Endogenous Transaction Costs and Tradability in a Micro Economywide Model – a Stylized Application With Nonseparable Households

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Paper prepared for the AAEA-WAEA Annual Meeting, Long Beach, California, July 28-31, 2002
Version 2 (May 2002), comments invited

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Abstract

This paper analyzes effects of transaction costs on household responses, adding to direct effects via price-bands, indirect effects through reduced availability of productive resources and through changes in price formation. A micro economywide model with nonseparable household models is developed, in which transaction costs determine effective prices through an endogenous, household-specific price-band. Moreover, transaction costs influence household decisions by claiming productive resources, and by affecting endogenous prices at household or micro-economy level. Comparison of two stylized village model specifications indicates that indirect effects of transaction costs reduce household supply response, despite reducing the range of prices for which households operate within their price-band. Results show that transaction costs need to be identified in terms of commodities used for transactions, and in terms of tradability of these commodities, to account for indirect effects of transaction costs.

Key Words:

Transaction costs; Computable general equilibrium model; Farm household model

JEL Codes:

Q12 (Micro analysis of farm firms, farm households, and farm input markets); R15 (Econometric and input-output models; Other models)

Endogenous Transaction Costs and Tradability in a Micro Economywide Model – a Stylized Application With Nonseparable Households

Marijke H. Kuiper[1]

Transaction costs play an important role in understanding policy response of rural households in developing countries. High transaction costs, for example due to poorly developed infrastructure, inhibit market access and can create interdependence between production and consumption decisions of rural households. Such nonseparability of consumption and production decisions can result in small or even counterintuitive policy response, like a reduction in marketed surplus in response to a price increase (de Janvry, Fafchamps and Sadoulet). Limited market access not only creates interdependencies within households, but also between households within a rural community. Lack of access to external markets, combined with heterogeneity between households, can result in local markets with endogenous prices and expenditure linkages (Holden, Taylor and Hampton). Counterintuitive policy responses then arise, if indirect effects (from interactions between households) outweigh direct effects (as predicted with (nonseparable) household models). General equilibrium models recently have been applied at the micro level to account for such interactions between households in villages (Taylor, Yunez-Naude and Hampton), or between villages and towns (Taylor, Yunez-Naude and Dyer).

This paper develops a micro economywide model in which nonseparable household models are embedded. Trading of commodities[2] outside the own community is subject to

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[2] Commodities is used to refer to both goods and factors (Ginsburgh and Keyzer, p. 108)

transaction costs, consisting of labor and capital needed to transport commodities. These transaction costs create a price-band between selling and purchasing prices. The prevailing trade regime, *i.e.* whether a household is a net seller, self-sufficient, or a net buyer, is determined endogenously, depending on the value of household shadow prices with respect to effective buying and selling prices.

This paper extends the existing literature by including the effect of transaction costs on the availability of productive resources and price formation. The limited number of existing studies looking at the impact of transaction costs on the trade regime, only account for the impact of transaction costs on prices paid and received by the household. This approach implicitly assumes that transaction costs consist of something purchased on a market, and that purchases for transactions do not affect prices. This assumption is not valid if transaction costs consist of commodities with limited tradability. Use of commodities for transactions will then affect price formation and availability of commodities for other activities.

To explore the impact of different assumptions on the impact of transaction costs on household response, applied models are developed based on a stylized village social accounting matrix (SAM). This SAM is constructed such as to reflect typical circumstances in an isolated village in a developing country, but simplified to the essentials needed to highlight the structure of the model.

Transaction costs are assumed to exist of a household nontradable (labor), and a village nontradable (capital). Poor infrastructure in developing countries leads to relative large amounts of time spent travelling to and from markets, thus composing an important part of the transaction costs incurred by households. Given frequent labor market imperfections in developing countries, time spent on travelling may be at the expense of time spent on production activities. Labor is assumed to be a household nontradable to simplify the analysis. As a result price-bands are household-specific. To study the impact of a commodity that is tradable at household level but has an endogenous village price, capital goods are assumed to be a second input for transactions.

Household response to increasing cash-crop prices is explored with two village model specifications: (*a*) transaction costs affecting price-bands and commodity balances (*b*) transaction costs affecting price-bands only. The second model resembles existing models looking at the impact of transaction costs on trade regimes. Comparison of the model results shows the indirect effects of transaction costs.

Transaction Costs in Price-bands and Commodity Balances of Households

Nonseparable household models play an important role in understanding policy response of rural households in developing countries. The seminal work of de Janvry, Fafchamps and Sadoulet shows how rational behavior of farmers in combination with market failures may give rise to sluggish or counterintuitive household responses. Nonseparability of household production and consumption decisions occurs when the effective price of a commodity used both in production and consumption is not exogenous to the household, but is determined endogenously by household demand and supply. In this case decisions at the production side will affect demand and supply of the commodity, which affects consumption decisions, and vice versa. Such nonseparability occurs if households are not price-takers in a market, if markets are missing, or if there is a gap between buying and selling prices (Löfgren and Robinson).

