Fuel and Food Trade-offs: A Preliminary Analysis of South African Food Consumption Patterns

Athur Mabiso and Dave Weatherspoon

Authors are
Ph.D. Student and Associate Professor respectively,
Agricultural, Food and Resource Economics Department
Michigan State University
202 Agriculture Hall
East Lansing, MI 48824
E-mail: mabisoat@msu.edu

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

Fuel and Food Trade-offs: A Preliminary Analysis of South African Food Consumption Patterns

Athur Mabiso and Dave Weatherspoon

Abstract

As oil prices continue to skyrocket and food riots surface across the globe, there are growing concerns that food-fuel tradeoffs are beginning to present serious challenges for food security across the world. In South Africa, where the government is embarking on a biofuels expansion strategy, understanding the nature of food-fuels tradeoffs is imperative for effective policy making and ultimately safeguarding consumers' welfare. Using time series monthly data constructed from various sources, this preliminary study makes a step toward explaining the nature of food-fuel tradeoffs in South Africa. By including fuel prices in the estimation of single-equation and seemingly unrelated regression (SUR) estimates of demands for maize meal (the South African staple food) and wheat bread (which is increasingly accounting for a large proportion of total expenditure in South Africa) the study presents preliminary findings. Further construction of the data used in this preliminary analysis is anticipated in order to allow for a systems approach that entails testing of separability between fuel and food, the estimation of cross-price elasticities and simulations of the expansion in the biofuels industry, for the elicitation of more information on the food-fuel tradeoffs in South Africa.

Introduction

As oil prices continue to skyrocket and food riots surface across the globe, there are growing concerns that food-fuel tradeoffs are beginning to present serious challenges for food security across the world (World Bank, 2008; NPR, 2008). The increased use of crops traditionally grown for food consumption to produce ethanol and bio-diesel implies that more of scarce resources such as land, capital and labor are being re-allocated away from the provisioning of food to supply energy. In developing countries, where governments have a history of struggling to feed millions of consumers, this may mean an exacerbated food insecurity situation as food access is further limited due to higher prices and lower food availability (von Braun and Pachauri, 2006).

However, it is possible that ethanol production could in fact cushion consumers from the negative effects of increasing world oil prices (Hazell and Pachauri, 2006). In South Africa, the government and industry are currently debating the merits of domestic ethanol and bio-diesel production and whether it could help mitigate the negative impact of high oil prices on consumer welfare (DME, 2007; Business Report, 2008). Indeed it is questionable to what extent ethanol and bio-diesel are gross substitutes or complements of oil in the South African fuel mix and whether fuels are a close substitute of food. If biofuels are gross substitutes of oil then an increase in production of ethanol or diesel should leave consumers better off as fuel refiners and ethanol blenders would likely substitute away from the use of large volumes of expensive oil. On the other hand, if biofuels are largely a complement of oil, then increases in ethanol or bio-diesel production would not be expected to cushion consumers from the increasing oil prices.

As in many parts of the world, food in South Africa has to be transformed then transported several miles before it reaches the consumer. Thus, a large percentage of the price of food that is paid by consumers is a result of high fuel costs incurred when transforming and transporting food. If ethanol or bio-diesel can act as a cheaper substitute it could reduce the proportion of the food price attributed to transportation and transformation costs. In addition, if ethanol or bio-diesel is a gross substitute of oil it could reduce the proportion of oil consumed by public and private human transportation, thereby lowering the cost of human transport and increasing consumer welfare. All these conceivable scenarios would also hinge on the nature of trade-offs between current fuels and food in South Africa. This calls for an analysis of the relationships between food and fuels, perhaps in the framework of demand analysis.

Separability of Food and Fuel

From a theoretical standpoint, the separability assumption with respect to food and fuel budgeting is often made implicitly when estimating consumer demand for food. While this allows for parsimonious estimation and enables us to do without having to collect data on many variables, it does not allow us to readily estimate the relationships between consumer demands for food and fuel.

There is a wealth of literature that looks at food demand and the separability assumption, particularly in the context of demand analysis of specific food categories (e.g. Eales and Unnevehr, 1988; Moschini, Moro and Green, 1994; Nayga and Capps, 1994; Lafrance, Beatty and Pope, 2006, etc.). These studies have made notable contributions in our understanding of consumer demand. However, these studies have not explicitly considered the relationship between food and fuel demand. Given the current questions pertaining to food and fuel demand, it is uncertain to what extent food demand analysis that excludes the demand of fuel can inform policy about consumer demand, especially in contexts where fuel prices are high and when fuel accounts for a significant proportion of consumption expenditure. Many studies have brought to the attention of agricultural and applied economists, the importance of considering population and socio-demograhics, advertising, health information, food safety and technical aspects such as functional form and estimation methods in demand analysis (e.g. Theil, 1965; Pollak, 1971; Stone, 1975; Deaton and Muellbauer, 1980; Pollak and Wales, 1992; Lee, Brown and Seale, 1994; Brester and Schroeder, 1995; Kinnucan, et al. 1997; Beatty and Lafrance, 2005). This study seeks to lay the groundwork for contributions that will add to this mass of literature and underscore the importance of incorporating fuel demand in the framework of food demand analysis.

