Why the Persistent Increase in Ghana's Rice Imports? Prescriptions for Future Rice Policy

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Authors' contributions

This work was carried out in collaboration between both authors. All sections of this work were written by author DB, while author RMF managed the literature searches and edited the manuscript. Both authors read and approved the final manuscript.

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ABSTRACT

Prompted by the persistent increase in rice imports (*and the implications thereof*) amidst implementation of various import reduction policies and strategies in Ghana, this study sourced assessment of the plausible determinants of volume and value of rice imports in Ghana. Use was made of an imperfect substitutes model (*an extension of the traditional import demand model*) applied in a multiple regression frame for the period 1965-2009. Based on a framework used in this study, the perceived determinants of rice imports were local rice production, relative price ratio between imported and local rice, real per capita income, relative price ratio between maize and imported rice, relative price ratio between millet and imported rice, consumer tax equivalent of tariff on rice imports, domestic (beginning) stock variation, domestic demand for meat, urbanization index, trade liberalization and lagged value of rice imports. Estimates for the respective models, however, revealed that, both volume and value of rice imports increase significantly with increasing real per capita income, increasing millet price (keeping that for imported rice unchanged),

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increasing demand for meat, urbanization and with trade liberalization. In as much as volume of rice imports decreased marginally with increments in domestic stock, effect on value of rice imports was not significant. Local rice production, consumer tax equivalent of tariff on rice imports, relative price ratio between imported and local rice, relative price ratio between maize and imported rice and lagged value of rice imports had no significant effects on both volume and value of rice imports. Among the variables with significant effects, increments in relative price ratio between millet and imported rice, and urbanization yield the greatest impact (positive) on both volume and value of rice imports. Given these findings, there arises a need for policy makers to look beyond variables currently emphasized in rice policy of the country. For Ghana to stand a chance of significantly reducing rice imports and meeting set targets, effort should be made to intensively pursue quality improvement of locally-produced food, especially the most consumed rice substitutes for which Ghana holds a strong comparative advantage and incorporate income dynamics, dynamics in millet price (relative to import price), dynamics in domestic meat demand, and patterns of urbanization in future rice policy.

1. INTRODUCTION

The fear of potential shocks (*due to uncertainty*) from global rice markets (*as occurred in 2007/2008*), increasing consumer demand[1] and increasing annual drainage of foreign exchange (*through importation of large quantities of rice to meet deficits in domestic supply*) have intensified government efforts in Ghana to promote rice production (*as a mean of substituting rice imports, pursuing self-sufficiency, enhancing food security and reducing poverty*). From the outmoded perception of rice being food only for the rich and urban elites in the 1960s and 1970s (*thereby attracting minimum policy attention*), rice has not only become a vital component of the average Ghanaian diet (in both rural and urban areas) since the late 1990s[2], but also a political and strategic commodity in the country. Besides providing livelihood through production, processing and marketing services for a greater share of rural (and some urban) dwellers in the country, rice was the 10th agricultural commodity in Ghana by value of production and ranked 8th in terms of production quantity during the period 2005-2010 [1,2]. In some areas of production, rice is deemed an important cash crop [3]. It is considered the second most important grain food staple in Ghana, next to maize [4]. Due to the significant role rice plays in food security enhancement and poverty reduction in the country, the rice subsector has received and continues to receive much attention in the country's agricultural policy. The focus of rice policy in Ghana in the 1960s and 1970s (before liberalizing rice trade) was on achieving self-sufficiency in rice and maintaining adequate buffer stock for price stabilization and food security in periods of shortfall. With this, government efforts were channeled towards improving productivity and competitiveness of the rice subsector through mechanization, granting subsidies on purchase of inputs like fertilizer and tractors and promoting commercial farming. Liberalization of trade (in 1983 *and the general adverse implications thereof on local rice producers*) and the subsequent withdrawal of government support led to a drop in profits accrued to commercial farmers and a progressive disengagement on their part [5].

This among other factors led to stagnation in production as annual growth in production declined (*from 8.35% (significant) during the period 1961-1970 and 5.66% (significant) for the period 1971-1980 to 5.11% (not significant) for the period 1981-1990*). Exposing local consumers to a variety of high quality rice during the liberalization period, however, amidst increasing per capita income, urbanization (*encompassing natural increase, rural-urban migration, and reclassification of rural and peri-urban areas as urban*), population growth, dynamics in relative commodity prices, changing consumer tastes and preferences, dynamics in availability of various staple foods and animal based products (*and demand thereof*) and westernization patterns led to a significant increase in local demand for rice (*demand increased from an insignificant annual rate of 2.08% during the period 1971-1980 to as high as*

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[1] *This conceptually refers to the food component (for human consumption) of total domestic supply and will henceforth be referred to as local demand for rice.*
[2] *Rice currently accounts for approximately 35 % of cereal calorie supply and 9 % of national food calorie supply- based on data from FAOSTAT (for the period 2001-2010).*

10.76% *(significant) during the period 1981-1990*).

As shown in Fig. 1, demand (*rice consumption*) has since the year 1983 been generally increasing at a rate well above production, triggering a rice supply deficit[3] in the process (*with a consequent decrease in self-sufficiency rate*). In spite of all policy efforts (*including ASRP [4] (1987-1990), MTADP [5] (1991-2000), GPRS[6] I and II (2003-2009), FASDEP[7] I (2002-2006), FASDEP II (2008-2010) and NRDS [8] (2008-2018)*) made to bridge deficits in supply and the relatively high (*compared to other West African countries*) comparative advantage the country has in paddy rice production [6], local rice production in the country covers only 35% of consumption needs, with the remaining 65% met through imports (and releases from domestic stock). Increasing volumes of rice imports have led to an increase in rice import bill of the country from as low as $7.04 million in 1961 to as high as $390.75 million in 2011. With this, the share of rice in cereal and agricultural imports increased respectively from 44.36% in 1961 to 68.71% in 2011 and 10.93% in 1961 to 22.20% in 2011. Volume of imports increased from 30,485 tonnes in 1961 to as high as 543,446 tonnes in 2011, with surges noted in (the years) 2001, 2003, 2004 and 2011. Surges in imports and the increasing import bill thereof, are of greater concern to the government and rice producers in the country. With import surges draining foreign exchange reserves of the country, influx of imported rice on local markets has over the past two decades led to a decline in market share of local rice (e.*g. from 43 percent in the year 2000 to 29 percent in 2003,* [3]), driven a greater share of rice producers into debts due to losses incurred in production and marketing (e.g. *about 66 percent of rice producers reportedly recorded negative returns between the years 2002 and 2004,* [3]), and shaken stability of incomes realized from local rice production [7]. These farmer/producer-related implications have triggered a drift of farmers from the rice sub-sector [8] into cultivation of more profitable crops including okra, cabbages, tomatoes, fresh maize and onion among others, thereby exposing the country to potential shocks from the world

