MTID DISCUSSION PAPER NO. 72

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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EVIDENCE AND IMPLICATIONS OF NON-TRADABILITY OF FOOD STAPLES IN TANZANIA 1983-1998

Christopher Delgado[1], Nicholas Minot[2], and Marites Tiongco[3]

I. 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*). In particular, it is often assumed that the agricultural sector will benefit from this policy because agricultural commodities are thought to be tradable, while most of the costs of agricultural production are non-tradable factors of production such as land and labor.

Agriculture has typically loomed large in the discussion of structural adjustment in Sub-Saharan Africa, at least since the time of the famous Berg Report (*World Bank, 1981*). The key idea was that the set of reforms associated with a depreciating RER would expand aggregate agricultural output through higher returns to tradables, and also through lower costs for non-tradables linked to costs of production of tradables. In much of Africa, export crops and tradable food crops have in fact tended to respond as predicted to favorable changes in the macro economy and domestic market liberalization where it has occurred, as Berg predicted (*Townsend, 1999*). Yet, there is little

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disagreement that outcomes have been mixed over the past 20 years, depending on countries and crops (*Kherallah et al., 2002*).

Recent empirical work on 14 Sub-Saharan African countries from 1975 to 1990 found the counter-intuitive result that depreciation of the RER was significantly negatively associated with aggregate agricultural output, contrary to the expectations of the previous paragraph (*Lamb, 2000*). Furthermore, rising food prices were associated with rising aggregate agricultural output, but rising export crop prices were associated with declining aggregate agricultural output, *ceteris paribus.* In Lamb's model, RER is proxied in the conventional manner as the Real Effective Exchange Rate, consisting of the nominal exchange rate deflated by the ratio of the domestic consumer price index to a weighted index of the price indices of the trading partners of the country in question.[4]

Lamb (*2000*) suggested that possible interpretations are that changes in exchange rates are not passed through to prices within a time period that shows up in the analysis, or else that RER does not fully proxy the macroeconomic incentives that theoretically stimulate aggregate agricultural output. Lamb interpreted the result that the short-run impact of export crop prices on aggregate agricultural output is negative, while they were positive for food prices, as evidence that higher export production in the short run comes at the expense of shifting resources out of food production into export crops. If correct, it

[4] Also see *Edwards* (1989) on this point. For the rest of this paper, "RER" in Tanzania will be used in the sense of the nominal exchange rate adjusted for differences in the consumer price index for Dar-es-Salaam vis-à-vis the World Bank's Manufacturing Unit Value index, which best proxies the price behavior of the manufactured exports of the developed countries (*World Bank*, various years). The base period for adjustment was taken as 1970, a period of relative macroeconomic balance in most of Africa, including Tanzania (*Delgado and Minot*, 2000). We also 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.

would go against the rosy view that depreciation of the RER and associated domestic market liberalization floats all boats in African agriculture, and potentially raise food security questions in some countries.

A fundamental issue raised by the present paper is that both arguments of the Berg Report-type and the seemingly contradictory results estimated after the fact by Lamb assume that food crops in Africa, like export crops (by definition) are tradables. Tradable goods by definition are either traded across national boundaries or are close substitutes in consumption and production for such traded goods. For price-taking countries, their prices tend to be heavily influenced by world prices and by the trade regime affecting the ability to import and export. Non-tradables on this view are typically services and factors of production, whose relative prices are endogenous outcomes of issues affecting the price of tradables more directly.

The empirical contribution of the present paper is to investigate the assumption of tradability of major food staples in a case study for Tanzania over the 1983-98 period, using monthly price data for 44 geographically-distinct markets and four crops: maize, rice, cassava, and wheat. The contributions of production of these crops to aggregate agricultural GDP in the mid 1990's were: 23 per cent (maize), 8 per cent (paddy), 4.5 per cent (cassava), and 0.5 per cent (wheat)[5] It is hypothesized that some staples such as cassava behaved as non-tradables all the time, and some only in remote places (primarily maize). Further, over the 1983 to 1998 period analyzed, an appreciable share of

[5] Given much lower prices per kg, the proportionate contribution of cassava to calories was much higher, and that of wheat lower.

aggregate staple food crop production in Tanzania is hypothesized to be non-tradable in fact, in the sense that domestic prices in some producing areas were not affected by changes in world prices or real exchange rates, but were instead significantly responsive to local supply and demand shocks. It is further hypothesized that the reverse was the case for tradable foods.

