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Semi-subsistence Farm Households and Their Implications for Policy Response

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ABSTRACT: *Semi-subsistence households play a considerable role in production and consumption in developing countries with a great part of consumption by these households is contributed by home production for home consumption (HPHC). However, this dual role of households in these countries as producers and consumers in a non-separable fashion has been under represented in most social accounting matrices for such countries and economy wide behavioural models (such as CGE models). This study bases itself on a SAM that has been developed for a typical developing economy which explicitly identifies a variant of HPHC and marketed commodities, and explicitly treats households as activities. The behavioural relationships in a CGE model, a variant of STAGE, are modified to conform to these features of semi-subsistence economies. Based on the modified SAM and CGE model, this study examines the implications for policy responses of semi-subsistence households with a focus on changes in border prices for commodities and trade and transport margins. The result shows that these policy and external shocks have considerable differential implications on the consumption and production decisions and welfares of different groups of representative households depending on the degree to which these households are insulated from the external and policy shocks as explained by their relative dependence on HPHC.*

Keywords: Semi-subsistence, farm households, price shocks, marketing margins, policy response, CGE model, simulations.

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1. Introduction

Agriculture still assumes a significant position in the overall economic performance of most developing countries in the world. This sector is, in many countries, dominated in terms of the number of farm households by semi-subsistence agriculture. A defining characteristic of such agriculture is that a substantial production is destined for home consumption, i.e., home production for home consumption (HPHC), which means that the 'basic' prices, i.e., farm gate prices of HPHC, are the same as the 'purchaser' prices, i.e., basic prices plus any trade and transport costs and any non-rebated commodity taxes. Consequently this means that to a greater or lesser extent these farm households are insulated from changes in border prices and/or market prices in urban centres; the degree of insulation depends upon the wedges between 'basic' and 'purchaser' prices, which in many areas in peasant economies exceed 50% of the purchaser prices. Moreover the opportunity costs of market purchases for semi-subsistence farm households are high due to their remoteness from markets, which reduces incentives to engage with markets and impacts upon the production decisions of these households.

The importance of HPHC is recognised in the System of National Accounts (SNA) where there are explicit guidelines on how products/commodities should be valued. However while such imputed prices are reportedly used by the national accounting agencies in many countries, it is rare for HPHC commodities are separately identified from the equivalent marketed commodities in published national accounts, and therefore it is not transparent how important they are in the consumption bundles of households in African households. A recently developed Social Accounting Matrix (SAM) for a typical semi-subsistence economy, Ethiopia, indicates that HPHC accounts for upwards of 40% of the value of total consumption in some rural households and hence for upwards of 50% of the 'volume' of consumption. These households are typically among the poorest rural households and therefore analyses of the implications for poverty and inequality in many developing African economies require explicit recognition of the decision-making processes of such households in economic models, which seem to be ignored in most economy wide behavioural models.

The model developed for this study, a variant of the STAGE model,[2] includes each farm household as both a production activity and a household. By definition HPHC commodity can only be consumed by the household if it is produced by the counterpart

[2] STAGE model is an open source model the code for which can be downloaded from www.cgemod.org.uk or is available by request from the developer.

production activity, which means there is a degree of non-separability between the consumption and production decisions. However each such household may also consume a marketed variant of the same commodity, e.g., teff, which is differentiated from the home produced variant but which requires the farm household to have acquired (cash) income by selling either products or factor services on the market. Total expenditures by such households are thus made up of expenditures on HPHC valued at basic prices, marketed products valued at purchaser prices and any household savings and taxes, which by definition must equal total incomes realised from HPHC and products sold, both valued at basic prices, plus any incomes realised by the sale of factor (primarily labour) services.

If such households engage in HPHC they are required to commitment a proportion of their factor endowments to HPHC, which means that the endowments available for the production of marketed products or sale on factor markets are limited. Consequently such households must engage in non-separable decision making with respect to their use of their own resources, i.e., their consumption decisions affects their production decisions and hence their factor allocation.

The adaptations to the STAGE model therefore extend beyond including paired activity and household accounts for rural households. The utility functions require extending to encompass decision-making between variants of commodities that are HPHC or purchased on the market. The activity/household's decision about whether to sell its outputs on the market or retain them for home consumption needs to be explicit, which means that the factor market clearing decisions by the households need to include the decision as to whether to allocate factor services to its own activity or for sale on factor markets. For simplicity this version of the model limits this decision to labour services. This approach to HPHC differs from the only other model known to include HPHC, i.e., the IFPRI standard model.

The modified STAGE model is calibrated using a SAM for Ethiopia developed as part of this research following the recommendations of the SNA on properly accounting for HPHC in situations where this phenomenon is considerable. The SAM is a development of series of SAMs developed by the Ethiopian Development Research Institute (EDRI) for the country since the late 1990's. The estimated SAM refers to the year 2010 and includes 39 commodity types of which 15 are HPHC commodities, 57 activities of which 35 are household activities, and 88 factor types of which 55 are labour classifications.

The simulations reported emphasise the extent to which *changes in border prices* and *trade and transport margins* are translated into changes in the production and consumption decisions of rural households and hence into rural welfare and poverty. Given the very large trade and transport costs faced by many rural households and the relatively limited interventions in border prices, reduction in trade and transport margins have much greater impacts on the decisions of rural households and their welfare. Importantly the analyses indicate that the extent to which rural households are insulated from the market means that changes in trade and border interventions have very limited impacts upon the decisions of semi-subsistence households. This conclusion is important since it suggests, strongly, that the welfare gains reported by studies of trade liberalisation and reductions in the domestic agricultural supports within developed market economies are likely to be large overestimates of the welfare implications for semi-subsistence households in many of the least developed economies.

The remaining part of the paper is organised as follows: While Section 2 describes semi-subsistence agriculture and the role of HPHC, Section 3 discusses non-separable decision making in semi-subsistence economies and Section 4 analyses the implications of non-separability under semi-subsistence economic settings for policy making. Section 5 follows up with introducing the database and modifications to and important features of the model. Section 6 presents simulations and discussion of results while the final section presents the implications of these observations for future analyses of trade liberalisation and reductions in the domestic agricultural support.

2. Semi-subsistence Agriculture and Home Production for Home Consumption

The rural economy still assumes a significant position in the overall economic performance of most developing countries in the world. It constitutes 11 and 17% of total output in sub-Saharan Africa and South Asia, respectively, with considerable disparity across countries. The share of agriculture in total value added is, for example, as high as 57, 53 and 46% in Sierra Leone, Liberia and Ethiopia, respectively (World Bank, 2013) as compared to less than 2% in most advanced economies. Moreover, a significant proportion of the population in most low-income countries still lives in rural areas, principally engaging in the agricultural sector. The statistics show that 63 and 69% of the people in sub-Saharan Africa and South Asia, respectively, are rural residents (World Bank, 2013).[3]

[3] About 70% of the population in low-income countries (UN classification) is still residing in rural areas.

Although agricultural practices can fall anywhere between complete subsistence production and complete commercialisation, the extreme of pure subsistence agriculture is less frequent even in the developing world. The most common farming practice in these economies is semi-subsistence agriculture, which can be understood as agricultural activity where operators predominantly relay on own factors to produce for own consumption with a possibility of engaging in the product and factor markets outside the household. According to Clifton and Wharton (1969) (cited in PROVIDE, 2006), however, this definition of semi-subsistence agriculture is not adequate as the definition tends to focus mainly on the characteristics of households and not on the technology they use and the external environment they are faced with. Hence, semi-subsistence agriculture should be broadly characterised in terms of multiple factors including output utilisation, input utilisation, level of technology, income and level of living of operators, and their decision making criteria.

In terms of output and input utilisation, semi-subsistence agriculture is characterised by a bulk of production directed towards satisfying subsistence consumption of the operators (Orden *et al.*, 2004) and high reliance on farmers own traditional inputs combined with a few purchased modern inputs produced and obtained from outside the farm. This farming system is characterised by mixed farming where farmers engage in the production of multiple crops together with vegetables and some level of livestock production. Semi-subsistence farmers also use traditional, simpler and less productive farming techniques (Azam *et al.*, 2012) which resulted in low level of incomes and widespread poverty. Lack of access to markets and constrained access to agricultural capital also limit these farmers to operate at subsistence levels restricting their capacity to be market oriented. The combined effect of these features is that households tend to consider their own consumption behaviours and the factors they own when making production decisions and that they take in to account what they produce, compare and combine these with marketed commodities when making optimal consumption bundles.

At the global level, semi-subsistence farm households account for no less than a quarter of the world's population (Mendola, 2007). The proportion should be considerably higher in Africa and other developing regions of the world. Moreover, semi-subsistence farming is the main source of employment, production, incomes and supply of commodities in rural areas and to the wider economies in countries dominated by traditional farming. Specifically, semi-subsistence farming contributes about 90% of agricultural output in sub-

Saharan Africa (Torero, 2011) and 75% of total agricultural production in East Africa (Salami *et al.*, 2010). In Ethiopia, peasant households contribute about 95.6% of total grain production and 96.7% of cereal production, the balance being contributed by commercial farms (CSA, 2011). These households are engaged in small-scale farming due to constrained access to farm lands. For example, more than two-thirds and 59%, respectively, of the holdings in sub-Saharan Africa (Torero, 2011) and Ethiopia (CSA, 2011) have average sizes of less than one hectare.

Home production for home consumption is an important feature of semi-subsistence households and constitutes a considerable share of production and consumption among the rural communities in developing countries. In terms of the share of HPHC in total output, Ethiopian annual agricultural sample surveys show that rural households consume about 60% of their output which can be as high as 90% for some commodities in some regions (see CSA (2010) for example). PROVIDE (2006) indicates that home production for home consumption constitutes to between 6.7 to 12.0% of total household incomes in selected districts of South Africa. Own production also constitutes a considerable part of household consumption expenditure in peasant economies. Deaton and Zaidi (2002) noted that home production contributes to about 16.8, 20.8 and 35.2% of total consumption expenditure in Vietnam, Ghana and Nepal, respectively. This reaches to 33.0, 32.0 and 55.0% of total food consumption in the respective countries. A recently constructed SAM for Ethiopia (Aragie and McDonald, 2014) also shows that HPHC contributes to about 40% of total consumption for some household groups in the country. Due to their semi-subsistence nature of production, households also depend on the local commodity markets to satisfy part of their consumption needs as, in most cases, they are not self-sufficient. To satisfy part of their cash requirements, members of the agricultural households also participate in non-farm employment activities.

