Market Integration and Efficiency in the Presence of Cross-border Trade Restrictions: Evidence from selected Maize Markets in Southern Africa

Emelly Mutambatsere, Ralph D. Christy

Evaluation Department, African Development Bank, Tunisia; and
Applied Economics and Management, Cornell University, Ithaca-NY.
Corresponding author's e-mail e.mutambatsere@afdb.org

Selected Paper prepared for presentation at the American Agricultural Economics Association Annual Meetings, Orlando, FL, July 27-29, 2008.

Abstract

This study evaluates the extent to which regional trade might be relied upon as a policy strategy in achieving food security in southern Africa. The logic is that if significant diversities exist in production expertise and capacities for countries within the region, in the presence of integrated marketing systems, free trade can improve both supply and trade efficiency. Two components of the debate are analyzed: revealed competitiveness in production and export of the main staple – maize; and for a selected set of major markets, the nature of market interactions within the current regional trade policy framework. The analyses employ mainly non-parametric assessments, including such measures as revealed comparative advantage, price difference and transfer costs trends, and cumulative distributions of arbitrage returns, supported by econometric measures of integration and efficiency including parity bounds analyses.

Results indicate substantial regional bias in maize trade among southern African countries, although competitiveness in maize production is restricted to a few countries that possess the capacity to supply significant quantities. Price and transfer costs trends, as well as the parametric market integration and efficiency tests, frequently fail to reject the null hypothesis of 'integration' in a selected set of markets in close proximity, regardless of country location, suggesting fairly consistent price movements, tradability of commodities and/or contestability of such markets across borders. For those markets, however, efficiency appears weak, as trade often fails to exhaust arbitrage profits. Markets not linked through trade tend to have a higher frequency of efficiency, so that the lack of trade often is justified by the lack of positive arbitrage returns. In those cases, market segmentation appears driven more by restrictive transport costs than tariffs or taxes on cross-border trade.

These results suggest that the dominant forms of inefficiency in the markets considered in this study are (1) insufficient arbitrage resulting from supply side constraints, and other non-cost trade restrictions and (2) restrictive transport costs. Border administered tariffs and other forms of taxes on imports seem to account for a relatively low proportion of transfer costs, and generally reduce arbitrage returns marginally. Therefore policy interventions addressing both food supply and access are necessary to ensure meaningful food security benefits from trade.

INTRODUCTION

International trade as governed by the theory of comparative advantage is expected to give rise to the classic gains from trade: productivity growth, lower prices, and overall welfare improvement. Specific to food security, free trade is expected to promote specialized production based on comparative advantage, increase supply of food, reduce transactions costs in food marketing hence improve market efficiency, and ultimately lower the average price of food for the consumer. Net food exporters are expected to gain from market enlargement, whereas importers gain from lower food prices. Restriction on the free flow of goods and services therefore are deemed growth constraining and welfare reducing, efforts to lower or eliminate barriers to trade have dominated present day economic growth and broader poverty reduction strategies.

In practice, however, the implications of trade policy reform (especially reform attained through regional trade agreements) are complex, and the gains/losses from freer trade not so unambiguous. This is because in its standard application, the theory of comparative advantage does not account for transport costs, market power, size and level of development of industry, or history, in determine a country's ability to turn comparative advantage into international competitiveness. When trade liberalization is implemented through regional free trade agreements, empirical consequences are even less obvious, since such agreements are by design exclusionary and not 'free' on an international trade level. Therefore the idea that freer regional trade necessarily leads to higher welfare for participating economies ought to be qualified, and specific policy recommendation enriched, by quantitative evidence. Political economy issues arising from greater economic integration ought to be taken into account: understanding the nature of comparative advantages, in order to identify exactly which players would benefit or lose from greater market openness, clarifies the policy debate and paves way for proactive responses. The extent to which markets can be relied upon to deliver commodities in an efficient, timely manner also has to be assessed, to ensure that surplus and deficit areas are sufficiently connected, before trade can be considered as a viable policy option.

This study contributes to addressing similar issues as they pertain to tariff elimination in southern Africa's food sector in the context of the Southern Africa Development Community (SADC) trade agreement. We analyze first, revealed competitiveness in production and export of the main staple – maize – across regional producers; and second, for a selected set of major markets, the nature of market interactions within the current regional trade policy framework. The objective is to assess if and where potential gains from freer regional trade in maize can be expected, and to establish the nature of market constraints where they exist.

METHODS AND DATA

Definition of concepts

Efficiency is the economic term used to describe a state in which all benefits from resource use have been exhausted. In production, efficiency results from both technical and operational competencies, and involves efficiency in scale of operation and resource utilization, given location and technological constraints (Sosnick 1964, Scarborough and Kydd 1992). In markets, efficiency refers to the state in which allocation of resources is such that aggregate profits have been maximized i.e. no arbitrage returns remain unexploited by traders. Integration of markets is a related concept that refers to the degree to which demand and supply shocks originating from one market are transmitted to another, evidenced by tradability or contestability of markets

(Fackler and Goodwin 2001, Barrett and Li 2002). In this study, we evaluate for a set of maize markets in southern Africa, efficiency in production (through revealed production and export advantages), integration of markets, and efficiency in commodity movement within the region.

Revealed Comparative Advantage

In international trade theory, the concept of comparative advantage has widely been accepted has as the dominant force governing the flow of commodities between countries, having the appeal of explaining, if only theoretically, global diversities in export expertise, voluntary participation in exchange, and mutual gain from it. As initially explained by Ricardo, comparative advantage was thought to be drive by inherent differences in resources endowments and production efficiencies. History, however, has shown that comparative advantage is not a static condition, and that advantages can be induced and nurtured through natural market responses, or direct policy interventions such as import restriction, subsidies and price supports. Such interventions give rise to industry competitiveness, whereby a particular country possesses superiority in performance compared to its foreign competitors. Such advantages arise more from lower costs of production induced through innovation and competition, rather than from inherent factor endowments (Neary 2003). Empirically, competitiveness is evidenced by the presence of larger export volumes, lower relative prices and/or better quality of products. Some would argue that in the present era of technological changes, changes in basic production factor endowments (e.g. skilled labor), and greater mobility of production factors such as capital, competitiveness has become a more appropriate indicator/predictor of trade flows than conventional comparative advantage (Porter 1990).