market. To minimize such exposition, various policies measures and strategies have since the year 1986 to date been implemented to help reduce imports and boost local production. In spite of the increments observed in production following implementation of such policy measures, imports continue to increase, yielding political, economic, food insecurity and poverty implications. To inform policy decision on the potential causes of the persistent increase in imports and relevant measures needed, efforts made so far have placed much emphasis on issues at the household and community level covering farmer and consumer perception and preferences for rice [9-13]*,* crowding-out of domestic rice production by imported rice [14] and on transmission between imported and local rice prices [15,16]. To the best of our knowledge, not a single article has been produced that places direct emphasis on the determinants of rice imports in Ghana. To complement research efforts made so far and findings thereof, we source identification and assessment of the magnitude and effects of various supply-based, economic, demographic and policy forces on volume and value of rice imports in Ghana using multiple regression technique. Relevant policy recommendations are made thereafter.

2. EVOLUTION OF RICE POLICY IN GHANA

As a commodity with political interest, rice has been given an in-depth look under various umbrella policies, programs and strategies in the country. With the focus of rice-related policy measures pre-liberalization of trade being focused on achieving self-sufficiency in rice and maintaining adequate buffer stock for price stabilization and food security in periods of shortfall, emphasis has over the past two decades been placed rather on promoting local rice production and consumption and more importantly on minimizing imports through imposition of high import tariffs. During the post-independence to the immediate pre-liberalization period (1958-1982), the rice-subsector received various productivity-enhancing incentives/support from the then government, notable amongst which were granting of subsidies on purchase of fertilizer and tractors (*as a means of inciting intensification and commercialization of rice in the country*) and use of controlled prices (*to incite appropriate farmer investment in their rice fields*). Liberalization of trade, and the accompanying Structural Adjustment Program (SAP) led to partial abolition of controlled prices, privatization

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[3] *Rice supply deficit refers to the difference between local demand for rice and observed rice production (output).*
[4] *Agricultural Services Rehabilitation Project*
[5] *Medium Term Agricultural Development Program*
[6] *Growth and Poverty Reduction Strategy*
[7] *Food and Agricultural Sector Development Policy*
[8] *National Rice Development Strategy*

of certain state monopolies and a progressive withdrawal of subsidies [5]. These developments led to a drop in profits accrued to commercial/large-scale farmers and a progressive disengagement on their part [5]. A significant number of key institutions (*especially those responsible for development and maintenance of seed multiplication and units for variety improvement*) that relied on government support also did collapse during the early stages of trade liberalization in the country. This led to stagnation in annual growth of rice output. The exposition of consumers to a variety of high quality rice during the liberalization period, however, amongst other factors, led to increasing local demand for rice, increasing rice supply deficit, increasing volume and value of rice imports, drainage of foreign exchange reserves, declining share of local rice on domestic markets, and consequent food insecurity and poverty

implications. In addressing some of the adverse implications from post-liberalization developments, several policy measures, programs and strategies have been initiated and implemented in the country since the year 1986. Some of such policies and the objectives for their initiation are covered in Table 1.

Efforts made under the various rice-related policy measures, programs and strategies were generally channeled towards boosting production, promoting local rice consumption and more importantly minimizing imports. In spite of increments observed in production following initiation and implementation of the various measures, Ghana's rice import bill and volumes continue to increase annually. Effort is made in this study to identify some of the plausible causes of the persistent increase in volume and value of rice imports.
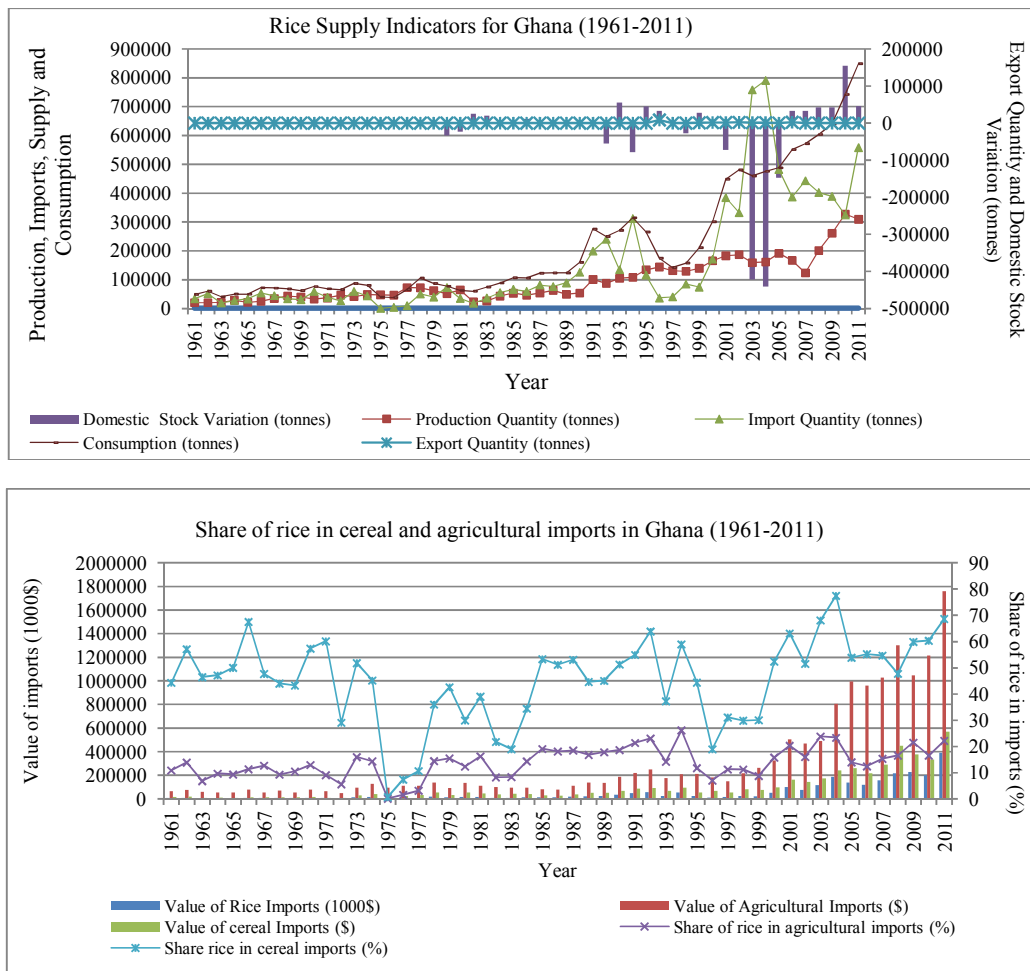

