Evidence and Implications of Non-Tradability of Food Staples in Tanzania 1983-1998

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Abstract

Economic reform programs assume that major goods are tradable, such that depreciation of the real exchange rate raises the value of output compared to factor costs in domestic currency. In Tanzania, major food staples that account for most real income are non-tradables in at least one-quarter of the country. This is demonstrated and implications assessed for the constraints imposed on macroeconomic-led adjustment strategies.

Keywords: tradable goods, non-tradable goods, exchange rate pass-through, Tanzania

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Introduction

An important component of many economic reform programs in developing countries is to stimulate the production and reduce consumption of tradable goods by increasing (depreciating) the real exchange rate (RER), defined as the relative price of tradables to non-tradables (Edwards 1989). It is often assumed that the agricultural sector will benefit from this policy because agricultural commodities are tradable, while most of the costs of agricultural production (land and labor) are not tradable.

In Tanzania, economic reforms were associated with a sharp and sustained depreciation in the RER after 1986, following a long period of appreciation from the late 1960's. This trend was sharply reversed after 1993, with a strong appreciation of RER (Delgado and Minot 2000).

These events were consistent with trends of domestic prices of food staples in Tanzania over the 1990-99 period. The real prices of the more tradable crops (wheat, rice, maize) rose from 1991 to 1993, and declined to less than 50 percent of their 1991 level thereafter. Admittedly, this pattern echoed in part the impact of the 1991-92 drought in southern Africa, and associated Tanzanian maize exports. Yet it is clear that the appreciating real exchange rate made imports of wheat and rice less expensive, driving down domestic prices. Furthermore, real prices of the less tradable crops (cassava, sorghum/millet, beans) continued to rise for another two years (except cassava), before falling after 1995. However, the declines were less than those of the tradable crops.

The transmission mechanism from RER to agriculture is fairly direct. Real exchange rates reflect the changes in the domestic price of traded goods relative to the price of non-tradable goods. The depreciating RER after 1986 meant, other things equal, that the prices of tradable goods were rising faster than the value of labor and land to produce them; the reverse was the case after 1993. In theory the returns to producers of traditional exports should have risen from 1986 to 1993. Unfortunately, world commodity prices were falling sharply, largely wiping out the gains from the depreciating RER. Given the extent of the fall in world prices in the 1990s, the situation of export crop producers would have been disastrous had the RER not been depreciating during at least the early part of the decade.

Conversely, the prices received by producers of non-tradables were declining during the 1986 to 1993 period. The most obvious manifestation of this is the austerity felt by employees in the urban non-tradable industries such as government services where wages did not keep up with the cost of living. Producers of non--tradable agricultural goods were also adversely affected during this period. After 1993, the price of non-tradables was rising relative to tradables, reducing incentives to producers of export crops, but raising the returns of producers of non-tradable goods.

In other words, the impact of economic reforms between 1986 and 1993 reduced the need for import controls and increased the returns to export and import-substitution activities, and deregulated private trade in food crops (liberalization in input distribution and export marketing), thus favoring producers of tradables. After 1993, the net impact of events was to favor the producers of non-tradables, despite the acceleration thereafter of implementation of agricultural reforms in Tanzania designed to do the opposite and favorable price trends for Tanzania's traditional export crops in world markets between 1993 and 1997. The answer to the puzzle lies in part in what was happening over the period to the overall structure of incentives in Tanzania due to macroeconomic policy, and in part to the fact that many agricultural products in Tanzania behave as non-tradable goods. The latter fact, as we shall see, does not de-link these prices from world markets or exchange rate effects, but changes the nature of the link substantially.

Thus, given the strong correlation between RER and domestic prices, it is important to investigate the exchange rate pass-through, because changes in the domestic equivalent of the world price can be due to either changes in the world price itself or due to changes in exchange rates. This paper will therefore focus on the effect of the changes in the structure of output price incentives on agricultural producers and consumers of different food staples. And to understand better the evolution of agricultural incentives under economic reforms, we will try to test whether food prices are more affected by domestic supply and demand conditions or by world prices and RER (see Kyle and Swinnen 1994).