Assuming that countries exploit their cost, resource-productivity, and endowment-based advantages to establish which industries to specialize in, industry competitiveness can be established simply by assessing a country's trade flows. Disaggregated export data for example can be taken as indicators of sectors in which domestic producers display competitiveness, whereas imports reflect lack of competitiveness. Clearly, revealed advantages may differ from comparative advantage predicted by theory, based on the macro and trade policy environment, therefore revealed comparative advantage is not here considered equivalent to Ricardian comparative advantage.

Since the introduction of the concept of revealed comparative advantage (RCA) by Balassa 1965, several different forms of RCA indices have been developed and applied in the analysis of open markets. In this study, we adopt the net trade RCA (3), derived directly from the exports-specific form – also known as the comparative export performance measure (1), and the import-specific form (2) (Murrell 1990).

$$x_{i,j} = \frac{X_{i,j} / X_{tot,j}}{X_{i,w} / X_{tot,w}} \quad (1) \qquad m_{i,j} = \frac{M_{i,j} / M_{tot,j}}{M_{i,w} / M_{tot,w}} \quad (2) \qquad \omega_{i,j} = x_{i,j} / m_{i,j} \quad (3)$$

i is the product, j is the country, $X_{i,j}$ refers to exports from country j of product i, $X_{tot,j}$ is the total exports from country j, $X_{i,w}$ is world exports of commodity i, and $X_{tot,w}$ is total world exports. $x_{i,j}$ measures whether the share of exports of commodity i from a given country j is greater or less than the export share of i on the world market. A value of $x_{i,j} > 1$ suggests that a country exports more of i relative to its total exports, than would an average country on the world market, revealing some relative comparative advantage in producing i. A value of $m_{i,j} < 1$ suggests that a country is revealed competitive in producing for itself the specified product. Thus using conditions (1), (2) and (3), comparative advantage is revealed when $x_{i,j} > 1$ and $m_{i,j} < 1$, or when

$\omega_{i,j} > 1$. Note that whereas in the former case, some ambiguity in interpretation occurs when the indices $x_{i,j}$ and $m_{i,j}$ move in the same direction, the latter condition ($\omega_{i,j} > 1$), a measure of the importance of a commodity to exports relative to its importance to imports, requires only that $x_{i,j}$ exceed $m_{i,j}$ for comparative advantage to hold (in fact equation (3) simplifies to $(X_{i,j} / X_{tot,j}) \div (M_{i,j} / M_{tot,j})$ as earlier suggested by Donges 1982).

The analysis of revealed advantages is supported by an assessment of the degree of self sufficiency, the extent of intra-industry trade[1] or cross-hauling, and the level of tariff and non-tariff protection in the sector, to help explain observed trade patterns and establish the presence of production capacities.

The main limitation of the RCA concept is that because imports are a direct function of a country's trade protection policy, with enough protection, comparative advantage will be 'revealed' for commodity *i*, regardless of the level of efficiency in its production relative to other (less protectionist) countries. However, it could also be argued that the comparative advantage of importance to policy is the advantage revealed by international trade, regardless of the forces behind that advantage. This is because in practice economies are subject instabilities that produce disequilibria, making it difficult to predict with a reasonable degree of accuracy the relative prices and trade volumes in an undistorted macro environment as predicted by Ricardian theory. Neoclassical trade theories also are based upon assumptions about pre-trade costs and prices that in practice are not observable, and upon several other restrictive assumptions with respect to

[1] The degree of intra-industry trade, i.e. the extent of cross-hauling for a given commodity, the Grubel-Lloyd intra-industry trade index can be used, and is specified as: $GLI_{i,j} = 1 - \left| \left(X_{i,j} - M_{i,j} \right) \div \left(X_{i,j} + M_{i,j} \right) \right|$. This index measures the proportion of minority trade flows in total trade between country j and the world, when bi-directional trade is observed. This often indicates seasonality of production, limited commodity storage, inter-country transportation bottlenecks, or non-homogeneity of products.

resource mobility and technology access. Also mentioned earlier, innovation has given rise to dynamism in comparative advantage, and in most industries comparative advantage is a result of deliberate policy interventions to develop and sustain advantages in specific sectors. The RCA index captures this type of advantage adequately.

Market Integration and Efficiency

To evaluate market integration and efficiency, a careful assessment of price difference, costs of transfer and observed bilateral trade patterns is performed non-parametrically, allowing the data from a set of sample markets to reveal the nature of market interactions in these diversely regulated markets. Several parametric assessments (price-based analyses and the extended parity bounds analysis, as defined in table 1) are also performed to establish robustness of results beyond the sample time frame.

In market analyses, the use of non-parametric measures is desirable because first, imperfect data can be used without masking underlying properties, the second, restrictions in the nature of variable distributions or other common restrictions imposed by econometric estimations can be avoided. The main limitation though is that non-parametric evaluations provide only information about the sample, and cannot say much about the population from which this sample was extracted, or the extent to which results can be generalized. Since the goals of studying markets is usually to have a broader view than understanding how markets operated within a restricted period of time, some conventional parametric tools are used validate robustness of results.