Fig. 1. Rice supply indicators and share of rice in agricultural imports for Ghana (1961-2011)
Data source: FAOSTAT and own computation

Table 1. Evolution of agricultural and rice policy/programs in Ghana

Period	Purpose for initiation/implementation of selected policies/strategies
Ghana agricultural policy: Action plan & strategies	
1986-1988	• To help achieve self-sufficiency in cereals and starchy staples like maize, rice and cassava in the short term • To help maintain adequate buffer stock for price stabilization and food security in periods of shortfall and in improving research
Agricultural services rehabilitation project (ASRP)	
1987-1990	• To help strengthen the capacity of agricultural research, extension, irrigation and policy planning
Medium term agricultural development program (MTADP)	
1991-2000	• To help increase productivity and competitiveness of the agricultural sector
Food and agriculture sector development policy (FASDEP I)	
2002-2006	• To help promote food security, poverty reduction, supply of raw materials to industry and to ensure the agriculture sector's continued contribution to GDP, foreign exchange and government revenue • To help revive the local rice industry through imposition of high tariffs on rice imports (as a measure of import restriction). [Rice imports have since the year 2003 been subjected to 20% import duty (FOB price, compared to 10% in Côte d'Ivoire [17]), 12.5% Value Added Tax (VAT), 2.5% National Health Insurance Levy (NHIL), 0.5% Export Development and Investment Fund Levy (EDIF), 1% Inspection Fee, 0.5% ECOWAS Levy, and 0.4% Ghana Customs Network (GCNET) [18]] • To help achieve the goals of Ghana Poverty Reduction Strategy through infrastructure development, promotion of appropriate technologies and improved extension services
Food and agriculture sector development policy (FASDEP II)	

2008-2010	• National food security and emergency preparedness via promotion of five staple food crops (cassava, cowpea, maize, rice and yam)
	  - For the rice subsector, emphasis under FASDEP II has been placed on developments along the rice value chain.
	  - Increasing rice yields by at least 50%
	  - Reducing rice imports by at least 30% [4]
	  - Increasing productivity of irrigation schemes by 25% and intensification of irrigation by 50% [19]
	• Improved growth in incomes and reduced income variability
	• Sustainable management of land and environment
	• Increased competitiveness and enhanced integration into domestic and international markets
	• Application of science and Technology in food and agriculture development
	• Effective Institutional coordination

National rice development strategy	
2008-2018	• To double domestic rice production by the year 2018 and enhance quality to stimulate demand for domestically produced rice

NB: rice was/is given an in-depth look under the highlighted objectives
Source: Authors' construct with information from Angelucci et al. [2], MoFA [4], MoFA [19], and Brooks et al. [20]

3. LITERATURE REVIEW ON DETERMINANTS OF FOOD IMPORTS

Although surges in rice imports for Ghana and increasing import bill are of greater concern to the government and rice producers in the country, not a single article has been produced (*to the best of our knowledge*) that directly source identification of the determinants of rice imports in Ghana. Efforts made so far at the national level, have placed emphasis on identifying the determinants of aggregate imports in Ghana (e.g. see Abbey and Clark [21], Leith [22], Jebuni et al. [23] and more recently Harvey and Sedegah [24]) using traditional import demand and macroeconomic models. Although the model used in this study is an extension of a simple traditional import demand model proposed and applied by Khan [25], Goldstein and Khan [26], and Gafar [27], and in this study

applied in a multiple regression frame for rice imports (volume and value), emphasis in this section is placed on reviewing research works on determinants of rice and other food imports. The basic traditional import demand model relates import of a commodity to real domestic income (*either aggregate or per capita*) of the importer and relative prices (*assuming a degree of substitutability between the foreign and domestic representations of the commodity of interest*). The basic a priori expectation in such a model is a positive association between income and import demand (*since increasing income increases the purchasing power of consumers in the importing country and their capacity to demand and meet cost of high quality (either cheap or expensive) products*) and a negative association between import demand and relative prices. Several investigations carried-out so far into identifying the determinants of rice and other food imports have however gone beyond these simple associations by covering other variables including local production (output) of the imported commodity, total import value, external reserves, exchange rate, a dummy for trade liberalization, population density on arable land, general population estimate, degree of trade openness, price of substitutes in consumption, per capita calorie intake, lagged import demand (*by volume*) and food aid per capita [28-32].

