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TESTING FOR MARKET POWER IN THE MARKETS FOR POTATO IN BURUNDI

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Regional trade integration that lowers trade barriers plays a major role in boosting country's trade performance and reducing food insecurity. Countries engaging in such regional free trade must be competitive in order to gain from it. This paper investigates the level of competitiveness between Rwanda and Burundi, EAC member-States, in Irish potato trade. The methodology is the application of New Empirical Industrial Organization (NEIO) theory on time series data (1990-2010). The results showed that the coefficient of conjectural variation λ is 0.23, implying a weak oligopolistic market. Quantity of imported potatoes from Rwanda negatively influences the potato retail price and the local production. The findings of this research carry two broad policy implications. First, policymakers need to pay attention on the formulation of market price policy in a way to support local price. Second, the structure of the potato market (weak oligopoly) means that Burundi can change the trend of potato imports to its advantage if improvement of potato production could be done through good agricultural practice and investment in this sector.

1. Introduction

Agricultural trade liberalization plays a crucial role in reducing food insecurity and also in enabling producers to have access to regional and even world market. Burundi agricultural production capacity is very weak due to various factors and one of them is a long and straining civil war. The country is a member of East Africa Community (EAC). It has aligned its trade policies so that its agricultural sector could be integrated in EAC by reducing trade barriers. But such efforts coupled with an inefficient domestic agricultural production exposed farmers to greater downside price risk because policymakers of Burundi has few trade policy instruments to cushion the farmers from episodes of very low regional prices. This study aims at analyzing the market power of the imported Irish potato commonly known as 'Ruhengeri in from Rwanda to Bururndi.

Potato is an important crop and cash earner for the poor in Eastern Africa and specifically in Burundi (Tesfaye *et al.*, 2010). It has gained a boost from Institute of Scientific Agronomic Research of Burundi (ISABU) through various research studies aiming at promoting its productivity. Currently, there is an on-going project 'PRAPACE (Regional Network for Improvement of Potato and Sweet-potato in Eastern and Central Africa) funded by various non-governmental agencies among them ASARECA (Association for Strengthening Agricultural Research in Eastern

and Central Africa) and national research institutes of the Eastern and Central Africa. The Irish potato is ranked the 6th most yielding crop in Burundi between 2001 and 2005 (FAO, 2008) but the least in Eastern and Central Africa where Kenya, Ethiopia and Rwanda are the dominant producers (ASARECA, 2010). Since Burundi set up agricultural strategies to revive the potato sector (GoB, 2008), the demand for this product keeps on growing because of the overgrowing population of Burundi and outstrips supply. The country has been relying on importation of potato from Rwanda in order to overcome its seasonal shortage, specifically in urban areas. The potential for regional potato trade has gone a notch high because of the existence of Common Market in Eastern and Southern Africa (COMESA) and EAC whose policies favor inter-regional trade in goods and services. However, an overreliance on potato imports has a negative impact on the local production and also thwarts the government of Burundi's efforts intending to revamp the potato sector.

A competitive market needs many sellers. In a perfect competition, sellers are price takers and cannot affect the market price because if they attempt to hike price, consumers will go elsewhere where it is cheap or switch their demand to other products. A monopoly, in contrary, has ability to drive the price up without fear of its competitors (Varian, 1992). In reality, all markets are somewhere in between the perfect competition and monopolistic market. An interesting scenario is that of the

oligopolistic market where there are few sellers. The latter will act like a monopoly and will able to set the market price to some extent. But all prices are not due to market power. According to Wohlgenant (2001), there are two types of market power in the theory of economics. Horizontal market power is exercised when a firm profitably drives up prices through its control of a single activity such as a supply of potato to Burundi's markets from Kigali market. Vertical market power arises when a firm involves in two related activities such as supplying both potato for consumption and potato seeds for production. In this paper, our focus is on the first category of market power since the goal is to evaluate the inter-trade between Burundi and Rwanda on single activity, that is, importation of potato which may cloud out the local supply or fills the supply deficit due to potato production or marketing inefficiency in Burundi.