The study focuses on food demand in South Africa, where food has historically accounted for a large percentage of total consumer expenditure and where fuel is increasingly accounting for a significant proportion of consumer expenditure even in the context of rising oil prices (DME, 2005). By estimating demand for retail food staples as a function of a price vector that includes fuel prices, important insights are drawn regarding fuel-food tradeoffs and potential tradeoffs that can be expected when ethanol and bio-diesel production expand in South Africa. However, given the current data limitations faced by the authors, this study does not explicitly model the demand for fuels or bio-fuels but makes a start in this direction using data sourced from various sectors in South Africa. It is hoped that this will lay a foundation for future studies in the area of food and fuel demand in South Africa, where increasing fuel prices are likely to have a large impact on food demand and food security.

The South African Context

Food markets in South Africa have historically been tightly controlled by the government with marketing boards regulating and awarding monopsony and monopoly rights to a few agents (Traub and Jayne, 2007). This has particularly been the case for maize meal (the staple), where the Maize Board set prices and appointed agents, mainly farmer cooperatives, to purchase and distribute maize to a limited number of licensed milling operators. Private individuals or business entities were prohibited from transporting and marketing maize from surplus regions of the country and over time this led to a high market concentration with few agents controlling most of the handling and storage of grains. After 1991 the government liberalized the grain markets and private actors were allowed to enter the market and take up roles of milling and distributing grains and maize meal (Jayne and Jones, 1997; Essinger, Hill and Laubscher, 1998). However, the oligopoly structure of the markets persisted due to various barriers to entry and retail prices of maize meal and wheat products continued to increase.

As for the South African fuels market, a slightly different history can be described. Innovations in the South African petroleum and refinery industries can be traced back to the early 1950s when the government-sponsored South African Coal, Oil and Gas Corporation Limited (SASOL) was originated to produce gasoline and petroleum by-products from coal (Time Magazine, 1979). This continued through the 1970s when the apartheid regime faced the OPEC oil embargo. Today, synthetic fuels from coal continue to supplement oil imports from Iran and Saudi Arabia in South Africa and constitute approximately 38.5% of South African crude oil consumption (EIA website, http://www.eia.doe.gov/emeu/cabs/South_Africa/Oil.html). Overall, coal is the largest source of South African energy, accounting for approximately 73% of all energy consumed in South Africa (DME, 2007). Recent interests in biofuels production could further reduce the proportion of oil imports. However, current ethanol production in South Africa continues to be largely non-fuel-grade and is produced for industrial purposes and for export while bio-diesel production constitutes a small but growing sector (F.O. Litch, 2008). The South African Department of Minerals and Energy (DME) released a National Biofuels Strategy in December 2007, which expresses support in terms of tax credits while mandating an 8% ethanol requirement in motor fuels by 2012 (DME, 2007; FAS, 2007). Currently, a relatively minute proportion of the total production of ethanol is blended with oil as an oxygenate to increase the octane rating of motor fuel and blending of ethanol is on a voluntary basis by small-scale refineries that produce for own-consumption under a maximum level blending rate of 9% set by government (Business Report, 2006).

Food Prices and Consumer Demand in South Africa

Literature that specifically looks at food demand in South Africa is very sparse owing to the dearth of data. Dunne and Edkins (2005) estimate the demand for the category food, beverages and tobacco using annual data from 1970 to 2002. They find that the long-run own price elasticity of demand for food ranges between -0.8 and -1.2 while the income elasticity ranges between 0.6 and 0.95.

Taljaard et al. (2004) focus on meats and estimate the demand for meats using the Almost Ideal Demand System (AIDS) model. They find that meats are not separable and therefore estimate demands jointly to find beef and mutton as luxury goods in South Africa. In contrast, chicken is found to be a necessity good. Selvanathan and Selvanathan (2003) also use annual data to estimate a Rotterdam demand system for several commodity groups for the period 1960-2001. They find that all own price elasticities are negative and less than unity while income elasticities of food, housing and medical care are also less than unity. Income elasticities for clothing, furniture, transport, and recreation are found to be greater than unity.