The dual role of households as producers and consumers in a semi-subsistence manner with a possibility of dependence on the market for part of their consumption needs affects of the relationship between household income, consumption and saving as defined in the standard economic literature. While the standard assumption is that households have a given level of income which they allocate between consumption and saving given the prevailing price, in semi-subsistence economies, households incomes are not predetermined as producer price for a good moves together with consumer price since the household

allocates part of its output for home consumption. This observation leads to the discussion on non-separable decision-making in semi-subsistence agriculture.

3. Non-separable Decision-making in Semi-subsistence Agriculture

The dual role of households in developing countries as producers and consumers and the implications this has on households' decision making have been repeatedly investigated over the past couple of decades using partial equilibrium agricultural household models. Barnum and Squire (1979), Ahn *et al.* (1981) and works in the seminal book edited by Singh, Squire, and Strauss (1986) are some of the early works. There is, however, no consensus on the separability or not of these two roles, leading to a continuing debate in the academic literature. The equally evolving theoretical and empirical evidence provides mixed result although the scholarship that the two decisions are non-separable dominates.

Separability implies that the household behaves as a pure profit maximising when making production decisions. In this case the household's characteristics and consumption patterns do not influence its production decisions (what, how much, and how to produce). Household resource endowment has no effect on production as the household can freely employ factors from the market. Likewise, on the demand side, the household is assumed indifferent between home produced and marketed commodities in all respects including prices. Hence, under the case of separability, due to the independence of these roles, household's decisions are recursive and sequential where it first makes production decisions under the objective of pure profit maximisation and then makes consumption decisions given its income and market prices for commodities.

Household decisions are said to be non-separable if the household's consumption and production decisions are interdependent and non-recursive. In producing commodities, the household considers own consumption patterns and the factors it owns. Hence, the household's socio-demographic characteristics are relevant in making production decisions as compared to the case of separability. In deciding the optimal consumption bundle, the household considers home produced commodities, compares and combines them with marketed commodities. Hence, the household makes production and consumption decisions simultaneously.

Several researchers have pointed out various indicators of (non-) separability of consumption and production decisions by households. Separability is related to the neoclassical outcome where markets for products and factors exist and are complete. If

perfect markets for all goods and services exist, the household becomes indifferent between consuming own-produced and market-purchased goods (Lofgren and Robinson, 1999; Tzouvelekas, 2011) as prices are identical. The same is true in relation to the allocation of factors of production. On the other hand, household's production and consumption decisions are non-separable if markets fail (lack of markets or imperfect markets for outputs and inputs). Market failure might be caused by high transaction cost of delivering commodities and factors to markets. Households with significant transaction costs will opt for self-sufficiency instead of market participation (Key *et al.*, 2000) while others might be smoothly linked to product and factor markets.

Lofgren and Robinson (1999) included the perception of the household on whether marketed goods are imperfect substitutes to own produced ones. If the household perceives them as imperfect substitutes, it considers its consumption behaviour in deciding what and how much to produce, forcing production and consumption decisions to be made simultaneously. Henning and Henningsen (2007) added labour heterogeneity (size and type) as another indicator of simultaneity of production and consumption decisions even when the household particulates well in the labour market by selling and buying labour. De Janvry and Sadoulet (2003) also indicated that labour heterogeneity influences the household's decision to participate in markets, where market non-participation implies non-separability.

De Janvry and Sadoulet (2003) defined non-separability of household production and consumption decisions when household decisions regarding production (use of inputs, choice of activities, desired production levels) are affected by its consumption characteristics (consumption preferences, demographic composition, etc.). In most rural settings, households depend on own factors such as labour to participate in production activities causing non-separability. For example, in Ethiopia, about 24 percent of the households surveyed under the 2004 Ethiopian Rural Household Survey (ERHS) report output failure associated with illness of a family member. Some 18 percent of the households also report output decline due to lack of labour from the market. These statistics also imply non-separability between households' consumption and production decisions in the case of Ethiopian rural households.

Under a situation where households production and consumption decisions are non-separable due to one or more of the above factors, the approach of first determining production and next consumption in behavioural models is not realistic (Henning and

Henningsen, 2007) and deceives policy outcomes derived from such analyses. The implications of non-separability are taken on below.

4. Implications of Non-separability

The dual roles of households in a rural-economy setting have almost invariably by definition been included in agricultural household theoretical and empirical models. Most of these models recognise the non-separability of households' production and consumption decisions. The assumption that households participate in both production and consumption of commodities (that they undertake some HPHC activities) in a non-separable fashion influences outcomes of policies and external shocks. In such a situation, the net impact of a shock depends on its impact on both the demand and supply side or how it is going to affect consumption and production decisions of household units. It also depends critically upon the interplay between producer and purchaser prices (McDonald, 2010).

Before providing a brief survey of the literature on empirical evidence on policy implications of recognising the non-separability, it is instructive to discuss in brief theoretically how it can influence policy outcomes against what one can tell intuitively without acknowledging the simultaneity. Assume an agricultural pricing policy that pushes product prices up with the intension to increase agricultural supply. The expectation under the standard neoclassical assumption is that a rise in price for a normal good unambiguously reduces consumption as a negative income effect due to an overall rise in prices reinforces a negative substitution effect for the good whose price increases (since consumers substitute away from the good whose price increases). On the other hand, in (non-separable) situations where the household participates both in production and consumption of the good, the impact is not straightforward and is indeterminate. The overall/net impact of the change depends on the implications of the change on the household as a consumer and as a producer. As a consumer, it is adversely affected by a higher commodity price, but as a producer, its factor incomes from the use of own resources in the production process increases. The latter further stimulates commodity consumption counteracting the decline in consumption due to the rise in consumption expenditure. The net effect depends on the relative size of the expenditure (consumption) and income (production) sides of the change.

Another interesting application is the role of infrastructural policy aiming at bridging the seemingly high transaction costs in developing countries. Specifically, one may be keen to understand the impact of transaction cost on total and marketable supply. Ceteris paribus, with no significant transaction cost, the prices of home produced and marketed

commodities would be equal and the household would be just indifferent between consuming home produced or marketed commodities. As a producer, it can respond smoothly for market advantages. On the other hand, suppose a positive amount of transaction cost. This creates a wedge between market determined exogenous prices and endogenously determined household shadow/producer prices. The direction of the wedge depends on whether the household is a net-buyer or a net-seller (Minot, 1999). For deficit households, the value of the marketed commodity they buy is higher by the level of the transaction cost as compared to the producer price for home produced counterpart. For surplus households, the value they receive by marketing their surplus (producer price) is lower from the market rate by the level of the transaction cost discouraging supply. In both cases, households' optimal strategy would be self-sufficiency where production decisions take into account households' consumption behaviours.

The empirics also show that simulation results and policy implications under non-separability are different from under a case where production and consumption decisions are independent. Among the pioneering works on the issue is by Barum and Squire (1979). In testing the policy relevance of agricultural household models, Barum and Squire (1979) econometrically estimate selected consumption and production elasticities under the assumption of independence and interdependence between consumption and production decisions. Using information from rural Malaysia, they find results that justify farm household models with interdependence in the decisions. Specifically, they obtain elasticity values with a different sign and magnitude in the case of interdependence as compared to the independence assumption. Also, unlike what one can expect intuitively, they find an increase in own consumption of rice as rice prices increase.

The other policy issue that is subject to analysis using non-separable models is agricultural policy (Tiberti, 2011; Taylor and Adelman, 2003). Tiberti (2011) tests the impact of agricultural policy reforms in the case of Tanzania using a dynamic non-separable village-level CGE model under labour market failure and identifies that farm production features very low own-price elasticity of supply. Taylor and Adelman (2003) explore household level impacts of agricultural policy changes on production and incomes in Mexico under alternative rural-market scenarios and obtained different results.

Taylor and Adelman (2003) and Kuiper & van Tongeren (2005) tested the policy implications of non-separability using trade policy. For example, Taylor and Adelman (2003) applies a non-separable household model on the case of Mexico and finds that trade

policy shocks under imperfections in the labour and food markets have, contrary to expectations of policymakers, a remarkably small impact on production and rural incomes.

Henning and Henningsen (2007) and Glauben *et al.* (2003) test the impact of policy changes under the assumption of labour market imperfections. Henning and Henningsen (2007) used comparative static analysis using partial equilibrium household model to test differences in farm households' price responsiveness in Mid-West Poland. They incorporate labour market imperfections under a non-separable framework and compare model results with results of a model under the assumption of perfectly operating labour market. They observed that price response under labour market imperfections deviates from the response under perfect labour markets even when the household buys and sells labour as long as labour heterogeneity exists. Studying farm household decisions under various tax policies, Glauben *et al.* (2003) used both separable (perfect labour market) and non-separable (imperfect labour market) household models on the case of Mid-West Poland to test for differences in results. The study shows clear difference between the two models. In particular, it indicates remarkable allocation effects induced by market surplus and input taxes in the case of non-separability.

Some other studies examined the effect of transaction costs on supply response and marketed surplus using household models (Oladejo *et al.*, 2011). Minot (1999) and Key *et al.* (2000) run household models. For example, using data on maize supply on a state in Nigeria, Oladejo *et al.* (2011) observed that transaction costs affect households supply decisions significantly which implies that outcomes under simultaneity between consumption and production are different from outcomes under separability. Key *et al.* (2000) obtained a discontinuous supply response to policy changes (unlike the smooth and well behaved response as predicted by standard models) by heterogeneous groups of households due to high transaction costs on the case of corn markets in Mexico. The authors obtained that transaction costs affect response to market incentives of net-selling households than net-buying households.

If decisions are not recursive, it is not only the impact of shocks (policy and exogenous) on production and consumption which depart from the standard neoclassical view, but also their impact on household welfare, poverty and income distribution in poor countries (Lambert and Magnac, 1998; McDonald, 2010). This is due to the depth and prominence of the simultaneity of production and consumption among poor households in

developing countries. It is also related to the inherent heterogeneity of households where these heterogeneous groups respond differently to the changes.

5. Data and Model

5.1. Data

This study follows a CGE model based analysis of semi-subsistence households and their implications for policy making and policy response. A SAM and set of satellite accounts provide the database for the CGE model. A 2010 SAM for Ethiopia which accounts for HPHC is used as the core database. The salient features of the SAM are that i) it splits commodities into HPHC and marketed counterparts and that 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 is constructed in conformity to the recommendations of the SNA that 'in situations where there is a significant amount of consumption represented by own account production, it would be useful to record the distinction between consumption expenditure by households on HPHC commodities from commodities purchased in the market place (ISWGA, 2008, *paragraph 14:65*). Hence, the SAM explicitly differentiates consumption of home produced commodities from marketed commodities by recognizing role of households as producing units. There are a total of 39 commodities of which 15 are HPHC and 9 are solely supplied by the market such as public services and industrial goods. Margin services are also separated into trade and transport margins.