Table 1: Methods continued

Level I	
Bivariate Correlations	$\rho(P_i,P_j) = \dfrac{Cov\ (P_i, P_j)}{\sigma(P_i).\sigma(P_j)}$ where ρ is the correlation coefficient, P_i and P_j are the commodity prices in two distinct markets *i* and *j*, Cov (P_i, P_j) is the covariance of the commodity prices in markets *i* and *j*, and $\sigma(P_i)$ and $\sigma(P_j)$ are standard deviations of the respective price series.
Price Causality	$P_{i,t} = \sum_{s=1}^{n} \alpha_s P_{i,t-s} + \sum_{s=1}^{n} \beta_s P_{j,t-s} + \xi_t$ (a) $\quad P_{i.t} = \sum_{s=1}^{n} \alpha_s P_{i,t-s} + \xi_t$ (b) where $P_{i,t}$ is the price in market *i* at time *t*, $P_{i,t-s}$ is the s^{th} lag of the price in market *i*, and *n* is the number of lags. Test if β_s is significantly different from 0.
Co-integration	$P_{i,t} = \alpha + \beta P_{j,t} + \xi_{i,t}$ where $\xi_{i,t}$ follows an autoregressive process : $\xi_{i,t} = \alpha_0 + \alpha_1\xi_{i,t-1} + \ldots + \alpha_q\xi_{i,t-q} + \nu_t$. Test for the stationarity of the error term, $\xi_{i,t}$
Level III	
Barrett-Li Model	Regime 1: $R_{jit} = 0$ and $q_{jit} > 0$, perfect integration with trade Regime 2: $R_{jit} = 0$ and $q_{jit} = 0$, perfect integration without trade Regime 3: $R_{jit} > 0$ and $q_{jit} > 0$, inefficient integration Regime 4: $R_{jit} > 0$ and $q_{jit} = 0$, segmented disequilibrium Regime 5: $R_{jit} < 0$ and $q_{jit} > 0$, inefficient integration Regime 6: $R_{jit} < 0$ and $q_{jit} = 0$, segmented equilibrium Competitive equilibrium prevails whenever the inter-market arbitrage condition holds with equality, or when transfer costs exceed price differentials so that no trade occurs: $R_{jit} = 0$; or $R_{jit} < 0$ and $q_{jit} = 0$ Market integration holds whenever the inter-market arbitrage condition is binding or when positive trade is observed: $R_{jit} = 0$; or $q_{jit} > 0$ Uses the maximum likelihood method to estimate λ_k, the probability of being in each regime

Data Requirements and Sources

The assessment of revealed advantages employed data on bilateral trade data at individual country level for the SADC region, historic and current tariff rates, non-tariff measures, and production and consumption levels, for the study period 2000-2006. Bilateral trade and tariff data for 12 of the 14 SADC countries[2] (excluding Angola and Democratic Republic of Congo) were obtained from the World Integrated Trade Solution (WITS) database, complemented by statistics obtained from the Food and Agriculture Organization database FAOSTAT, the UN

[2] Angola, Botswana, DRC, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, South Africa, Swaziland, Tanzania, Zambia and Zimbabwe.

Conference for Trade and Development (UNCTAD)'s TRAINS and COMTRADE databases, the World Trade Organization (WTO)'s IDB database. Data on non-tariff measures were obtained from the TRAINS database, and production and consumption data were obtained from FAOSTAT, supplemented by statistics from national statistics offices such as STATS SA for South Africa, and National Statistics Office for Malawi.

A sample of four major markets in the region is selected for the market integration and efficiency analysis: Gauteng in South Africa, Blantyre in Malawi, and Maputo and Mocuba in Mozambique. For Mozambique, the two markets included: a central market in the southern, maize deficit region (Maputo), and a representative market for the northern, surplus region (Mocuba) represent an interesting choice in which hypotheses about intra-country versus cross-border trade can be tested. The choices of Blantyre (a maize deficit region in Malawi), and Gauteng (a major wholesale market in South Africa) follows-on to address if the two regions in Mozambique were better integrated internally or across borders. We infer also the significance of cross-border trade restrictions in increasing transfer costs for this sample of markets.

For the integration and efficiency analyses, data on monthly time series maize retail prices for each of these markets, direction-specific transfer costs between market pairs, and direction-specific trade volumes for market pairs, were used. These data were sourced from central statistics offices, the commodity marketing institutions, and from departments of agriculture, trade and energy. The complete data set comprised monthly time series wholesale price data available for each market for the time period: January 2000 to December of 2006. All of the price statistics were reported in local currency, and were converted to their US$ equivalents using the appropriate exchange rate. These values were used as the 'normalized' price series without further inflation adjustments. Some differences in price data sources for the three markets are worth noting: whereas the retail price data for the South African markets were obtained from the major wholesalers (as the wholesaler's selling price), prices from Malawi and Mozambican markets were captured directly at the retail level. This disparity could be of importance is explaining observed price differences, and is discussed further in the results section.

The transfer costs variable was derived from several different sources each comprising of incomplete and asymmetric data across the four markets, which made for quite a challenge in deriving the complete time series set. The primary source were the per km hauling costs for road and rail transportation estimated in the World Bank's diagnostic trade integration studies for Malawi and Mozambique (2001), SADC freight studies by Vink *et al* 2002, and the Food Agriculture and Natural Resources Policy Analysis Network (FANRPAN) 2003[3]. From these sources, several point estimates spread across 2001 and 2002 are obtained, and are extrapolated to cover the study period using data on fuel prices, distance between markets and transport cost indices. Data on prevailing tariff rates through the study period were used to estimate the tariff costs per unit traded, and for Mozambique, the value added tax assessed on imported maize intended for re-sale in grain form (set at 17% during the study period, Tschirley *et al* 2005) is included as a component in the transfer costs variable. Costs such as handling, insurance, and costs associated with border inefficiencies could not be captured here, however, considering that

[3] Other secondary sources include Tostão and Brorsen 2005, Erero and van Heerman 2005, Erero and van Heerman 2005, and SAGIS 2005.

maize is a non-perishable, low-value commodity, we might expect border losses due to spoilage, and insurance costs, to be relatively small.