It is hypothesized that if a good is tradable, then it is more responsive to real exchange rate policies and international prices. Using ordinary-least-squares (OLS) regression, tradability of major food staples in Tanzania in both isolated markets and well-connected markets will be formally tested. This paper will also assess directly the extent to which different food staples are insulated from world price movements.

The following section discusses the differences between tradable and non-tradable goods. The paper continues with the description of data used, regression results, discussion and implications for growth strategies involving agricultural development.

Differences between tradable and non-tradable agricultural goods

Simple economic models have typically assumed that physical goods (such as food) are all tradable, while services and factors of production are non-tradable. More sophisticated analysis may allow for the fact that some highly perishable items (fresh milk, say) or items whose weight or bulk is high compared to value (cinderblock bricks, for example) are non-tradables. However, it is rare that macroeconomic analyses allow for the fact that major food staples, such as maize, might behave as non-tradables (Delgado 1992). It is rarer still that analysts test the tradability assumption for food staples (Kyle and Swinnen 1994).

Structural adjustment has at its core the necessary shift in incentives from sellers of non-tradables to sellers of tradables, in order to restore competitiveness and the trade balance. If local food staples cannot be traded internationally because of low value/bulk ratios and distance to ports, then prices are set by local supply and demand fluctuations rather than changes in exchange rate or world prices. The expansion of local production of non-tradables is constrained by effective local demand for the item. An increase in supply in the local market leads to rapidly falling prices and producer revenues. On the other hand, tradable goods, in theory, can always be imported or exported at the prevailing world price so the price is determined largely by world prices and the exchange rate[1].

Two qualifications need to be noted. First, the markets for tradables and non-tradables are connected. Since people in rural areas of many developing countries (including Tanzania) spend most of their income on food, the price of food is highly correlated with the reservation wage of labor ("wages goods" in an earlier literature on closed economies—see Mellor, 1966). The non-tradability of food may limit the effectiveness of RER depreciation in stimulating tradable supply. If expanding tradable output results in a non-negligible reduction in staple food production, or supply is inelastic in the short-to-medium run, the resulting higher price of food will offset some of the incentive to expand tradables. This will occur both directly through the relative price of outputs and indirectly by raising the implicit wage rate of family labor. Second, the degree of tradability of a given commodity varies by location. The same good can be a non-tradable in one location (typically in a remote area where local production of the good occurs) and a tradable near the ports or near major roads and rail lines.

This paper argues that major food staples in "semi-open" agriculture might behave as non-tradables (see Delgado, 1992). If a staple is tradable, and provided that there are no prohibitive tariffs or quotas, then in a small "price-taking" country such as Tanzania, movements in world prices for the good in question, the price of substitutes, and the

1 We assume that Tanzania is a price taker, which is reasonable given the fact that Tanzania does not currently dominate world trade in any single commodity.

market exchange rate should largely determine movements in its domestic price. Conversely, if a staple is non-tradable, then its demand will be relatively stable and its price will be determined primarily by the local and national supply of the good.

Data

Food price behavior and the evidence of tradability and non-tradability of Tanzania's main food staples are analyzed based on data from a monthly survey of 44 markets of retail food prices over the period 1983 to 1998 collected by the Market Development Bureau (MDB) and compiled by the Famine Early Warning System (FEWS) project office in Dar-es-Salaam in Tanzania. Food retail price series were collected using a reasonable protocol[2] and showed seasonal fluctuations and considerable variation across a large sample of markets, as anticipated. Food producer prices were collected beginning in 1990/91 only, while export crop producer prices prior to 1991 were largely official prices.