There is extensive representation of 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 activity accounts 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 households. Rural households are further classified by agro-ecological zones: moisture sufficient and drought prone highlands, and moisture sufficient and drought prone lowlands. In addition, the SAM provides a detailed account of factors of production. There are a total of 88 factors where about two-third are labour types classified into five skill types for each political region in 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).

The unique structure of the SAM and the information contained provides interesting insights on the working of semi-subsistence economies such as the role of HPHC in total commodity supply and total domestic demand. The 2010 Ethiopian SAM also shows the level of domestic production transformed into home consumption and to the market. About 27.2 and 32.4% of food and total production, respectively, are not marketed, i.e., supplied for own consumption at home. Each reaches to about 50% for some group of rural households showing that production for home consumption is predominantly a rural phenomenon. On average, rural households supply about 31% of food commodities and close to 33% of their total production to home consumption, with significant disparity across groups of households (Table 5.1). The national rate of home consumption of domestic production is 13%. An important feature of home consumed commodities is that these commodities do not involve marketing margins and taxes.

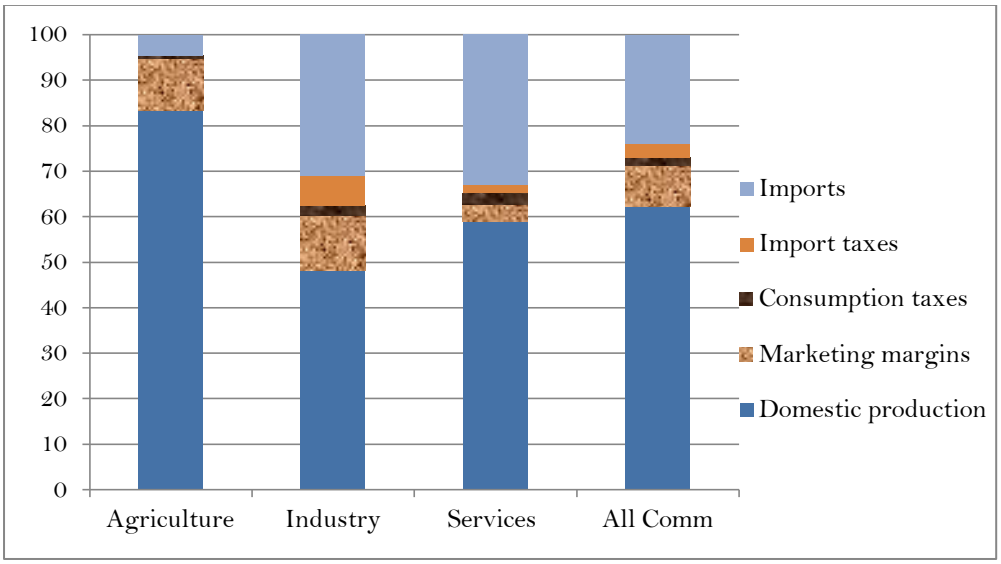
Table 5.1: Composition of domestic production

Activities	HPHC Food	Market Food	HPHC All	Market All
Drought prone highland	27.5	72.5	31.6	68.4
Drought prone lowland	52.9	47.1	54.9	45.1
Moisture sufficient highland	24.0	76.0	28.8	71.2
Moisture sufficient lowland	17.6	82.4	19.4	80.6
Rural household	30.5	69.5	33.7	66.3
Other urban	37.4	62.6	49.4	50.6
Major urban	31.1	68.9	42.4	57.6
Non-household	0.0	100.0	0.0	100.0

Source: Own computation based on the 2010 SAM for Ethiopia

Marketing (trade and transport) margins are exceptionally important for agricultural and industrial commodities where these account to about 11 and 12% of total supply of marketed agricultural and industrial commodities, respectively (Figure 5.1). The service sector faces a 4% marketing margins associated with supply of some utilities; making the overall size of marketing margins 9% of total commodity supply. The high marketing margin partly explains the prevalence of production for home consumption. Taxes also create a wedge between prices of home consumed and marketed commodities, although consumption and import taxes are lower for agricultural commodities. Taxes account 9 and 4% of industrial items and services, respectively, averaging to 5% of marketed commodity supplies.

Figure 5.1: Components of commodity supply (%)



Source: Own computation based on the 2010 SAM for Ethiopia

On the other hand, the commodity row of the 2010 Ethiopian SAM provides interesting information on commodity use pattern by commodity type (production for home consumption versus market consumption). See Table 5.2. Consumption of own produced food and total commodities reaches to 15 and 25% of aggregate food and total commodity demand at national level. These reach to 60 and 50%, respectively, for some rural households to average to as large as 49 and 31% for rural households. Urban households are overwhelmingly dependant on marketed commodities potentially exposing them to the effects of commodity price shocks.

Table 5.2: Composition of commodity demand

Households	HPHC Food	Marketed Food	HPHC All	Marketed All
Drought prone highland	56.0	44.0	33.5	66.5
Drought prone lowland	66.3	33.7	52.2	47.8
Moisture sufficient highland	46.5	53.5	28.8	71.2
Moisture sufficient lowland	28.8	71.2	11.9	88.1
Rural	49.4	50.6	31.6	68.4
Other urban	0.5	99.5	0.4	99.6
Major urban	0.4	99.6	0.3	99.7

Source: Own computation based on the 2010 SAM for Ethiopia

On top of the core database, set of satellite accounts are used to record model elasticities (mainly consumption, trade and production elasticities) and more importantly factor use by activities and factor supplies by domestic and foreign institutions so that physical factor supplies by households can be traced, factor use in HPHC activities can be constrained to factor supply by the households engaged in the HPHC activities and that the

distribution of factor incomes to households can be mapped to changes in the physical distribution of their factor endowments, i.e., transition across skill types for example.

5.2. Model structure

The incorporation of HPHC under non-separability assumption also has important modelling implications mainly related to behavioural specifications on commodity consumption and factor allocation decisions while it might also require modifying the production relationships in the baseline models so that production systems in peasant economies are properly represented.

5.2.1. Production structure

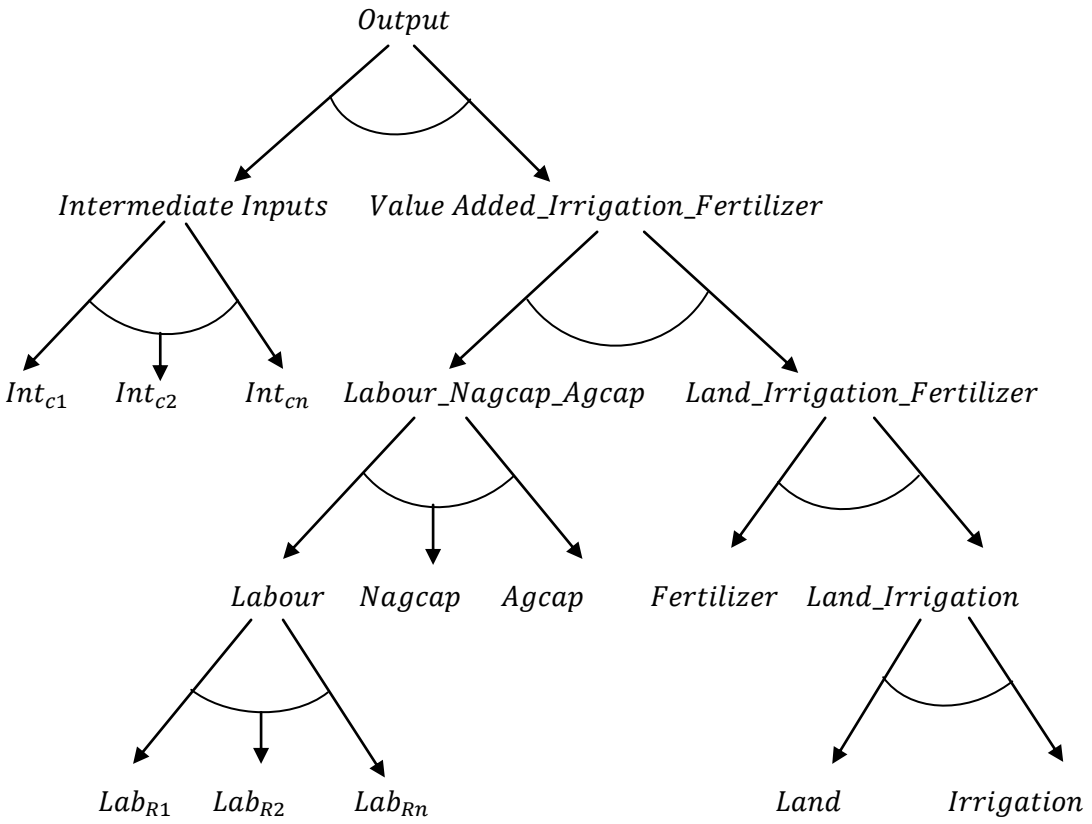
Production follows multi-level nested structure (Figure 5.2) where household and non-household enterprises aim at maximising profit by employing the optimum level of factors and intermediate inputs. All activities are generally assumed to use nested CES technology, but different producers may have different values of substitution elasticity. Specifically, the production nesting structure in the STAGE model discussed in McDonald (2007) is modified to feet to the production nesting considered appropriate for the kind of economies this study focuses. Note that at least labour use by household enterprises for producing for own consumption is constrained by the household's own labour endowment and this condition is imposed in the labour market equilibrium condition.

At the lowest strata of the nest, physical land is combined with irrigation to form land-irrigation aggregate. This aggregate input is then aggregated with fertilizer to form land-irrigation-fertilizer input which is used in the agricultural sector. This way of aggregating land, irrigation and fertilizer across different stages helps capture the different rate of substitution among the inputs; it helps to account the close substitutability between land and irrigation in efficiency levels. On the other hand, labour is aggregated by skill at the very lowest nest of this side of the production structure. The aggregate skill classes are then combined to form aggregate labour factor at regional level. This aggregate labour factor is combined with non-agricultural capital and agricultural capital to form aggregate non-land value added input. At the very top of the production nest, aggregate value added inputs are combined with intermediate commodities to generate output of each activity.

Accommodating this nesting structure in the production block of STAGE requires modifying the production nesting and incorporating irrigation and fertilizer commodities as

part of the value added and not as part of intermediate inputs in production. Overall, the nesting structure shows that focus is given to the agricultural sector.