The study of oligopoly market power stresses on two approaches, namely, the Structure-Conduct-Performance (SCP) and the New Empirical Industrial Organization (NEIO). The first focuses on the profitability and market concentration (2009) while the second seeks primarily the determinants of the gap between price and marginal cost (Bresnahan, 1982). Given the SCP approach is static, NEIO is a very attractive tool to use in this study, for it is dynamic and has a high estimation power. It overcomes the inability of SCP of linking profitability to industry structure (Wohlgenant, 2001). There is a large empirical literature on the

NEIO approach (Su *et al.*, 2011, Hanekom, *et al.*, 2010, Song, *et al.*, 2009, Durevall, 2007, Alvarez and Fidaldo, 2000, Rakotoarisoa and Shapouri, 2001, and Nzuma, 2006). All converged to seeking the degree of seller market power exercised in the specific commodity market.

For instance, the conjectural variation indicator was computed in Hartili, Ozkan, Jones and Aktas's paper on milk sub-sector of Turkey (2006). Their findings led them to reveal critical conduct parameters of NEIO perceived to be the components of reflecting firms' expectations about the reaction of other firms to an increase in quantity. A non-linear three-stage-least square approach was used to estimate a model whose among parameters, a conjectural variation of 0.82 was found. The latter estimate is close to one and it suggests that firms expect changes in their purchases of raw milk to be offset by purchases of their rivals enjoying oligopolistic benefits.

The aim of this study is to determine the market competitiveness in potato imports of Burundi. By applying the New Empirical Industrial Organization (NEIO), the paper develops and estimates the structural econometric model that yield the price, income and production elasticities for potato and also the host of results that are used to determine the impact of import prices on retail prices. The concentration of potato import players hinges that it can impact on the local production as well as on the potato farmers'

income. The remaining of this paper is organized as follows. First the theory of NEIO is given in the part of the methodology. The specification of the model and the source of the data complete the part of methodology. The results and the recommendations end the last of this paper.

2. Methodology

The discipline's emphasis on firm behavior and market structure is to a large extent influenced by. the work of a group of economists at Harvard in the 1930's. Edward Mason and his PhD student Joe S. Bain formulated a framework for empirical analysis called the Structure-Conduct-Performance (SCP) that attempts to describe how these key aspects of the market structure relate to each other. The SCP paradigm became the dominant framework for empirical work in IO between the early 1950s until the early 1980s. Its influence only began to wane in the 1980s with the emergence of game theoretical analysis of oligopolistic markets - an approach labeled as the 'New Industrial Organization' (NIO). The body of empirical associated with this approach is known today as the New Empirical Industrial Economics (NEIO).

The NEIO paradigm was expanded by the Chicago School of Thought (post-1980). It entails the use of statistics and econometrics in order to understand the market power of firms in the sense of Cournot duopoly model. During 1980-90 game

theory took center stage with emphasis on strategic decision making and Nash equilibrium concept. However, critiques met the use of game theory as with this theory anything can happen, i.e., less precise.

After 1990, empirical industrial organization with the use of economic theory and econometrics lead to a complex empirical modeling of technological changes, merger analysis, entry-exit and identification of market power. As developed by Bresnahan (1982), the NEIO approach allows one to analyze the extent of market power in a market within a demand and supply framework. Market power exists when one group of marketing agents has a higher bargaining power than the other group of marketing agents. Economists and policy makers are interested in the degree of market power in different industries as its presence signals a market failure.

A natural method of measuring market's competitiveness (or inexistence of market power) is the price-marginal cost markup since the price is equal to the marginal cost at a perfectly competitive market. Typically, a demand equation, a marginal cost equation, and an optimality equation representing the equilibrium of marginal revenue and marginal cost are specified and estimated as a simultaneous system.

Market power is identified by examining the change in the price cost relationship from one equilibrium position to another. Critical to the determination of the market power parameter is the statistical significance of the variable, which rotates either the demand function or cost schedule. Profit maximization is an underlying assumption of the model, although the estimated market power parameter measures the amount of market power exercised by firms.