RESULTS

Revealed advantages

Food security, as defined during the World Food Summit 1996, is said to exist when 'all people, at all time, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life.' From this rather broad definition three specific components of food security can be identified: availability, access and utilization. Food availability ensures that food supply is adequate to provide for the nutritional needs of the population; access ensures that incomes and prices maintain sufficient purchasing power to enable attainment of a satisfactory diet; and utilization ensures effective use of food to maintain healthy livelihoods. In southern Africa evidence shows that food production still lies below consumption requirements for the region as a whole, and for most individual countries; and regional food availability remains highly susceptible to sporadic supply shifts. Food production is dominated cereals (maize, wheat, rice, millets and sorghum), which account for up to 90% of the total cultivated land, with the regional staple, maize[4], accounting for the largest share. Cereals contribute on average 54% of the total calorie intake, though per capita food consumption lies below the world average of 2,760 calories, at an average of 2,200 calories per day with some inter-country diversity. Child malnutrition rate lies at about 25%.

An assessment of the region's capacity to produce maize indicates that with the exception of South Africa and Tanzania, individual counties are at best, self sufficient producers. Using the

[4] Except for Madagascar, where rice is the staple and is produced in larger quantities than maize.

self sufficiency ratio, described by Lafay 1990 as the ratio of the quantity of commodity *i* produced in country *j* to its demand: $d_{i,j} = (Q_{i,j} / D_{i,j}) \times 100$, we note that about half of the region is self sufficient in maize production[5] while the rest are deficit producers (see table 2).

Table 2: Revealed Comparative Advantages and Descriptive Statistics, 2000-2006

	Maize Self Sufficiency Ratio	MFN Ad Valorem Rate (and % NTM Incidence)	SADC Imports as % of total imports	SADC Exports as % of total exports	Degree of Intra-industry Trade	Regional Net-trade RCA	Global Net-trade RCA
Botswana	0.14	2*	0.987	0.998	0.014	0.005	0.0071
Lesotho	0.43	2	0.958	1	0.281	0.194	0.7479
Madagascar	1.18	5	0.477	0.003	0.923	0.507	1.9543
Malawi	1.22	0 (100)	0.734	0.658	0.306	0.162	0.707
Mauritius	0.07	0 (100)	0.166	0	0.016	0.004	0.0137
Mozambique	1.07	2.5 (100)	0.619	0.599	0.480	0.089	0.2071
Namibia	0.32	2	0.967	0.984	0.110	0.010	0.0283
South Africa	1.86	2	0.074	0.672	0.534	1.440	3.0180
Swaziland	1.22	2	0.997	1.000	0.042	0.014	0.0296
Tanzania	1.06	25 (100)	0.296	0.674	0.514	0.326	0.7843
Zambia	0.69	15 (100)	0.923	0.902	0.492	0.166	0.3991
Zimbabwe	0.59	25 (100)	0.642	0.948	0.16	0.032	0.0706

*Converted to ad valorem equivalent from specific SACU rates using average value of trade.

Sources: World Development Indicators 2005; FAOSTAT 2006; WITS 2005, TRAINS 2006, Author's Calculations

Average tariff rates and presence of non-tariff measures through the study period, as reported in the WITS and UNCTAD TRAINS databases respectively, are also captured in table 2. Reported tariffs have decreased even further over the past few years, in accordance with individual countries tariff reduction schedules under the SADC trade protocol. Clearly, average tariff rates for individual countries in the region lie below the MFN rates for some of the world's largest

[5] Consumption values included in these assessments are 'food consumption' values, and do not include non-food requirements such as seed and feed needs. The values also mask inter-seasonal variability often observed in availability trends.

producers of cereals (for example Argentina, China, India, Thailand, and Japan), and are also low in comparison with rates observed in other African regions. Non-tariff measures (NTMs), as defined by UNCTAD in the TRAINS database, represent any form of quantitative control measures (licensing, import/export prohibition, export restraint arrangements), finance measures (exchange rate policy, foreign exchange allocation) and price control measures (administrative pricing, antidumping measures, countervailing measures, voluntary export restraint pricing), excluding tariff quotas and enterprise-specific restrictions (Bora 2005). The percentage values tell us simply how many tariff lines under a given HS subheading are covered by the existing non-tariff measures, without any information on the nature of the NTMs, or the extent to which these are trade distorting. For most of the countries identified above, NTMs come in the form of import/export regulation: trade license requirements, trade taxes, monopolistic measures or export bans. The unit costs for the first two (license fees for Malawi and import taxes for Mozambique) were captured in the transfer cost data in analyzing market efficiency.

Given this trade protection environment, the average proportion of trade between each country and the rest of the region, versus trade with the rest of the world are also assessed. These values show evidence of a strong regional bias in exports, and an also significant, though less prominent, regional bias in sourcing imports. We note that countries like Botswana, Lesotho, Namibia and Swaziland (SACU countries), and Malawi, Zambia and Zimbabwe (COMESA countries) exhibit the highest regional bias in trade, whereas some of the coastal countries (Tanzania, Mauritius and Madagascar) exhibit limited linkages to the region. Results show also some non-trivial extra-regional exports of maize from the surplus producers Malawi, Madagascar, Mozambique, South Africa and Tanzania, suggesting some untapped potential for improved trade among SADC countries.