For example, in investigating the determinants of cereal imports by developing countries by region, by income group and by commodity, Morrison [28] discovered that the level of economic development and population density on arable land are statistically the most significant long-run factors explaining cereal imports in developing countries. Food aid was however found to be statistically the most significant short-run factor. In assessing trade liberalization and import demand for rice in Nigeria, Ogundele [29] found nominal exchange rate, per capita income and local output of rice to be significant determinants of rice imports, although only per capita income had appropriate sign in terms of effect. Inelastic (and insignificant) positive cross price elasticity for substitution of imported rice with local rice was found. This, he inferred, indicates that imported rice and local rice are not directed substitutes in Nigeria and that there appeared to be segregation in market demand for the two commodities. In the short-run however, only income and local rice production had significant effects on import demand for rice in Nigeria. Their respective effects were highly elastic, 3.30 for per capita income and 3.11 for local rice

output. In as much as the former effect affirms the fact that imported rice in Nigeria is considered more of a luxury than "Giffen" or inferior good, the later effect reaffirms the fact that local rice and imported rice are not perfect substitutes in Nigerian diets. The effect of liberalization dummy was also not significant, indicating that increasing trends observed in the demand for rice in Nigeria cannot be primarily attributed to trade liberalization. Although Nkang et al. [30], in a study on "rice production, imports and food security in Nigeria" found a negative instead of positive (as found by Ogundele [29]) effect of increment in local rice production on quantity of rice imported, the effect was highly inelastic (-0.138). This, they inferred, implies that a 10% increase in domestic rice production would only reduce rice imports by 1.38% and that policy measures geared towards reducing current volumes of rice imports by increasing local rice output may not achieve their objective in the short-run. It was as well discovered that reducing total import value by 10% would only reduce rice imports by 4.47%, issuing policy signal that measures to significantly reduce rice import volumes in the short-run may fail to achieve set targets if emphasis is placed on reducing total import value. Lagged volumes of imports were found to have a significant negative (elastic) effect (-1.860) on current volumes imported. Although not much was written about this effect, it generally reflects a low rice import absorption capacity of the country. External foreign exchange reserves were also found to have an elastic positive (1.297) effect on volumes of rice imported into the country.

In examining trends and drivers of production and import demand for four selected agricultural commodities for leading producers and importers, Rickard and St. Pierre [31] discovered some interesting relationships. A review of the respective results for the production and import demand models revealed that prices were more important in the import demand models than they were in the production models. The four commodities covered in the respective import demand models were chicken (with beef as a substitute in consumption), corn (with wheat as a substitute), tomatoes (with banana as a substitute) and coffee (with cocoa as a substitute). From the results for per capita import demand for chicken, imports were found to decrease with increasing price of imported chicken meat. Increments in per capita income and level of trade openness stimulated demand for imported chicken meat. In the equation for

corn, own price and price of substitute (wheat) had no statistically significant effect on import demand for corn. Per capita income, per capita calorie consumption and trade openness were however found to stimulate import demand for corn, while increments in domestic production led to a decline in imports. An increase in price of imported tomatoes led to a significant negative effect on quantity of the commodity imported, while increment in price of the substitute (banana) was found to stimulate import demand. Income and trade openness had significant positive effects on import of tomatoes. Although positive, the effect of per capita calorie intake on import demand for tomato was not significant. A highly inelastic negative (-0.06) association was found for the effect of domestic production on import demand for tomatoes. Under the equation for coffee, trade openness was the only variable that had a significant effect on import demand for the commodity. In analyzing import demand for food in Nigeria using a Cobb-Douglas function (and based on the Ordinary Least Squares estimation), Udoh et al. [32] discovered that, domestic production, gross domestic product (GDP), trade openness, external reserves and Structural Adjustment Programme are the major determinants of food imports in Nigeria and that response of import demand to changes in each of these variables was inelastic. Although research works reviewed in this section throw some light on the plausible determinants of food import demand, effort is made in this study to move a step further by including and addressing some potentially complex associations that may have been ignored by researches done so far.

4. FRAMEWORK

Guided by demand theory[9], the traditional import demand model relates the quantity of a commodity imported by a country to relative price ratio (*between foreign and local representations of the commodity*) and to domestic real income [25, 26, 27]. A degree of substitutability is generally assumed between imported and local representations of the commodity of interest. In contrast to the perfect substitutability assumption of perfect substitutes' model, an imperfect substitutes' model under the traditional import

demand frame as applied in this study, ensures that a given country's market is not filled completely with foreign representation of a good or a domestic representation on the other hand, but rather a mix of both. This facilitates free choice by consumers between the two brands given some constraints, most notably price of the local and foreign representations of the commodity and income of the consumer (be it an individual, a country, or a group). A basic import demand model can be expressed as follows:

$$IQ_t = f(Y_t, P_t^I, P_t^D) \qquad (1)$$

Where IQ_t represents import demand for rice at time t, Y_t is the real per capita income at time t, P_t^I is the import price of rice at time t, and P_t^D is the price of domestic rice at time t. Under the imperfect substitutes' framework of the traditional import demand model however, equation (1) is reformulated as follows:

$$IQ_t = f\left(Y_t, \frac{P_t^I}{P_t^D}\right) \qquad (2)$$

Expressing the respective prices in a ratio helps to account for and correct multi-collinearity effects. As expressed above, equation (2) is basically founded on the primary assumption of homogeneity. The relative price ratio helps in explaining why economic agents (consumer, wholesalers, retailers, and importers) switch demand between the foreign and local rice brands [33]. Also referred to as the equilibrium model (*based on the assumption of instantaneous adjustment of imports and prices to their respective equilibrium*) and first proposed by Khan [25] for aggregate import demand analysis, Equation (2) has mostly been utilized in a log-linear frame as against the linear frame. According to Khan [25] and Arize and Afifi [34], the log-linear frame has the following advantages over the linear frame:

1. Expressing the import demand equation in log-linear frame allows imports to react in proportion to dynamics (increments and declines) in the explanatory variables and
2. Assuming constant elasticities helps to avoid the problem of drastic falls in the elasticities as imports rise

Along these arguments, equation (2) has mostly been expressed as follows:

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[9] *Demand theory is a theory guiding the relationship between consumer demand for goods and services and their prices. It tries to explain how demand for a commodity/good/service is impacted on by changes in price of the commodity/ good/service, and by income levels and utility derived from patronizing / consuming the commodity/ good/service of interest.*

$$log(IQ_t) = \beta_0 + \beta_1 log(Y_t) + \beta_2 log\left(\frac{P_t^I}{P_t^D}\right) + \varepsilon_t \tag{3}$$

From equation (3), log represents natural logarithm; β_0 is an intercept term, β_1 and β_2 are income and relative price elasticities of demand and ε is an error term assumed to be randomly and normally distributed. In this expression, the a priori expectation is that $\beta_1 > 0$ and $\beta_2 < 0$.