Agbola et al (2003) estimated the demand for six broad food groups using the 1993 South Africa Integrated Household Survey cross-section data. They found modest own-price elasticities of demand with dairy products being the most inelastic (-0.96) and meat products being the most elastic. While it is widely agreed that fuel/energy prices influence the demand of other products, and particularly basic foodstuffs, all the South African studies documented here do not estimate demand for food with direct inclusion of the demand for fuel or fuel prices. This is a limitation of these studies in that it is not possible to make inferences regarding the nature of food-fuel trade-offs in South Africa.

Data and Variables

In this study we constructed a time series data set covering the period January 2000 to January 2008 using secondary data collected from multiple sources. Monthly food prices for several food products (maize meal, bread, rice, eggs, milk and sugar[1]) were collected

[1] Prices on other goods were also collected but because of shortness of the series and missing data they were not included in this study (e.g. chicken and topside steak). Furthermore, some of the products not

from Statistics South Africa, which is the South African government agency responsible for official price data collection and reporting. We combined the price data with maize meal and bread wheat flour[2] consumption data from the South African National Chamber of Milling; an industry association comprising of maize and wheat milling firms. Data on monthly consumption of other foods anticipated from Statistics South Africa were not available at the time of writing this paper. Nevertheless, monthly data on total expenditure were collected from Statistics South Africa as well as consumer price indexes (with base year 2000) and population statistics that were used to deflate prices and compute consumption expenditures on a real per capita basis. Foreign currency exchange rate data (South African Rands per U.S. dollar) were collected from the U.S. Economic Research Federal Reserve Bank of Saint Louis' website (http://research.stlouisfed.org) and included in the data set in order to convert values into U.S. currency whenever needed. Price series for gasoline (unleaded petrol with a 95 octane rating), diesel (with 0.05 sulfur content), and kerosene (referred to as paraffin in South Africa) were collected from the Department of Minerals and Energy (DME) and the South African Petroleum Industry Association (SAPIA). While values of total expenditure are also available from the Reserve Bank of South Africa's Quarterly Bulletin Time Series, these were slightly different from those collected from Statistics South Africa. We chose to use data from the same source (Statistics South Africa) to avoid possible differences in variable definitions. Because data on disaggregated volumes of gasoline, diesel and kerosene consumption were only obtained recently and were

included are not considered part of the standard South African diet and are not consumed on a regular basis by most South Africans (e.g. spaghetti, hake, and pilchards)

[2] Bread wheat flour was used as a proxy for the amount of bread consumed. Data on actual bread sales was yet to be received from Statistics South Africa

available on a quarterly basis, the estimation of quarterly demands is not included in this version of the paper.

Demand Estimations

Following standard time series econometric procedures, preliminary analyses of the data were done by first plotting the data over time. Figure 1 in Appendix A shows prices of petrol (gasoline) and compares it to the U.S. gasoline prices. Food price plots are also shown in figure 2. In addition, we tested for the presence of unit roots and cointegration in the log-transformed prices and expenditure shares using Dickey-Fuller tests. As is common with most time series data, we found unit roots in the prices except for the prices of maize meal and wheat bread. For the nonstationary prices we used the Dickey-Fuller test on the residuals of cointegrating regressions to test for cointegration and the prices were found to be cointegrated. In terms of the measures of quantities demanded, the expenditure shares for maize meal and bread (bread-wheat flour) were found to be stationary.

Single equation demands for maize meal and bread were then estimated using OLS (assuming no correlation in the residuals). The log-log specification shown in equation 1 below was used in the single equation demand estimations.

$$\begin{aligned} \ln w_m = {} & \alpha_0 + \alpha_1 \ln p_m + \alpha_2 \ln p_{bread} + \alpha_3 \ln p_{sugar} \\ & + \alpha_3 \ln p_{eggs} + \alpha_3 \ln p_{petrol} + \alpha_4 \ln p_{paraffin} + \alpha_5 \ln p_{diesel} + \alpha_6 \ln y + \varepsilon \end{aligned} \qquad (1)$$

Where w_m is the share of expenditure for maize meal and p is the price with the subscript denoting the good, where the subscript m denotes maize meal. y is the total expenditure on food and energy goods while ε is the error term. Given that the residuals of the OLS demand estimates were autocorrelated, we used the Newey-West seriel correlated robust standard errors for inferences. These results are shown in tables 2a and 2b. Incorporating lags to account for the dynamic nature of the time series was done for separate models not reported but these results were not significant. The SUR estimations used similar functional form with the only difference being that of joint estimation to account for cross-equation correlation in the residuals. Results of the SUR estimation are shown in table 3.