Figure 5.2: Nested production relationships in STAGE



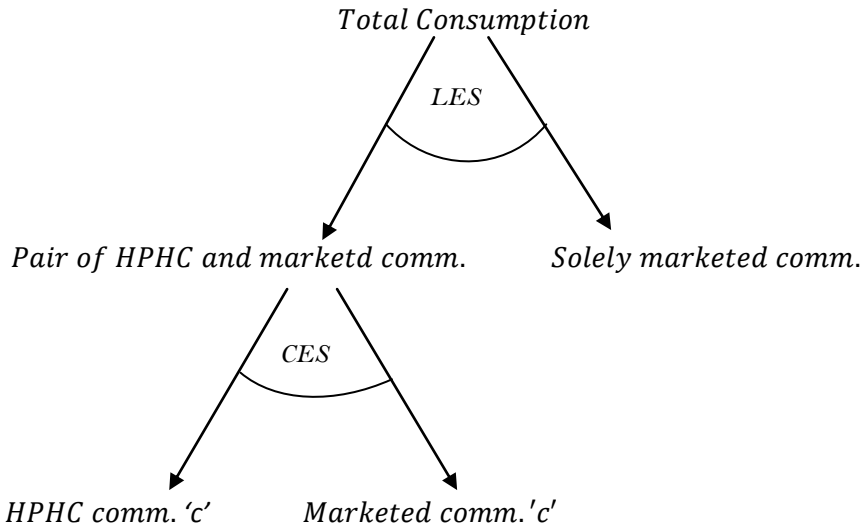
Source: Own compilation

5.2.2. Consumer behaviour under HPHC

Consumers' behaviour is defined by a two-stage consumption nesting (Figure 5.3) such that households demand for commodities can reflect the source of commodities as defined in the SAM. 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 maximise their utility from the consumption of a set of combined commodities (from the lower nest) subject to their budget constraints and the LES demand systems 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 (HPHC and market) commodities generated in the lower nest of the consumption tree.

Figure 5.3: Nested consumption relationships with HPHC and marketed commodities



Source: Own compilation

5.2.3. Factor market under HPHC

Accounting for HPHC has rather considerable implications on how factor supply is defined, since HPHC activities by a household fully rely on its own factors.[4,5] Employing hired labour from the market means selling the output so as to pay for the factor, which in turn effectively implies non-existence of HPHC. However, the use of family labour for HPHC activities means that the labour cannot be available for other activities at the same time. The assumption here is that factors used for each activity are perfectly separable, i.e., the same factor cannot be used at the same time in multiple activities. This left a semi-subsistence household with a daunting task of deciding where to allocate labour: to HPHC activities or

[4] In models which recognise factor ownership and contribution to the factor market by enterprises and other institutions, factor supply has to be broadly defined at institutional level.
[5] As indicated somewhere else above, for simplicity, the model development focuses only on labour for the moment.

the labour market.[6] This raises complication on how i) labour supply should be defined and ii) its mobility across regions, sectors, and skill types should be captured.

The first issue principally demands defining labour supply at the household/institutional level. This further requires recording the supply of labour at the household level than at the economy wide level which has been the practice in most economy wide models. National labour force surveys and population censuses can provide rich data on households' endowment of labour. Unlike the classical case where the allocation of labour across alternative uses depends on relative factor returns as solved from the household's maximisation problem given its labour endowment, the household's labour allocation decision under HPHC also depends on its consumption behaviour which can be captured by the distribution of consumption of own output and the initial allocation of labour in the HPHC activities.

The second issue is related to labour mobility or transition across alternative uses and labour segments (such as geographically and across skill types) in response to changes in incentives. Applied CGE models tend to follow CET or *constant elasticity labour supply function* to capture labour mobility with the assumption that labour mobility is imperfect. However, the standard assumption in CGE models is that factor incomes are distributed to households in fixed proportion (i.e., factor income shares are fixed), an assumption which requires that (McDonald, 2010): i) labour is fully employed, and ii) that each household's endowment of labour is fixed. Nevertheless, in situations where labour is allowed to transit from one employment regime to the other or across skill types, the fixed share assumption becomes no more feasible and any transition will have important implications on the distributional aspect of the model on households. Following the suggestion in McDonald (2010), this problem is resolved in this version of the STAGE model by replacing the matrix of fixed share coefficients that controls the functional distribution of income by a matrix of variables that tracks changes in the supply of each labour type by each household.

5.3. Model closure and market clearing conditions

Model closure and market clearing conditions are tricky conditions in CGE modelling. Hence, the modeller needs to rely on the best of his informed judgment on the workings of the economy in relation to the behaviours of economic agents such as savers, investors and the government and the interaction the domestic economy has with the rest of the world.

[6] See McDonald (2010) for detailed presentation of factor allocation implications of incorporating HPHC activities in CGE models.

With regard to the interaction of the economy with the rest of the world, a small country assumption is imposed, i.e., the country is assumed to be a price taker in the export and import markets. Saving-driven investment closure is imposed such that investment adjusts endogenously to the availability of loanable funds. The level of foreign savings is also fixed and the exchange rate is the equilibrating variable. We also assume that the government savings are fixed and the government expenditure is allowed to freely adjust. Furthermore, factors are assumed to be fully employed and labour is mobile across sectors.

6. Simulations and Results

6.1. Simulation scenarios

This study examines a total of three major simulations under two major classes: scenarios related to changes in border prices associated with external price shocks and scenarios on possible changes in trade and transport margins due to improvements in soft and hard infrastructures. Specifically, the study investigates the impacts on production, consumption, and supply decisions of rural households in response to changes in border prices and marketing margins under a situation of considerable HPHC in a non-separable fashion. The distributional and welfare implications of such changes on rural and urban households are also examined. Equivalent variation (EV), measured as percentage share of households initial consumption expenditures, is used to assess the welfare implications. Technically speaking, EV is the income change the representative household is prepared to accept, in the new situation, to avoid the policy or exogenous change (Creedy, 2000).

6.1.1. Changes in border prices

World price of commodities has been erratic over the past few years where commodity prices have increased by about 47% between 2007-2011 and by 20 and 16% in 2007 and 2008 alone, respectively, where food prices achieved their peaks (FAO,2014). Such surges in commodity prices can easily diffuse to domestic commodity markets especially in developing countries as governments have very little capacity to stabilise local prices. The poverty and distributional effects of such shocks has been of interest for national and international development agents.

To assess the differential effects of changes in commodity prices on different representative household groups (RHGs) when HPHC is accounted for in general equilibrium models, exogenous rises in world prices of imports are considered. Specifically,

the price impulses evaluated in this study affect the domestic price formation process through the relationship:

$$PM_c = pwm_c * (1 + tm_c) * ER$$

where PM_c is import price for commodity c in local currency, pwm_c is *cif* price of imports in foreign currency units, tm_c is tax rate on imports and ER is the exchange rate measuring the price of a foreign currency in local currency units. The border price simulations take on pwm_c in the import price equation.

The experiments considered here are that how would different households, mainly with deferent level of reliance on HPHC, be affected if world prices for i) all commodities, ii) food commodities and iii) non-food commodities increase by 10%, respectively, via-a-vis the level at the base scenarios. Since a rise in world price of commodities means a higher price for Ethiopian exports, a 5% rise in the country's exports is also assumed under this scenario. The less than proportionate rise in price of the country's exports is due to the primary nature of the exports which generally fetch lower prices and face stiff competition in the international market.

Since the change in world price of imports will affect the total import bill of the country and hence the import tax revenue, and since a fixed government/internal balance is assumed in the model closure, a tax replacement mechanism need to be established to maintain the internal balance. Apart from import tax which accounts for 59% of government tax revenue, VAT, sales tax and income tax are the main sources of tax revenue where these account 22, 11 and 7% of total tax revenue, respectively, whereas excise tax contributes to only 1% of tax revenue. Since the import tax is set fixed to maintain the government saving after the change in border prices, VAT, sales tax, income tax, and excise tax are the options available to be used as tax replacement instruments to maintain fixed government balance by compensating for tax revenue changes (loss or gain). The choice of tax replacement instrument should depend on the general patterns of tax reforms in countries which are sometimes recommended by international financial institutions such as International Monetary Fund (IMF). The trend in this regard is towards reducing tariff rates (import and export taxes) and relying more on consumption taxes (VAT and sales taxes) than on production taxes (Lauren *et al.*, 2008). As a result introducing and reforming the VAT system has become the centerpiece of increasing tax revenue in most developing countries

including Ethiopia.[7] Hence VAT is selected as the baseline tax replacement instrument where internal balance is maintained through an endogenous change in the VAT rate.

However, VAT is known for its regressivity (Lauren *et al.*, 2008) (by raising the price of commodities that are important for the poor) and that relying heavily on VAT as a source of tax revenue would miss out the redistributive or equity role of governments as inequality is severe in developing countries. As a result a progressive direct/income tax following multiplicative adjustment is introduced as alternative tax replacement instrument. The shift from a 'regressive' VAT to a progressive and multiplicative income tax would provide a clear picture for sensitivity analysis.

On top of changing the tax replacement instrument, extra sensitivity analysis are run by switching the saving-investment closure and changing the magnitude of the simulated changes. Specifically, the baseline saving driven investment closure is switched to investment driven saving balance. The sensitivity analysis is also extended by considering different rates of increase in the world price of imports and comparing the results with the scenario of a 10% exogenous shock on prices of all, food and non-food commodity groups.

6.1.2. Changes in trade and transport margins

The commodity markets in developing countries are still characterised by significant trade and transport margins, contributing their parts to the exceptionally high cost-of-living for some groups of households while limiting market participation in the product and factor markets for others. As a result, reducing the high marketing margins has remained to be a policy challenge facing these countries. To examine how different groups of consumers and producers fare if the government invests on reducing trade and transport margins, alternative scenarios are run: (i) a decline in quantity of margins per unit of domestic demand in the economy, and (ii) an improvement in the efficiency of activities that produce margin services, i.e., transport, communication and trade activities relative to other activities. The impacts of these shocks to the general equilibrium system are propagated mainly through purchaser prices:

$$PQD_c = PQS_c * (1 + ts_c + tex_c) + \left(\sum_m ioqttqq_{(m,c)} * PTT_m\right)$$

[7] There is no intension at the moment to get in detail into the debate in the tax literature and the general 'one fits all' critics to international financial institutions.

where PQD_c is purchaser price of commodity c, PQS_c is supply price, ts_c is sales tax rate, tex_c is excise tax rate, PTT_m is price of trade and transport margin m, and $ioqttqq_{(m,c)}$ is quantity of margin m used per unit of domestic demand. While simulation (i) affects the economy through $ioqttqq_{(m,c)}$, simulation (ii) affects PTT_m by affecting the efficiency of margin services provision.