2. WHY BOTHER?

An alternative explanation of both the successes of Berg's predictions in some cases and Lamb's seemingly contrary empirical results is that while export crops are tradables, and thus respond to a combination of world price changes, domestic policy wedges, and real exchange rates, food crops are imperfectly tradable in significant parts of rural Africa. Where the non-tradable share of agriculture is high, it will be argued, trade regime and domestic market reform can be consistent with rising export output and prices and shrinking aggregate agricultural output, without having to assume either data anomalies or that farmers were moving all their resources into export crops at the expense of food in the structural adjustment era.

The impact of trade regime and market reforms may be small for crops in those regions where both real prices and production of food staples respond more to local structural supply and demand factors such as drought and population than to relative prices and exchange rates at a national level. Furthermore, even if export crop production expands in zones with non-tradable food crops, the situation is more complicated than that in a zone of fully tradable commodities, where changing

comparative advantage would be accompanied by a shift of resources out of food staples and into export crops such as coffee and cotton. If the zone with non-tradable food crops is demand-constrained, as seems likely where the share of non-tradable food is high in total output, then an export boom will draw unused resources into both export and food production, until the price of food starts rising relative to export crops as resources become fully utilized (*Delgado*, *Hopkins and Kelly, 1998*). Trade of food into the region (by definition difficult for a non-tradable commodity) may not occur until price rises for food relative to other commodities are very significant, undermining the theory that export crops can continue to grow without losing much of their profitability.

A depreciating real exchange rate where all crops are tradable would be expected to raise the output of both cash and food crops. In some cases, output of both will increase, and in some, the higher-value activity will substitute for the lower value one, but the aggregate value of output will rise. But if food prices are driven by a different and exogenous set of factors, such as local supply and demand shocks, it is quite possible for macroeconomic reform embodied in a depreciating RER to stimulate export crop output on the one hand, and to discourage output of that part of the food sector that is non-tradable on the other. Furthermore, the food sector in Tanzania accounted for 65 per cent of agricultural GDP compared to 9 per cent for export crops in the early 1990s (*Delgado and Minot 2000)*, and this relative proportion is not unusual in Sub-Saharan Africa. Under these proportions, what happens to the non-tradable food portion of agriculture will exceed the first-round impact on aggregate output of what happens to export crops if at least 14 per cent of food production by value is non-tradable ($65 \times 0.14 > 9$).

Another reason the non-tradability of food matters to macroeconomic outcomes in rural Sub-Saharan Africa is that the non-tradability of major food grains, where established, suggests limited ability for government to control a key strategic variable that affects both immediate human welfare (through food prices and real incomes of consumers), and also long-run competitiveness through the rising labor costs of producers (*Delgado, 1992*). Finally, a year of good rainfall or successful public investment in increasing production of food in regions where it is a non-tradable can quickly lead to precipitous declines in the producer price of food and subsequent retrenchment of producers from the sector.

It will be argued below that if a significant share of food output behaves as non-tradables, then the focus of agricultural strategy needs to be nuanced. In addition to the already difficult task of pursuing rural growth poles wherever they can be found in the expectation that they will pull the rest of the rural economy along, there remains the need to worry about balance between tradables and non-tradables, while waiting for success in promoting better internal economic integration.

3. PRODUCTION AND PRICE TRENDS IN TANZANIA 1985-1998[6]

The relative importance of agriculture in Sub-Saharan has declined a bit since the 1970s of the Berg Report, but still remains high. As recently as 1997, the sector still accounted for 35 per cent of GDP, 40 per cent of exports, and 70 per cent of employment

[6] The general reference for figures and interpretations in this section is *Delgado and Minot* (2000) unless otherwise indicated.

if South Africa is excluded (*Townsend, 1999)*. The proportions for the poorer countries without oil exports are even higher; for Tanzania, agriculture accounted for over 80 per cent of employment and over half of net exports and GDP in the late 1990s. Therefore understanding the links between relative agricultural prices and macroeconomic variables such as RER is especially relevant in countries such as Tanzania, and by extension to most of Sub-Saharan Africa, where agriculture continues to dominate the national economy, at least from the standpoint of employment.