Preliminary Results

The summary statistics of the variables used in the analyses are presented in table 1. Results from the single equation demand estimations are relatively modest, with maize meal being a normal good with an own price elasticity of -0.42 (p-value<0.074). The own-price inelasticity of maize meal demand is consistent with the fact that maize meal is the staple food in South Africa. It would be expected that consumers will not be relatively responsive to maize meal price changes in their demand for maize meal. The cross-price elasticity of maize meal with respect to diesel and kerosene (paraffin) are negative suggesting that the fuels are gross complements of maize meal. If the price of paraffin increases by 1% the demand for maize meal would decline by 0.59%. This result is foreseeable since paraffin is mainly used by poor households for lighting and cooking and to the effect that maize meal has to be cooked before consumption the two products could be viewed as complements. Similar results are found for the demand for wheat bread e.g. the cross-price elasticity of demand for wheat bread with respect to petrol is positive (0.87), which implies that if the price of petrol increases by 1% the quantity of wheat-bread demanded would rise by 0.87%. While cross-price elasticities of demand for diesel with respect to maize meal and the wheat bead are negative for both products, it is surprising to see that they are both non-significant at 5% significance level. It is possible that due to high correlation in fuel prices there may be near perfect colinearity in prices making the estimates to be non-significant (the correlation coefficient for petrol and diesel prices is 0.95). Income elasticities estimated on the basis of the log-expenditure on energy and food show that both maize meal and wheat bread demands are negatively related to income implying that maize meal and wheat bread are inferior goods. This result is somewhat different from previous studies in South Africa (e.g. Dunne and Edkins, 2005; Selvenathan and Selvanathan) which do not incorporate fuel prices. Results from the SUR estimation show that the own-price elasticity of demand for maize meal is -0. 43 (p-value=0.011), which is more or less the same as the result from the single equation estimation. For bread, the own-price elasticity estimate equals 0.12 also similar to the estimate from the single equation estimations. Both goods are still relatively inelastic. Further detailed results are shown in table 3.

Proposed Approaches

With construction of the current data used in this study expected to continue, it is anticipated that tests of separability will be able to be performed to assess the theoretical necessity of jointly estimating the demands for food and fuels in a system. In the case of limited time series data, the use and development of incomplete demand systems estimations is also an approach worth exploring, particularly given that availability of data in developing countries is a major hindrance to the analysis of many policy relevant issues related to consumer demand. In terms of functional form, estimations should perhaps use several functional forms (including the QUAIDS given its flexibility) in order to assess robustness of results. Recent work on Bayesian Averaging Classical Approaches by Sala-i-martin, Doppelhofer and Miller (2004) and Bryant and Davis (2008) are also potential avenues to be explored. As asserted by Bryant and Davis (2008, p103) “considering more general theories of demand [might be] methodologically more progressive than comparing functional forms based on the traditional theory, which invokes weak separability.”

Given that the areas where food-fuel tradeoffs are likely to have the greatest impact are in the developing countries where data are not readily available, it is a matter of practicality that methods of analyzing food demand may also have to rely more on systematic imputation approaches. One tried-and-tested approach is that of simulating policy effects based on estimates from elasticities of demands. However, in order to effectively simulate the relationships between demand for food and fuels, there is need for elasticities that are empirically drawn from demand estimates that incorporate fuel products.

Conclusion

This study has made the case for the need to incorporate fuel and energy products in the framework of food demand analysis. While data limitations have precluded the study from actually demonstrating the value of the proposed approach, the study has presented preliminary findings of single equation and SUR estimates. From the preliminary results of this study, we find that fuel prices (petrol, diesel and kerosene) are mostly inversely related to the demands for maize meal and wheat bread in South Africa (a somewhat expected result). The cross-price elasticity of petrol with respect to the demand for maize meal is 0.94 and 0.87 with respect to the demand for bread. These elasticities of demand could imply that if ethanol displaces 10% of oil in the gasoline demand in South Africa, and assuming that the price of ethanol is lower than the current price levels of oil then the ethanol could indeed cushion consumers to some extent, from the adverse effects of oil price increases. Nevertheless, more in-depth analyses and simulations are required. Concerns about ethanol bio-ethanol production causing higher prices of food in South Africa may in fact be valid because there is some positive relationship between consumption food staples and fuel prices. However, there could be two effects arising from an increase in ethanol use and biofuel in South Africa and these details need to be empirically investigated in the future.

References

Agbola, F. W., Marita, P and Mclaren, K. (2003) "On the estimation of demand systems with large number of goods: an application to South African household food demand." 41st Annual Conference of the Agricultural Economic Association of South Africa (AEASA), http://ageconsearch.umn.edu/handle/123456789/16762 Accessed March, 26, 2008.

Beatty, T.K.M. and J.T. LaFrance. 2005. "U.S. Demand for Food and Nutrients in the 20th Century." *American Journal of Agricultural Economics* 87: 1159-1166.

Brester, G.W. and T. C. Schroeder. 1995. "The Impacts of Brand and Generic Advertising on Meat Demand" American Journal of Agricultural Economics, 77(4): 969-979.