To establish the significance of the seeming untapped potential discovered above, it is important to assess the extent of cross-hauling in order to establish the country's *net* contribution to regional supply. The degree of intra-industry trade is more informative than a one-sided evaluation of either imports or exports because it allows us to separate, say, exports that are a result of overall surplus production, from seasonal exports that will need to be replaced, or are a result of re-exports of maize sourced from a surplus trading partner. The seasonal nature of the commodity considered here makes this trade behavior reasonable, since the presence of inter-seasonal price differences, differences in storage capacities and intra-country transportation bottlenecks can lead to bidirectional trade. Results reveal a higher tendency for cross-hauling in countries that are relatively large producers of maize. Of the four exhibiting both food self sufficiency and extra-regional export bias, results show that South Africa is the only net exporter of maize; Madagascar imports almost as much as it exports, while Mozambique and Tanzania import much more than they sell[6]. Notice that although South Africa appears capable of solely serving the region's maize import needs, a significant portion of its exports are in fact re-exports, and need to be compensated for by (extra-regional) imports to balance domestic requirements. In cases where re-exports are substantial, the source of advantage could simply be easier access to surplus markets outside of the region, rather than greater efficiency in production necessarily.

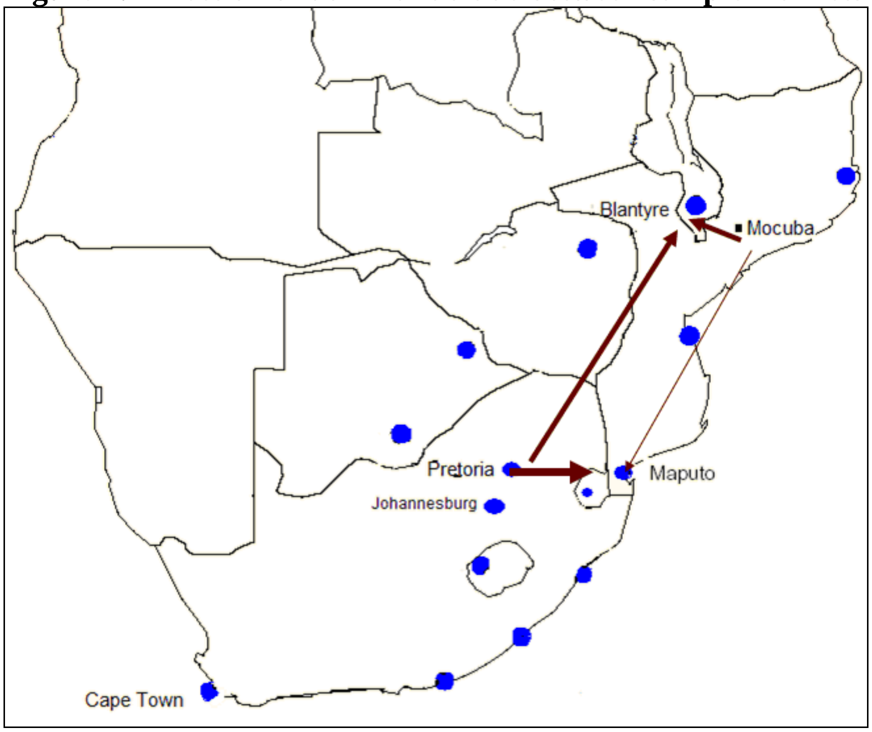
[6] These results could be an indication that (1) countries restore food stocks through imports, (2) imports cover most of the feed and non-food manufacturing needs, or (3) per unit values of imports tends to exceed per unit values of exports.

The revealed comparative advantage indices are computed in two ways: first, using SADC region trade as the basis for relative performance, and second, using world trade values. In each case, computations are done on an annual basis, as well as on average trade values for the study period and results for the latter are presented in table 2. World trade based RCAs are in principle more comprehensive measures of revealed comparative advantage since they assess the extent to which a country's trade patterns compare to an average producer on the world market. RCAs assessed regionally are also interesting as they provide information on competitiveness of given producers against other producers in the region, a result of interest in light of the intra-regional trade focus of policy reforms in SADC. Results show that the only country exhibiting net competitiveness in maize production in the region – South Africa – is also competitive by global standards. Madagascar, another seemingly competitive regional country is a small producer of maize by regional standards, producing only about 350,000 tons a year (though self sufficient), and is not a significant exporter both by global and regional standards. A look at the underlying drivers of competitiveness shows that the net global advantage is purely import driven, and can be explained by the relatively low local demand for maize in this rice consuming country. For the rest of the region, Tanzania is the next best producer (i.e. reveals least comparative disadvantage), followed by Malawi, Lesotho and Zambia. Of these, only Tanzania and Malawi exhibit some capacity to be net suppliers to the region.

