor supply in that as long as

there is some spare capacity in the economy, then a stimulus to the food producing sectors does not necessarily cause shifting resources from other activities.

Apart from food aid, commercial food import constitutes a negligible proportion of total food supply from abroad. As discussed earlier, food aid is specified as a competitive import, which is not subject to the Armington aggregation function, and hence variations in the import elasticity parameters caused a very small change from the main simulation for food production and aggregate GDP. Even then the small variations, the differences appearing only after the second decimal points, suggested the existence of an inverse relationship between the sizes of the parameter values and the positive stimulus that the policy shock is expected to have on food production and aggregate GDP. This means that if purchasers shift demand to imports away from domestically produced food stuff because of increases in food prices in the domestic market, then the policy shock may lead to a rise in imports. On the other hand, if consumers prefer local produce (a relatively low parameter value) then the positive impact of the policy shock could be even larger than results reported in the main simulation.

The last row of [Table 5](#) displays simulations results obtained by assuming a 10% efficiency improvement in the transport services producing sectors. In the baseline SAM the transport service producers are grouped into “public services” and “private services” (see [Appendix I](#)). Improvements in trade and transport costs would mean reduction the size of a wedge between supply and demand prices, hence providing incentives for producers and consumers in the domestic market. Consequently, if the removal of in-kind food aid and its replacement by cash payments is accompanied by reduction in transport costs, then this should provide a considerably larger stimulus to the domestic economy. Accordingly, a 10% improvement in the efficiency of the transport sector would cause food production to increase by 9.2%, more than twice the rate of increase in food production if only cash payment replaced in-kind food aid. The overall effect on the rest of the economy would be even larger, with the GDP effect of this efficiency improvement being given as a 7.2% increase, a considerably larger proportionate rise compared to the corresponding results reported earlier.

Conclusions

This paper has examined whether or not food aid has disincentive effects on agricultural production in Ethiopia. It employed a computable general equilibrium modelling approach, a suitable technique to account for feed-back effects of such policy shocks and the relationship between food aid and food production in Ethiopia. We have distinguished between tied food aid (that is in-kind food aid) and cash equivalent payments. Accordingly, the impact of the removal of tied food aid (in-kind transfers) was simulated in two scenarios: no cash equivalent transfer payments to households in scenario 1 and cash equivalent transfer payments to households in scenario 2. The motivation behind this simulation set-up was to isolate the disincentive effects of additional grain supply in the agricultural commodity market from the purchasing power problem of households.

The simulation experiments suggested that the impact of the policy shock on the food producing sector of agriculture, the sector that receives the exogenous shock, was positive in both scenarios. The removal of food aid generates a demand stimulus for agriculture and hence the food producing sector expands by 2.2% in scenario 1 and by 4.5% in scenario 2. It is interesting to note that the differential impacts between the two scenarios: the removal of

food aid has smaller expansionary effects in scenario 1 because of limited purchasing power of households or household budget constraints. In this scenario, the food crops sector was the only commodity group that experiences a positive impact with most other agricultural and non-agricultural sectors encountering adverse effects although mostly by negligible proportions. However, in scenario 2, when households receive cash equivalent transfer payments, then not only that the food sector experience a larger expansion but also most other sectors receive positive stimulus which comes via inter-sectoral multiplier effects.

The simulation results indicate that the overall impact of removing food aid is positive with significant expansion in factor employments in agriculture. Employment rises by 4% and 2% in agriculture and non-agricultural sectors, respectively. Moreover, agricultural land use expands by about 1.4%. In terms of aggregate macroeconomic effects, expenditure measure of GDP marginally rises by 0.45% and this is a net outcome of expansionary effects on household consumption and imports by (increases by 1.64% and 2.36%) but an adverse export effect, a decline by 3.76%. As we expect with most macroeconomic policy shocks, this shows a conflicting outcome from the policy shock occurring due to the removal of in-kind food aid, with its expansionary effect on the domestic economy causing imports to rise but exports to fall; because diversion of exports for domestic use would have an adverse consequences on Ethiopia's external current account.