Bryant, Henry L. & Davis, George C. Revisiting Aggregate U.S. Meat Demand with a Bayesian Averaging of Classical Estimates Approach: Do We Need a More General Theory?. 2007. *American Journal of Agricultural Economics* 90(1): 103-116. doi: 10.1111/j.1467-8276.2007.01054.x

Business Report, "Maize Surplus Boost for Biofuels" January, 7, 2008. www.busrep.co.za/index.php?fSectionId=552&fArticleId=4195783 Accessed March, 26, 2008.

Business Report, "Free State to get first bio-ethanol plant" February, 24, 2006. www.busrep.co.za/index.php?fArtcileId=3128837 Accessed, January, 6, 2008.

Deaton, A and J. Muellbauer. 1980. An Almost Ideal Demand System. American Economic Review 70: 312-26.

DME, Department of Minerals and Energy, 2007. "Biofuels Industrial Strategy of the Republic of South Africa" Pretoria, South Africa

DME, Department of Minerals and Energy, 2005. "Energy Price Report 2005" Directorate: Energy Planning and Development, Pretoria, South Africa

Eales, J and L.J. Unnevehr. 1988. "Demand for Beef and Chicken Products: Separability and Structural Change." *American Journal of Agricultural Economics* 70:521-532.

EIA, Energy Information Administration website. http://www.eia.doe.gov/emeu/cabs/South_Africa/Oil.html, Accessed March, 26, 2008.

Essinger, S., L.D. Hill and J.M. Laubscher. 1998. "Privatization progress in the South African Maize Industry. Staff Paper, University of Illinois, Urbana-Champagne

FAS, Unites States Foreign Agricultural Service. 2007. "South Africa, Republic of Biofuels Situation Update 2007" *Gain Report – Number SF7044*, United States Embassy, Pretoria, South Africa

F.O. Litch, "World Ethanol and Biofuels Report", March, 10, 2008, vol. 6 No. 13.

Hazell, P. and R.K. Pachauri. December 2006. "Bioenergy and Agriculture: Promises and Challenges." Focus 14, Brief 1. IFPRI. Washington, D.C.

Jayne, T.S. and S. Jones. 1997. "Food Marketing and Pricing Policy in Eastern and Southern Africa: A Survey." *World Development* 25(9): 1505-1527.

Kinnucan, H., H. Xiao, C. Hsia and J. Jackson. 1997. "Effects of Health Information and Generic Advertising on U.S. Meat Demand." *American Journal of Agricultural Economics* 79: 13-23.

LaFrance, J.T., T.K.M. Beatty, and R.D. Pope. 2006. "Gorman Engel Curves for Incomplete Demand Systems." In *Exploring Frontiers in Applied Economics: Essays in Honor of Stanley R. Johnson*, M.T. Hott and J.–P. Chavas, ed., Berkeley Electronic Press.

Lee, J-Y., M.G. Brown, and J.L. Seale. 1994. "Model Choice in Consumer Demand Analysis: Taiwan, 1970-1989." *American Journal of Agricultural Economics* 78:504-512.

Moschini, G., D. Moro and R.D. Green. 1994. "Maintaining and Testing Separability in Demand Systems." *American Journal of Agricultural Economics* 76:61-73.

Nayga, R.M. and O. Capps. 1994. "Tests of Weak Separability in Disaggregated Meat Products." *American Journal of Agricultural Economics* 76:800-808.

NPR, National Public Radio, Morning Edition, April 11, 2008, "World Bank Chief: Biofuels Boosting Food Prices" http://www.npr.org/templates/story/story.php?storyId=89545855 Accessed April 21, 2008

Pollak, R. 1971. "Conditional Demand Functions and the Implications of Separable Utility." *Southern Economic Journal* 37(4):423-433

Pollak, R. and T. Wales. 1992. "*Demand System Specification and Estimation*." Oxford: Oxford University Press.

Sala-i-martin X., G. Doppelhofer, and R. Miller. 2004. "Determinants of Long-Term Growth: A Bayesian Averaging of Classical Estimates (BACE) Approach." *American Economic Review* 94:813–35

Selvanathan, S. and S. Selvanathan. 2003. "Consumer Demand in South Africa." *South African Journal of Economics*. 71(2):325-344.

Taljaard, P.R., Alemu, Z.G. and van Schalkwyk, H.D. 2004. "The demand for meat in South Africa: an Almost Ideal Demand Estimation." *Agrekon*, 43(4), 430-443

Theil, H. 1965. "The Information Approach to Demand Analysis" Econometrica, 33(1): 67-87. http://links.jstor.org/sici?sici=0012-9682%28196501%2933%3A1%3C67%3ATIATDA%3E2.0.CO%3B2-F Accessed January, 6, 2008

Time Magazine. August, 20, 1979. "Synfuel Success: Alchemy in South Africa", http://www.time.com/time/magazine/article/0,9171,947358,00.html Accessed, March, 30, 2008.

