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Research Article

Tradeoffs Between Maize Importation and Reliance on Local Production: A Case of Commercial Maize Millers in Kenya

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Abstract

The supply of maize in Kenya has often fallen short of the demand resulting to an influx of cheap maize imports from neighboring countries. Tradeoffs thus arise among commercial maize milling firms whether to import or use locally produced maize in their operations and which alternative maximizes their income. This study aimed to determine the effect of tradeoffs between maize importation and reliance on local production on the income of commercial maize milling firms in Kenya. Data was collected from 106 commercial maize milling firms that produced packaged maize flour. A census of the entire population was employed and a semi-structured questionnaire used to guide personal interviews and online surveys with the respondents. Data was analyzed using descriptive analysis, gross margins and two-stage least square regression. Results indicate that firms that used locally produced maize only were majorly micro to medium-scale, had relatively low-skilled employees, lower production capacity and employed relatively less sophisticated technology. Firms that used locally produced maize only in their operations realized higher incomes and lower cost of procuring maize monthly compared to firms that used both locally produced and imported maize. Additionally, the determinants of firm's income were the miller's decision on maize source, total number of employees, total cost of maize, mean monthly sales and mean production costs. Therefore, government policies should be geared towards lowering the cost of procuring maize from both local and import sources. These include reviewing import duties on food grain, streamlining cess collection across counties and improving road infrastructure.

Keywords

Commercial Maize Milling Firms, Trade Offs, Two-Stage Least Square Regression

1. Introduction

Maize is Kenya's most important food crop and has huge importance in the country's food security and economic well being. It accounts for 36% caloric food intake and 14% of the household income in Kenya [2, 42]. Maize is also an important raw material for industrial use. The main products of maize processing include corn starch, corn oil, maize flour, animal feed, ethanol and biofuels. In Kenya, the main products are maize flour and animal feeds [22, 34, 9].

The maize milling industry in Kenya is important as the majority of the country's population depend on maize flour to

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make thick porridge (ugali), which is the common food consumed by the majority of the households [22, 13]. According to KNBS data, the annual per capita consumption of maize and maize products as at 2018 was 69.5 kg. The country's population as at the 2019 census was 47.6 million with an inter-censual population growth rate of 2.3% [21]. As a result of the increase in population, the demand for maize and maize products in the country has increased. This has led to an increase in the number of milling companies [17].

According to the National Cereals and Produce Board (NCPB), the number of registered maize millers in the country is 103 and the estimated capacity of maize mills is 1.77 million tons per annum [20]. The industry is dominated by few large scale firms that account for nearly 70% of the total milling capacity. These include Mombasa Maize Millers, Capwell Industries Ltd, Unga Group Ltd, Pembe Flour Mills, Nairobi Flour mills and Kitui Flour Mills [39]. According to Mutiga [28], medium to large-scale millers have a combined milling capacity of 85-90% of the total national maize milling capacity while micro to small millers have a combined capacity of 10-15% of the total national maize milling capacity.

The supply of maize in the country has however fallen short of the demand over the years mainly due to unfavorable and unpredictable weather patterns, pest infestations and supply chain disruptions. As a result, the country has had to rely on imports mainly from EAC countries, especially Uganda and Tanzania [23, 16]. However, climate change has led to the supply of maize from traditional import destinations for Kenya to decline. Countries in the EAC and COMESA region that used to have surplus maize are now rationing their maize exports in order to feed their population. This has forced some of the large-scale firms to source their maize from outside the region, which has proved to be costlier and economically non-viable for most of the firms [6, 2].

The government has often intervened in the maize sector through policies aimed at maintaining stabilized and reasonably high maize prices as an incentive for producers to increase maize production. It has also made efforts to cushion consumers from high maize flour prices by opening windows for importation of duty-free maize [29]. However, the maize milling firms are still struggling with maize shortage which has led to an increase in the price of maize grain. This has forced the maize milling firms to increase the price of maize flour [33]. According to Andae [6], nearly half of the small-scale maize milling firms in the country shut down operations in 2022 due to maize shortages and inadequate finances to import the grain. The dilemma therefore arises among commercial maize milling firms on whether to use locally produced maize or imported maize in their milling operations and which of the two alternatives maximizes their income.