Both missing markets and differences between buying and selling prices can be analyzed with a price-band model, illustrated in figure 1. Starting from an exogenous market price, transaction costs increase the effective purchase price, and decrease the effective sale price faced by the household. Household demand and supply then determine the household shadow price of the commodity, with effective purchase and sale prices forming upper and lower boundaries. Depending on the intersection of the demand and supply curve, the household is (*1*) a net buyer, (*2*) self-sufficient, (*3*) a net seller of the commodity. If the household is a net buyer or seller, the household shadow price equals the effective purchase or sale price. If the household is self-sufficient, the household shadow price is endogenously determined within the price-band. A missing market can be conceptualized in this model as a wide price-band (in the most extreme case a sale price of zero and an infinite purchase price), such that the household always operates within it.

[insert figure 1: price-band]

Household response then consists of two decisions, (*i*) a discrete decision on their position in the market (determining their position as net buyer, net seller or not participating), and (*ii*) a continuous decision on production and consumption levels (determining their supply response). Most studies using the price-band model take the first decision, the position of the household in the market, as exogenous, focussing on the implications of this position on household response. A limited number of studies explicitly account for factors affecting the width of the price-band and the resulting market participation decision of the household. Goetz and Key, Sadoulet and de Janvry estimate the impact of different factors on the market participation decisions with a household model. Löfgren and Robinson embed nonseparable household models in a CGE model, in which the market-position of households is endogenous.

These three studies include the impact of transaction costs through price-bands only, implicitly assuming that transaction costs consist of something purchased on a market, and that purchase of commodities for transactions does not affect price formation. If commodities are purchased on a market, purchases are limited by the cash constraint. Inclusion of purchased commodities in the commodity balance does not affected household decision making, as long as purchases do not affect market prices. Additional purchases can then be made at an exogenous price, as long as sufficient cash is available. Purchased transaction commodities can thus be omitted from the commodity balance without affecting household decision making, if their price is exogenous. By accounting for the impact of transaction costs on effective household prices, transaction costs are indirectly included in the cash constraint. For example, using the effective price for selling output (the market price reduced with transaction costs), reduces the amount of cash available to the household. The difference between value of output at market prices and the value at effective household prices are the transaction costs of selling the output, thus indirectly including transaction costs in the cash constraint.

Including transaction cost only in the price-band is no longer valid if prices of commodities are determined endogenously, like in the model by Löfgren and Robinson. Limited tradability (at household or economy level) results in endogenous commodity prices. Although households may continue to perceive prices as exogenous, market-clearing prices are influenced by household supply and demand, including the demand for transaction commodities. To account for the impact of transaction costs on overall demand, and thus on prices, commodities used for transactions need to be included in the commodity balance.

In addition to affecting endogenous prices, the use of commodities as transaction inputs may also affect production decisions, by reducing the amount of resources available for production. Defining transaction costs as comprising costs of information, search, negotiation, screening, monitoring, coordination, enforcement and transportation (Sadoulet and de Janvry), transaction costs are likely to affect the resources available for production. For example, transportation in most developing countries requires a lot of time, due to poor infrastructure. With imperfect labor markets, this time spend on transportation may be at the expense of other productive activities. Even if time spend on transportation may be reduced by a transport service sector, search, negotiation and screening still require family time.

The household model used in this paper accounts for the impact of transaction costs on the effective prices faced by the household through price-bands, on endogenous prices, and on the availability of resources for production. A standard household model is used in which households maximize utility subject to a production function, a commodity balance and a cash constraint (see for example Singh, Squire and Strauss). Since the focus of this paper is on comparing the impact of different assumptions on transaction costs, the model is kept as simple as possible. Cobb-Douglas utility and CES production functions are assumed, allowing calibration of the model with the stylized SAM, and substitution-elasticity parameters for the production functions. To allow switches in trade regimes, the model is written as a mixed complementarity problem, by explicitly incorporating nonnegativity constraints on purchased and sold quantities (Rutherford). Manipulation of the first-order-conditions of this optimization problem results in the household model presented in the first part of table 1.

[insert table 1: model description]

Price equations form the first part of the household model. The first equation defines cost-pricing of output: households are assumed to be price-takers in a competitive environment with a constant returns-to-scale technology. Household-specific input-output coefficients (α_{hio}) provide the amount of input per unit of output; multiplication with the input price and summing over all inputs determines output price. The complementarity constraint allows the household to stop producing if input costs exceed output price.

Price equations (2) and (3) determine the price of traded commodities. Selling and purchasing prices are distinguished to allow introduction of price-bands in the model. If a commodity is purchased, the first part of equation (2) holds as an equality, *i.e.* the household shadow price ($\tilde{p}^{p}_{hj}$) is equal to the market price (p^{p}_{j}) plus transaction costs. If a commodity is sold, the first part of equation (3) holds as an equality, *i.e.* the household shadow price is equal to the market price minus transaction costs. If a commodity is produced for own consumption only, quantities purchased and sold are equal to zero, implying that the household shadow price lies between the purchasing (upper limit) and selling prices (lower limit) defined by (2) and (3).

The trading regime for each household is thus determined endogenously, depending on market prices and transaction costs (Löfgren and Robinson).

Household nontradability is defined implicitly by not including commodities in the set of purchased (*P*) or sold commodities (*S*). Their prices are not bounded by outside prices, and thus determined endogenously on the basis of supply and demand within the household.