The markets surveyed are listed in Table 1, along with their regional location and approximate distance to Dar-es-Salaam (by far the largest market in Tanzania) by road or rail. These markets are further sub-divided into 24 well-connected markets and 20 isolated markets. The well-connected markets are located on or near a rail link to Dar-es-Salaam or Tanga (important coastal ports), or they are on or near a major all-weather road to Dar-es-Salaam or Tanga. Seventeen of the twenty regional capitals are classified

2 Five or six prices were recorded, if possible for each product twice monthly. These are then averaged into a single monthly price.

as well-connected. Isolated markets are all other markets included in the price data. As can be seen from Table 1, proximity to the capital and the coast are not good indicators of isolated status, since many well-connected markets are far from the coast and some "isolated" markets are near the coast but do not have good transport infrastructure.

Methods

If a staple is tradable and trade policy is not prohibitive, then movements in its domestic price should be largely determined by movements in world prices for the good in question and the market exchange rate, through either changes in imports (for importables) or changes in exports (for exportables). Conversely, if the staple in question is a non-tradable, and domestic demand is constant, then its price will be determined primarily by the local and national supply of the good.

These assertions are tested more formally by estimating the parameters of equation (1), by OLS regressions, one for each combination of three staple crops (wheat, rice, maize, and cassava) and two market types (well-connected and isolated). The dependent variables are the monthly market-level retail prices (Pr) over the 1983 to 1998 period, deflated by monthly National Consumer Price Index for Dar-es-Salaam (NCPI). Explanatory variables consist of twelve monthly fixed effects (M_t) to capture seasonal patterns, a monthly time trend (T_t), monthly US export prices lagged three months[3] (Px_{t-}

3 Lags of 0 and 6 months were also tested. Three months gave the best fit for tradable crops, and none of the lags were statistically significant for any of the non-tradables. Ninety days is a plausible delay between order and international delivery of grain in East Africa.

$_3$), national production of the good in question from the most recent harvest (Qn_t), regional production of the good from the most recent harvest (Qr_t) , and the real exchange rate (RER_t)[4]. All prices are adjusted to constant 1998 Tanzanian shillings (Tsh) or US dollars.

$$(1) \qquad \Pr_{ijt} = \alpha_0 + \sum_{j=1}^{12} \alpha_j M_j + \alpha_{13} T_{jt} + \alpha_{14} Px_{tj-3} + \alpha_{15} Qn_{it} + \alpha_{16} Qr_{it} + \alpha_{17} RER_{jt} + e_{ijt}$$

where i = wheat, rice, maize, and cassava; j = month (1 to 12), t = year, the α's are unknown coefficients to be estimated and e_{ijt} is a random error term.

Results and Discussion

Results of the regressions are shown in Table 2. Results for the goodness-of-fit (R^2) show that this model explains 95 percent of monthly domestic price variation for rice over the 1983 to 1998 period in both well-connected and isolated markets. This alone suggests that rice is probably a tradable (Kyle and Swinnen 1994), as common sense would also suggest. World rice prices have a positive influence on Tanzanian rice prices, as would be expected. Local and national rice production are also inversely correlated with domestic rice prices, as would be expected given the importance and inland nature of much of Tanzania rice production. The latter gives a high degree of natural protection to rice in inland areas of Tanzania such as the Lake Victoria region.

4 The continuous monthly time trend is designed to control for any secular trends in the data.

The strict interpretation of the world rice price coefficient for domestic rice prices in isolated markets in the table is that for every US$1.00 per kg increase in world rice prices, Tanzanian domestic prices in isolated markets will increase by Tsh 183 per kg three months later, compared to more than Tsh 250 per kg in well-connected markets. These are equivalent to a 28 percent pass-through rate for the world price increase in isolated markets and a 38 percent pass-through rate in well-connected markets.[5]

World wheat and maize relative prices also have significant impact on Tanzanian domestic rice prices. The negative coefficient on world maize prices probably stems from maize and rice being substitutes in consumption in Tanzania and how import decisions are made. If world maize prices are low, importers and government authorities import more maize and less rice, putting upwards pressure on domestic rice prices.

Finally, the real exchange rate has a significant negative effect on Tanzanian rice prices, as predicted. The higher the exchange rate (expressed as Tsh/US$), the more it costs to import, and the more valuable import substitutes such as rice become. The bottom line is that rice prices in Tanzania unequivocally behave as prices of a tradable good in both isolated and well-connected markets.