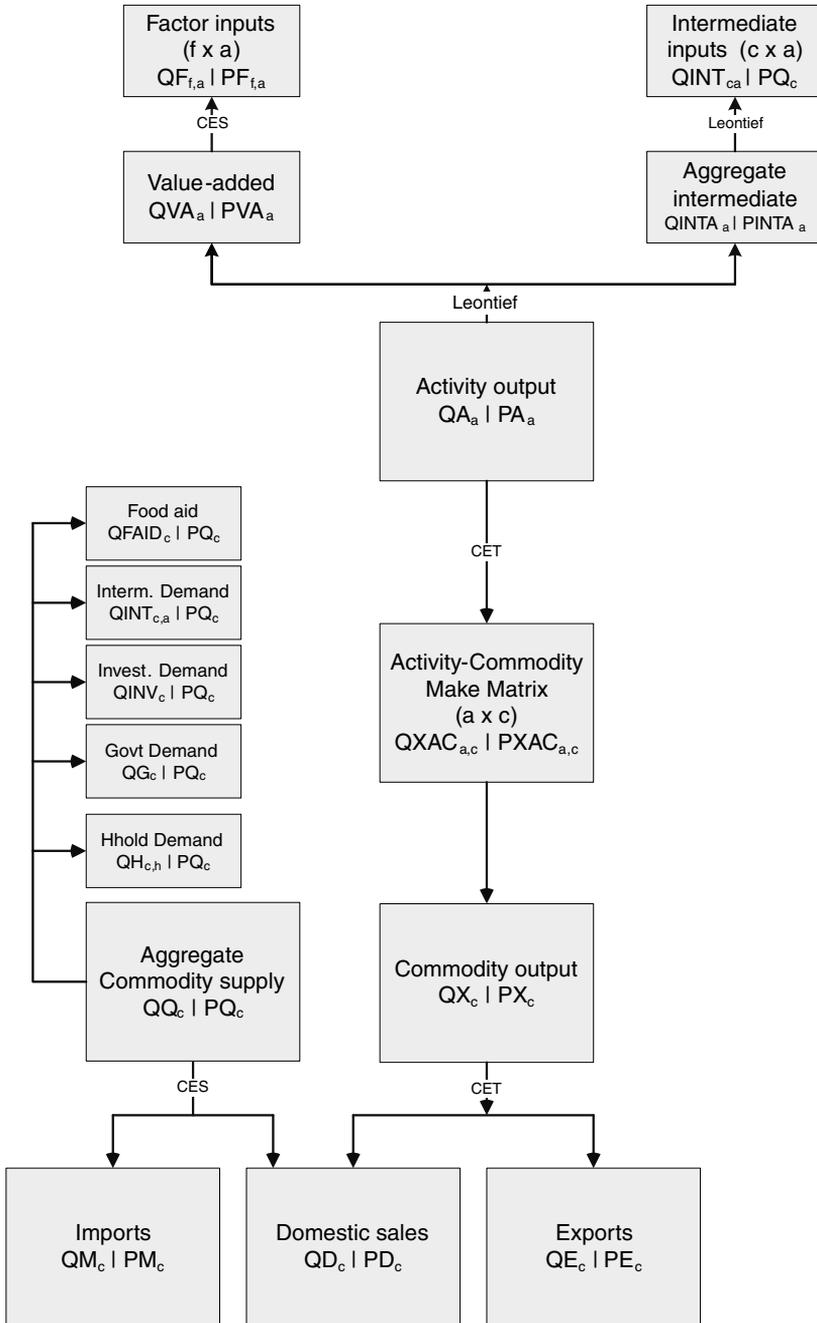
The finding of this study supports the disincentive hypothesis originally put forward by Schulz (1960). It is useful to compare our results with studies cited earlier that have used Ethiopian data, employed descriptive or econometric techniques and have rejected the disincentive hypothesis. For instance, the key to Levinsohn and McMillans' analysis was the assumption that food price in Ethiopia would increase considerably if food aid is abolished. They estimated this using a single commodity (wheat) demand and supply equations and predicted that food price would rise by 52.8% if food aid was removed from the system. However, we have employed a multi-commodity and multi-sectoral general equilibrium modelling framework, accounting for multiplier effects, and have shown that food prices rise by a maximum of 2.51%. The adverse effect of this increase in food price was outweighed by the positive effects to agriculture and the ripple effect of this throughout the economy.