Market Integration and Efficiency

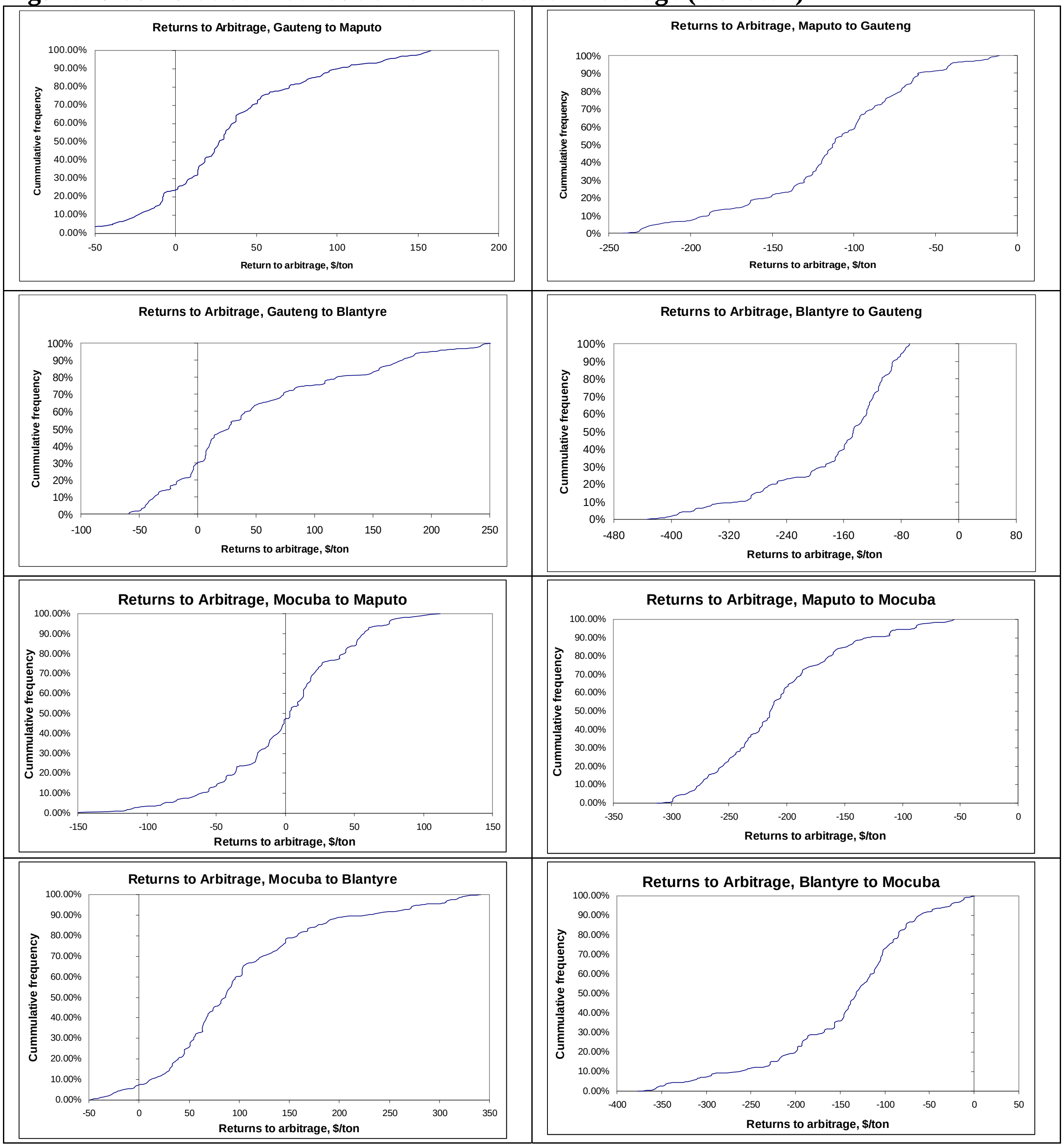
To assess market integration and efficiency in a sample of four markets was extracted from three SADC countries and represented in figure 1. In addition to showing the location of the markets, figure 1 also depicts observed direction of major trade flows through the study period (the weight of the arrows is meant to captures relative differences in trade volumes). Figure 2 shows the cumulative frequency of arbitrage returns – the difference between the retail market prices and direction-specific transfer – realized through the study period. Results from all econometric assessments of market integration and efficiency are presented in Appendix 1 and also discussed below.

Figure 1: Direction of dominant trade between sample markets



Price and transfer costs statistics indicate that Maputo maize prices are higher than Gauteng prices for most of the study period, and the returns to arbitrage on the Gauteng to Maputo trade route are positive for about 75% of the time. The Maputo to Gauteng trade route records consistent negative returns to arbitrage, indicating no opportunities for gainful trade. Trade flows generally follow suite, statistics show that low, infrequent maize exports occur from Mozambique to South Africa. In those few cases, however, such trade appears inefficient; as arbitrage returns computed from market prices are almost always negative (the Barrett-Li tests reveal a 4.7% probability of regime 5).

Figure 2: Cumulative Distribution of Returns to Arbitrage (USD/ton)



For the Gauteng – Blantyre market pair we observe again a one-sided trend in positive returns to arbitrage, with Blantyre prices exceeding the market prices for Gauteng for most of the study period. Trade from South Africa to Malawi, however, is not as substantial or as frequent as trade observed with Mozambique, despite seemingly comparable opportunities for arbitrage profits in the markets in Malawi, possibly reflecting other structural restrictions to entry in those markets.

Results from the econometric analyses indicate that the Gauteng-Maputo market pair is characterized by substantial price correlation, significant unidirectional causality in the Gauteng to Maputo direction, and highly significant price co-integration. Similar trends are observed between Gauteng and Mocuba. Considering that no significant direct market interaction exit between northern Mozambique and South Africa, the close price co-movements between Maputo and Mocuba possibly account for the significant price causality observed between Mocuba and Gauteng. Also, because Gauteng is a larger market than either Maputo, and due to the observed trade flows, we expect that price causality move in the observed direction. Gauteng and Blantyre also follow similar trends with the exception that in this case, causality seems to run in an unexpected direction[7], from Blantyre to Gauteng, and co-integration holds with less significance.

When we consider the linkage between Blantyre and Mocuba, we observe also that prices in Blantyre almost always exceed Mocuba prices, and returns to arbitrage in the Mocuba to Blantyre trade route are frequently positive. Here, trade moves in the expected direction, and although profits are close to zero more frequently than observed in other markets (efficiency is expected with a 22% probability, according the BLM), trade volumes still fall short of exhausting arbitrage profits (the Barrett-Li model results also indicate a 60% probability of regime 3). In-country, Maputo and Mocuba are characterized by negative returns on the Maputo to Mocuba trade route, and positive returns with a frequency of slightly over 50% in the opposite

[7] It is possible, though unlikely (Malawi's imports account for only 5% of South Africa's aggregate exports), that causality is demand driven, and the seller is responsive to its markets. Results are more likely indicative of spurious causality.

direction. However due to proximity of Mocuba to Blantyre, arbitrage returns are generally higher on that trade route, compared to Mocuba-Maputo, partially accounting for the higher trade flows observed there. The Maputo-Blantyre market pair is characterized by alternating positive and negative price differences, with the prices in Blantyre exceeding Maputo prices for about 50% of the study period. Opportunities for gainful arbitrage between these two markets appear limited compared to other market pairs in the sample, with the Blantyre to Maputo trade route recording non-negative returns less than 10% of the time, and the Maputo to Blantyre route for about 20% of the time. No significant trade occurs between these two markets.