Quantity of margin services: Improvement in trade and transport margins can be reflected in the quantity of margin services required to facilitate trade in the economy implying a reduction in the gap between producers and purchasers prices as reflected in the domestic price formation process. Decline in quantity of margins affect domestic prices of commodities by reducing per unit price of margin services. Scenarios of 20% and 50% decrease in quantities of both trade and transport margins are assumed (due to the greater room for reducing per unit quantities of margin services in the country) over the baseline level. The simulation scenarios are then compared with alternative rates of decrease in $ioqttqq$ and results under different closure rules.

Efficiency of margin services: An alternative to the above simulation is improvement in the efficiency of activities that produce margin services. The production and welfare implications of such improvements in the efficiency of margin services provision could differ across activities and households. Under this simulation scenario, a 20% and 50% increase in the efficiency of activities that produce margin services is assumed over the baseline level. It is assumed that such improvement in efficiency would increase producer prices and decrease consumer prices thereby increasing overall production and economic welfare, and more strongly so for agents facing high trade and transport costs. Sensitivity analyses are also run.

6.2. Discussion of results: changes in border prices

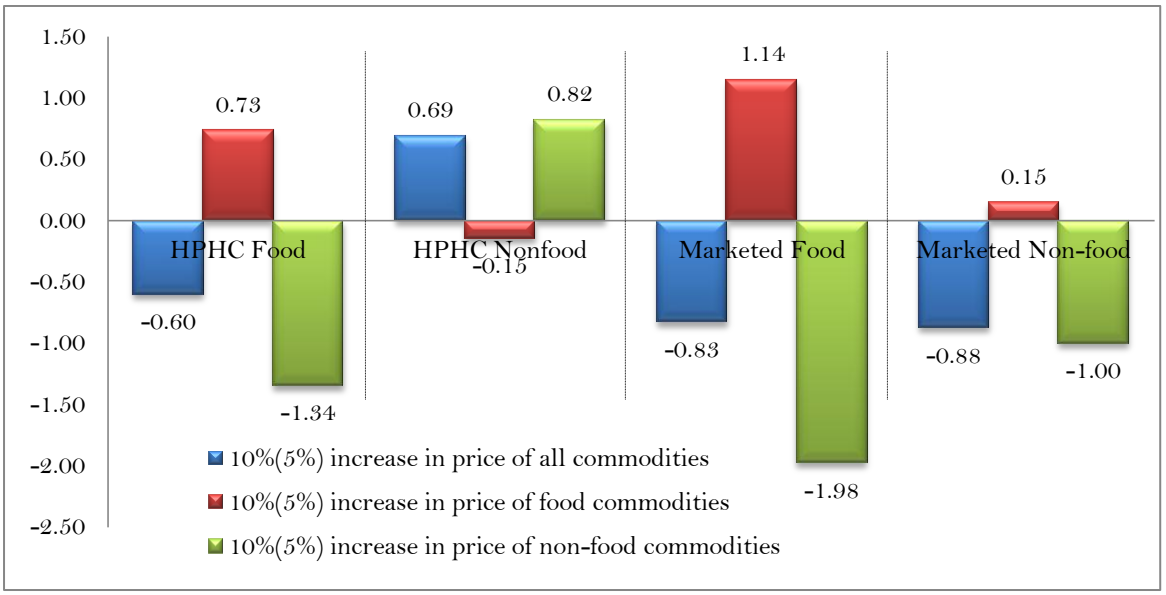
6.2.1. Production

Changes in border prices of imports have implications on domestic production of commodities mainly by affecting the cost structure of activities based on the extent to which the activities are integrated with international commodity markets; as source of intermediate inputs for example. The impacts of three sources of increase in commodity prices are considered: all commodities, food commodities and non-food commodities. When the simulated rise in commodity prices come from all commodities, the production of marketed commodities declines considerably as compared to HPHC commodities. The

production of HPHC non-food commodities rather increases in response to this border price shock although HPHC non-food commodities account to only 3.5% of total household consumption. The decline in the production of marketed commodities is down to the rise in cost of production due to high price of intermediate inputs. A similar rate of shock on import prices of non-food commodities has a much stronger effect on the production of food and non-food HPHC and marketed commodities in a consistent way to the impact of an overall rise in border prices.

The case of exogenous increase in import prices of food commodities is different than the observations discussed above and is rather interesting. This particular shock increases the production of HPHC and marketed commodities where the impact is stronger on food production. The rise in domestic production is convincing as a shock to the prices of food imports will not considerably affect the cost structure of producers but rather creates an incentive to local producers due to the growing domestic price of food. In terms of types of commodities by source, the production of commodities for own use is less affected as compared to production for the market.

Figure 6.1: Simulated changes (%) in production by commodities



Source: Own computation based on model results

Another way of looking at the production implications of border price shock is the relative consequences of the shock on different types of activities, manly across household and non-household activities. The impacts of the price shocks on commodity production discussed above are the reflection of how the simulated price changes affect activities. It can be noted from Table 6.1 that exogenous increase in prices of non-food and all commodities

consistently discourages production by both household (rural and urban) and non-household enterprises although the impact is smaller for rural household activities; this can be justified by the considerable reliance of rural households on HPHC and local intermediate inputs and the big share of household owned value added factors in production.[8] Although the increase in domestic production (by all activities) in response to exogenous increase in border prices of food commodities looks puzzling at first, the increase could however be due to a positive response by domestic producers to the price incentive. Note also that the greater response comes from household activities which also take into account the households consumption behaviour as consumers when making production decisions as producers and it is rational to expect these agents to try and satisfy their own consumption needs when prices of marketed commodities increase.

Table 6.1: Simulated changes (%) in production by activities and commodities

	Source of price change		
	All commodities	Food commodities	Non-food commodities
Drought prone highland	-0.49	0.94	-1.44
Drought prone lowland	-1.81	0.72	-2.55
Moisture sufficient highland	-1.24	0.53	-1.78
Moisture sufficient lowland	-1.76	1.67	-3.40
Rural	-1.33	0.97	-2.29
Urban	-0.48	5.00	-5.35
Non-household agricultural	-1.91	0.29	-2.23
Non-household non-agric.l	-1.11	0.41	-1.50

Source: Own computation based on model results

6.2.2. Consumption

Exogenous increase in commodity prices has impacts of different magnitude across household groups where the overall impact on consumption is negative for urban households irrespective of the group of commodities for which import price rises. On the other hand, rural households experience a slight net expansion in consumption when an exogenous increase in prices of food commodities is considered. These households increase the consumption of HPHC food and marketed food and non-food commodities. However, when increase in prices of non-food and all commodities are considered, both rural and urban households experience a decline in consumption although the percentage drop in consumption is higher for urban households. For example, a 10% increase in import prices of non-food commodities leads to a 3.3 and 2.9% drop in consumption of marketed non-food

[8] Value added inputs contribute to 91% of input cost for household activities compared to 64% for non-household enterprises.

commodities for major urban and other urban households as compared to a 2.1% drop for rural households.

Apart from developments in the income dimension of the household, changes in quantity consumption is influenced by movements in domestic prices of commodities associated with the changes in border prices. The price development shows that the domestic price of non-marketed commodities responded hugely (in relative terms) to the import price shocks. This accompanied rise in domestic price of non-marketed commodities partly explains the considerable drop in consumption. It is interesting to note that the prices of HPHC commodities move up together with the simulated growth in border prices for (marketed) food. This is due to the close substitution between pairs of notionally identical HPHC and marketed commodities causing the prices for HPHC commodities to increase. The role of cost of production should rather be more direct and strong in determining purchaser prices.

Table 6.2: Simulated changes (%) in consumption

		Source of price change		
		All commodities	Food commodities	Non-food commodities
Rural households	HPHC Food	-0.09	0.36	-0.44
	HPHC Non-food	2.48	-1.25	3.76
	Market Food	-1.97	0.28	-2.28
	Market Non-food	-2.13	1.72	-3.70
Other urban households	HPHC Food	-0.09	-0.06	-0.03
	HPHC Non-food	0.74	-1.65	2.42
	Market Food	-2.50	-0.72	-1.81
	Market Non-food	-2.91	0.57	-3.39
Major urban households	HPHC Food	-0.20	-0.13	-0.06
	HPHC Non-food	0.47	-1.87	2.37
	Market Food	-2.95	-1.03	-1.95
	Market Non-food	-3.31	0.26	-3.50

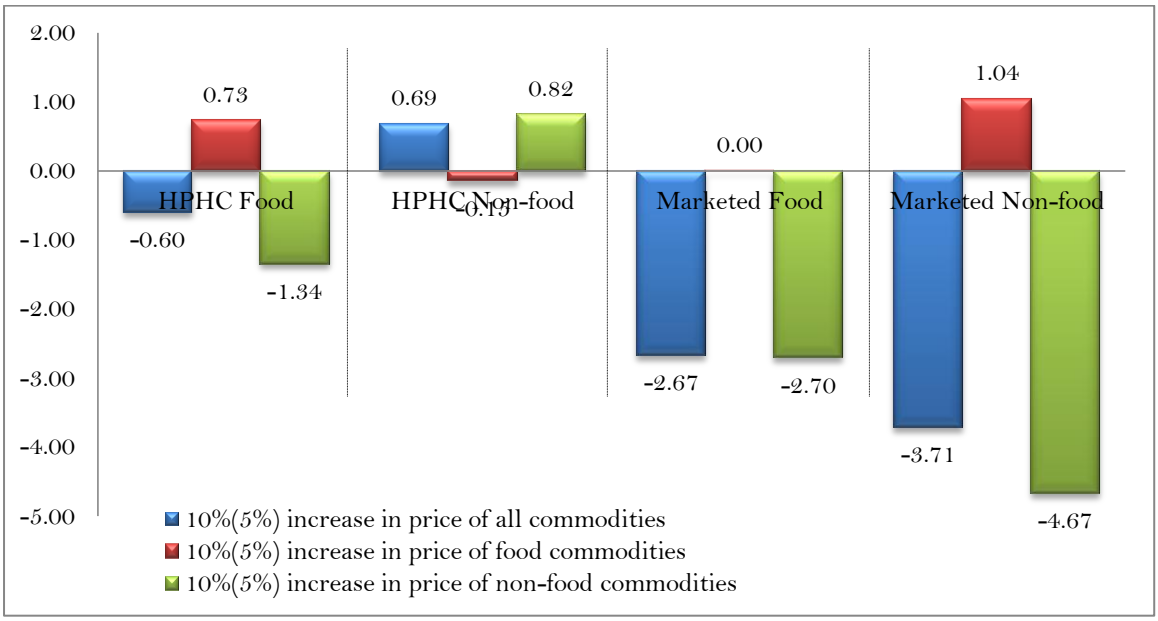
Source: Own computation based on model results

6.2.3. Supply

Local commodity supply is a function of domestic production for domestic supply and import supply. The impact of border price shock on domestic supply of the four commodity groups is identical in direction when the shock comes from non-food and all commodities. The case of a positive border price shock on food commodities is unique. A 10% rise in border prices of all commodities with import demand function (together with a less than proportionate increase in price of all of Ethiopia's exports) leads to a contraction of the

supply of food and non-food marketed commodities by about 2.7 to 3.7%, respectively, with a very marginal impact on supply of HPHC commodities (Figure 6.2). The impact of a similar level import price shock on non-food commodities is stronger on all four groups of commodities. If the rise in world price of imports is restricted to food commodities, the consequences of such a shock are opposite in direction but weaker in magnitude as compared to the observation under the previous two cases.