Maize, on the other hand, behaves like a tradable in well-connected markets and like a non-tradable for isolated markets. In isolated markets, maize prices are influenced only by regional and national production in the most recent harvest. World prices have no statistically significant influence on maize prices in these markets, nor does the RER. In well-connected markets, however, maize behaves like a tradable. A US$1.00 increase

5 The average 1998 free market nominal exchange rate in 1998 was Tsh. 656 per US dollar.

in world maize prices translates three months later into a Tsh. 586 per kg increase in Tanzanian maize prices, implying a pass-through rate of about 90 percent. Regional maize production decreases maize prices somewhat, but much less so than in the case of isolated markets. National maize production has hardly any impact at all in well-connected markets. The bottom line is that maize behaves like a non-tradable in isolated markets and like a highly tradable good in well-connected markets. Based on regional production data, it is estimated that at least one-quarter of all Tanzanian maize production occurs in isolated areas as defined here[6].

For comparison purposes, another set of regressions was run to explain fresh cassava prices in terms of world cereal prices, given that domestic food cassava does not have a comparable world market counterpart. As can be seen in Table 2, fresh cassava in both isolated and well-connected markets behaves as a non-tradable. As expected, the goodness-of- fit of these regressions (R^2) indicates that the independent variables "explain" a smaller percentage of the variation in the dependent variable than was the case in the regressions for tradable staples.

Although the t-tests on the own-price coefficients in these regressions are probably sufficient to make the case for non-tradability, we also test to see whether retail food prices in the isolated markets are driven by the same forces and in the same way as those for well-connected markets. More specifically, we test whether the hypothesis that the values of the coefficients in the isolated markets are the same as those in the well-

6 This is clearly a conservative estimate, since it assumes that any region that is largely served by rail or paved road infrastructure is entirely well-connected, whereas many villages and towns in such regions clearly are isolated, as suggested by Table 3.3.

connected markets. As shown in Table 3, in the case of rice, there is no statistically signficant difference between the coefficients in isolated and well-connected markets. This confirms the earlier conclusion that rice is tradable throughout the country. In the case of maize, there is a statistically significant difference between the coefficients in the isolated and well-connected markets, supporting our conclusion that prices are driven by different forces in each type of market. Finally, there are statistically significant differences between the models of isolated and well-connected cassava markets. This is consistent with our conclusion that cassava is non-tradable, though it indicates that the demand elasticities may vary by region[7].

Why does maize behave as non-tradable?

Based on regional production levels, it is estimated that at least one-quarter of all Tanzanian maize production occurs in isolated areas where maize is behaving as a non-tradable good. Does this imply that maize growth in isolated areas is limited by domestic demand? If so, is it because of high transaction costs? To further investigate these issues, we calculate the evolution of spreads between food prices in different parts of the country and Dar-es-Salaam. Assuming that wholesale-to-retail markups do not differ greatly in percentage terms across markets, the difference in retail prices between two locations between which trade is actually occurring is a good indicator of total marketing costs, including the trader's margin. Equation (2) models the evolution of monthly price

7   If we assume that demand is stable and price changes are caused by shifts in supply, then the equilibrium price traces the the demand curve

spreads between outlying markets and Dar-es-Salaam between January 1986 and December 1998.

(2)

$$Pm_{ijt} - Pdar_{ijt} = \beta_0 + \sum_{j=1}^{12} \beta_j M_j + \beta_{13} Dist_m + \beta_{14} Dist_m^{\ 2} + \beta_{15} I + \beta_{16} LOR + \beta_{17} MP + + \beta_{18} T_{jt} + e_{mijt}$$

The dependent variable in this analysis is the difference between the deflated monthly retail price in Dar-es-Salaam (*Pdar*) and those of 43 other markets (m) in month j, year t. The explanatory variables include road distance from Dar-es-Salaam ($Dist_m$), road distance squared ($Dist_m^2$) to allow for a non-linear relationship, a dummy variable for isolated markets (*I*), one for markets in well-connected towns, located on a rail line or near a major road (*LOR*), one for markets in port towns (*MP*), a continuous monthly time trend (T_{jt}), and twelve monthly dummy variables (M_j) to control for seasonal effects. The purpose of these dummy variables is to partially control for the fact that not all markets actually trade with Dar-es-Salaam, in which case price differences may be less than the marketing cost. All price differences are expressed in constant December 1998 Tsh/kg.