Effective prices of household tradables are determined by the market price (exogenous to the household) and transaction costs. Transaction costs are defined by a (fixed) transaction coefficient, specifying the amount of inputs required per unit of traded commodity (τ_{hjt}). This transaction coefficient may differ for purchasing and selling, and it may differ among commodities and among households. Together with prices of inputs used in transactions, transaction coefficients determine the difference between market prices and effective prices faced by the household.

Multiplying transaction coefficients with quantities purchased and sold yields the total amount of inputs used for transactions, q_{hj}^{t}, in (8). By including these quantities in the commodity balance (9) the model accounts for the impact of transaction costs on the availability of production factors for production and consumption (leisure) in case of household nontradables, and on the price formation for commodities traded in local markets (see next section).

A constant-returns-to-scale production technology is assumed, output levels thus can not be determined in isolation of demand. However, per-unit input coefficients can still be determined, using the first-order-condition of cost minimization for a single unit of output (Ginsburgh and Keyzer, p. 130). These (price-dependent) input-output coefficients are calculated in (4), implicitly defining the production technology. The input-output coefficients determine the total demand for inputs for each household (5), as well as the output price of each commodity (1). The Cobb-Douglas utility function results in fixed expenditure shares (6). Cost pricing implies that households obtain income (7) from their factor endowments, and possible exogenous sources of income.

In summary, the innovative aspects of the household model presented in table 1, are the household-specific price-bands defined in (2) and (3), and the impact of transactions costs on the availability of productive resources (9). Furthermore, by including transaction inputs in the commodity balance, their impact on market-clearing prices is accounted for as discussed below.

Nonseparable Decisions in a Micro Economywide Model: Two Models

Factors causing nonseparability of household decisions are also likely to create interdependencies between heterogeneous households in a rural community. Poorly developed infrastructure may hamper trade with the rest of the world, but still allow trade within a community. If households differ enough in resource endowments, production systems or preferences to allow trade, local markets with endogenous prices and expenditure linkages will exist. Through these local linkages changes initially affecting only a single type of household, may influence the whole community by changing demand and supply of locally traded commodities.

To allow for such local interactions the household models are embedded in a village-level general equilibrium (economywide) model. Following the approach of Taylor and Adelman village level trade balances are added to the household models discussed above (see lower part of table 1). For commodities that are household tradables but village nontradables, the trade balance determines a local market-clearing price (10). The model assumes that households are price-takers in these local markets: for households prices of locally traded commodities are exogenous, while for village as a whole these prices are endogenous.

The trade balance of village tradables (11) calculates total amounts imported by and exported from the village: the total amount sold by the households is exported from the village, and the total amount purchased is imported in the village. For these commodities the market price is fixed outside the village. The model does not require the equivalent of a balance-of-payments constraint: all households satisfy their budget constraint, which in combination with the trade balance satisfies the balance of payments for the village as a whole.

If commodities used for transactions are household tradables but village nontradables, changes in traded volume will affect prices of transaction inputs. The transaction inputs are included in the commodity balance and thus incorporated in the demand and supply determining the village market equilibrium (10). Changes in demand for transaction inputs will thus affect local prices, determined by the Lagrange multiplier of (10).

Equation (1) - (11) constitute a micro economywide model with endogenous trade regimes and transaction costs. Main differences with the model developed in Löfgren and Robinson are the household-specific endogenous transaction costs, and the inclusion of transaction inputs in the commodity balance, thus including the impact of changes in traded volume on endogenous prices of transaction inputs and on availability of resources for other activities.

To explore the implications of different assumptions on transaction costs two versions of the model presented in table 1 are developed. Model A assumes that part of the transaction inputs (labor) are a household nontradable, while part of the transaction costs (capital) are locally tradable. Transaction costs are incorporated in the commodity balances of the households. For the household nontradable labor, this accounts for the impact of using labor for transactions on availability of labor for other uses. For capital, a village nontradable, inclusion in the commodity balance accounts for the impact of traded volumes on the endogenous village price of capital.

Model B ignores the impact of transaction costs on availability of production factors and on price formation by only including transaction inputs in the price equations. This amounts to eliminating equation (8) from the model presented in table 1. Model B resembles the approach used in other studies of transaction costs and market participation decisions. Comparison of the stylized versions of Model A and Model B, that are identical in all other respects, shows the impact of accounting for the indirect effects of transaction costs on household responses.

A Stylized Village Economy

Table 2 presents a stylized village SAM, constructed to reflect typical circumstances in an isolated village in a developing country, but kept as simple as possible. The SAM has to households, four household-specific activities, five commodities and three production factors. Despite an isolated location (in terms of travelling time to nearby towns and markets), the village has links with the outside world through selling of cash crops, purchasing of external inputs for production, and purchasing of manufactured goods for consumption.

[insert table 2 SAM]

Two types of households are distinguished to reflect the importance of non-agrarian incomes in rural communities. Some members of the migration household are assumed to have migrated to urban areas in search for better employment opportunities. This is reflected by receipts of remittances, and a higher land/labor ratio than the nonmigration household. Past remittances also have led to more investments in capital goods, compared to the nonmigration household.