Several studies have been conducted on the effect of maize importation on producer and consumer welfare [2]. More studies have been conducted on the sustainability of maize production in Kenya [44]. On the millers' side, studies indicate that the shortage in maize supply has affected the firms' operations, forcing them to rely on imports from the region or the world market [25]. However, there is still a gap on the effects of tradeoffs between maize importation and dependence on local production in Kenya. Therefore, the aim of this study is to determine the effect of tradeoffs between maize importation and reliance on local production on the income of commercial maize milling firms in Kenya.

2. Materials and Methods

2.1. Study Area

The study was done in the Republic of Kenya. The country is located in the middle of Eastern Africa and lies between 1 ℃N and 38 ℃E. It covers an area of approximately 582,646 square km. Kenya is bordered to the north by South Sudan and Ethiopia, to the east by Somalia, to the south by Tanzania and to the west by Uganda.

Agriculture is the main economic activity practiced by 6.4 million households. Maize is the main crop grown with 5.1 million households cultivating maize in the country [21]. The main maize growing areas in the country are Trans Nzoia, Uasin Gishu, Nakuru, Narok, Bomet, Kericho, Bungoma, Kakamega, Nyeri, Embu and Kiambu. Maize cultivation is practiced on both large-scale and small-scale systems. Small-scale systems account for 70% of the total production whereas large-scale systems account for only 30% of the total production [2].

2.2. Sampling Procedure and Data Collection

A quantitative research design was applied in this study. Data was collected through personal interviews and online surveys. A semi-structured questionnaire was used as a guide to the interviews and online surveys. The questionnaire captured data on; miller attributes such as location, daily production capacity, size of the firm, total number of employees, number of years of operation, employee skill level of employees and milling technology used in production; profitability of the firm which comprised of the cost of production and the revenues obtained from selling the maize flour and; challenges affecting the maize milling firms.

According to Masoud [25], the number of registered commercial maize mills in Kenya was reported to be 150. A census of the entire population was thus carried out to eliminate sampling errors and to achieve a desirable level of precision. The commercial maize mills were categorized according to the regions in which they are located. The country was divided into 5 regions namely; Nairobi and Central region, Rift Valley region, Western and Nyanza region, Eastern and North Eastern region and the Coast region. The regions were divided based on proximity and similarity in consumption patterns, level of urbanization and ethnic communities

inhabiting them.

The Nairobi and Central region comprised six counties namely; Nairobi, Kiambu, Murang á, Kirinyaga, Nyandarua and Nyeri. In the Rift Valley region, only four counties were considered based on the distribution of the commercial maize mills. These were Laikipia, Nakuru, Uasin Gishu and Trans Nzoia counties. In the Western and Nyanza region, only Busia, Bungoma, Kakamega and Kisumu county were considered because the majority of the commercial maize mills were located there. In the Eastern and North Eastern region, only Meru, Machakos, Makueni and Kajiado counties were considered. In the Coast region, only Mombasa, Kilifi and Taita Taveta counties were considered. This is where the majority of the firms were located.