Blantyre and Maputo, however, are shown to exhibit significant bidirectional causality and co-integration holds with high levels of significance. We observe, as expected, more significant correlation and causality in the price relationship between Blantyre and Mocuba. Considering the limited integration between the southern and northern regions of Mozambique (Tostão and Brorsen 2005, Tschirley *et al* 2005, Arndt forthcoming), we may also expect limited price co-movements between Maputo and Mocuba. The high degrees of causality and co-integration between in this market pair, however, seem to suggest that although these markets appear segmented, important feed back relationships exist in the price discovery process.

The results from the integration and efficiency assessments presented in this section support the hypothesis that markets in close proximity are better linked through trade (i.e. are more integrated) than distant markets, even in the presence of trade borders and/or trade restrictions (for example South Africa and southern Mozambique or Malawi and northern Mozambique). In fact for these market pairs, the probability that trade fails to exhaust arbitrage returns tends to be higher than the probability that transfer costs are too restrictive for trade. A look at the disaggregated transfer costs variable shows that in each of these cases, tariffs contributed very little to total transfer costs (MFN tariff rate were already very low at entry into force of the trade protocol), although other trade taxes tended to contribute more. Factoring-in value added tax on South African import into Mozambique, for example, substantially reduces arbitrage returns, and the probability of positive returns drops from almost 90% to the observed 75%. The costs of most non-tariff barriers to entry, however, could not be captured, and may partially explain the observed trends.

On transport costs, we note that the per unit cost of transfer between South Africa and southern Mozambique (estimated at USD 0.027/km/ton by rail) is lower than the per unit cost of transfer between southern and northern Mozambique (USD 0.029-0.055/km/ton by road, no rail), or between northern Mozambique and Malawi (USD 0.074/km/ton by rail). Factoring-in distance between the markets, we observe that it costs at least twice as much to move a ton of maize from northern Mozambique to the south, relative to the cost of moving grain from South and that the latter costs are still lower after adding tariffs and taxes. With regards to the use of different forms of price data, the use of wholesale selling prices for South Africa in this analysis, relative to the retail market prices used for Mozambique and Malawi, is perfectly consistent with the observed trade patterns (South Africa is primarily the seller and the other two are primarily buyers), thus should not bias to any significant degree the observed arbitrage returns. This disparity, however, may partially explain the apparent irrational (though very infrequent) exports from either Malawi or Mozambique to South Africa.

CONCLUSION

This study sought to analyze the extent to which regional trade might be relied upon as a policy strategy in achieving food security in southern Africa. We analyze first, revealed competitiveness in production and export of the main staple – maize – across regional producers; and second, for a selected set of major markets, the nature of market interactions within the current regional trade policy framework. The objective is to assess if and where potential gains from freer regional trade in maize can be expected, and to establish the nature of market constraints where they exist.

Results indicate substantial regional bias in maize trade among southern African countries. The region as a whole, however, is a net deficit producer of maize, with about half of the countries barely self sufficient food producers while the rest are net importers. Competitiveness in maize production is restricted only to South Africa, and a few other countries that possess the capacity to supply significant quantities. In a selected set of markets, price and transfer costs trends, as well as the parametric market integration and efficiency tests, frequently fail to reject the null hypothesis of 'integration' for those market pairs in geographic proximity, regardless of country location; suggesting fairly consistent price movements, tradability of commodities and/or contestability of such markets across borders. For those markets, however, efficiency appears weak, as trade often fails to exhaust arbitrage profits. Markets not linked through trade tend to have a higher frequency of efficiency, so that the lack of trade often is justified by the lack of positive arbitrage returns. In those cases, market segmentation appears driven more by restrictive transport costs than tariffs or taxes on cross-border trade.

These results suggest that the dominant forms of inefficiency in the markets considered in this study are (1) insufficient arbitrage resulting from supply side constraints, and other non-cost trade restrictions and (2) restrictive transport costs. Border administered tariffs and other forms of taxes on imports seem to account for a relatively low proportion of transfer costs, and generally reduce arbitrage returns marginally. Therefore policy interventions addressing both food supply and access are necessary to ensure meaningful food security benefits from trade.

REFERENCES

Arlindo, P. and D. Tschirley. 'Regional Trade in Maize in Southern Africa: Examining the Experience of Northern Mozambique and Malawi.' *Policy Synthesis for Cooperating USAID Offices and Country Missions*, Number 67, 2003.

Arndt, C. 'The Doha Trade Round and Mozambique.' Chapter 5 in Hertel, T.W., Winters, A.L. (eds) *Putting Development Back into the Doha Agenda: Poverty Impacts of a WTO Agreement,* Forthcoming.

Balassa, B. 1965. Trade Liberalization and Revealed Comparative Advantage, Manchester School 33: 99-123.

Ballance, R.H., H. Forstner, T. Murray. 1987. 'Consistency Tests of Alternative Measures of Comparative Advantage.' Review of Economics and Statistics 69 (1): 157-169.

Barrett, C.B., J.R. Li. 'Distinguishing Between Equilibrium and Integration in Spatial Price Analysis'. *American Journal of Agricultural Economics*, Volume 84, pp292-307, May 2002.

Baulch, B.J. 'Testing for Food Market Integration Revisited'. *Journal of Development Studies*, pp512-534, April 1997.

Donges, J.B. 1982. The Second Enlargement of the European Community: Adjustment Requirements and Challenges for Policy Reform, J.C.B. Mohr (Paul Siebeck) Tubingen.