Equation (3) has been the basic model upon which aggregate and disaggregate import demand assessments have been founded. In studying import demand using this narrow frame, a lot of other simple and complex associations are ignored, thereby creating a wide information gap. Demand for a commodity i, is influenced not only by the immediate own and substitute prices of the commodity and income of the consumer, but also influenced by other innumerable factors and circumstances. In our opinion, and as discovered from other research articles reviewed in this study, import demand (volume and value of imports) for rice is influenced basically by two primary factors; namely the import price of rice (foreign rice) and other factors. Other factors, as shown in Fig. 2 include price of presumed true substitute for imported rice (thus, local rice), domestic production of presumed true substitute, domestic stock variation, real per capita income, price of pseudo substitutes/alternatives (maize and millet, in our case), price and demand for complements (meat in our case), demographic developments (urbanization, in our case), policy and trade measures (trade liberalization, import tariff (*captured in this study using consumer tax equivalent of tariff on rice imports*), in our case), import absorption capacity of importer (reflected by coefficient of lagged volume of imports) and adjustment made towards increasing cost (*driven either by increasing import price of rice or import volume or both*) of imports (reflected by coefficient of lagged value of imports). The latter two help in capturing the effect of consumer preference, habits and expectations, as well as account for the effect of some relevant determinants that might have been omitted.

In our opinion, a country generally resort to importation of rice to help meet deficit in supply (*bearing in mind variation in stock*) when domestic rice production efforts directed towards meeting demand is limited. Improvement in such efforts is expected to, *ceteris paribus*, contribute significantly towards reducing reliance on rice

imports. This may hold only if imported and local rice are true (*or close to being true*) substitutes. Should they be indeed true substitutes, then an X% increase in the price of imported rice (holding that of local rice constant in the relative price ratio) should lead to at least an X% decrease in rice imports. An X% increase in the price of local rice in the relative price ratio (holding that of imported rice constant) should lead to at least an X% increase in rice imports. Deviations less than 10% above or below the true value of X indicate that the foreign and local rice brands are *close to being true* substitutes (although they may not be perfect substitutes). Thus, for example, a decrease of at least 10% in rice imports following a 10% increase in import price or at least a 10% increase in rice imports following a 10% increase in the price of local rice is a possible confirmation of true substitutability of the two brands. Validation of this is however based on observance of a *significant and elastic negative* association between production and imports. A decrease of at least 9% in rice imports following a 10% increase in import price or at least a 9% increase in rice imports following a 10% increase in the price of local rice is a possible confirmation that the two are *close to being true substitutes*. Validation of this is however based on observance of a *significant negative association* between production and imports.

Increments in domestic stock, *ceteris paribus*, should lead to a *significant* decline in volume of rice imports (*regardless of the degree of substitutability between local and foreign rice based on the total domestic supply equation[10]*). Effect however, on the value of rice imports would depend on developments in price of foreign rice (as dictated by policy, supply and demand forces). Increasing per capita income increases purchasing power of the consumer and his ability to demand and meet the cost of commodities that give him a greater satisfaction. By this, we expect imports of foreign rice (believed to be of relatively higher quality than local rice) to increase with increasing per capita income. With urban areas accounting for over 75% of total rice consumption in Ghana [35] and having higher preference for high quality foreign rice from Thailand, India, Pakistan, Vietnam and the U.S. [36], we expect an increase in rice imports with urbanization.

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[10] $Supply_t = Beginning\ stock_t + Production_t + Imports_t$. *Increments in the beginning stock generally imply reduced pressure in meeting of domestic demand and suppression in the urgency for importing rice.*
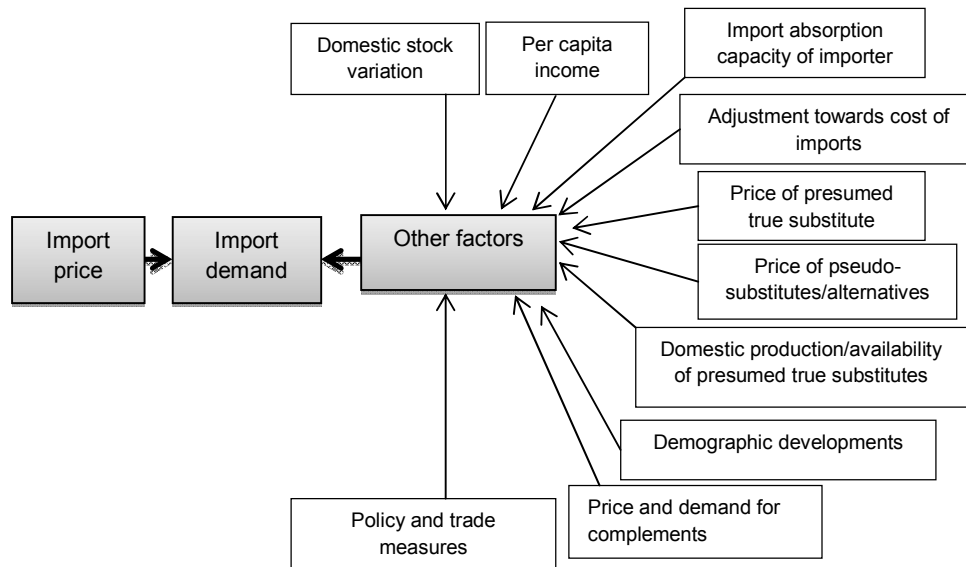
Fig. 2. Perceived determinants of rice imports
Source: Authors' construct

A key observation in food consumption patterns (and demand thereof for local and foreign representations of food) in Ghana and parts of West Africa is the existence of "push-and-pull" between some food items which are not necessarily true (or close to being true) substitutes for rice (*in our opinion*[11]), but act as true (*or close to being true*) substitutes through relative price effects (*and at times as displacers of rice in diet through availability effect*, *although the availability effect is not considered in this study due to detected signals of multi-collinearity whenever they are included*).