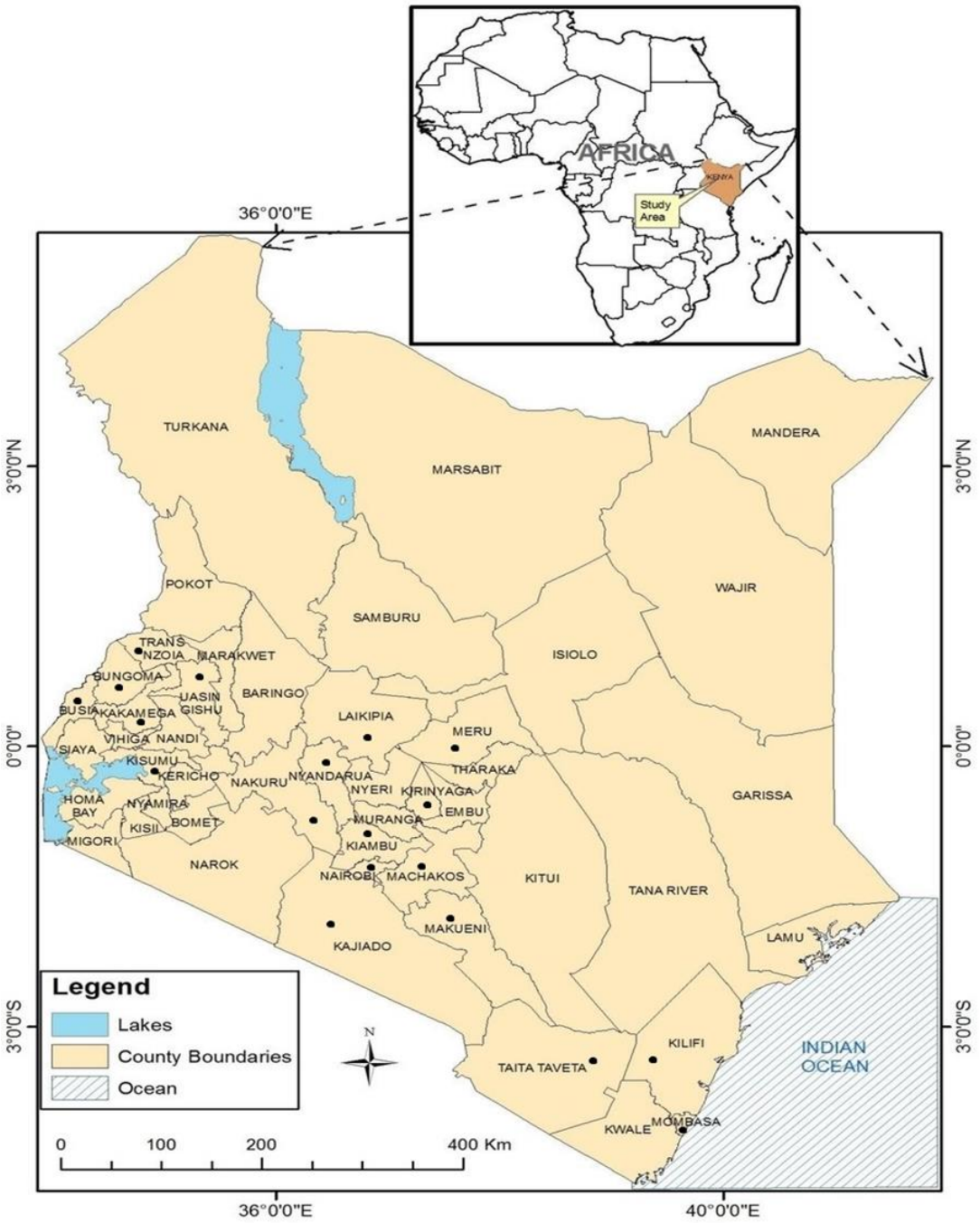

Figure 1. *Map of the study area.*

Commercial maize milling firms were selected from the counties in each region. Middle and first line staff of the milling firms were involved in the interviews. These included managers, directors, supervisors, accountants, machine operators and salespersons.

2.3. Analytical Technique

The data obtained was analyzed using descriptive analysis, gross margin analysis and a two-stage least square regression. Gross margins were first calculated to get the difference in gross revenues between the firms that used locally produced maize only and those that used both local and imported maize. Gross margin is defined as the value obtained by subtracting variable expenses from gross production value [38]. The gross margin analysis is widely adopted because there is no need for distribution of fixed costs to the firm's operations. The gross margins were calculated using the formula below

$$GM = \sum P_y Y - \sum P_x X \quad (1)$$

GM is the firm's gross margin, P_y is the unit price of maize sold per ton, Y is the quantity of maize sold in tons, P_x is the unit cost per ton of maize purchased locally or imported and X is the quantity of maize purchased locally or imported in tons. A t- statistic test was used to test the mean differences between the two alternatives.

A two-stage least squares regression model was then used to determine the effect of these tradeoffs on the maize milling firms. The income obtained by the firms was used as the measure of the effect of the decision made by maize milling firms on which source of maize to use.

The firms' decision on the choice of maize source may influence the income that the firm obtains from its milling operations. Additionally, the income that a firm gets may also influence their decision on the choice of maize source. As a result, simultaneity occurs and the error terms between the dependent and independent variables become correlated leading to endogeneity problems [46]. Therefore, the 2SLS regression model is used to control for endogeneity.

The general structural equation for the model is shown in the following equation

$$Yi = \alpha_1 S + \alpha_2 X_i + \varepsilon_i \quad (2)$$

Yi represents the income obtained by the maize milling firms, S is the milling firm's choice of maize source, α is the vector of parameters to be estimated, X_i is the vector of explanatory variables

In the first stage of the 2SLS, the endogenous variable (S) was regressed on all the exogenous variables and a set of instrumental variables and the results of this regression obtained.

$$S = \beta_1 Z_i + \beta_2 X_i + \mu \quad (3)$$

S represents the endogenous variable (miller's decision on maize source), β is a vector of coefficients, X_1 is a vector of exogenous covariates, Z_i is a vector of instrumental variables that have an impact on the miller's decision but not on the income of the firms, μ is the random error term

In the second stage, the predicted value of equation 3 was used to replace the original endogenous variables in the structural equation. As a result, equation 4 was obtained which could now be estimated using OLS. The resulting coefficient estimates were considered efficient.

$$Yi = \alpha_1 \hat{S} + \alpha_2 X_i + \varepsilon_i \quad (4)$$

The validity and quality of the instruments used in the model was estimated using F-test. According to Stock [41], the weak instrument hypothesis is rejected if the F-test value is greater than 10. The Durbin and Wu-Hausman tests were used to confirm the endogeneity of the proposed variable.