Results for wheat, rice, maize and cassava are shown in Table 4. The first row shows the mean price spread between all markets and Dar-es-Salaam in all months over the 1986 to 1998 period. Spreads are highest for wheat (Tsh 174) and rice (Tsh 135) and lowest for maize (46 Tsh/kg).

The continuous time trend coefficient indicates that wheat spreads have declined at an average monthly rate of Tsh 1.35 over the period 1986-98, while rice and maize spreads declined moderately at about Tsh 0.06 to 0.08 per month. Cassava spreads, which involved a smaller number of markets due to missing observations, increased significantly over the period (0.6 Tsh/kg per month).

Distance to Dar has a positive effect on spreads for wheat rice and maize, as expected. For rice, for example, each additional kilometer from Dar-es-Salaam adds 0.11 Tsh/kg to the spread (or US$0.16 per ton/km). The presence of statistically significant but very small negative coefficients for distance squared is interpreted as evidence of economies of scale in transport as distance increases, as expected.

If a market is on line of rail or on a major road, other things being equal, the spread for wheat and maize will be reduced by 12 Tsh/kg and 4 Tsh/kg, respectively. However, well-connected markets have a significantly higher spread for rice. This implies that they have lower rice prices, perhaps because the main rice producing regions of the country are all on railroads. If a market is isolated, the spread increases significantly for maize by 11 Tsh/kg, but is not significant for wheat, rice and cassava. This implies that the maize prices in isolated markets are lower than in well-connected markets. If the supplying market is a port city, the spread is significantly lower for wheat, rice, and (to a lesser degree) maize. This is not surprising given that wheat and rice are imported every year and maize is occasionally imported. Finally, spreads are lowest when inland prices are high. This is the case at the start of the cropping season for the three cereals, and right after the cereals harvest for cassava, as shown in Table 4.

In sum, there is solid evidence from both point studies and broad-based statistically-significant trends that transport costs remain very high, and thus absolute spatial margins are still quite high in Tanzania. This, combined with occasional prohibitions on cross-border trade, is a fundamental reason why a quarter of the country's maize supply was seen to behave as a non-tradable crop. Market-mediated structural reforms will continue to be difficult to implement until spatial marketing margins can be brought down further, through infrastructure improvements and rural transportation policies that reduce transportation costs.

Implications of non-tradability of food staples for incentives

If at least a quarter of locally produced food staple supplies behave as non-tradables, certain simplifying assumptions of conventional economic theory for open economies no longer hold. Instead, parts of Tanzania should be considered what Myint (1975) called the "semi-open" economy, where competitiveness of exports matters to overall growth (as in open economies), but where the competitiveness of tradable sectors generally also depends on what is exogenously occurring in the non-tradable sectors (as in closed economies) (Myint 1975; Delgado 1992; Delgado, Hopkins and Kelly, 1998). In the purely open economy, producers should follow their comparative advantage in production and trade for their preferred consumer goods (such as food). Thus, production and consumption decisions are separate. Resources can appropriately be concentrated in specialized growth poles (such as cash cropping zones or urban light manufacturing, depending on comparative advantage) that will pull everyone else along.

In the semi-open economy, however, there is a need for balance between the tradable and non-tradable sectors, as in closed economies. This is fundamentally because producers consume significant amounts non-tradable items (such as food staples) with additional income earned from exports. If the production of these non-tradable consumer items, sometimes called "wages-goods[8]", is inelastic in the short to medium run, their prices will be bid up relative to the prices of tradables. For example, an export boom will rapidly increase local demand for food. If food is non-tradable and inelastic in supply, this will increase the price of food, leading to increased wage demands as workers try to protect their standard of living. Higher wages will choke off the export expansion. Under these circumstances, lack of production growth in the non-tradable staple food sector will choke off export gains made possible by structural adjustment reforms.