Differences in factor endowments give rise to local village markets in land and capital. Reflecting differences in factor endowments, the nonmigration household rents in land and capital from the migration household. Labor is assumed to be a household nontradable: both households produce the same crops and thus have identical peak-demands for labor, while the isolated location of the village prevents short-term off-farm employment. In addition to a subsistence crop (a household nontradable), both households produce two high-value cash crops. One of these is a food crop, consumed by the household. The other is a nonfood crop requiring further processing outside of the village, thus not consumed by the household.

The SAM explicitly registers household consumption of output, and inputs used for buying and selling transactions. The intersection of institution and activity accounts gives the consumption of own output. The remainder of the production is sold outside the village, involving transaction costs covered by the transacting activity. The transacting accounts also registers the inputs required for purchasing external inputs and manufactured goods. Reflecting different factor endowments, the nonmigration household is assumed to use less capital and more labor for transactions compared to the migration household. For Model B, which does not account for the use of inputs on the availability of production factors, the SAM is adjusted by eliminating the inputs used for transactions from the SAM. This provides both model specifications with the same starting point in terms of levels of production and marketed surplus.

Total transaction costs are initially the same for both households. The high-value nonfood crop is assumed to be sold to a trader positioned about halfway between the village and the town, thus having half the transaction cost of the other commodities. To reflect limited substitution possibilities in agricultural production, all CES production functions are assumed to have a substitution elasticity of 0.5.

Model Simulations: Food Crop Price-bands

Household responses to a stepwise increase in the price of the high-value nonfood crop are simulated with the two village models to analyze how different transaction costs assumptions affect household decisions. Results of the simulation are discussed in terms of participation in the market for the high-value food crop, the only commodity both bought and sold by the households. This focus on the high-value food crop allows an analysis of all trade regimes: selling, self-sufficiency and buying. The supply response of the nonfood crop is the second focal point of analyzing the differences between the two models. Nonfood supply response is strongly affected by participation in the food crop market.

Increasing the nonfood price reduces the attractiveness of the food crop as a source of cash income. As a result households switch to production for own consumption, start purchasing, and finally cease to produce the food crop. Changes in the price-band of the food crop when the nonfood price is increased are shown in the upper part of figure 2 for Model A. The change in price-band clearly differs between the households. For the nonmigration household the price-bands initially narrows. Due to differences in production technology, the shift from the food to the nonfood crop reduces the demand for labor and increases the demand for capital. The nonmigration households uses more labor and less capital for transactions with the outside world. For this household the decreasing labor price outweighs the increasing capital price, thus reducing transaction costs. The migration household uses more capital, and as a result the opposing changes in capital and labor prices cancel, leaving the price-band unchanged for the first range of simulated nonfood price increases.

[insert figure 2: price-bands]

The nonmigration household does not participate in the food market at the start of the simulation. The migration household switches to producing the food crop only for own consumption when the nonfood price increases with 7.1 percent. This switch leads to a sudden drop in the production of the food crop by the migration household, no longer providing a market surplus. Increasing the nonfood price raises household income, thus increasing demand for the food and the subsistence crop. The induced increase in food and (labor-intensive) subsistence crop production raises the price of labor, while the increase in the capital price continues. As a result the price-band of both households starts widening from the point where the migration household enters its price-band.

The nonmigration household starts purchasing the food crop first, viz. when the price of the nonfood crop has increased with 27.6 percent. This switch results in a drop in the production of the food crop and an increase in nonfood production to pay for the purchased food crop.

When the nonfood price increases with 31 percent, the nonmigration household ceases food crop production, now completely relying on food purchases financed by nonfood crop production. At this price increase the migration household still produces the food crop only for own consumption. Through the local trade in land and capital its food crop shadow price is affected by the trade-regime switches of the nonmigration household, as can be seen in figure 2. These local interactions slow the increase in the shadow price of the food crop for the migration household, thus postponing its switch to purchasing the food crop until the nonfood price increases with 33.1 percent. After a nonfood price increases of 37.1 percent, the migration households also specializes in the nonfood crop.

The general pattern in Model B is much the same as in Model A (see the lower part of figure 2). However, ignoring the impact of transaction inputs on household and capital prices causes both price-bands and switch points to differ somewhat. For the nonmigration household differences between the two models are small. The range of nonfood prices for which the migration household relies on its own food production is extended in Model B: it stops selling earlier at price increase of 6.6 percent (7.1 percent in Model A), while starting purchasing the food crop at a price increase of 35.2 percent (33.3 percent in Model A). Production stops at a price increase of 39.0 percent (37.1 in Model A).

Absence of transaction inputs from the commodity balance in Model B leads to differences in labor and capital prices. Differences in capital prices are minimal. Relative to the total availability of capital in the village economy, limited amounts of capital are used for transactions. Larger amounts of labor are used, and labor is a household nontradable. For the migration household labor is a relatively scarce factor. Differences between the two models are therefore more pronounced for this household. For example, when the nonfood price starts increasing, the migration household shifts towards selling more of the nonfood crop, at the expense of the food crop. Because the nonfood crop requires less transaction inputs, this shift reduces the demand for capital and labor. In Model A this reduction in demand for transaction inputs slows the increase in the food crop price, and hence the point at which the household stops selling the food crop. In Model B this impact on endogenous prices is not included, therefore the migration household switches at a lower nonfood price increase. The difference in labor prices, due to the impact on the commodity balances, also causes an increasing difference in the width of the price-bands in Model A and B. This difference becomes visible in figure 2 at the higher ranges of simulated nonfood price increases.