3. Results and Discussion

3.1. Distribution of Commercial Maize Milling Firms in Kenya

A total of 106 commercial maize milling firms participated in the study. This represented 63.1% of the target population. 44.3% of the respondents used locally produced maize only whereas 55.7% used a combination of both locally produced and imported maize. The results indicate that the supply of maize in the country has not been sufficient to meet the demand and as a result millers have had to rely on imports from other regions [25].

In terms of distribution across the country, the majority of the firms (30%) were located in the Rift Valley region. This was to ensure consistent supply of maize and reduce transportation cost since the region harbors the major maize producing counties in the country and is considered as the food basket of Kenya [41, 35]. Further, 27% of the firms were located in the Nairobi/Central region, 21% in the Eastern/ North Eastern region, 16% in the Western/Nyanza region and 6%in the Coast region. The Nairobi/ Central region has over 6.5 million people who rely on maize as their main subsistence food hence many of the maize millers are located in this region to supply maize flour to the market [21, 8]. The Coast region had the least distribution of maize milling firms since the region is a perennial deficit area in maize production [45]. In the specific counties, the majority of the firms were located in Nairobi (18.9%), Trans Nzoia (12.3%) and Uasin Gishu, Machakos and Meru at 8.5% respectively. Mombasa, Kilifi and Taita Taveta had the lowest number of millers accounting for 2.8%, 1.9% and 0.9% respectively.

3.2. Characteristics and Nature of Commercial Maize Milling Firms in Kenya

The commercial maize milling firms were categorized into different sizes according to daily production capacity [11]. 66.67% of the milling firms surveyed were large-scale firms and had a daily capacity of more than 50MT/day while 13.33% were medium-scale firms (21-50Mt/day). 10.48% of the firms were

micro (posho-mill) firms with a capacity of less than 10Mt/day. Small-scale firms (11-20Mt/day) accounted for only 9.42%.

There was a significant association between the size of the firm and the firm's decision on where to source maize. %. Majority of the micro(posho) millers (90.91%) used locally produced maize only in their milling operations. Similarly, a study by Kang éthe [19] indicates that posho mills depend on maize brought to the mills by farmers themselves. On the other hand, the majority of large-scale millers (64.79%) use a combination of locally produced maize and imported maize. This is because large-scale millers have the financial muscles and are able to get formal imports of maize whenever there is shortage in the country [6].

Table 1. *Size, milling technology and employee skill-level of fims.*

Variable	Local Only (N=47)	Both (N=59)	X^2
Firm Size			12.3750**
Micro (10.48%)	90.91%	0.09%	
Small-scale (9.42%)	50%	50%	
Medium-scale (13.33%)	50%	50%	
Large-scale (66.67%)	35.21%	64.79%	
Employee Skill Level			25.1195***
Unskilled	75%	25%	
Semi-skilled	62.22%	37.78%	
Skilled	14.63%	85.37%	
Highly-skilled	42.86%	57.14%	
Technology used			12.3331**
Hammer mill	66.67%	33.33%	
Attrition mill	76.47%	23.53%	
Roller mill	33.33%	66.67%	
Automated plc	22.22%	77.78%	

*, **, *** significance level at 10%, 5% and 1% respectively

The technology used in milling varied across the two groups and its association to the firm's decision on where to source maize was significant at 5%. The results indicate that 66.67% and 76.47% of the firms that used hammer mills and attrition mills respectively used locally produced maize only in their milling operations. According to Nasir [30], hammer mills are simple to use and produce high extraction of maize flour. Additionally, they are cheap hence economically feasible for micro, small and medium-scale milling firms. Attrition mills were preferred since they are efficient in energy conservation compared to larger machines like roller mills [4]. Additionally, 66.67% and 77.78% of the firms that used roller mills and automated plc machines used both locally and imported maize in their milling operations. These machines were preferred because of their operational and energy efficiency [36, 11]. These findings provide evidence that firms that purchased maize locally only used less advanced milling technology compared to firms that used both local and imported maize.