Such food items are in this study classified as 'pseudo-substitutes'. Crops that fit this category in Ghana are maize and millet. As an intermediate tradable[12] commodity (*compared to highly tradable commodities like rice, wheat, coffee, and cocoa, etc.*), increments in domestic price of maize compared to that of foreign rice could lead either to an increase in imports or a decrease on the other hand, depending on how well the country is able to correct for such

increment through international trade (*which depends on how the country's engagement in international trade for maize has evolved*), the role maize plays in the average Ghanaian diet and consumer preference for maize. Unlike the intermediate and highly tradable commodities, increment in price of a semi-(or non-) tradable commodity like millet [37] poses a greater food insecurity threat to the poor in developing countries and adjustments made to correct for such increment usually include the importation of other pseudo-substitutes (including rice, maize and wheat) to 'pull' (bring down) price of millet. In addition, increment in price of millet, diverts demand towards other local pseudo-substitutes for both human consumption and for use in preparation of feed for livestock. This consequently drives up (pushes) demand and price for such substitutes as well, leaving the country with no other option than seeking external solution through cheap imports to bring down prices of the domestic semi- and intermediate tradable pseudo substitutes. Developments in price and demand for meat have interesting implications for rice imports. Increasing demand for meat stimulate demand for cereals and grains (including maize, millet, sorghum, etc.) used in preparation of livestock feed, thereby pushing (driving up/increasing) prices for such grains. As is observed in times of price increment for semi-tradable and intermediate tradable commodities, the country resorts to cheap imports of rice to help bring down (pull) prices of such commodities and to as

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[11] *We believe that the only true substitute for rice is rice itself, thus a conflict between foreign and local brands of rice. All other commodities acting as substitutes for rice (unlike the case for cocoa and coffee),are only false (pseudo-) substitutes (alternatives) and cannot give the consumer an equivalent satisfaction as he/she may derive from consuming rice, neither can such commodities appropriately haul the same nutritive, aesthetic ,and prestige-related values like rice.*
[12] *Tradable in this context refers to international trade and not domestic trade (as found on local markets).*

well meet deficits in national food supply resulting from competition between use of grains for food and for preparation of livestock feed. Increasing price of meat leads to a decrease in demand for meat and as well in demand for rice, and consequently a decrease in rice imports. Increasing demand for meat, on the other hand stimulates demand for rice and consequent imports (*by this, meat and rice have somewhat complementing association, instead of acting as substitutes*). The effect for price of meat, is however, not captured in this study due to inability to access well documented time series data for an index that reflects how average price of meat in general has evolved. As pointed out by Tussie and Aggio [38], trade liberalization helps the poor (*although debatable for most net food importing developing countries*) in the same way it does other consumers, through lowering prices of imported goods and that of import substitutes. This consequently increases real incomes. These simple attributes of trade liberalization has import demand enhancing implications. Lowering prices of imported goods, *by the law of demand*, should lead to an increase in demand for such goods. Similarly, increasing real income stimulates demand for high quality imports (including high quality foreign rice). Either way, we expect demand for rice to increase with liberalization. Declines in price of imported goods and increments in real income are only few of the outlets through which trade liberalization impact import demand for rice and other cereals in developing countries. Trade liberalization, as suggested by Kearney [39], can enhance availability of certain foods (especially calorie-rich foods, including rice) through removal of barriers to foreign investment in distribution of such foods. This facilitates high penetration of local markets by such foods, and incites demand for them once their aesthetic and nutritive attributes are in line with consumer food expectations. Besides trade liberalization, another policy-related force that stands impacting import demand for rice in Ghana is rice import tariff (*the effect of which is however captured using consumer tax equivalent[13] of tariff on rice imports*). Imposition of such tax raises the price consumer pays for consuming foreign rice, has the tendency to reduce consumption, has the tendency to reduce the quantity of rice imported, *and if appropriately responded to by local rice producers,* stimulates domestic rice production. With this, in contrast to our import demand

stimulating expectation for trade liberalization, we expect increments in consumer tax equivalent of tariff on rice imports to dampen (*lead to a decline in*) rice imports. In countries with high import absorption capacity, increments in lagged volume of imports are usually accompanied by significant increment in imports for the subsequent year(s). This usually reflects either a highly production-constrained importer (thus, an extreme net importer) or a strong preference of consumers in the importing country for foreign rice. Regardless of the import absorption capacity of the importer, we expect both volumes and value of rice imports to decrease significantly with increasing value of lagged imports (*this expectation would only be violated if the importer is highly constrained in production or has rice quality management challenges which shifts consumer preferences away from the local rice brand thereby making them generally irresponsive to increments in cost of imports*). This is and should generally be a rational consumer's adjustment towards increment in cost of imports. A rational consumer seeks maximization of his/her utility but at a relatively lower cost. Due to extremely high correlation (0.9673) detected between lagged volume and lagged value of imports, the former is dropped (*as the latter is deemed of greater relevance to us; also, models with lagged value of imports had better explanatory power over the alternative and passed the various residual diagnostic tests carried out*).

In assessing determinants of rice and other food imports, emphasis has so far been generally placed on a single explained variable (*either volume or value of imports*) using various import demand and macroeconomic models. In this study however, we source assessment of the determinants of both volume and value of rice imports using two separate multiple regression equations. This is to enable us assess the effect of selected predictors on volume of rice imports and translations of such effects on the value of rice imports.

5. METHODOLOGY

Given our detailed explanation and expectations about the plausible determinants of rice imports and associations thereof, we build our study on the following two (*imperfect substitutes*) import demand equations:

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[13] *This is equal to domestic consumption tax + production subsidy for rice*

Equation with quantity of rice imports as response variable

$$[\log(IQua_t)] = \beta_0 + \beta_1\log(MRpro_t) + \beta_2\log(IPLRP_t) + \beta_3\log(Yp_t) + \beta_4\log(MaPIP_t) + \beta_5\log(MiPIP_t) + \beta_6(Contaxeq_t) + \beta_7(Dstockv_t) + \beta_8\log(Meatkg_t) + \beta_9\log(Urbrurin_t) + \beta_{10}Libdummy_{1983} + \beta_{11}\log(IVal_{t-1})$$

(4)

Equation with value of rice imports as response variable

$$[\log(IVal_t)] = \beta_0 + \beta_1\log(MRpro_t) + \beta_2\log(IPLRP_t) + \beta_3\log(Yp_t) + \beta_4\log(MaPIP_t) + \beta_5\log(MiPIP_t) + \beta_6(Contaxeq_t) + \beta_7(Dstockv_t) + \beta_8\log(Meatkg_t) + \beta_9\log(Urbrurin_t) + \beta_{10}Libdummy_{1983} + \beta_{11}\log(IVal_{t-1})$$