Model Simulations: Nonfood Crop Supply

Participation in the food market affects the own supply response of the nonfood crop. Figure 3a shows the supply response of the nonmigration household, figure 3b of the migration household. The migration household has a much higher supply response than the nonmigration household, producing at least three times its base-level production. In contrast, the nonmigration household reduces its production below base level for the major part of the simulation, only increasing its production for a limited range of price increases. The initial reduction in nonfood production by the nommigration household is due to the sharp production increase by the migration household. Until ceasing to sell the food crop, the migration household has a supply response of 32 percent. This increase in the nonfood production leads to a fast increase in the capital price, and an increase in land prices as the nonmigration household rents capital and land from the migration household. This increase in production costs outweighs the increase in nonfood price, causing a reduction in the production of the nonfood crop by the nonmigration household.

[insert figure 3: supply response]

When the migration household ceases selling the food crop, its shadow price of the food crop starts increasing. This slows the switch towards the nonfood crop, reducing the supply responses of both households. The next change in supply response occurs when the nonmigration household switches to purchasing the food crop. The required cash is earned by increasing the production of the nonfood crop. The increase in nonfood production requires capital, rented from the migration household. The migration household then reduces its production of the nonfood crop, instead receiving income by renting out capital and land.

After the nonmigration household starts purchasing the food crop, every nonfood price increase leads to a fast reduction in food crop production. This releases capital for nonfood production, which thus keeps increasing. When food production comes to a halt, no more capital becomes available and the supply response of the nonmigration household turns inelastic again.

When the migration household starts purchasing the food crop, it needs to increase its nonfood production. This leads to a similar responses as for the initial price increases, including the supply reduction by the nonmigration household. Production of the food crop by the migration household is also phased out fast with subsequent price increases, releasing capital for nonfood production. When production of the food crop by the migration household ceases, supply becomes inelastic again for both households.

Model B shows a stronger supply response than Model A. More resources are available for production since inputs used for transactions are not accounted for. In addition, effective prices start diverging more and more when nonfood prices keep increasing. This leads to higher effective nonfood price increases in Model B for the same increase in market nonfood market prices. There are qualitative differences between the models during price-ranges with an inelastic supply. When the nonfood price increases from 107 to 127, the supply response of the nonmigration household in Model A is –2.4 percent, against 1.7 percent in Model B. In Model A accounting for transaction use of capital leads to a slightly higher price of capital, yielding the negative supply response. Similarly, in both other ranges of inelastic supply Model B has a relatively more elastic supply response.

Conclusions

The price-band model clarifies small or even counterintuitive household supply response when transaction costs create a difference between market and effective household prices. Transaction can costs also indirectly affect household response, however, by claiming scarce resources and influencing endogenous prices. The model developed in this paper accounts for the direct effect of transaction costs by including a price-band, and for the indirect effects by including inputs used for transactions in the household commodity balance. Transaction costs become household-specific if transaction inputs are household nontradables. The model in this paper incorporates the impact of changes in traded volume on the price of transaction inputs, and thus on the width of the price-band. Such price-effects result from transaction inputs being nontradable at household or village level.

Simulations with two model specifications show the impact of accounting for indirect effects of transaction costs. Two main findings of the simulations are that level of tradability determines the size of the indirect effects, and that accounting for the indirect effects has no clear-cut impact on household response.

The amount of transaction inputs relative to total endowments determines the size of the indirect impact of transaction costs. Relevant total endowments are determined by the tradability of transaction inputs. The difference between the two model specifications is mostly due to the household nontradable transaction input, labor. For a household nontradable transaction input the household endowment is relevant, where for a household tradable but village nontradable input (capital) the larger total village endowment is relevant. Differences between the two model specifications are therefore more pronounced for the migration household which has a relatively small labor endowment.

Accounting for the indirect impact transaction costs has no clear-cut impact on household response. On the one hand, changes in traded volume change the demand for transaction inputs.

If tradability of transaction inputs is limited, price changes resulting from the change in demand may widen or narrow the price-band, increasing or decreasing supply response. On the other hand, supply response reduces when accounting for the use of transaction inputs with limited tradability, because selling more output reduces the amount of production factors available for increasing production.

Indirect effects of transaction costs can change the expected household supply response from positive to negative, and from elastic to inelastic, highlighting the importance of quantifying transaction costs beyond their monetary impact on effective household prices. The level of tradability of transaction inputs plays a key role in determining their indirect effect on household response. Identification of the tradability of commodities used for transactions is thus needed to account for indirect impacts of transaction costs through competition with production activities, and through changes in price formation.