Employees in the milling firms comprised both skilled and unskilled labor. Firms that purchased locally produced maize only used unskilled and semi-skilled labor at 75% and 62.22% respectively. Firms that used a combination of both locally produced and imported maize used skilled and highly skilled labor at 85.37% and 57.14% respectively (Table 1). Skilled labor was confined to certain aspects of maize milling including machine operation, premix handling, quality control and assurance and administration [22].

Table 2. Years of operation, production capacity and total number of employees of firms.

Variable	Local Only		Both		t-test
	Mean	SE	Mean	SE	
Years of operation	9.45	1.15300	13.44	2.336	-1.4189*
Production Capacity	106.29	15.049	270.97	44.603	-3.1795***
Total no. of employees	30.72	10.608	61.36	7.658	-2.3980**

*, **, *** significance level at 10%, 5% and 1% respectively

In terms of duration in business, firms that used locally produced maize only had been in business for a significantly shorter duration than firms that used both locally produced and imported maize. On average, firms that used locally produced maize only had been in business for 9 years compared to 13 years for firms that used both locally produced and imported maize. Firms that rely on domestic maize struggle to survive when maize shortage occurs, some having to cut down operations or shut down [1, 6].

The average daily production capacity for firms that used both locally produced and imported maize was statistically higher (270.97 tons) compared to firms that used locally produced maize only (106.29 tons) in their milling operations. This indicates that firms that used both local and imported maize were processing maize in large volumes compared to firms that used local maize only.

The maize milling sector was found to contribute greatly to employment in the country. Firms that used local maize only had an average of 31 employees whereas firms that used both local and imported maize had an average of 61 employees. Similarly, Ndichu [31] found that the average number of employees in maize milling firms in Kenya was 70. In terms of gender distribution of employees, male employees accounted for 70.5% whereas female employees accounted for 29.5%. This indicates the important role that the milling industry in Kenya plays in creating employment, particularly for women.

3.3. Sources of Maize

Results in figure 2 below show that 50% of the firms sourced their maize from the Rift Valley region. The region harbors the largest maize producing counties in the country which account for more than 51% of the total maize production [41]. 32.61% obtained their maize from the western region whereas 13.04% obtained their maize from the Central region. The Western region is a major maize producing region after Rift Valley since maize is the staple crop and source of income for the people in the region [32]. A few of the firms obtained their maize from the Nyanza (3.26%) and the Coast (1.09%) regions. According to Wekesa (44), the coast region is a low potential zone for maize production hence most of the maize produced in the area is used for subsistence purposes and a small proportion sold for cash.

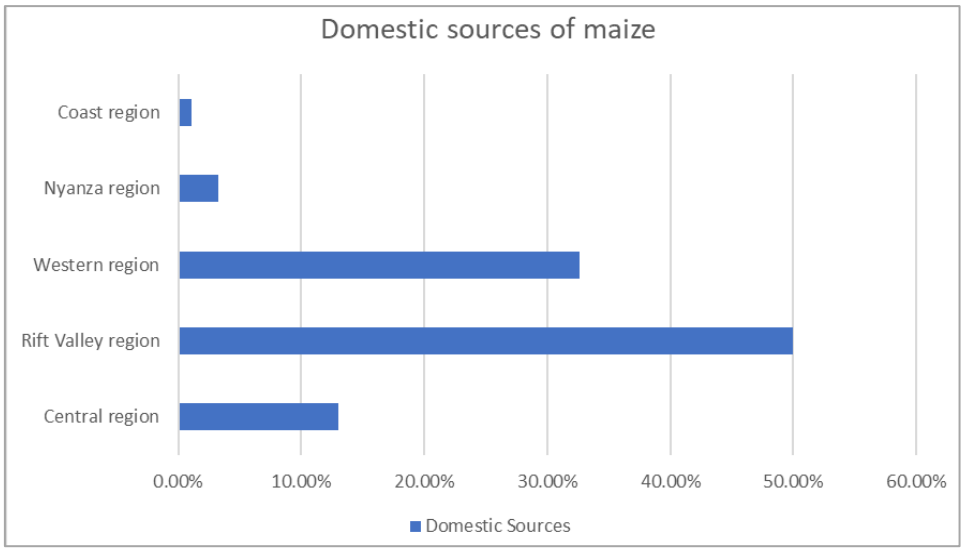

Figure 2. Domestic Sources of maize.