The study of this kind has been pioneered by Bresnahan (1982). It starts with the firm maximization goal:

$$\textbf{Max } \Pi_i = p(q).q_i - c(q_i) \quad \text{..... (1)}$$

The first order condition as before is (differentiation):

$$p(q) + q_i\, p'(q)(\partial q/\partial q_i) - c'(q_i) = 0 \quad \text{..... (2)}$$

According to Bresnahan (1982), the term $\partial q/\partial q_i$ becomes:

$$\partial q/\partial q_i = (\partial q_i/\partial q_i) + \partial q/\partial q_i = 1 + \lambda_i \quad \text{..... (3)}$$

Where $(1 + \lambda)$ is the conjectural variation or the competitiveness of the market conduct. Rearranging equation (7), we have the following in the aggregate market:

$$p(q) + \Psi q p'(q) = MC \quad \text{..... (4)}$$

Where: $\Psi = \partial q/q_i$ **and** $MC = c'(q)$

In equation (9), the left hand describes the perceived marginal revenue, with Ψ explaining the degree of competitiveness (or conduct) in the industry.

In other literature, we find that $(1 + \lambda_i)$ linked to Lerner Index in oligopoly scenario (Cournot duopole model):

$$L_i = [(p(q)-MC(q_i)]/p(q) = (S_i/\varepsilon).(1 + \lambda_i) \quad \text{..... (5)}$$

Where: $\lambda_i = dq_1/dq_2$, S_i = firm market share and ε = price elasticity demand.

Theoretically, λ_i is the conjectural variation variable that measures the output response of the firm's rivals (here firm 1 and firm 2 being two rivals). It also shows the degree of coordination (collusion) between two firms (Scherer and Ross, 1990). This variable is depended on other factors such as seller concentration, set of entry barrier measures and industry or firm characteristics. It is also known as conjectural variation elasticity at the industry level-in Bresnahan/Lau (1982) method (- which is interpreted as the average on the individual firm's conjectural variation elasticities (Bask, Lundgren & Rudholm, 2007).

Given the need of establishing a long-run profit equilibrium in a dynamic context, the SCP and NEIO paradigms will not help since the estimation of their models of time series data lead to spurious regression. A search for unit roots and use of co-integration approach was used in this paper as one way to solve this problem of spurious regression or nonsense regression. Nevertheless, the NEIO approach remains static while competition is dynamic (Hunnicutt and Weninger, 1999). To try to overcome this limitation of SCP and NEIO models, the advanced theory on persistence profitability can be applied. The same authors revealed other shortcoming of Conjectural Variation model (CV) or NEIO such as the over-emphasis on price as the crucial determinant of market power. In fact, the trade policy and the infrastructure (roads, telecommunication, food warehouses, etc.) are important to potato imports.

3. Model Specification

The NEIO approach uses the aggregate data of firms and attempts to integrate both the microeconomic theory with structural econometrics models in order to arrive to the estimation of Market Power based on prices and quantity decisions of firms.

Let q be the market demand of the firms comprises of homogenous products (q_1, q_2, …, q_n) in such way that industry output is:

$$q = \Sigma q_i \quad \text{..... (6)}$$

The market demand equation is given by the implicit function:

$$q_t = q(p_t, z_t)$$

Where:

p_t = total quantity demanded,

p_t = Price of output,

z_t = Exogenous variables affecting demand (e.g. income, price for substitute products, etc.),

t = time subscript

Frequently, the demand equation is also expressed as an inverse equation since both p and q present simultaneity.

Hence, $q_t = q(p_t, z_t) \rightarrow p_t = p(q_t, z_t)$ ..... (7)

Industry revenue is given by:

$$r_t = p_t \cdot q_t \quad \text{..... (8)}$$

From equation (8), we derive the perceived marginal revenue, i.e., $MR_t(\lambda)$ as follows (see equation 5):

$$MR_t(\lambda) = p_t + \lambda q_t(dp_t/dq_t) = MC \quad \text{..... (9)}$$

Again, λ is the conjectural variation variable or the index of the degree of market power, i.e, the gap between the market price and industry marginal cost. If there are 5 firms in industry, it indicates how firm 1 conjectures that other firms will vary their output choice when firm 1 makes a slight change in its output. The task will be to compute empirically the value of λ since $\lambda = 0$ means perfect competition, $\lambda = 1$ means perfect monopoly and if $\lambda \in [1,0]$ means the firms are in the range of oligopoly.