Figure 6.2: Simulated changes (%) in commodity supplies



Source: Own computation based on model results

6.2.4. Welfare changes

Table 6.3 presents the welfare impacts (measured by the equivalent variation associated with the change as a percentage of initial consumption expenditure) of exogenous rise in border prices of food, non-food and all commodities. Owing to the considerably different magnitudes of the impacts of exogenous increase in import prices (accompanied by a rise in prices of the country's exports) of commodities on various determinants of welfare (i.e., production(incomes), commodity supplies, consumption, and prices) on different groups of the community, the total welfare impacts of the changes are also considerably different across representative households although the overall welfare effects are marginal-the small welfare impacts of border price changes indicate the role of HPHC in insulating the impact of such shocks in peasant economies where more than 80% of households are farm households with more than half of their consumption expenditure covered by production for own consumption. This is evidenced by the 1.3% decline in expenditures of rural households

(which is lower by 40%) as compared to about 3.0% for urban households when rise in import price of all commodities is considered.

The role of HPHC is much more pronounced when one examines the welfare changes associated with a 10% increase in border prices of food commodities; rural households are completely immune from adverse welfare implications although food accounts to about 60% of total expenditures of these households. Rural households experience welfare loss when the prices of non-food imports increase. This is because about 73% of non-food consumption by rural households comes from the market. Urban households face welfare loss when the prices of any class of commodities are increasing and the loss is consistently higher for this group of households as compared to their rural counterparts.

Table 6.3: Simulated changes (%) in welfare as measured by equivalent variation

	Source of price change		
	All commodities	Food commodities	Non-food commodities
Drought prone highland	-1.42	0.73	-2.12
Drought prone lowland	-1.23	0.07	-1.27
Moisture sufficient highland	-1.25	1.27	-2.48
Moisture sufficient lowland	-1.09	0.63	-1.68
Rural	-1.25	0.67	-1.89
Other urban	-2.67	0.07	-2.70
Major urban	-3.20	-0.15	-3.01

Source: Own computation based on model results

6.3. Sensitivity analysis: changes in border prices

6.3.1. VAT and direct tax replacement schemes

This section examines whether the results discussed above using VAT replacement scheme are different from those based on the direct/income tax replacement scheme; i.e., the section examines the sensitivity of results to tax replacement closure. The sensitivity analysis focuses on the welfare impacts as welfare provide a holistic picture of what is happening in the model as the tax replacement option is switched.

Table 6.4 shows that the welfare loss (gain) is higher (lower) irrespective of household groups when the tax replacement chosen is VAT as compared to the alternative case of income tax (compare Table 6.3 and Table 6.4). Both rural and urban households seem to gain (see the positive changes in Table 6.4) from the rise in border prices of all and food commodities under income tax adjustment as compare to the marginal loss under the baseline VAT adjustment. For example, a 10% increase in price of imported commodities

increases the welfare (as percentage share of initial consumption expenditure) of rural households by 0.45% under the income tax replacement as compared to a 1.25% drop under the VAT replacement rule. This is due to a relatively small increase in domestic price of commodities in the face of a considerable expansion in household incomes under the income tax replacement alternative. What is more peculiar to the results in Table 6.4 as compared to those in Table 6.3 is that the welfare gains/losses are higher/lower for urban households as compared to rural households. This is due to a decline or only marginal increase in consumption of marketed commodities by rural households' vis-à-vis the magnitude of the response by their urban counterparts.

Table 6.4: Simulated changes (%) in welfare as measured by equivalent variation: alternative

	Source of price change		
	All commodities	Food commodities	Non-food commodities
Drought prone highland	1.16	2.80	-1.09
Drought prone lowland	-1.16	0.17	-1.29
Moisture sufficient highland	2.13	3.97	-1.11
Moisture sufficient lowland	-0.33	1.30	-1.44
Rural	0.45	2.06	-1.23
Other urban	5.29	6.64	0.62
Major urban	4.76	6.43	0.33

Source: Own computation based on model results

6.3.2. Investment-saving closure swop

The sensitivity analysis here compares the baseline results where a saving driven investment was assumed with the results under alternative investment-saving closure rule, i.e., investment driven saving balance. The share of domestic final demand of investment is fixed and households and enterprises savings rates are made to vary equiproportionately. VAT is the tax replacement instrument.

The comparison of the welfare impacts of exogenous change in border prices under these two investment-saving closure rules is made in terms of the directions and differences in the magnitudes of the changes. The simulation results under investment driven savings balance are closely consistent with the results under the baseline investment-saving closure assumption in terms of direction of the impacts of the shock but the magnitude of the impacts significantly differ between the two scenarios (Table 6.5). The differences (in percent) between the welfare changes are bigger when food price shocks are considered. Note that the baseline scenario understates the net welfare impact on rural households

when a simulated rise in food prices are considered and slightly overstates the welfare impact when an exogenous rise in non-food commodities is examined.

Table 6.5: Comparison of the welfare changes under alternative investment-saving closures

	Source of price change			
	Food		Non-food	
	Direction*	Difference (%)	Direction	Difference (%)
Drought prone highland	+ve,+ve	-15.0	-ve,-ve	4.4
Drought prone lowland	+ve,+ve	-295.1	-ve,-ve	13.6
Moisture sufficient highland	+ve,+ve	-3.6	-ve,-ve	1.5
Moisture sufficient lowland	+ve,+ve	-5.2	-ve,-ve	1.6
Rural	+ve,+ve	-14.5	-ve,-ve	4.4
Other urban	+ve,+ve	-31.1	-ve,-ve	0.6
Major urban	-ve,-ve	10.5	-ve,-ve	0.4

Source: Own computation based on model results
*The direction indicates the effects on welfare from the baseline scenario and alternative investment-saving closure rules, in order.

6.3.3. Sensitivity of welfare changes to magnitude of shocks

The discussion so far has been on the production, consumption, commodity supply and welfare impacts of a hypothetical10% increase in border prices when consumption by some segment of the population is dominated by own account consumption. How sensitive are model results to alternative magnitude of shocks? To answer this, price shock levels below (5%) and above (20%) the baseline hypothetical change in border prices discussed so far are picked. A corresponding 2% and 10% increase in prices of the country's exports are also assumed, respectively, jointly with the import price shocks. As is the case above, we restrict our sensitivity analysis to the resultant welfare changes. Discussion is based on the baseline closures: under saving driven investment closure and VAT tax replacement alternative.

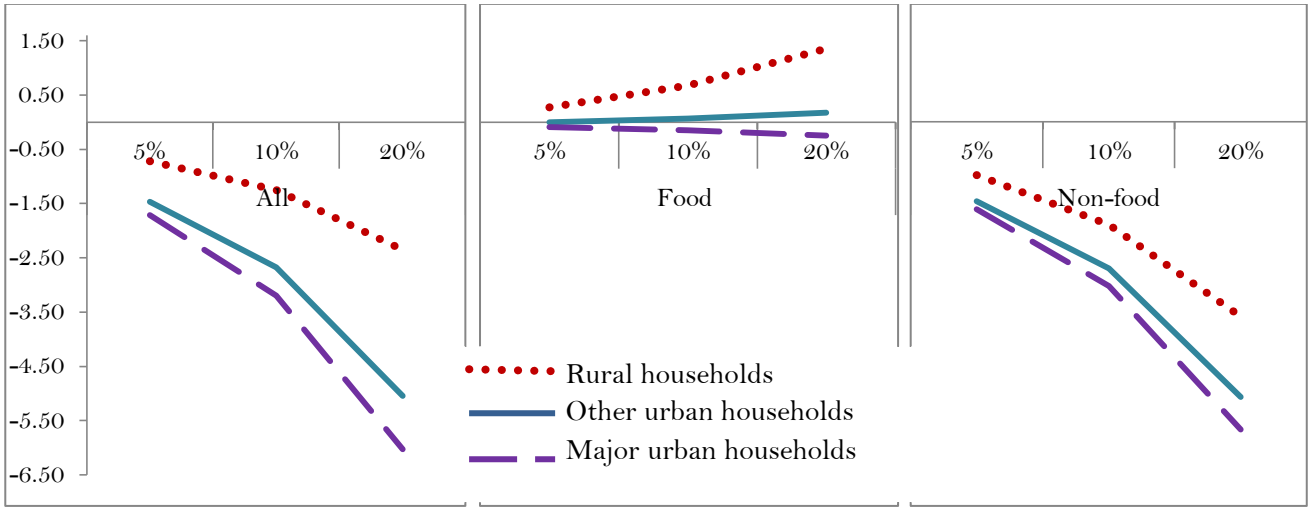
The overall observation from the series of simulations is that increase in border prices of imports accompanied by a less than proportionate rise in prices of the country's exports would negatively affect the welfare of urban households more than it affects that of rural households. The differences on welfare effects between these broad groups of households reach as high as 60% although the effects are small in percentage terms (See Figure 6.3). It can also be noted that the welfare impact becomes stronger as the magnitude of the simulated change in world prices increase as seen from the increasing slope of the lines in the figure.

When the simulated increase in world prices of all imports increase stepwise (accompanied by equiproportional increase in prices of Ethiopia's exports), the magnitude of

the welfare loss moves on the same direction (increases) for both rural and urban households. This is evidenced by the declining lines in the first part of Figure 6.3 where welfare changes get more negative as the magnitude of border price shock increases from 5% to 20%. Likewise, the welfare loss increases as a higher percent increase in import prices of non-food commodities is considered.

Meanwhile, as the change in prices of imported food commodities increases (accompanied by equiproportional increase in prices of Ethiopia's food exports), the welfare gain for rural households increases while major urban households continue loosing. Their considerable reliance on HPHC commodities as a source of food seems to insulate rural households from the adverse welfare impacts of international price shocks as compared to urban households who almost fully rely on market commodities.