Further, 84.72% of the firms that imported obtained their maize from countries within the EAC, whereas 11.11% and 4.17% obtained maize from the SADC region and other world regions. Majority of the white maize is mostly imported duty free from the East African Community countries. Informal maize trade inflows from Uganda and Tanzania are also high and undocumented [22, 3, 1]. However, decline in the maize supply from the EAC region due to climate change has led to millers seeking maize from countries such as Zambia and South Africa (SADC region) and Mexico, USA and Brazil [6, 12].

3.4. Challenges Affecting Commercial Maize Milling Firms in Kenya

The maize milling firms that participated in the study unanimously agreed that maize supply in the country was not sustainable. 94.34% of the firms indicated that inadequate and inconsistent maize supply was the greatest challenge they faced. Maize production in the country has declined over the years owing to climate changes and pest and disease prevalence [22]. Additionally, the global maize crisis has forced countries to reduce their maize exports. The war between Ukraine and Russia had also caused disruptions in the supply of grains globally [33, 12].

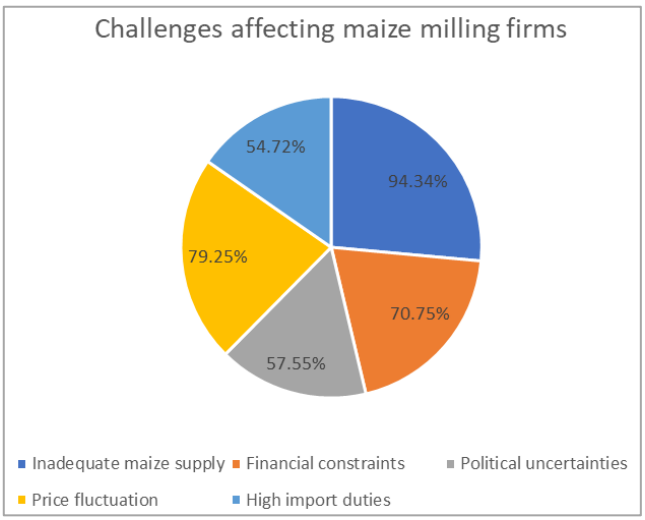

Figure 3. *Challenges affecting maize milling firms in Kenya.*

Further, 79.25% of the firms indicated that fluctuations and volatility of maize prices was also a major challenge affecting their operations. This is attributed to the high demand of maize in the country and world coupled with the decline in maize production as a result of the ongoing climate change [40]. Additionally, 70.75% of the millers indicated that they faced financial constraints which hindered their milling operations. Majority of the millers were operating under bank facilities therefore, delayed payments led to imbalances of maize stock in the firms. This forced some to shut down operations due to the lack of financial muscles to import grain amid shortage of maize in the country [6].

The milling firms also indicated political uncertainties (57.55%) and high import duties (54.72%) as challenges affecting their business. According to Mmeri [27], political uncertainty has a negative significant effect on private domestic investments in Kenya. Additionally, according to Makgetla [24] tariffs on main staple foods led to an increase in their costs without visibly promoting more sustainable and competitive production.

3.5. Gross Margin Analysis

Gross margin analysis was done to provide a comparison of the net returns obtained by the firms that used locally produced maize only and those that used both imported and locally produced maize. The results indicate significant differences between the two categories of firms in terms of the quantity of maize purchased, quantity of maize flour sold, cost of maize, total variable costs and the gross revenues.

The average quantity of maize flour sold was 207 tons and 441 tons for firms that used local maize only and firms that used both local and imported maize respectively. Firms that used both locally produced and imported maize achieved higher monthly sales since they were able to cushion themselves during maize shortage in the country through importing. Additionally, the average quantity of maize purchased was 200 tons and 594 tons for firms that used local maize only and firms that used both local and imported maize respectively. In order to get better prices and minimize transaction cost of importing, the firms that used imported maize had to purchase large quantities of maize.

The average total variable costs incurred was 10.2 million shillings per month for firms that purchased locally produced maize only and 45.1 million shillings per month for firms that used both locally produced and imported maize. The bulk of these costs was in the cost of purchasing maize either locally or imported. Generally, the cost of maize for firms that used both local and imported maize was significantly higher compared to that of firms that used locally produced maize only. This can be attributed to the additional transaction costs incurred in importing maize.

Table 3. Gross margin differences between firms.