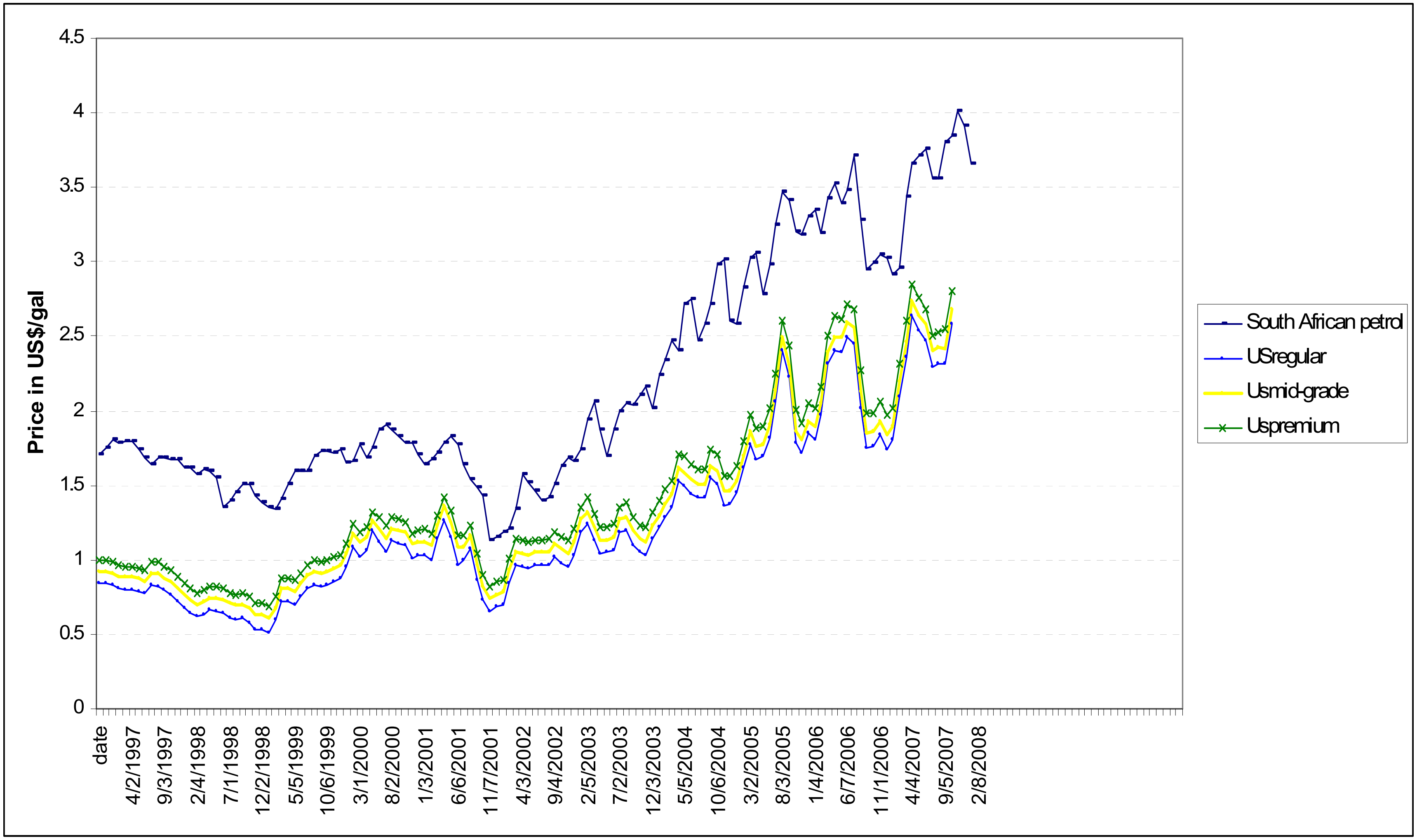
Traub, L.N. and T.S. Jayne. 2007. "The effects of price deregulation on maize marketing margins in South Africa" *Food Policy*. doi:10.1016/j.foodpol.2007.10.004

von Braun, J and R.K. Pachauri. November 2006. "The Promised and Challenges of Biofuels for Poor in Developing Countries." IFPRI. Washington, D.C.