Similarly, Levinsohn and McMillan have argued that food aid benefits poor households than rich ones but we have argued that actually the opposite is likely to be the case. Our simulation experiments have indicated that poor rural households are likely to benefit much more than any other household group. Also, "net-buyers" of food, such as wage earners, do not necessarily get hurt as a result of abolishing food aid, because the expansionary effect of removing food aid in terms of generating employment and income outweighs any adverse effect that comes from food price increases. In our simulation experiments urban entrepreneurs are the only group who encounter minor decline in welfare mainly because increase in agricultural prices would squeeze their profit margins as cost of raw materials increase.

It should be noted that the aggregate nature of the model used for this study allows only a cautious policy recommendation in favour of cash transfers. As noted earlier, if cash transfer causes regionally differentiated food price increases, then welfare losses may be suffered by groups of households who are not targeted. Firmer policy recommendations will be made with future improvement of this model with its disaggregation both spatially and across different beneficiary categories.

Appendix I. Description of model structure

Structure of production and flow of commodities



Subscripts

a	Activities (12)	1	Peasant farming – highland mixed
		2	Peasant farming – lowland mixed
		3	Peasant livestock production – pastoralists
		4	Handicraft and small-scale manu./processing
		5	Large/medium Agro-manufacturing – public
		6	Large/medium Agro-manufacturing – private
		7	Large/medium Other manufacturing – public
		8	Large/medium Other manufacturing – private
		9	Other industry n.e.c. – public
		10	Other industry n.e.c. – private
		11	Service – public
		12	Services – private
l	Commodities (8)	1	Food crops
		2	Traditional agricultural exportables
		3	Non-traditional agricultural exportables
		4	Other agricultural products
		5	Agro-industrial products
		6	Other industrial products
		7	Public goods services
		8	Other services
f	Factors (4)	1	Family labour
		2	Wage labour
		3	Capital
		4	Land
h	Households (3)	1	Farm households
		2	Wage earners
		3	Entrepreneurs

Appendix II. Calibration of a subsistence consumption parameter, γ_c

The algebraic manipulations involves transforming the familiar Linear Expenditure System (LES) given in Eq. (1) below into a more concise formulation, Eq. (3), which simplifies the estimation of the minimum subsistence consumption level. We heavily relied on Powell et al. (2002) for this derivation. The Engel elasticity parameter, E_{ch} , is give as a ratio of the marginal budget share, β_{ch} , and the average budget share, δ_{ch} , where c and h denote commodities and households.

$$P_c QH_{c,h} = P_c \gamma_{c,h} + \beta_c \left(EH_h - \sum_c P_c \gamma_{c,h} \right) \quad (\text{A.1})$$

Dividing both sides Eq. (1) by P_c and then re-arranging the terms with further manipulation of variables:

Table A1
Elasticity of income

Commodities (c) \ households (h)	Farm Hholds*	Wage earners	Entrep-reuners**
Food crops	1.130	0.958	0.915
Traditional agricultural exportables	1.130	0.958	0.915
Non-traditional agricultural export.	1.130	0.958	0.915
Other agricultural products	1.040	1.084	1.095
Agro-industrial products	1.010	1.022	1.025
Other industrial products	0.790	0.906	0.935
Public goods services	0.960	0.964	0.965
Other services	0.960	0.964	0.965
The Frish parameter (ω)	-4.000	-3.500	-3.000

Source: computed from de Janvry and Sadoulet (2002): Table A.3.3, Africa and Asia.

$$\gamma_{c,h} = QH_{c,h} \left[1 - \frac{\beta_c EH_h}{P_c QH_{c,h}} \frac{(EH_h - \sum_c P_c \gamma_{c,h})}{EH_h} \right] \quad (\text{A.2})$$

$$\text{This means that } \gamma_{c,h} = QH_{c,h} \left[1 - \Phi \frac{\beta_c}{\delta_{c,h}} \right] \quad (\text{A.2'})$$

where, $\Phi = \frac{EH_h - \sum_c P_c \gamma_{c,h}}{EH_h}$ and the Frish parameter, $\omega = (-\Phi)^{-1}$.

Eq. (2') shows the necessary relationships to estimate the subsistence quantity of commodity c required for consumption by household h, $\gamma_{c,h}$. $QH_{c,h}$ and $\delta_{c,h}$ can be computed from the base year database, the SAM. The Frish parameter and the marginal budget shares are obtained from the literature (de Janvry and Sadoulet, 2002). See Table A1.

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