Exogenous shocks such as drought will also lead to price spikes for non-tradable food staples, a common occurrence in Africa (Delgado 1992). Even if under used-land and labor are available, it takes another year at least before local production can recover. On the other hand, non-tradability suggests that local production is primarily demand-constrained over the longer-run, consistent with the probability that local resources are not fully employed where these commodities are important in production. It is also consistent with a high long-term price elasticity of supply. In Tanzania, maize’s short-run supply elasticity has been estimated 0.25 and the long-run supply elasticity at 1.96 (Delgado and Minot, 2000).

In coastal urban areas, commercially viable imports of cereals can avert harmful price spikes because of economies of agglomeration and of lower transport costs to the

8 So called because they are the physical counterpart to returns to labor in low income societies where most income is spend on staples.

outside world. Elsewhere, subsidized food aid can temporarily help keep food prices lower than they would be otherwise. Besides the dominant humanitarian motive, this has the additional benefit of protecting the livelihoods of numerous small-scale farmers who depend on slim profit margins in non-food tradable-good activities. However, a viable long-run growth strategy will require developing the food sector to the point that a growing supply at a relatively stable price is ensured, whether from technological change in own production or cheaper commercial imports through improved infrastructure, or a mix of the two. The analysis above is critical to understanding the puzzling performance of the traditional export crop sector in Tanzania since 1986.

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Table 1 —Market coverage of MDB price survey, main food staples,

1983-1998

Market Classification	Region	Market	Distance to Dar (Km)
Markets classified as well-connected (on line of rail or near a major road)	Arusha	Arusha	647
	Kilimanjaro	Moshi	562
	Kilimanjaro	Gonja (Same)	472
	Dar-es-Salaam	Dar- es-Salaam	0
	Coast	Mafia	140
	Coast	Bagamoyo	60
	Coast	Kisarawe	20
	Morogoro	Morogoro	196
	Tanga	Tanga	354
	Tanga	Lushoto	363
	Mwanza	Mwanza	1,164
	Mwanza	Magu	1,224
	Mwanza	Kwimba	1,075
	Mara	Musoma	1,369
	Mara	Tarime	1,429
	Shinyanga	Shinyanga	1,001
	Kigoma	Kigoma	1,442
	Dodoma	Mpwapwa	435
	Dodoma	Dodoma	479
	Tabora	Tabora	1,039
	Tabora	Urambo	1,139
	Mbeya	Mbeya	851
	Iringa	Iringa	501
	Iringa	Mafinga	581

Table 1—continued

Market Classification	Region	Market	Distance to Dar (Km)
Markets classified as isolated	Arusha	Mbulu	700
	Kagera	Bukoba	1,425
	Mwanza	Geita	1,284
	Mwanza	Sangerema	1,200
	Mara	Ukerewe	1,400
	Shinyanga	Maswa	1,075
	Shinyanga	Kahama	1,000
	Kigoma	Kasulu	1,352
	Kigoma	KIbondo	1,222
	Rukwa	Mpanda	1,400
	Rukwa	Sumbawanga	1,186
	Singida	Singida	709
	Iringa	Njombe	791
	Ruvuma	Songea	992
	Ruvuma	Mbinga	1,082
	Ruvuma	Tonduru	720
	Mtwara	Mtwara	558
	Mtwara	Newala	680
	Mtwara	Masasi	600
	Lindi	Lindi	459

Source: The underlying data were collected by the Government of the United Republic of Tanzania, Market Development Bureau, Ministry of Agriculture and Cooperatives, and compiled by the Famine and Early Warning System (FEWS) project office, Dar-es-Salaam. The classification of markets as "well-connected" or "isolated" is from Delgado and Minot (2000)