(5)

Where $\log(IPLRP_t) = \log\left(P_t^I \big/ P_t^D\right)$, $\log(MaPIP_t) = \log\left(Ma_t^D \big/ P_t^I\right)$, $\log(MiPIP_t) = \log\left(Mi_t^D \big/ P_t^I\right)$,

and $\log(Urbrurin_t) = \left(\dfrac{\log\left(Urbpop_t \big/ Totpop_t\right)}{\log\left(Rurpop_t \big/ Totpop_t\right)}\right)$,

$IQua_t$ – import quantity of rice (tonnes), $IVal_t$ - import value of rice (1000\$), $MRpro_t$ –local rice production (milled equivalent(tonnes)), import price of rice (CIF, 1000\$/tonne): $P_t^I = \frac{IVal_t}{IQua_t}$, P_t^D- price of local rice (farm-gate price, in SLC[14] as proxy), Yp_t-real per capita income (constant 2005, USD) , Ma_t^D-maize price (farm-gate price, in SLC as proxy), Mi_t^D – millet price (farm-gate price, in SLC as proxy), $Contaxeq_t$- consumer tax equivalent of tariff on rice imports (%), $Dstockv_t$ - domestic stock variation (tonnes), $Meatkg_t$- per capita demand (consumption of) for meat, $\log(Urbrurin_t)$[15] – urbanization index expressed in logarithmic form as a ratio between the log of urban population index (urban population/total population) and the log of rural population index (rural population/total population), $Libdummy_{1983}$- a dummy variable for trade liberalization (1 for years>=1983, 0 otherwise), and $IVal_{t-1}$- lagged value of rice imports (an indicator for adjustment towards cost of imports). Data on volume and value of rice imports, local rice production, prices of local rice, maize and millet, domestic stock variation and per capita demand for meat were gathered from the agricultural production, commodity balances, price and trade database of FAO (FAOSTAT). Data on real per capita income was gathered from TheGlobalEconomy.com (http://www.theglobaleconomy.com/), consumer tax equivalent of tariff on rice imports from Anderson and Nelgen [40], and population related data from development indicators of the World Bank. Import price for rice was computed by authors using value and volume of rice imports, while the dummy for trade liberalization was generated in STATA. Based on definition for the various variables, and an initial assumption that local and foreign rice are at least *close to being true* substitutes (if not perfect substitutes), we hold the following a priori expectations:

A priori expectation:

For equation 4: $B_1, \beta_2, \beta_6, \beta_7, \beta_{11} < 0$; $\beta_3, \beta_5, \beta_8, \beta_9, \beta_{10}>0$; $\beta_0, \beta_4 < >0$

For equation 5: $B_1, \beta_6, \beta_7, \beta_{11} < 0$; $\beta_3, \beta_5, \beta_8, \beta_9, \beta_{10}>0$; $\beta_0, \beta_2, \beta_4 < >0$

To compare relative strength of significant explanatory variables in the respective specifications, a 'beta' condition was added to each of the equations before running in STATA. The beta coefficients are basically measured in standard deviations (thereby recording the strength of coefficients in the same standardized units), instead of the original units in which the variables were measured, and this helps in comparing relative strength of the predictors.

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[14] *SLC-standard local currency unit.*
[15] *Defining urbanization index as shown in equations (4) and (5) helps in capturing the effect of both increments and declines in urban and rural population (This is deemed appropriate definition for assessments based on total (instead of per capita) rice imports. This definitions helps to minimize the effect of errors made during counting and recording of population figures, and in attaching appropriate weights to dynamics in rural and urban population. For assessments based on per capita import demand (instead of total import demand), the appropriate definition would have been $log(Urbrurin_t) = log\left(\frac{\left(Urbpop_t / Totpop_t\right)}{\left(Rurpop_t / Totpop_t\right)}\right)$ since errors made in counting and recording population figures used in deriving variables on per capita basis are generally not corrected for but allowed to self-adjust in a given system).*

6. RESULTS AND DISCUSSION

As a check on the appropriateness and reliability of estimates obtained for the respective specifications, residuals from the two import demand equations (4 and 5) were diagnosed for normality (*using Lawrence's iqr (inter-quartile range) residual normality test*), stationarity (*based on Augmented Dickey Fuller test of residuals*) and non-serial correlation (using both Durbin-Watson (DW) and Durbin's alternative (h) tests). As shown in Table 2 and *Appendix A*, residuals for the respective equations were found to be fairly normally distributed, non-serially correlated and stationary by nature. Having found these, we now proceed with discussion of our results.

With the exception of local rice production, effects for all the other variables are in conformity with our a priori expectations. Not all conforming effects are however significant. Both volume and value of rice imports are found to increase significantly with increasing real per capita income, increasing millet price (keeping that for imported rice unchanged), increasing demand for meat, urbanization and with trade liberalization. Although we found a weakly significant (at 10%) negative effect of increments in domestic stock on volume of rice imports, effect on value of imports was not significant.

The relative price ratios for imported and local rice, and maize and imported rice had no significant effects in either equation, and neither did local rice production. Besides being insignificant, the effect of local rice production on both volume and value of rice imports was positive instead of negative. Although rice consumption tax (tariff on rice imports) (*captured using consumer tax equivalent of tariff on rice import*) is imposed with a mindset of reducing demand for foreign rice by transferring cost to the consumer (*thereby increasing price paid by the consumer above both the FOB and CIF import prices*) and indirectly stimulate domestic rice production through reduced competition, effect of the consumer tax equivalent variable in each of the models is not significant (although negative as expected). The effect of lagged value of rice imports on current volume and value of rice imports is not significant in either equation. This reflects poor adjustment of the country towards increasing cost of imports, probably due to high consumer preference for imported rice and consequent low response towards increment in cost of imports, high quality gap between local and imported rice, or to other structural challenges which preclude effective and appropriate adjustment of the country to increasing cost of imports.