Erero, J.L., J. van Heerden. 'The Role of Freight Rates in the Race between Road and Rail in South Africa: A Computable General Equilibrium Analysis.' *The Biennial Conference of the Economic Society of South Africa*, 2005.

Fackler, P.L., B.K. Goodwin. 'Spatial Price Analysis.' Chapter 17 in B. Gardner and G. Rausser (eds), *Handbook of Agricultural Economics*, Volume 1, 2001.

Food and Agriculture Organization, *'Some Issues Relating to Food Security in the Context of the WTO negotiations on Agriculture'*. Discussion Paper Number 1. 2001.

Granger, C.W.J. 'Investigating Causal Relations by Econometric Models and Cross-Spectral Methods.' *Econometrica*, Volume 37, 1969.

Heckscher, E., B. Ohlin. 1991. *Heckscher-Ohlin Trade Theory*. ed H. Flam and M.J. Flanders, Cambridge MIT Press.

Lafay, G. 1992. 'The Measurement of Revealed Comparative Advantages.' Chapter 10 in M.G. Dagenais, and P.A. Muet (eds.) International Trade Modeling.

Murrell, P. 1990. The nature of socialist economies: lessons from Eastern European foreign trade. Princeton University Press.

Kandiero, T., C. Tyala. 'The Impact of Transport Cost on Trade in the Southern African Customs Union Region.' *The Biennial Conference of the Economic Society of South Africa*, 2005.

Tostão E., B.W. Brorsen. 'Spatial Price Efficiency in Mozambique's Pos-Reform Markets.' *Agricultural Economics*, Volume 33, 2005.

Traub, L.N., T.S. Jayne. 'The Effects of Market Reform on Maize Marketing Margins in South Africa: An Empirical Study.' *MSU International Development Working Paper Number 83*, 2004.

Tschirley, D., J. Nijhoff, P. Arlindo, B. Mwinga, M.T. Weber, and T.S. Jayne. 'Anticipating and Responding to Drought Emergencies in Southern Africa'. *NEPAD Regional Conference*, 2004.

Vink, N., J. Kirsten. *Pricing Behavior in the South African Food and Agricultural Sector: A report to the National Treasury*. Final Draft 2002.

World Bank, *Malawi Diagnostic Trade Integration Study*. 2002.

World Bank, 'Removing Obstacle to Economic Growth in Mozambique.' *Mozambique Diagnostic Trade Integration Study*. 2004.

Zant, W. *Food Import Risk in Malawi: Hedging Malawi Maize Imports with Options and Future*. International Taskforce on Commodity Risk Management, May 2005.

Appendix 1: Market Integration and Efficiency Tests Results

Correlations

	Gauteng	Blantyre	Maputo	Mocuba
Gauteng	1.000000	0.285294	0.455502	0.061226
Blantyre	0.285294	1.000000	0.144453	0.347452
Maputo	0.455502	0.144453	1.000000	0.655694
Mocuba	0.061226	0.347452	0.655694	1.000000

Pairwise Granger Causality Tests

Null Hypothesis:	F-Statistic	Probability
MAPUTO does not Granger Cause GAUTENG	0.49462	0.87520
GAUTENG does not Granger Cause MAPUTO	2.55029	0.01096**
MOCUBA does not Granger cause GAUTENG	0.93962	0.49456
GAUTENG does not Granger cause MOCUBA	3.04863	0.00287**
BLANTYRE does not Granger Cause GAUTENG	2.45264	0.01309**
GAUTENG does not Granger Cause BLANTYRE	1.60123	0.12159
BLANTYRE does not Granger Cause MAPUTO	3.44616	0.00105**
MAPUTO does not Granger Cause BLANTYRE	2.60165	0.01006**
MOCUBA does not Granger Cause BLANTYRE	3.09785	0.00273**
BLANTYRE does not Granger Cause MOCUBA	2.79726	0.00607**
MOCUBA does not Granger Cause MAPUTO	1.66494	0.10731
MAPUTO does not Granger Cause MOCUBA	1.95617	0.05229*

Johansen Co-integration Tests Results

Series	Eigenvalue	Likelihood Ratio	Hypothesized Number of CE(s) in H_0
Gauteng Blantyre	0.094606	19.67869	None *
	0.027999	4.373356	At most 1 *
Gauteng Maputo	0.233366	41.85852	None **
	0.054691	7.311602	At most 1 **
Gauteng Mocuba	0.169226	28.95427	None **
	0.043427	5.594127	At most 1 *
Maputo Blantyre	0.227857	43.72418	None **
	0.100379	12.69386	At most 1 **
Blantyre Mocuba	0.169260	29.65901	None **
	0.067832	8.148101	At most 1 **
Maputo Mocuba	0.175919	35.67387	None **
	0.085740	11.29465	At most 1 **

*(**) denotes rejection of the null hypothesis at 5%(1%) significance level

Barrett-Li Model Tests

Direction of Trade	Regime Probability								
	λ_1	λ_2	λ_3	λ_4	λ_5	λ_6	σ_u	σ_v	α
Gauteng to Maputo	0.0097	0.000	0.8932	0.000	0.0971	0.000	74.997	0.001	1.09869
Maputo to Gauteng	0.1074	0.000	0.000	0.000	0.0470	0.8444	61.255	31.1558	-42.4078
Blantyre to Mocuba	0.000	0.0633	0.0415	0.000	0.1160	0.7781	109.97	32.9646	-72.5606
Mocuba to Blantyre	0.2298	0.0877	0.6130	0.0675	0.000	0.000	117.70	37.4335	17.66256
Maputo to Mocuba	0.000	0.0353	0.0000	0.0000	0.000	0.9636	57.481	45.8424	-16.4739
Mocuba to Maputo	0.000	0.5229	0.0000	0.1501	0.000	0.3269	58.957	38.0174	14.9787