Figure 6.3: Sensitivity of welfare changes (%) to magnitude of price shocks



Source: Own computation based on model results

6.4. Discussion of results: changes in trade and transport margins

Due to a strong room for improving margin services in the country, this section examines the effect of infrastructural improvements that would (i) cut marketing margins by 20 and 50% as the first set of simulations and (ii) increase the productivity of activities that produce trade and transport services by 20 and 50% as the second set of experiments.

6.4.1. Production

Changes in demand for margin services and improvements in the efficiency of margin services provision have considerable impacts on activities and production of commodities. Although both household and non-household activities experience expansion, non-

household activities face the strongest impact of improvements in margin services. For example, Table 6.6 shows that a 20% increase in efficiency of marketing margin services provision increases overall production by household activities by about 3.0% and that of non-household activities by about 3.5%. Non-household non-agricultural activities experience the most significant expansion as these activities use a lot of margin services. A 20% decline in quantity of margin services per unit of domestic demand increases economic activity by household and non-household enterprises by 2.5 and 5.9%, respectively. The effect is much strong if per unit quantity of margin services needed declines by 50%.

In terms of production by commodity, efficiency improvements and decline in quantities of per unit margin services increase the production of marketed commodities more strongly than the production of HPHC commodities indicating that market supply responds more than production for own consumption and that producers become more integrated to the market. The production of marketed non-food commodities increases by 11-15% if the state of marketing margin in the country improves by half.

Table 6.6: Simulated changes (%) in production by activities and commodities[9]

	adva*1.20	adva*1.50	ioqttqq*0.80	ioqttqq *0.50
Activities				
Drought prone highland	1.38	2.59	0.87	2.24
Drought prone lowland	2.93	5.73	1.91	4.85
Moisture sufficient highland	2.46	5.01	1.84	4.70
Moisture sufficient lowland	1.90	3.71	2.22	5.69
Rural	2.16	4.26	1.71	4.37
Urban	3.77	6.67	3.32	8.39
Non-household agricultural	2.11	4.63	5.72	15.64
Non-household non-agricultural	4.78	11.23	6.06	19.48
Commodities				
HPHC Food	1.20	2.33	0.34	0.89
HPHC Non-food	1.19	2.16	0.46	1.28
Market Food	1.37	2.81	3.04	9.00
Market Non-food	4.68	11.03	4.82	15.26

Source: Own computation based on model results

6.4.2. Consumption

Simulated improvements in trade and transport margins improve the consumption of marketed commodities while the consumption of HPHC commodities declines as households become more dependent on markets. For example, a 50% increase in efficiency of activities

[9] *adva* is variable capturing the efficiency in production and *ioqttqq* is a parameter indicating the quantity of margin services used per unit of domestic demand.

that produce margin services, i.e., transport, communication, and trade, would increase the consumption of marketed food by 5.1, 3.9 and 2.8% by rural, other urban and major urban households, respectively (Table 6.7). Meanwhile, halving the current level of margin services required per unit of domestic demand would increase market consumption by a stronger magnitude of 12.6, 8.3 and 7.6% by rural, other urban, and major urban households, respectively, although the increase comes at the expense of HPHC. This result is theoretically consistent as a decline in marketed margins would reduce the gap between producers and purchasers prices thereby increasing the incentive for agents to engage in markets.

Table 6.7: Simulated changes (%) in consumption

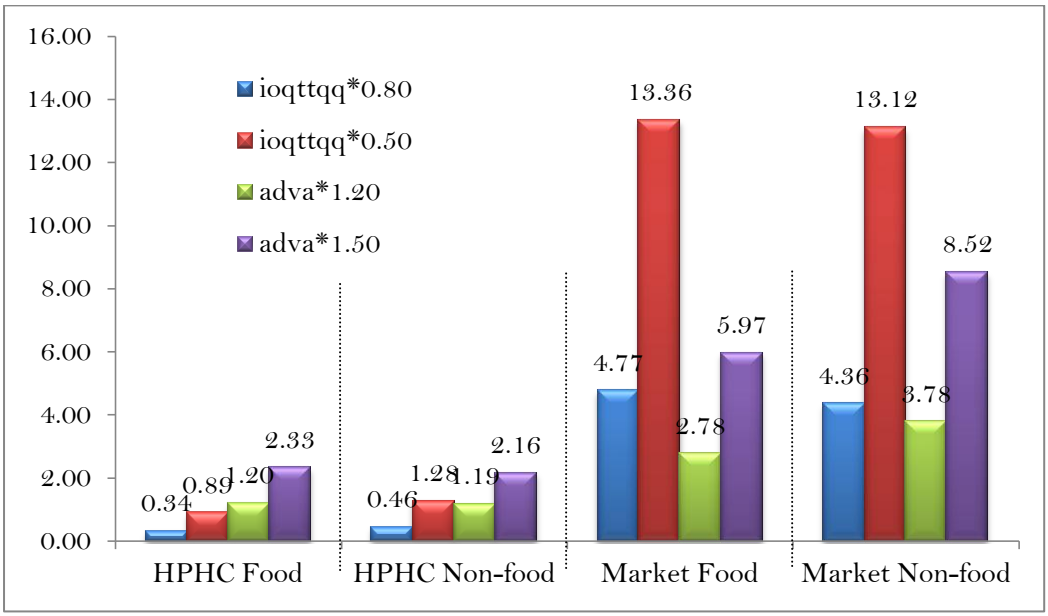
		adva*1.20	adva*1.50	ioqttqq*0.80	ioqttqq *0.50
Rural households	HPHC Food	0.37	0.65	-0.71	-1.72
	HPHC Non-food	0.10	0.03	-1.30	-2.97
	Market Food	2.73	5.13	4.73	12.59
	Market Non-food	1.52	3.11	1.58	3.86
Other urban households	HPHC Food	-0.05	-0.11	-0.51	-1.30
	HPHC Non-food	0.58	1.00	-0.15	-0.09
	Market Food	2.04	3.86	3.17	8.29
	Market Non-food	1.38	2.89	1.33	3.19
Major urban households	HPHC Food	-0.20	-0.38	-0.59	-1.50
	HPHC Non-food	0.19	0.27	-0.36	-0.61
	Market Food	1.47	2.78	2.90	7.57
	Market Non-food	0.77	1.75	1.02	2.35

Source: Own computation based on model results

6.4.3. Supply

The change in domestic supply of HPHC commodities is a mirror image of domestic production of these commodities. On the other hand, supply of marketed commodities is influenced by how the supply of these commodities from domestic producers and imports are affected by the policy change that facilitates trade and transport. Since both domestic production and import supply of marketed commodities increase due to the policy change, total domestic supply of marketed food and non-food commodities expand by a considerable proportion especially when decline in quantity of margins per unit of domestic demand is considered. The supply of marketed food increases by a range of 5-13% when the simulated decline in quantity of margin services required per unit of domestic supply is 20-50% (Figure 6.4). The supply of HPHC commodities also increase but only marginally.

Figure 6.4: Simulated changes (%) in commodity supplies



Source: Own computation based on model results

6.4.4. Welfare

Table 6.8 presents the welfare implications of reduction in marketing margins due to infrastructural investments in Ethiopia. The result shows that infrastructural improvements lead to gains in welfare to both rural and urban households. The relative rank of welfare gains of rural and urban households reverses when one considers the impact of a 20-50% improvement in efficiency of margin services provision and the same rate decline in the per unit margin services requirement for domestic demand. If improvements in the efficiency of margin services provision are considered, rural households enjoy bigger expansions in their welfares in relation to urban households and the reverse is true in the case of decline in per-unit margin service requirement. While in the former case the welfare gains to rural households are larger by 0.7 and 1.2 percentage points (where changes in welfare is measured as percentage of initial household consumption expenditure) for a 20 and 50% shock, respectively, the welfare gains to urban households are greater by 0.2 and 0.4 percentage points for similar level of shocks to per unit margin requirement. The gain in welfare by households is due to expansion in consumption and reduction in commodity prices, among others, as the historically high marketing margins facing the households decline.

Table 6.8: Simulated changes (%) in welfare as measured by equivalent variation

	adva*1.20	adva*1.50	ioqttqq*0.80	ioqttqq *0.50
Drought prone highland	2.17	4.92	1.86	4.79
Drought prone lowland	0.98	2.48	1.02	2.54
Moisture sufficient highland	2.89	6.50	2.12	5.44
Moisture sufficient lowland	2.45	5.60	1.68	4.32
Rural	2.12	4.88	1.67	4.27
Other urban	1.84	4.57	2.02	5.10
Major urban	1.02	2.78	1.70	4.28

Source: Own computation based on model results

6.5. Sensitivity analysis: changes in trade and transport margins

6.5.1. Investment-saving closure swop

An alternative to the baseline neoclassical saving driven investment closure is investment driven saving closure. Switching from the former to the later closure rule causes a considerable change in simulation outcomes both in terms of the magnitude of the welfare impacts and relative distributional effect across household groups. In terms of magnitude, the welfare impacts of a same level improvement in the efficiency of margin services provision fall by about 40 and 10% for rural and urban households, respectively, as the baseline investment-saving closure rule is replaced by an investment driven saving closure. A higher rate of drop in welfare gain is observed (for rural households) when a decline in per unit margins services requirement is considered.

Table 6.9: Simulated changes (%) in welfare as measured by equivalent variation: alternative

	adva*1.20	adva*1.50	ioqttqq*0.80	ioqttqq *0.50
Drought prone highland	1.29	3.04	1.09	2.77
Drought prone lowland	-0.66	-1.03	-0.41	-1.22
Moisture sufficient highland	2.52	5.69	1.80	4.58
Moisture sufficient lowland	2.19	5.02	1.45	3.69
Rural	1.33	3.18	0.98	2.46
Other urban	1.67	4.20	1.87	4.69
Major urban	0.89	2.50	1.59	3.97