Economic reforms associated with structural adjustment policies in Tanzania were followed by a sharp and sustained depreciation in the RER (as defined above) 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 thereafter to the end of the 1998. Widespread market liberalization reforms of Tanzanian agriculture began to be phased in over the same period, beginning with the food crops and ending with the minor cash crops in the late 1990s.

Data pertaining to output volumes of food and export crops has been controversial at times in Tanzania in the period in question. A careful sorting out of evidence from many sources within Tanzania found that between 1985 and 1998, the six main food crops had an aggregate growth rate of 3.5 per cent by weight, and the major export crops grew at an aggregate 5.4 per cent per annum by weight.

Maize is the principal staple food crop, and is grown on about 44 per cent of crop land (depending on the season), by more than four-fifths of all rural households. The largest surpluses are generated in relatively remote inland areas: Iringa, Mbeya, Ruvuma

and Rukwa. National production growth over the 1985-98 period was 2.4 per cent per annum, 0.3 per cent per annum less than population growth. Growth was slightly higher in the period after major market liberalization in 1991, and lower before then. Fertilizer use—adversely affected by withdrawal of subsidies—fell by about one-quarter from the late 1980s to the mid 1990s. Real maize prices (officially set and enforced until 1991) declined slightly over the period prior to 1991, tripled thereafter to 1993, and then declined sharply thereafter, reaching pre-liberalization levels by 1998 (*Delgado and Minot, 2000*). Maize has variously been exported in small amounts, imported in large amounts, or not traded over the period, depending on weather outcomes and administrative fiat.

Rice production increased fourfold between 1985 and 1998. Production has been promoted by research and investment policies, and although the main production areas are far inland, they tend to be near major road and rail infrastructure. The income elasticity of demand for rice is relatively high (1.25 in rural areas), and rice is imported even in years of good production. Similarly, wheat is a relatively high value starch that is imported even in good years and which is growing rapidly in demand. Rice prices tend to be more correlated with maize than with wheat, but both shot up after liberalization in 1991, although wheat prices declined more slowly than maize after 1993. A priori, both wheat and rice are thought to be tradable crops influenced by world prices and exchange rates.

Cassava on the other hand is both an important food source in Tanzania and typically thought to be non-tradable. It has a very low value-to-bulk ratio versus other

food staples, making transport relatively costly. Furthermore, although it stores in the ground for years unharvested, the fresh root is highly perishable once dug up. Production trended upwards over the period, but is quite variable and both production and prices have tended to be counter-cyclical with maize, suggesting a role of unharvested cassava as a food security crop for bad times, in addition to regular seasonal use. A priori, cassava is expected to be non-tradable, with its local price influenced mainly by local demand that rises with poor weather for maize production.

Tanzania has a varied and rich set of agricultural exports, including coffee, cotton, tobacco, cashew, and tea. On the whole, world real prices for these commodities fell in the late 1980's and early 1990s, rose from 1992/93 to around 1997/98, and fell thereafter. Real domestic producer prices were affected by both the real exchange rate and domestic institutional reforms associated with liberalization of crop procurement and processing. Different rates of market liberalization by commodity led to different trends in crop producer prices from the late 1980s through the 1990s. However as a generalization, producer prices for export crops were more stable than world prices in the 1980s (at low mean levels compared to world prices), but tended to head in similar directions (up and down) to world prices in the 1990s, as would be expected under increased liberalization.

Interestingly, the relative trends in domestic prices of both major export crops and the hypothesized major traded food staples in Tanzania over the 1990s were consistent with the trends in Tanzania's RER. The real (inflation adjusted) prices of the more tradable crops (wheat, rice, maize) rose from 1991 to 1993, and then declined to less than

50 per cent of their 1991 levels by 1999. The pattern of prices for the generally tradable food crops was clearly also influenced by the impact of the 1991-92 drought in southern Africa, and associated Tanzanian maize exports. Yet it is also clear that the appreciating real exchange rate after 1993 (i.e. moving away from the desired depreciation under macroeconomic reform after 1986) made imports of wheat and rice less expensive, driving down real domestic prices for these crops. Real prices of the less tradable crops (cassava, sorghum/millet, beans) tended to rise for another two years, before falling after 1995. Furthermore, the declines after 1995 were less than those of the tradable crops.