World Bank. 20008. World Bank Press Release No:2008/264/PREM "Rising Food Prices Threaten Poverty Reduction" April 9, 2008, Washington D.C. http://web.worldbank.org/WBSITE/EXTERNAL/NEWS/0,,contentMDK:21722688~pagePK:64257043~piPK:437376~theSitePK:4607,00.html Accessed April 21, 2008

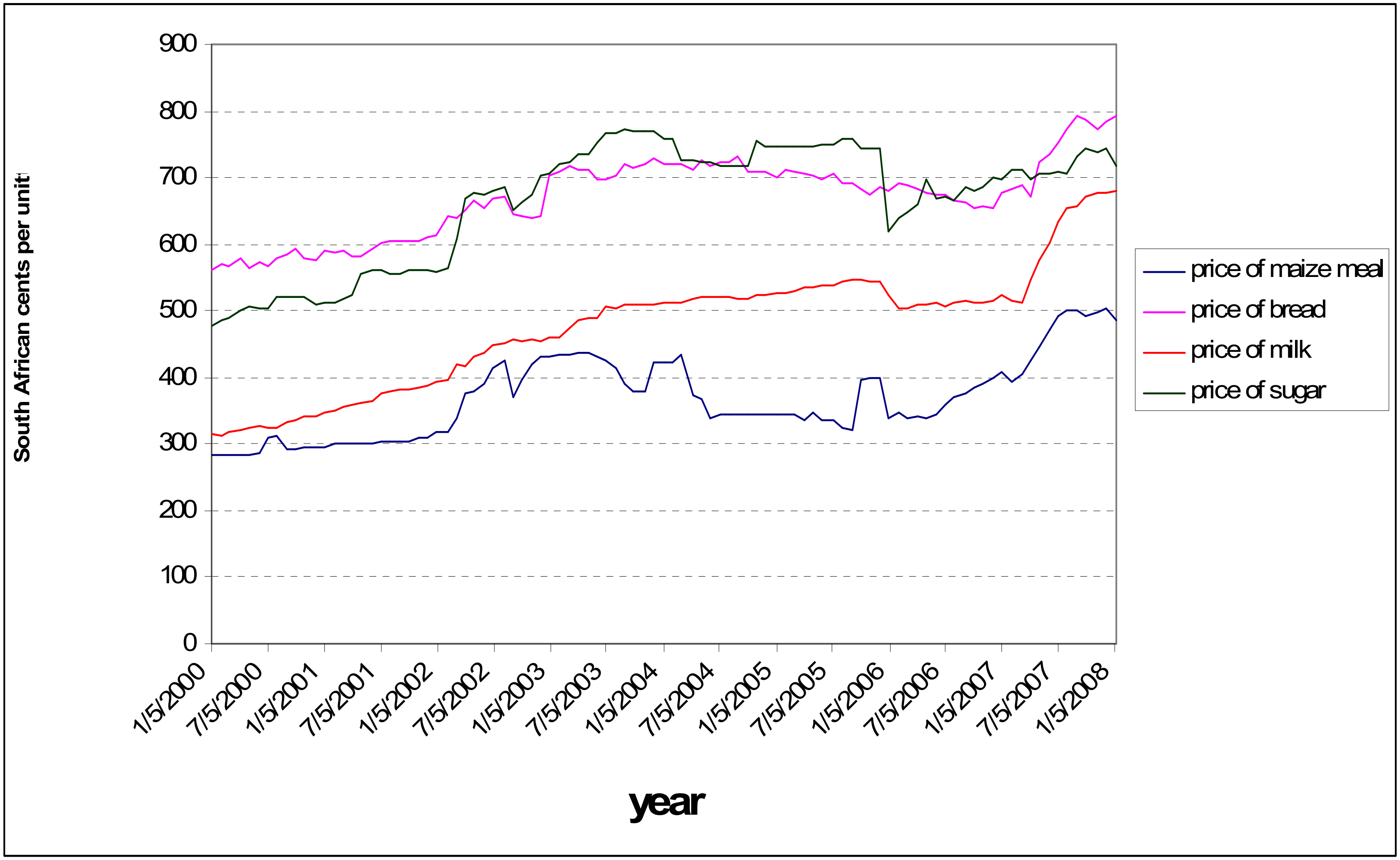
Appendix A: Graphical Price Trend Analysis

Figure 1. Comparison of gasoline prices between South Africa and the United States (1996 to 2007)



Source: Energy Information Administration, U.S. Department of Energy (EIA) and South African Petroleum Industry Association (SAPIA)

Figure 2. Food Price Trends



Source: Statistics South Africa

Appendix B: Description of Data and Tables

The time series data range from January 2000 to January, 2008 (frequency=monthly)