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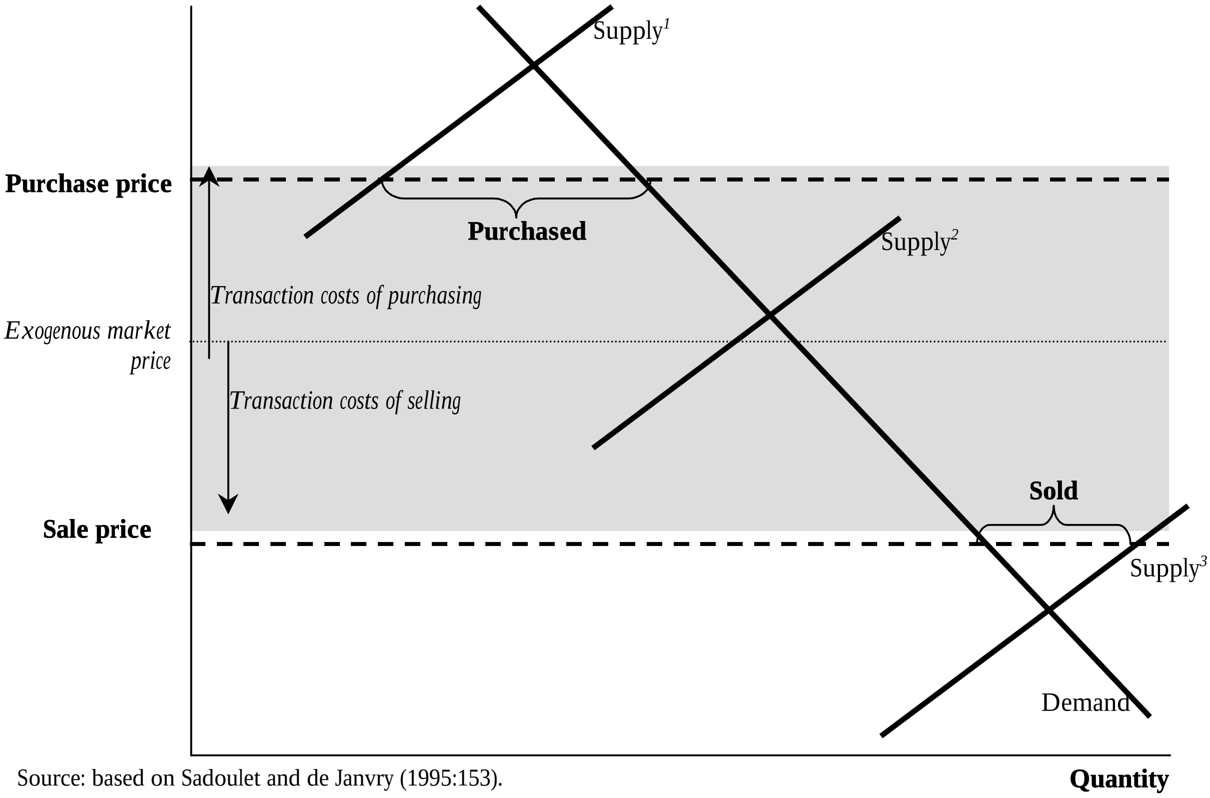
Figure 1: Supply Response with Price-Bands



Source: based on Sadoulet and de Janvry (1995:153).

Table 1: A Micro Economywide Model with Endogenous Transaction Costs and Endogenous Trade Regimes

Model structure[#]				
Household model (equations hold for all $h \in H$)				
Cost pricing of output:	$\sum_i \tilde{p}^i_{hj}\alpha_{hio} \ge \tilde{p}^o_{hj}$	$q^o_{hj} \ge 0;\ q^o_{hj}(\sum_i \tilde{p}^i_{hj}\alpha_{hio} - \tilde{p}^o_{jh}) = 0$	$\forall\ j \in O$	(1)
Price purchased goods:	$p^p_j + \sum_t \tilde{p}^t_{hj}\tau^p_{hjt} \ge \tilde{p}^p_{hj}$;	$q^p_{hj} \ge 0;\ q^p_{hj}(p^p_j + \sum_t \tilde{p}^t_{hj}\tau^p_{hjt} - \tilde{p}^p_{hj}) = 0$	$\forall\ j \in P$	(2)
Price sold goods:	$\tilde{p}^s_{hj} \ge p^s_j - \sum_t \tilde{p}^t_{hj}\tau^s_{hjt}$;	$q^s_{hj} \ge 0;\ q^s_{hj}(\tilde{p}^s_{hj} - p^s_j - \sum_t \tilde{p}^t_{hj}\tau^s_{hjt}) = 0$	$\forall\ j \in S$	(3)
Production decisions[1]	$\kappa_{hio}[\tilde{p}^o_{hj} / \tilde{p}^i_{hj}]^{\sigma_{ho}} \ge \alpha_{hio}$	with $\sigma_{ho} = 1/(1-\rho_{ho})$	$\forall\ j \in I, a \in A$	(4)
Total input demand:	$q^i_{hj} = \sum_o \alpha_{hio} q^o_{hj}$		$\forall\ j \in I$	(5)
Consumption decisions:	$q^c_{hj} = \dfrac{\mu_{hc} w_h}{\tilde{p}^c_{hj}}$	with $\sum_c \mu_{hc} = 1$	$\forall\ j \in C$	(6)
Full-income:	$w_h = \sum_j \tilde{p}_{hj}\bar{q}^\omega_{hj} + \bar{y}_h$			(7)
Transaction inputs:	$q^t_{hj} = \sum_j (\tau^p_{hjt} q^p_{hj} + \tau^s_{hjt} q^s_{hj})$		$\forall\ j \in T$	(8)
Commodity balance:	$q^o_{hj} + q^p_{hj} + \bar{q}^\omega_{hj} = q^c_{hj} + \sum_o q^{io}_{hj} + q^s_{hj} + q^t_{hj}$		$\forall\ j \in J$	(9)
Village trade balances				
Village nontradables:	$\sum_h q^s_{hj} = \sum_h q^p_{hj}$		$\forall\ j \in VNT$	(10)
Village tradables:	$q^m_j + \sum_h q^s_{hj} = \sum_h q^p_{hj} + q^e_j$		$\forall\ j \in VT$	(11)