In this study, we are going to carry out a research in determining the market power of an importation of tradable agricultural commodity (potato) by adopting the NIEO Approach. The imports model will be:

$$impq_t = \alpha_0 + \alpha_1 p_{rt} + \alpha_2 i_t + \alpha_3 pcb_t + \alpha_4 q_t + \alpha_5 limpq_{t-1} + e_{it} \quad \text{..... (10)}$$

Where:

$impq_t$ = Total quantity of potato imported into Burundi at time t,

p_{rt} = Retail Price of potato at time t,

i_t = Annual per-capita income at time t,

pcb_t = Per-capita consummation of potato at time t,

q_t = Quantity of potato production in potato at time t,

$limpq_{t-1}$ = lag total quantity of potato imported into potato (or at time t-1),

e_{it} = Stochastic error term, normally distributed with mean μ and variance σ^2.

Given that:

$$\mathbf{MC = \beta_0 + \beta_1 p_{it} + \beta_2 t} \quad \textbf{(11)}$$

Where:

MC = Marginal cost in importing potato,

P_{it} = Imports Potato price, that represents a proxy to cost of Potato to retailers,

T = Time trend that captures marginal cost rise due to technological advance in for instance transport, storage, etc.

If we substitute equation (11) into equation (9) and change $IMPQ_t$ for Q_t and P_{rt} for P_t, we get optimality condition:

$$p_{rt} = \beta_0 + \beta_1 p_{it} + \beta_2 t + \beta_3 impq_t + e_{2t} \quad \text{..... (12)}$$

And we can obtain α_3 by applying a derivation on IMPQ and attach to it the conjectural variation variable as shown in equation such as:

$$\beta_3 = -\lambda(dp_{rt}/dimpq_t) \quad \text{..... (13)}$$

From equation (10), we derive:

$$dimpq_t/dp_{rt} = \alpha_1 \rightarrow dp_{rt}/dimpq_t = 1/\alpha_1 \quad \text{..... (14)}$$

Put together equation (13) and equation (14), we obtain:

$$\beta_3 = -\lambda\,(dp_{rt}/dimpq_t) \rightarrow \beta_3 = -\lambda\,(1/\alpha_1) \quad \text{..... (15)}$$

Now, the end of it is to estimate the value of λ by this formula:

$$\lambda = -\alpha_1\beta_3 \quad \text{..... (16)}$$

In summary, to estimate the value of the conjectural variation variable in this context, one must estimate a simultaneous equation made up of equation (10) and equation (12) in order to derive the coefficients α_1 and β_3 using adequate tools of simultaneously equation, i.e., instrumental variable estimation IV

Indirect Least Squares (ILS), 2-Stage Least Squares (2SLS) and 3-Stage Least Squares (3SLS) methods. In this paper, the 3-Stage Least Squares approach was used to estimate the simultaneous equations underlined here beneath (Gujarati, 2004, p.770). We should note that the two equations are over-identified according to the order condition.

$$impq_t = \alpha_0 + \alpha_1 p_{rt} + \alpha_2 i_t + \alpha_3 pcb_t + \alpha_4 q_t + \alpha_5 limpq_{t-1} + e_{it} \quad \text{.....(17)}$$

$$p_{rt} = \beta_0 + \beta_1 p_{it} + \beta_2 t + \beta_3 impq_t + e_{2t} \quad \text{.....(18)}$$

Then, depending on the value of λ, we may formulate the recommendations by bearing in mind that always the monopoly market is detrimental to both consumers and producers.

4. Data

Secondary data on potato price prevailing in the central market of Bujumbura and potato production were collected from ISTEEBU publication. Other sources were FAOSTAT, UNCTAD BRB and the International Monetary Fund (IMF). Extrapolation method was used to compute the missing data. The availability of the potato import price time series were found by dividing potato imports values by potato imports volumes downloaded from FAOSTAT.