The depreciating RER after 1986 meant, other things equal, that the relative prices of tradable goods were rising faster than the relative 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 1986-93. Unfortunately, real world commodities prices were falling sharply, largely wiping out the gains from the depreciating RER. Given the extent of the fall in world real 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 real prices received by producers of non-tradables were declining during the 1986-93 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 RER changes 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.

Thus macroeconomic and trade regime reform in Tanzania between 1986 and 1993, combined with increasing domestic market liberalization after 1991, stimulated both export and food crop real prices (i.e. relative to non-agriculture) and output. After 1993, RER began to appreciate (making both imports cheaper and exports less valuable), and by hypothesis decreasing the relative returns to tradables compared to non-tradables. The negative effect on export crops in Tanzania was not felt until 1998, because world commodity prices were growing until then at rates high enough to offset the effects of an appreciating RER. After 1997, the relative incentives to produce export crops in Tanzania declined in comparison to other goods as a steep fall in world prices reinforced the unfavorable movements in RER since 1993. Tradable food crops such as rice and wheat suffered real price declines after 1993, due to the effects of adverse RER movement and declining world food prices, even as domestic production in Tanzania

suffered from drought in 1994 and 1995. The real prices of less tradable foods such as cassava, beans and millet stayed high through 1995, and declined thereafter more slowly than the more tradable foods.

4. 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 1983-98 collected by the Market Development Bureau (MDB) and compiled by the Famine Early Warning System (FEWS) project office in Dar-es-Salaam in Tanzania (*MAC-FEWS, 1999*). The food retail price series were collected using a reasonable protocol and showed seasonal fluctuations and considerable variation across a large sample of markets, as anticipated.[7]

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. This classification was straightforward for approximately four-fifths of the 44 markets, using a detailed road map and knowledge of the country. Classification of the remaining one-fifth of the markets involved making

[7] Five or six retail prices were recorded, if possible for each product twice monthly. These are then averaged into a single monthly price. Additional information for gaps or verification come from producer prices. Producer prices recorded prior to 1991 were largely official prices, and not much use here.

inquiries of staff of the Ministry of Agriculture and Cooperatives familiar with the markets in question, and was necessarily more subjective. The classification principle was reasonable year-round connectivity of the market in question to a major trunk road or rail connection, without significant extra expense of transport from the market to a point on the main trunk road or line-of-rail from which further transport could easily be obtained.

Ex post, virtually all the "well-connected" markets were within 10 km of a year-round road or rail connection, and virtually all "remote" roads were not. Seventeen of the twenty regional capitals are classified 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. Other data linked to the markets studied came from *MAC* (1998), and world prices and RER components from *World Bank* (2000 and preceding years).

Table 1—Market coverage of MDB price survey, main food staples, 1983-98

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—Cont. Market coverage of MDB price survey, main food staples, 1983-98

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: Table 3.3 of *Delgado and Minot,* (2000), pp. 28-29. The underlying data were collected by the Government of the United Republic of Tanzania, Market Development Bureau, Ministry of Agriculture and Cooperatives (MAC), and compiled by the Famine and Early Warning System (FEWS) project office, Dar-es-Salaam (MAC FEWS 1999). The classification of markets as "well-connected" or "isolated" is from Delgado and Minot (2000).

5. APPROACH

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 regression, separately for the eight combinations of four staple crops (wheat, rice, maize, and cassava) and two market types (well-connected and isolated, as defined in the previous section).

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 (Px_{t-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)[8]. All prices are adjusted to constant 1998 Tanzanian shillings (Tsh) or US dollars.

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

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

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.

6. RESULTS AND DISCUSSION

ARE SOME STARCHY STAPLES NON-TRADABLES?

Results of the regressions are shown in Table 2. Results for the goodness-of-fit (R^2) show that this model explains 95 per cent 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 largely a tradable in Tanzania, as common sense would also suggest (*Kyle and Swinnen, 1994*). World rice prices have a positive influence on Tanzanian rice prices, as would be expected. Yet local and national rice prices are also inversely correlated with domestic rice production, as would be expected given the importance and inland nature of much of Tanzania rice production. The latter gives a degree of natural protection to rice in inland areas of Tanzania such as the Lake Victoria region.