Sets, parameters, variables	
Sets	
C	Consumed commodities
E	Exported commodities
F	Factors
I	Inputs
J	Commodities
H	Households
M	Village imports
O	Output
P	Purchased commodities
S	Sold commodities
T	Transaction inputs
VNT	Village nontradables
VT	Village tradables
ω	Factor endowments
Parameters	
κ	CES parameter[1]
ρ	Substitution parameter
σ	Substitution elasticity
τ	Transaction coefficient
μ	Budget shares
$\bar{y}$	Exogenous income
Variables	
α	Input-output coefficients
p	Village prices
$\tilde{p}$	Household shadow prices
q	Quantities
w	Household income

[#] Subscripts indicate type of commodity and / or household; superscripts denote the way in which the commodity is used.

[1] A CES production function is used: $q^o = k[\sum_i \gamma_i q_i^\rho]^{1/\rho} = [\sum_i k^\rho \gamma_i q_i^\rho]^{1/\rho} = [\sum_i \kappa_i q_i^\rho]^{1/\rho}$, where κ_i combines the distribution parameter (γ_i) and efficiency parameter (k) of input i.

Table 2: A Stylized SAM of an Isolated Rural Village economy

			Activities								*Commodities*					*Factors*			*Households*		*ROW*
			(A1)	(A2)	(A3)	(A4)	(A5)	(A6)	(A7)	(A8)	(C1)	(C2)	(C3)	(C4)	(C5)	(F1)	(F2)	(F3)	(H1)	(H2)	(R)
Activities	(A1)	Subsistence crop, nonmigration hh.																	4.0		
	(A2)	High-value food crop, nonmigration hh.																	4.5		
	(A3)	High-value nonfood crop, nonmigration hh.											14.4								
	(A4)	Transacting, nonmigration hh.											0.6	0.6	0.7						
	(A5)	Subsistence crop, migration hh.																		2.0	
	(A6)	High-value food crop, migration hh.										6.9								3.0	
	(A7)	High-value nonfood crop, migration hh.											4.3								
	(A8)	Transacting, migration hh.										0.6	0.2	0.4	1.2						
Commodities	(C1)	Subsistence crop																			
	(C2)	High-value food crop																			7.6
	(C3)	High-value nonfood crop																			19.5
	(C4)	External inputs		1.5	4.8			3.3	1.4												
	(C5)	Manufactured good																	7.3	13.6	
Factors	(F1)	Labor	3.0	1.5	2.4	1.5	1.5	3.3	0.7	1.6									0.3	0.2	
	(F2)	Land	0.5	0.8	2.4		0.3	1.7	0.7												
	(F3)	Capital	0.5	0.8	4.8	0.3	0.3	1.7	1.4	0.8											
Households	(H1)	Nonmigration household														8.7	3.0	4.4			
	(H2)	Migration household														7.3	3.3	6.2			2.0
Rest of world	(R)	External trade												10.0	19.0						
Totals			4.0	4.5	14.4	1.9	2.0	10.0	4.3	2.5	0.0	7.6	19.5	11.0	20.9	15.9	6.3	10.6	16.0	18.8	29.0

Figure 2: Food Crop Price-bands of Nonmigration and Migration Households in Model A and in Model B (% change from base)