Variable	Local Only (N=47)		Both Local & Import (N=59)		t-test
	Mean	SD	Mean	SD	
Quantity sold (in tons)	207	31	441	53	-3.5930***
Selling price (in Kshs)	86,008	3,711	88,266	4,634	-0.3679
Gross Revenue (Ksh/month)	18,700,271	2,952,960	43,614,443	4,569,428	-2.9813**
Quantity purchased (ton)	200	38	594	46	-6.4222***
Price purchased (Ksh)	52,078	1,241	54,808	2,951	-0.7877
Cost of maize (Ksh)	10,159,618	1,940,361	45,035,646	3,008,770	-5.8127***
Labor (Ksh)	8,456	541	7,577	390	1.3487*
Fuel (Ksh)	9,512	608	8,524	439	1.1804*
Packaging (Ksh)	9,513	609	8,525	438	1.1805*
Utility (Ksh)	7,928	507	7,104	365	1.3488*
Distribution (Ksh)	7,399	473	6,630	341	1.9020*
Transport (Ksh)	10,042	642	8,998	462	1.9098*
Total Variable Costs (Ksh/month)	10,212,469	349,907	45,083,004	314,113	-2.5974***
Gross margin (Ksh/month)	8,487,802	378,732	-1,468,561	560,995	0.3657

*, **and *** denote significance at 10%, 5% and 1% respectively

The average gross revenue was found to be 18.7 million Ksh and 43.6 million Ksh per month for firms that used locally produced maize and firms that used both locally produced maize and imported maize respectively. Firms that used both locally produced maize and imported maize attained higher gross revenues since they were able to continue with operations during periods of maize shortage in the country through importing maize.

The results further indicate that the average gross margins were 8.5 million shillings for firms that used locally produced maize only and -1.5 million shillings for firms that used both locally produced maize and imported maize. This shows that firms that used both local and imported maize suffered losses of up to 1.5 million. This can be attributed to the high transaction costs incurred by firms that import maize, especially the cost of purchasing maize. According to FAO [12], the associated costs of fulfilling statutory and customs import requirements significantly eat into firms' profit margins thus acting as a disincentive to importers of food commodities such as maize, sugar and dairy products.

3.6. Effect of Tradeoffs on the Income of Firms

The effect of tradeoffs between maize importation and dependence on local production on firms' income was determined using Two-Stage Least Squares regression (2SLS). The firms' income is determined by (and jointly determines) the millers' decision on whether to use locally produced maize only or both imported and locally produced maize. The variables ImportDec and LocalDec (which refer to the firm's decision to import maize and firm's decision to use locally produced maize only, respectively) were treated as endogenous variables in the model.

The Durbin and Wu-Hausman tests were done to determine whether the variables presumed to be endogenous, could instead be exogenous. Results indicated significant p- values of 0.002 and 0.070 for the Durbin and Wu-Hausman tests respectively. The null hypothesis of exogeneity was thus rejected implying that the variable was indeed endogenous. The first-stage summary statistics were obtained to determine the explanatory power of the instruments. The results (Prob > F= 0.0051) were significant at 1% showing that the additional instruments had explanatory power for the endogenous variable. The inference based on the 2SLS estimator was reliable since the F-statistics value (22.80) exceeded 10 [41, 26]. The results of both the OLS and 2SLS model estimates are presented in table 4.

Table 4. Results of the 2SLS regression analysis.

Variables	Dependent Variable (LocalDec)	Dependent Variable (Log of Income1) Local Only		Dependent Variable (ImportDec)	Dependent Variable (Log of Income0) Both Local and Import	
	OLS (1st stage) (I)	OLS estimates (II)	2SLS estimates (III)	OLS (1st stage) (IV)	OLS estimates (V)	2SLS estimates (VI)
Intercept	0.0451	18.4501***	17.6605***	3.5118	19.4734**	7.6239
Region (Instrument)	0.1604	0.9524	1.0107	-0.5489**	0.0409*	-----
Import Duties (Instrument)	0.0001***	0.0063	-------	0.0013*	1.2934	1.5861
Import Decision	--------	--------	------	------	-1.7856	1.9621**
Local purchase Decision	-------	0.0417	0.7873**	-------	--------	------
Total no. of employees	-0.0001	-0.0071	-0.0054	-0.0018	0.0314	0.0675*
Mean monthly sales	0.0006**	-0.0037**	-0.0047**	0.0003	-0.0070	-0.0087**
Mean production costs	0.0014**	-0.0001	-0.0001	0.0001	-0.0001	-0.0001***
Technology used	-0.0015	-0.2564	-0.3493	-0.0206	-1.0415	-0.7944
Quantity of maize purchased (tons)	0.0723	-0.1161	-0.1200	0.0719	-0.1964	-0.1042
Mean Domestic price of maize (ksh)	0.0001	-0.0001	-0.0001	0.0001	0.0002	-0.0001
Mean Import price of maize (ksh)	------	-------	-------	0.0001	-0.0001	-0.0000
Total cost of maize (ksh)	0.0695	0.0427	-0.0480	-0.0317	0.2845	0.9441**
Import licenses	0.1604	0.2102	0.3378	0.5491*	1.8247	0.1625