Number of observations = 97 months

Table 1. Summary statistics for variables used

South African currency per unit	Mean	Std. Dev.	Min	Max
Petrol Price in cents per liter	458.619	118.440	275	723
Diesel Price in cents per liter	421.836	130.946	204.53	725.3
Paraffin Price in cents per liter	326.16	104.346	171.93	587.1
Price of Maize meal in cents per kg	368.598	60.193	283	504
Price of Bread in cents per kg	670.526	59.420	561	794
Price of Milk in cents per liter	476.340	91.833	313	679
Price of rice in South African cents per kg	700.217	63.298	602	820
Price of Eggs in South African cents per dozen	790.072	166.320	509	1110
Price of sugar in South African cents per kg	664.856	90.751	478	773
Value of total expenditure in on food and energy in Rands	1.65E+07	3737429	9984251	2.65E+07
Quantity of maize meal in tons	231457.2	34039.41	166186.3	306940.6
Quantity of wheat-bread in tons	202936.1	16405.67	164264.4	238590.6

Table 2a. OLS (Newey-West) results of single equation demand estimation for maize meal in South Africa

Number of Observations = 97 (January 2000 to January 2008)

Natural Log of Price Variable	Coefficient (Elasticity)	Newey-West. Std. Errors	T-statistic	p-value	95 % Confidence Interval	
Maize meal	-0.424	0.234	-1.81	0.074	-0.890	0.042
Bread	3.254	0.552	5.90	<0.001	2.158	4.350
Sugar	0.918	0.311	2.95	0.004	0.300	1.537
Eggs	-3.727	0.375	-9.93	<0.001	-4.473	-2.982
Petrol	0.941	0.360	2.61	0.011	0.225	1.656
Paraffin	-0.588	0.258	-2.28	0.025	-1.101	-0.075
Diesel	-0.029	0.118	-0.24	0.808	-0.264	0.206
Total expenditure (food and energy)	-0.851	0.070	-12.23**	<0.001	-0.989	-0.713
Constant	-7.346	0.706	-10.4		-8.7489	-5.9431

Number of observations= 97

F-Statistic (6,90) = 31.55

R-square = 0.7207

Root Mean Square Error = 0.17478

Table 2b. OLS (Newey-West) results of single equation estimation of demand for bread in South Africa (quantity of bread flour used as a proxy of amount of bread).

Natural Log of Price Variable	Coefficient (Elasticity)	Newey-West Std. Errors	T-statistic	p-value	95 % Confidence Interval	
					Lower	Upper
Maize meal	-0.143	0.137	-1.05	0.296	-1.415	0.128
Bread	1.982	0.337	5.88	<0.001	1.313	2.652
Sugar	.7341	0.187	3.93	<0.001	0.363	1.105
Eggs	-2.126	0.242	-8.77	<0.001	-2.608	-1.645
Petrol	0.868	0.257	3.38	<0.001	0.358	1.378
Paraffin	-0.533	0.179	-2.98	0.004	-0.888	-0.178
Diesel	-.0679	0.109	-0.62	0.535	-0.285	.1487
Total expenditure (food and energy)	-1.324	1.728	111.31	<0.001	-1.557	-1.091
Constant	-6.070	0.462	-13.14		-6.988	-5.153

Number of observations = 97
F-Statistic (6,90) = 53.54
R-square = 0.7714
Root Mean Square Error = 0.1127

Table 3. SUR Estimation of the demand for bread and maize meal in South Africa

	Elasticity	Std. Err.	Z	P>z	[95% Conf.	Interval]
Demand for Bread						
Maize meal Price	-0.121	0.122	-1.000	0.319	-0.360	0.117
Price of bread	1.502	0.156	9.650	0.000	1.197	1.807
Price of sugar	0.157	0.175	0.900	0.369	-0.185	0.499
Price of eggs	-0.830	0.192	-4.330	0.000	-1.206	-0.455
Price of Petrol	0.581	0.227	2.560	0.010	0.137	1.025
Price of diesel	-0.256	0.178	-1.440	0.150	-0.604	0.093
Price of paraffin	-0.116	0.189	-0.610	0.541	-0.487	0.255
_constant	-7.875	1.593	-4.940	0.000	-10.997	-4.753
Demand for Maize meal						
Price of Maize meal	-0.425	0.166	-2.550	0.011	-0.751	-0.099
Price of wheat	2.756	0.213	12.970	0.000	2.340	3.173
Price of sugar	-0.222	0.238	-0.930	0.352	-0.689	0.245
Price of eggs	-1.616	0.262	-6.170	0.000	-2.129	-1.103
Price of petrol	0.367	0.309	1.190	0.235	-0.239	0.974
Price of diesel	-0.340	0.243	-1.400	0.162	-0.816	0.136
Price of paraffin	0.086	0.258	0.330	0.740	-0.421	0.592
_constant	-14.771	2.175	-6.790	0.000	-19.035	-10.508
Equation	Obs	Parms	RMSE	R-sq	chi2	P
ln(expenditure share on bread)	97	7	0.092	0.855	573.28	0
ln(expenditure share on maize meal)	97	7	0.126	0.865	623.46	0