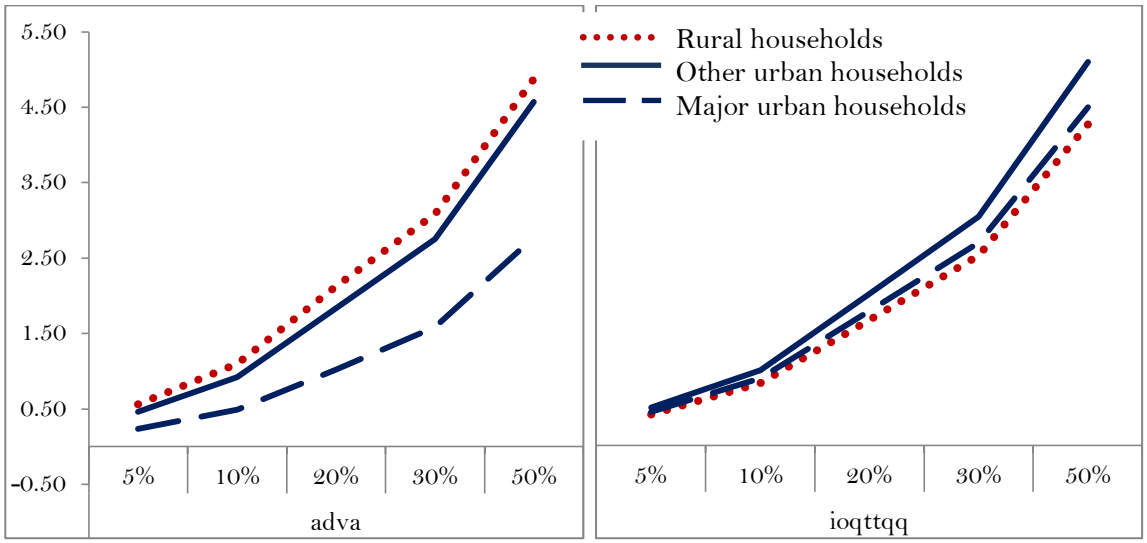
Source: Own computation based on model results

6.5.2. Sensitivity of welfare changes to magnitude of shocks

One way of testing the sensitivity of the results is by way of observing how principal variables behave when the magnitude of the policy shock changes. The welfare change (Figure 6.5) shows a remarkable increase as both the magnitude of the simulated change in per unit margin service requirement and the efficiency level of activities that produce margin services (trade, transport and communication) increase. The result shows that rural

households benefit the most out of any infrastructural improvement explained by increase in efficiency of margin services provision and urban households become the main beneficiaries if the infrastructural improvement is explained by reduction in per unit margin services for domestic demand. Note that the benefit of such changes for other urban households outweighs that of major urban households.

Figure 6.5: Sensitivity of welfare changes (%) to magnitude of margins changes



Source: Own computation based on model results

7. Concluding Comments

Semi-subsistence households constitute a considerable proportion of production and consumption with a great part of consumption by these households contributed by HPHC. However, this dual role of households in developing countries as producers and consumers in a non-separable fashion has been under represented in most social accounting matrices for such countries and economy wide behavioural models (such as CGE models). This study bases itself on a SAM that has been developed for a typical developing economy which i) explicitly identifies variants of HPHC and marketed commodities, and ii) explicitly treats households as activities. The behavioural relationships in a CGE model are modified to conform to these features of semi-subsistence economies. Based on the modified SAM and CGE model, this study examines the implications for policy response of semi-subsistence households focusing on i) changes in commodity prices, and ii) marketing margins for demonstration purposes.

The simulations reported emphasises the extent to which changes in border prices and trade and transport margins are translated into changes in the production and consumption decisions of rural households and hence into rural welfare and poverty. Simulation results

show that exogenous rise in prices of commodities affect the production and consumption of marketed commodities as compared to production for own use. It is also noted that price shocks affect production by non-household activities more severely as compared to production by household enterprises indicating the considerable immunity of production by rural households from market shocks in the input market. Consistently, results on the welfare implications of external price changes indicate that the welfare loss to rural households are significantly lower than that of urban households, a case explained by the considerable reliance of the former on HPHC. Results obtained from reduction in marketing margins are also theoretically consistent and shows that both urban and rural households can benefit a lot from infrastructural improvements although the evidence shows that rural households benefits the most.

The result that rural households are insulated from the market means that changes in border prices have very limited impacts upon the decisions of semi-subsistence households. This conclusion is important since it suggests, strongly, that the welfare gains reported by studies of trade liberalisation and reductions in the domestic agricultural supports within developed market economies are likely to be large overestimates of the welfare implications for semi-subsistence households in many of the least developed economies. It should be recalled, thus, that policy advises for developing countries should be backed-up by databases and analytical frameworks that are properly modified to explain salient but mostly over-sighted features of such economies including but not limited to HPHC.

8. References

Ahn, CY, Singh, IJ., and Lyn Squire, L (1981). "A Model of an Agricultural Household in a Multicrop Economy: The Case of Korea" Review of Economics and Statistics 63(4):5220-525.

Aragie, EA. and McDonald, S. (2014) Semi-Subsistence Households: Accounting for Home Production for Home Consumption. Paper prepared for the CSAE Conference 2014: Economic Development in Africa, 23rd - 25th March 2014, St Catherine's College, Oxford

Azam M, Imai K, Gaiha R (2012). Agricultural supply response and smallholders market participation- the case of Cambodia. Kobe University. Discussion Paper Series. DP2012-09.

Barnum, H. and Squire, L. (1979) An econometric application of the theory of the farm-household. Journal of Development Economics 6 (1979) 79-102. North-Holland Publishing Company

Creedy, J. (2000) Measuring welfare changes and the excess burden of taxation. *Bulletin of Economic Research*. 52(1):1-47

CSA (2010, 2011). Agricultural Sample Surveys. Ethiopian Statistical Agency, Addis Ababa, Ethiopia.

Deaton, A. and Zaidi, S. (2002). Guidelines for Constructing Consumption Aggregates for Welfare Analysis. LSMS Working Paper No. 135, World Bank, Washington.

De Janvry, A., and Sadoulet, E. (2003) Progress in the modelling of rural households behaviour under market failures. In Alain de Janvry and Ravi Kanbur (ED) Poverty, Inequality and Development, Essays in Honour of Erik Thorbecke, Kluwer publishing

FAO (2014) FAO Food Price Index. Food and Agriculture Organisation (FAO). www.**fao**.org/world**foods**situation/**foodpricesindex**/en/ Retrived on March 12, 2014.

Flaig, D., Grethe, H., McDonald, S., and Siddig, K. (2012) Intersectoral Factor Movements: Do Adjustment Costs Matter for Welfare? Paper presented at EcoMod2012 conference, Seville, Spain, July 4, 2012 - July 6, 2012

Glauben, T., Henning, C., and Henningsen, A. (2003) Farm household decisions under various tax policies: Comparative static results and evidence from household data. Paper presented in the 25th International Conference of the IAAE, Durban, South Africa, 16-22 August 2003

Henning, C., and Henningsen, A. (2007) Modelling Farm Households' Price Responses in the Presence of Transaction Costs and Heterogeneity in Labour Markets. *American Journal of Agricultural Economics* 89(3), p. 665-681.

ISWGNA (2008) System of National Accounts (2008 SNA). Inter-Secretariat Working Group on National Accounts (ISWGNA). United Nations Statistics Division and the United Nations regional commissions, New York; International Monetary Fund – IMF, Washington, DC; World Bank, Washington, DC; Organisation for Economic Cooperation and Development – OECD, Paris; Statistical Office of the European Communities - Eurostat, Brussels/Luxembourg.

Key, N., Sadoulet, E., and de Janvry, A. (2000) Transactions Costs and Agricultural Household Supply Response. American Journal of Economics. 82 (May 2000): 245–259

Kuiper, M., and van Tongeren, F. (2005) Growing together or growing apart? A village-level study of the impact of the Doha Round on rural China. Chapter 8 in Putting Development Back into the Doha Agenda: Poverty Impacts of a WTO Agreement, Thomas W. Hertel and L. Alan Winters (eds.) (2005) World Bank, Washington, D.C.

Lambert, S. and T. Magnac (1998) Implicit Prices and Recursively of Agricultural Households' Decisions. mimeo, Paris, INRA (ENS): 33.

Lauren, D., Tiffany, M., and Stephanie, O. (2008) Taxation Policy in Developing Countries What is the IMF's Involvement? For The Bretton Woods Project. DV406 Consultancy Project

Lofgren, H., & Robinson, S. (1999) To trade or not to trade: non-separable farm household models in partial and general equilibrium. TMD discussion papers 37. International Food Policy Research Institute (IFPRI).

McDonald, S. (2010) Modelling Households as Joint Producers and Consumers. Paper prepared for the 13th Global Economic Analysis Conference, "Trade for Sustainable and Inclusive Growth and Development", United Nations Conference Centre, Bangkok, Thailand, June 2010

McDonald, S. (2007) A Static Applied General Equilibrium Model: Technical Documentation STAGE Version 1: July 2007 DRAFT. Tech. rep. Department of Economics/& Strategy. Oxford Brookes University. UK.

Mendola M (2007). Farm household production theories: A review of "institutional" and "behavioural" responses. Asian Dev. Rev. 24(1): 49-68.

Minot, N. (1999) Effect of transaction costs on supply response and marketed surplus: simulations using non-separable household models. International Food Policy Research Institute. MSSD Discussion Paper No. 36

Oladejo, J. Ajetomobi, J. and Fabiyi, Y. (2011) Transactions Costs and Agricultural Household Supply Response of Maize Farmers in Oyo State of Nigeria. Journal of Agriculture and

Social Sciences. ISSN Print: 1813–2235; ISSN Online: 1814–960X. 10–041/SBC/2011/7–2–69–74. http://www.fspublishers.org

Orden D, Torero M, Gulati A, (2004). Agricultural markets and the rural poor. Background paper for workshop of the Poverty Reduction Network (POVNET), March 5, 2004.

Oya, C., Cramer, C., and Sender, S (2008) 'Discretion and Heterogeneity in Mozambican Rural Labour Markets.' In: de Brito, Luis and Castel-Branco, Carlos and Chichava, Sergio and Francisco, Antonio, (eds.), Reflecting on Economic Questions. Maputo, Mozambique: IESE, pp. 50-71.

PROVIDE (2006) The Economic Contribution of Home Production for Home Consumption in South African Agriculture. Background Paper 2006:1. Elsenburg. South Africa

Singh, I., Squire, L., and Strauss, J. (eds.). (1986). Agricultural Household Models—Extensions, Applications and Policy. Baltimore: The Johns Hopkins University Press.

Taylor, J. E., and Adelman, I. (2003) Agricultural Household Models: Genesis, Evolution, and Extensions. *Review of Economics and the Household.* Volume 1, Numbers 1-2 (2003), 33-58. DOI: 10.1023/ A:1021847430758

Tiberti, M. (2011) The Impacts of Agricultural Policy Reform in Tanzania: An Agricultural Household Model-Based Assessment. Part of a PhD dissertation. University of Florence

Torero M (2011). A framework for linking small farmers to markets. Paper presented at the IFAD Conference on New Directions for Smallholder Agriculture. International Fund for Agricultural Development. Italy. 24-25 January 2011. Rome, IFAD HQ.

Tzouvelekas, V. (2011) Production and Consumption Decisions of Rural Households under Price Risk: A Mean-Variance Approach. Paper presented at the 5th Conference on Research in Economic Theory and Econometrics (CRETE).

World Bank (2013). World Development Indicators (WDI) 2013. World Bank Group. Washington, DC. USA.