*, ** and *** denote significance at 10%, 5% and 1% respectively

The association between the total number of employees and income was significant and positive for firms that used both local and imported maize. By implication, increasing the number of employees in the firm was likely to increase the income obtained by the firms. According to Anjaneyulu [7], firms that have good and required human resources are likely to earn good revenue and profits. These results are however inconsistent with those of Kaen and Bauman [18], who found that profitability of firms was negatively correlated with the number of employees in the firm.

The average monthly production costs had a significant and negative influence on the income of firms that used both local and imported maize. Therefore, increase in the production costs led to a decrease in the income obtained by firms. This is possible because marginal cost of production increases as a firm increases their output and although firms may get high revenues, the resulting high production costs will shrink the firm's profits This is inconsistent with Istan [15] found out that production costs had no significant influence on the firms' profitability and Sausan [37] found out that production costs had a positive effect on profitability of firms.

Further, the total cost of maize had a significant and positive influence on the income of firms that used both locally produced and imported maize. By implication, an increase in the cost of maize resulted in an increase in the income obtained by the firms. This is possible because, as the cost of maize increased the firms also increase the retail prices of maize flour in order to sustain their operations This is consistent with Dewi [10], who found that the cost of goods sold including direct raw materials had a significant and positive influence on the profitability of the firm.

The association between the mean monthly sales and income was significant and positive for both categories of firms.

This implies that a decrease in monthly sales led to an increase in the income obtained by firms. These results are inconsistent with the results obtained by Alarussi and Alhaderi [5] who found that the firms' total sales had a significant and positive effect on their profitability.

Moreover, the firm's decision to purchase locally produced maize only had a positive and significant influence on the income obtained by firms that used locally produced maize only. In addition, the firm's decision to import had a positive and significant influence on the income of firms that used both locally produced and imported maize only. This implies that firms that chose to use locally produced maize as well as firms that chose to use both locally produced and imported maize maximized their incomes. This is consistent with Hugo [14] who found that a wider horizon of raw material source is positively related to the operating profit to sales ratio, meaning that firms that had a wider scope of sourcing raw materials obtained higher profits compared to firms that sourced raw materials locally.

4. Conclusion

The study unveiled that firms that used locally produced maize only were majorly micro to medium-scale, had relatively low-skilled employees, lower production capacity and employed relatively less sophisticated technology. Whereas, firms that used both locally produced and imported maize were majorly large scale, had skilled and highly skilled employees, higher production capacity and employed relatively more sophisticated technology. The major challenges affecting maize milling firms were inadequate supply of maize, price fluctuation of maize, financial constraints, political uncertainty and high import duties respectively. Additionally, the results indicate that firms that used locally produced maize only in their milling operations realized higher incomes per month compared to firms that used both locally produced and imported maize. Although the cost of maize accounted for the largest cost share in both categories of firms, results indicate that the total cost of maize for firms that used locally produced maize was significantly lower than for firms that used both locally produced and imported maize. The determinants of the firm's income were the miller's decision on maize source, total number of employees, total cost of maize, mean monthly sales and mean production costs. The authors therefore recommend that government policies should be geared towards lowering the cost of procuring maize from both local and import sources. These include reviewing import duties levied on food grain, streamlining cess levy collection across counties to avoid double taxation and improving road infrastructure to lower the cost of maize transportation. This will aid in lowering the total cost of maize thus enabling firms to obtain higher incomes.

Abbreviations

KIPPRA	Kenya Institute for Public Policy Research and Analysis
KNBS	Kenya National Bureau of Statistics
NCPB	National Cereals and Produce Board

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Author Contributions

PMN and GO conceived the present idea, PMN developed the theory and performed computations, GO and HB verified analytical methods and supervised findings of this work. All authors discussed the results and contributed to the final manuscript.

Conflicts of Interest

All authors have no conflicts of interest.

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