Table 2—Determinants of staple food prices in Tanzania

	Rice		Maize		Cassava	
	Isolated Market	**Well-connected Market**	**Isolated Market**	**Well-connected Market**	**Isolated Market**	**Well-connected Market**
Mean value of dependent variable: Price (Tsh/kg)	528	532	148	168	164	205
Estimated parameters						
Continuous monthly time trend	-1.00	-1.11	-0.36	-0.53	-0.35	-0.29
Deflated lagged US export prices :						
Wheat	871	707	n.s.	-703	n.s.	n.s.
Maize	-579	-378	n.s.	586	n.s.	n.s.
Rice	183	250	n.s.	47	n.s.	n.s.
Production at start harvest year:						
All Tanzania	-0.25	-0.30	-0.02	-0.02	n.s.	0.10
Local administrative region	-0.75	-0.68	-0.19	-0.13	0.05	n.s.
Real exchange rate (Tsh/$)	-0.19	-0.18	n.s.	-0.05	-0.20	n.s.
Seasonal low:						
Lowest 3 monthly dummies	July-Sept.	July-Sept.	June-Aug.	Aug.-Oct.	June, July, and Nov.	Jan., Aug, and Nov.
Number of observations	2,230	3,096	2,184	2,976	1,204	1,805
Adjusted R^2	0.95	0.95	0.89	0.92	0.82	0.78

Notes: n.s. = not statistically different from zero at the 5 percent level.
Effect on monthly local price in regional markets deflated by national CPI. OLS regressions on monthly price (constant 1998 Tsh) per kg; data are reported for 44 markets across Tanzania, where market price data were collected by the Market Development Bureau and compiled by FEWS, January 1983-December 1998, deflated by monthly national CPI. Monthly observations are matched with explanatory variables from multiple sources; the base margin is the mean of the dependent variable; production data pertain to the June period preceding the month in question. All non-zero coefficients shown are significant at 5 percent or better.

Table 3—Tests of whether prices are determined in isolated markets the same way that they are in "line of rail" markets

Commodity	**F-statistic**	**Degrees of Freedom of F**	**Conclusion About H_0 at 5%**	**Comment**
Rice	0.969	(3,096; 2,211)	Fail to reject	H_0 cannot be rejected at 20%
Maize	1.005	(2,976; 2,165)	Reject	H_0 narrowly fails
Cassava	2.103	(1,805; 1,185)	Reject	H_0 rejected

Notes: $F=\frac{(e'e-e_1'e_1)/m}{e_1'e_1/(n-k)}$

Where e'e is the sum of the squared residuals from regressions pooling isolated and well-connected markets as defined in Table 1, m is the number of well-connected market observations, n is the number of isolated market observations, k is the number of parameters estimated, and $e_1'e_1$ is the sum of squared residuals in the isolated markets regressions.

Table 4—Determinants of spreads between Dar-es-Salaam price for food staples and interior market retail prices 1986-1998

Result	Wheat	Rice	Maize	Cassava
Mean of dependent variable: Price difference with Dar-es-Salaam (Tsh/kg)	174.09	135.30	45.88	101.90
Estimated parameters				
Continuous time trend	-1.35	-0.06	-0.09	0.60
Road distance from Dar (km)	0.11	0.11	0.05	n.s.
Road distance squared	-0.00	-0.00	-0.00	n.s.
Markets on a rail line	-12.41	21.32	-3.71	n.s.
Market is isolated	n.s.	n.s.	10.87	n.s.
Market is a port city	-20.25	-32.04	-5.53	n.s.
Lowest two monthly dummies	Nov. Jan.	Dec. Jan.	Oct. Nov.	Jul. Aug.
Number of observations	3,504	4,861	4,721	1,220
Adjusted R^2	0.67	0.68	0.71	0.60

Source: From OLS regressions by crop using data from MAC FEWS (1999); the dependent variable is the local price minus the Dar price; prices are in December 1998 Tsh per kg. All coefficients are statistically significant at 5 percent or better unless shown as n.s. N.s. indicates not statistically significant at 5 percent.