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.

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 per cent 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 per cent or better.

Source: Table 3.4 of *Delgado and Minot*, (2000), p. 30.

These are equivalent to a 28 per cent pass-through rate for the world price increase in isolated markets and a 38 per cent pass-through rate in well-connected markets.[9]

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 also from 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 mostly tradable good in both isolated and well-connected markets.

Maize, on the other hand, the primary food crop in the country, 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 (at any lag), nor does the RER. In well-connected markets, however, maize behaves like a tradable. A US$1.00 increase in world maize prices translates three months later into a Tsh. 586 per kg increase in Tanzanian maize prices,

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

implying a pass-through rate of about 90 per cent. 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 comparison of regional production data with maps of population and grid infrastructure, it is roughly estimated that at least one-quarter of all Tanzanian maize production occurs in isolated areas as defined here.[10]

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-connected markets. As shown in Table 3, in the case of rice, there is no statistically

[10] 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 are not.

significant 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.

Table 3—Tests of whether prices are determined in isolated markets the same way that they are in well-connected 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, 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.

Source: Table 3.5 of *Delgado and Minot* (2000), p. 31.

WHY DOES MAIZE BEHAVE AS NON-TRADABLE?

Maize could behave as a non-tradable in one-quarter of the country for a variety of reasons, including local government movement restrictions, capital market failures, transport bottlenecks, and so forth. Yet the most likely explanation, which embodies

some of the possibilities above, is that it costs too much to move a bulky starch from A to B, within a wide price band.

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

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

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)[11]. 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.

[11] Given adjustment for being on the line of rail, which controls for the fact that Tanzania's rice producing regions are inland around Lake Victoria, yet well-connected to other points on the line of rail.

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.

Table 4—Determinants of spreads between Dar-es-Salaam price for food staples and interior market retail prices 1986-98

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: Table 4.1 of *Delgado and Minot* (2000), p. 45. 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 per cent or better unless shown as n.s. N.s. indicates not statistically significant at 5 per cent.

7. CONCLUSIONS

There is solid evidence from both point studies and broad-based statistically-significant trends that absolute spatial marketing 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.

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 of 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", is inelastic in the short to medium run, their prices will be bid up relative to the prices of tradables.[12] 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-

[12] So called because they are the physical counterparts to returns to labor in low income societies where most income is spend on staples.

run supply elasticity has been estimated at 0.25 and the long-run supply elasticity at 1.96 (*Delgado and Minot, 2000*).

Finding ways to further stimulate tradables in those regions where much of the food supply is non-tradable will have multiplier impacts on aggregate agricultural output provided that: (a) unused productive resources are available to be brought into production by new opportunities; and (b) the stimulus from the growth in tradables is widely distributed to people who want to buy the non-tradable goods that the previously underemployed resources are capable of producing, such as traditional food staples (*Mellor, 1966; Delgado, Hopkins and Kelly, 1998*).

In coastal urban areas and those areas where food is fully tradable, commercially viable imports of cereals can avert harmful price spikes because of economies of agglomeration and of lower transport costs to the outside world. In cash crop zones where food is non-tradable, 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 that in most years are more remunerative than growing food staples, and rely at least in part on purchased food. It is also beneficial to larger farms whose primary cost of production is the cost of labor, highly correlated with the cost of food. 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.

Significant supply shocks for food, as happened in 2000-02 in much of Southern Africa well after the period of analysis of this paper, can raise the relative price of food so high that a non-tradable becomes an exportable in areas still capable of producing food. This appears to have been the case in Rukwa, one of the "isolated" areas of Tanzania referred to above.[13] In such cases, a demand shock outside the immediate area has been so large as to resolve demand constraints, yet it remains to be seen if this tradability can be sustained in the long-term. Similarly, investment in infrastructure will surely turn non-tradables into tradables over time. The question remains as to the cost/benefit calculation and what to do for zones where food supply is non-tradable in the meantime. The prescriptions for getting agriculture moving in fully tradable areas still apply, but there is the added problem of pro-actively promoting outlets for the demand-constrained non-tradables that local resources are capable of producing in larger amounts.

[13] We are indebted to an anonymous reviewer for this point.

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