The same method was done to estimate the local price of potato considered as the retail price i.e., the ratio of production of potato in value over the production in volume. The per capita potato consumption was computed by assuming that the annually consumption potato in volume is roughly70% of annually potato total production. Therefore, per capita potato consumption was derived from the ratio of potato consumption over the population of the same year. All nominal variables involving prices and incomes were deflated by consumer price index and gross domestic deflator.

In order to avoid running a nonsense or spurious regression, it was important to check the presence of unit roots on the time series data of the variables considered in the model. The tests of augmented Dick-Fuller and the Philips-Peron were used in this study.

5. Results

The following analysis allows measuring the market power of imported potato to Burundi and the determinants of potato imports from Rwanda.

Table 1: Descriptive Analysis of Model variables

Variables	Mean	Maximum	Minimum	Std. Dev.
impq (in tons)	220.52	1029.20	6.00	310,.68
pr (in Burundi Francs per kilogram)	266.4890	452.5200	166.34	93.91
PCB (in Burundi Franc)	133923	177853	91382	36452
limpq (in logarithmic form)	3.88	6.01	1,.86	1.67
p (CIF)	137.33	295.20	25.80	104.19
q (in tons)	23603	28900	10256	7009

Source: Authors' results

The results showed that potato production in Burundi has been erratic and the imports from Rwanda track well the trend of local production in order to fill the gaps between local production and consumption (deficits). The annual change for potato production and imports are respectively 93.91 and 114.52 tons. The price margin of imported potato is relatively high (19109 Burundi Francs), almost twice the price of potato imports. This may be attributed to various forms of trade barriers that make it expensive.

Unit Root Test

Before running the estimation of the model, we check the level of stationarity of the variables under study (Table 2). Failing to run such test, the econometric theory posits that the estimation of the model risks being spurious.

Table 2: Unit Root Test Results

Variables	ADF		Phillips-Perron		Order of Integration	Decision
	Statistic Test	Prob.	Statistic Test	Prob.	Rank	Stationarity
IMPQ	-4.944	0.000	-4.507	0.000	I(0)	Stationarity
P_r	-4.45	0.0002	-5.045	0.000	I(0)	Stationarity
I	-0.916	0.786	-0.919	0.7816	I(1)	No stationarity
PCB	-1.159	0.691	-0799	0.8194	I(1)	No stationarity
Q	-0.533	0.884	0.038	0.9616	I(1)	No stationarity
LIMPQ	-4.862	0.000	-4.899	0.000	I(0)	Stationarity
P	-6.589	0.000	-6.675	0.000	I(0)	Stationarity

Source: Authors' results.

From above table, we found that three variables are not stationary. When we differentiated them, they become stationary. We noted such changes in the estimation model by including **Δi, Δpcb and Δq** variables in the simultaneous model under study,

Hence, the system of equations regressed using the 3-stage estimator looks like the following:

$$impq_t = \alpha_0 + \alpha_1 p_{rt} + \alpha_2 \Delta i_t + \alpha_3 \Delta pcb_t + \alpha_4 \Delta q_t + \alpha_5 limpq_{t-1} + e_{it} \quad \text{.....(19)}$$

$$p_{rt} = \beta_0 + \beta_1 p_{it} + \beta_2 t + \beta_3 impq_t + e_{2t} \quad \text{.....(20)}$$

The results of simultaneous equations are shown below.

Table 3: Model results

	Demand Equation		
Variables	**coefficient**	**t-test**	**prob.**
Constant	2945.75**	12.66	0.000
pr	23.11	9.76	0.011
di	-521.60*	-1.66	0.101
dpcb	2486.23**	2.62	0.004
dq	-0.32**	-2.93	0.000
limpq	563.51**	15.75	0.000
R^2 (Adjusted)	**0.93**		
F-Stat.	**98.05****		**0.000**
Optimality Equation			
Constant	-60.86**	-3.41	0.001
p	0.06**	3.96	0.000
impq	0.006*	2.12	0.038
t	1.96**	6.74	0.000
R^2 (adjusted)	**0.75**		
F-Stat.	**38.16****		**0.000**

Note: * and ** levels of significance at 5% and 1% respectively

Source: Authors' results

These simultaneous equations are well fitted. F-Statistics values are very significant ($p<0.01$). The coefficients of determination are in the acceptable range ($R^2 = 0.93$ and 0.75), which means that the 93% variations in quantity of imported potato and 75% variations in retail imports price are explained by the explanatory variables of equation 19 and 20 respectively.