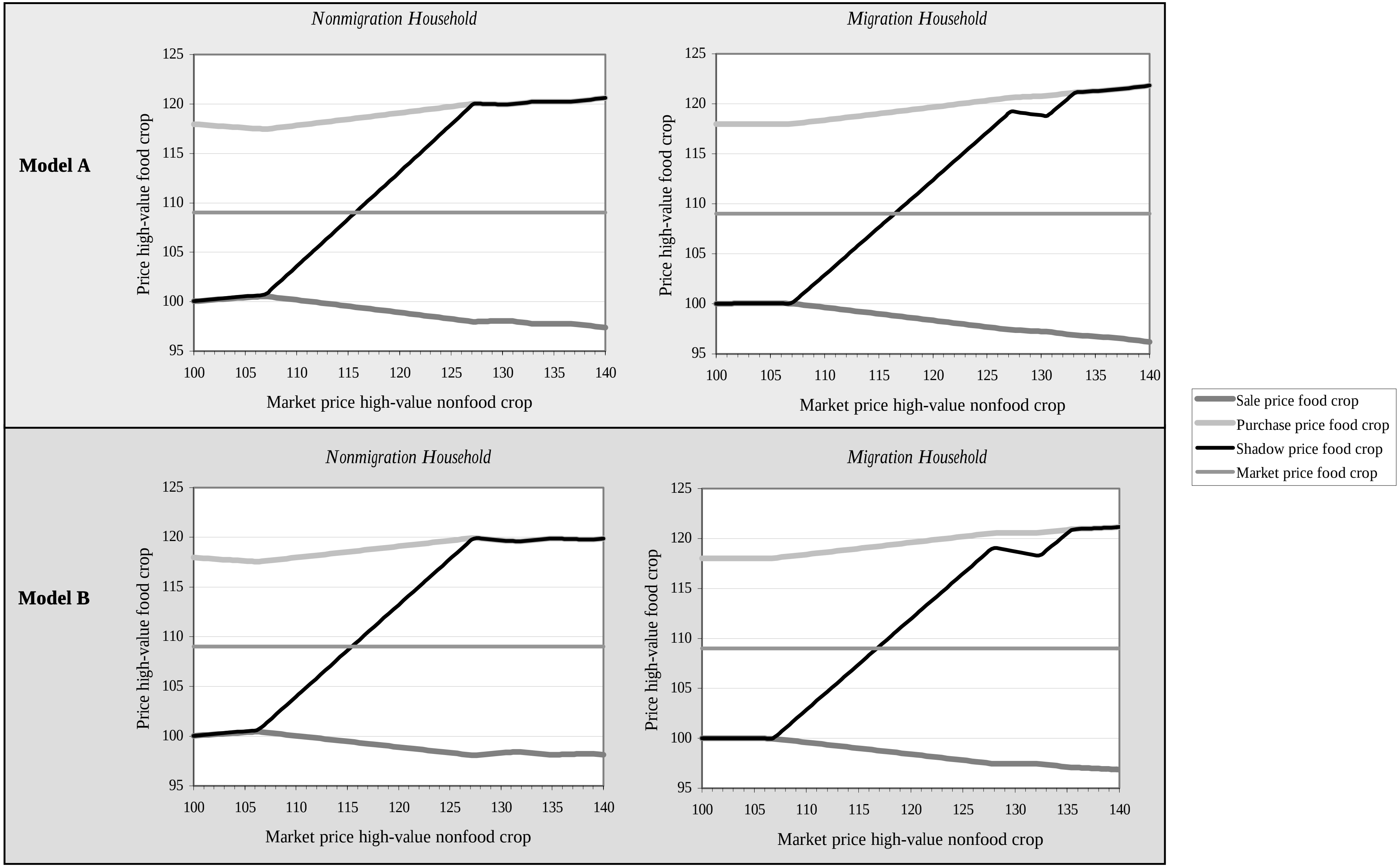


Figure 3a: Nonfood Supply Response for the Nonmigration Household (% change from base)

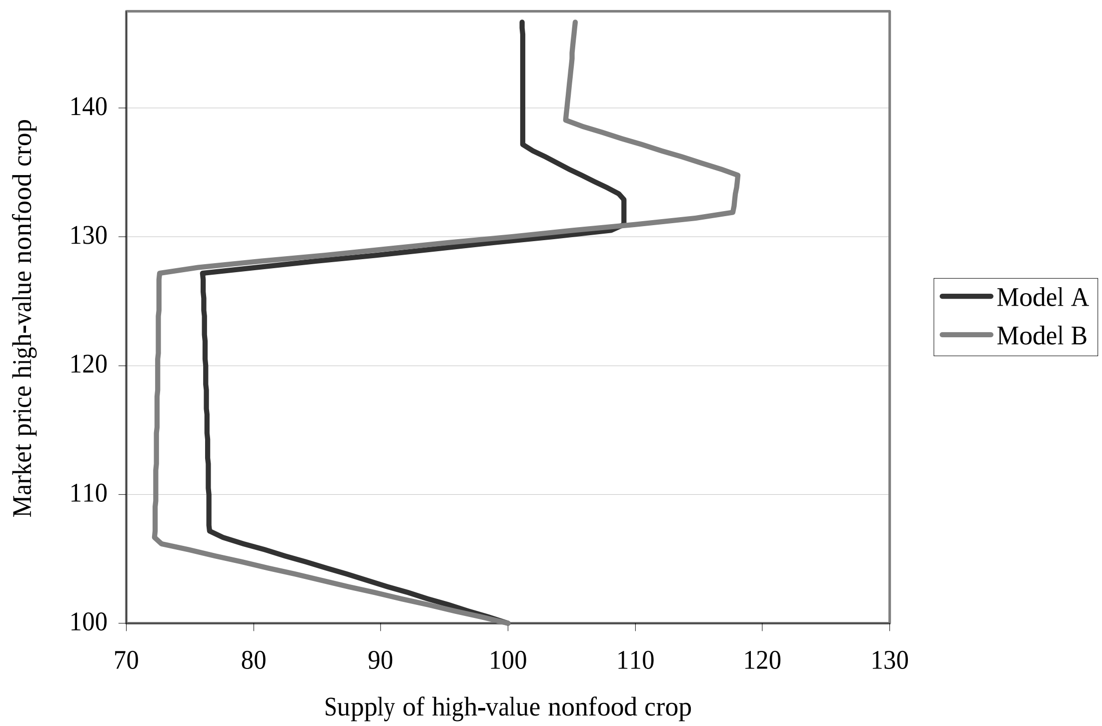


Figure 3b: Nonfood Supply Response for the Migration Household (% change from base)