In the first equation, apart from annual per capita income, all other variables are statistically significant, implying that they are crucial determinants of supply of imported potato from Rwanda. Apart from import potato price, other variables have the right sign. For instance, one Burundi Francs increased of imported potato price reduces by 0.32 units of the quantity of potatoes produced in Burundi, hence its competitiveness. In addition, this own elasticity of demand indicates that traders are highly sensitive to price changes and any small price increase would drive them away to importing potato from Rwanda. In the second equation, the local production of potato has a negative association with the retail price of local production of potato. If there is a bumper harvest, this will exert a pressure on the price of local potato production. In other words, a one unit increase of local potato production will lead to 1% decrease of price of local potato and make it less competitive.

The point estimate of weighted conjectural variation parameter is obtained by multiplying α_1 by β_3 [(23.11) *(0.006) =0.14], which

is 0.14. This value is not close to one and it suggests that the potato import market is closer to competition than to monopoly. This is somewhat expected given that the potato industry is not regulated and free entry favored a reduction of market concentration. Custom reforms introduced by State in order to comply by the new EAC custom union rules, have encouraged traders to import much potato from neighboring country. Fresh potato attracted a low taxation and the government of Burundi has considered it among commodities of necessity that benefited a tariff waiver since the year 2010 when the high inflation turns food to be inaccessible by poor households. Over the past three years (2008-2010), potato production in Burundi has declined by half, from 28900 tons to 10256 tons. All these factors have undoubtedly played a role in reducing the market power of potato cross-border traders in Burundi potato market.

6. Conclusion

Potato consumption has manifested a high increase due to Burundi's integration in East Africa Community. Imports of fresh potato are provided by the neighbouring country Rwanda which has a great comparative advantage in this crop.

The Burundi government has attempted to shift the demand potato imports by investing in the research centre in order to provide highly producing potato cultivars to the farmers that

could meet the taste and preference of consumers. This has yielded successful result. The study was aiming to gauge the determinants of potato imports from Rwanda by using the NEIO approach. The time series data for 1994-2010 were collected mainly for FAOSTAT and UNCTAD but supplemented with the data from ISTEEBU and BRB.

The results show that both retail potato imports price, retail of local potato variety price and per income per capita on one hand and local potato production on the other hand have an impact on potato importation, while a decline in local potato production was attributed to, among others, the custom reforms that resulted in an upsurge in potato importation. The coefficient of conjectural variation indicated that the potato market is not concentrated as expected.

Therefore, we recommend that the government of Burundi keeps on investing in potato research to make the sector more competitive in the region. Since the potato market is relatively competitive, this may be an opportunity for farmers to penetrate the market if the production of potato is more efficient than it is now.

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Appendix

Equation	Obs	Parms	RMSE	"R-sq"	F-Stat	P
s1	43	5	395.8623	0.9278	98.05	0.0000
s2	43	3	19.10571	0.7510	38.16	0.0000

	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
s1						
pr	23.11554	2.368095	9.76	0.000	18.39907	27.83201
di	-521.5983	314.4774	-1.66	0.101	-1147.934	104.7378
dpcb	2486.233	948.7981	2.62	0.011	596.5374	4375.928
dq	-.3200313	.1090427	-2.93	0.004	-.5372087	-.1028538
limpq	563.5086	35.77338	15.75	0.000	492.2598	634.7575
_cons	2945.75	232.6803	12.66	0.000	2482.327	3409.173
s2						
p	.0623545	.0157444	3.96	0.000	.0309968	.0937121
t	1.960754	.2910817	6.74	0.000	1.381014	2.540493
impq	.005958	.0028147	2.12	0.038	.0003521	.0115639
_cons	-60.85432	17.83319	-3.41	0.001	-96.37219	-25.33645

Endogenous variables: impq pr
Exogenous variables: di dpcb dq limpq p t

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