Among the variables with significant effects on volume of rice imports, increments in $\log(\mathrm{MiPIP}_t)$ (thus log of relative price ratio between millet and imported rice) and $\log(\mathrm{Urbrurin}_t)$ (log of urbanization index) yield a relatively higher impact than the other variables. A one standard deviation increase in the former leads to a 4.42 standard deviation increase in $\log(\mathrm{IQua}_t)$ (thus log of volume of rice imports), while a one standard deviation increase in the latter leads to a 2.57 standard deviation increase in log of volume of rice imports. These two variables as well yield a relatively higher impact than the other variables (*with significant effects*) in their effects on value of rice imports. With the price ratio variable yielding a 5.02 standard deviation increase in log of value of rice imports for a one standard deviation increase in this ratio, a one standard deviation increase in the log of urbanization index leads to a 1.46 standard deviation increase in the log of value of rice imports. In interpreting outcomes based on the concept of elasticity, we find elastic positive response of volume and value of rice imports towards increment in real per capita income, millet price to imported rice price ratio, increasing domestic demand for meat and urbanization, while the trade liberalization dummy also yield import stimulating effects. Elasticity estimates for income and urbanization are relative higher in the volume-led equation than they are in the value-led equation, while estimates for domestic demand for meat and the relative price ratio between millet and foreign rice are relatively higher in the value-led equation than they are in the volume led equation. In attending first to significant positive associations across the two equations, it is observed that a 10% increase in real per capita income leads to a 51.89% increase in volume of rice imports and 33.21% increase in value of rice imports. The former effect is significant at the 1% level, while the latter is significant at the 5% level. Increasing per capita income increases the purchasing power of consumers in Ghana, as well as their ability and willingness to demand and meet cost of high quality foreign rice.

Given these estimates, we infer that although foreign rice is generally becoming a major component of the average Ghanaian diet, consumers continue to treat it as a luxury commodity; hence, the more than proportionate

Table 2. Regression output for the import demand equations

Variable	Dependent variable: $\log(IQua_t)$				Dependent variable $\log(IVal_t)$			
	Coef.	Std. Err.	P >|t|	Beta	Coef.	Std. Err.	P >|t|	Beta
$\log(MRpro_t)$	0.226	0.543	0.681	0.103	0.309	0.542	0.573	0.143
$\log(IPLRP_t)$	-0.132	0.596	0.826	-0.370	0.617	0.594	0.307	1.741
$\log(Yp_t)$	5.189***	1.317	0.000	0.520	3.321**	1.313	0.017	0.337
$\log(MaPIP_t)$	-0.907	0.539	0.102	-2.311	-0.694	0.537	0.206	-1.787
$\log(MiPIP_t)$	1.728**	0.687	0.017	4.424	1.940***	0.685	0.008	5.022
$(Contaxeq_t)$	-0.507	0.345	0.151	-0.188	-0.481	0.344	0.171	-0.181
$(Dstockv_t)$	-2.48e-06*	1.24e-06	0.053	-0.169	-1.51e-06	1.23e-06	0.230	-0.104
$\log(Meatkg_t)$	3.623**	1.705	0.041	0.291	4.247**	1.699	0.018	0.345
$\log(Urbrurin_t)$	3.739***	0.999	0.001	2.574	2.090**	0.996	0.044	1.455
$Libdummy_{1983}$	1.861**	0.853	0.037	0.644	1.576*	0.851	0.073	0.551
$\log(IVal_{t-1})$	-0.114	0.162	0.487	-0.110	-0.135	0.162	0.411	-0.132
_cons	-36.53***	9.825	0.001		-25.83**	9.795	0.013	
No. of obs	44				44			
F(11, 32)	13.34				13.08			
Prob >F	0.000				0.000			
R^2	0.821				0.818			
Adj. R^2	0.760				0.756			
Root MSE	0.699				0.696			
D-stat (12, 44)	1.731				2.089			
Durbin's Alt χ^2	1.183				0.262			
Prob > χ^2	0.277				0.609			
ADF of resid	-5.125***				-5.805***			

*NB: coefficients are rounded up to 3 decimal places, ***1%, **5%, *10%*
H_0 for Durbin's Alt: no serial correlation

change in import demand for rice following an increase in per capita income. Although relatively higher than estimate obtained for Nigeria (3.30) by Ogundele [29], the significant positive (5.19) estimate observed for the effect of per capita income on import demand (volume-wise) for rice is in conformity with the expectations upon which the traditional import demand model is founded. As suggested by the HLPE [41], food demand becomes less sensitive to price changes as income increases and this proposition by HLPE duly reflects in the current study. Although we note quite significant growth in price of foreign rice (relatively lower annual growth rate (1.24%) though in the post-liberalization period compared to the pre-liberalization period rate of 7.21%; *see Appendix B*), increasing annual growth rate (2.03%) of real per capita income in the post-liberalization period (compared to a declining rate of -1.38% in the pre-liberalization period) in part accounts for the highly significant annual growth rates of 9.88% and 11.23% respectively for volume and value of imports in the post-liberalization period (compared to the respective insignificant annual rates of -4.07% and 2.85% in the pre-liberalization period). Either 'hidden' during policy reasoning or intentionally ignored in rice policy formulation, dynamics in the price of millet have quite important implications for past,

current and future rice imports. As a semi-(non-)tradable commodity, increments in the price of millet would continue to stimulate volumes and value of rice imported into the country, through pseudo-substitution effect and through its indirect effect on demand and price for other highly, intermediate and semi-(non-) tradable food commodities in the country. As shown in Table 2, a 10% percent increase in the price of millet (keeping that for imported rice unchanged) leads to a 17.28% increase in volume of rice imports and 19.40% increase in value of rice imports. The former effect is significant at the 5% level, while the latter is significant at the 1% level. Having not only a significant positive effect, but also yielding the highest impact (based on beta coefficients) on import demand for rice, dynamics in price of millet must be incorporated in future rice policy decisions/formulation, if the country is to stand any chance of achieving its goal of reducing imports by at least 30% by the year 2018 [4]. In line with our a priori expectation, import demand for rice increases with increasing demand for meat. A 10% increase in domestic demand for meat leads to a 36.23% increase in volume of rice imports and 42.47% increase in value of imports. Both effects are significant at the 5% level. With urban areas dictating rice consumption in Ghana and favoring imported rice

over local rice, an increase in the urbanization index (*reflecting increasing share of urban population in the total –either due to natural increase, community reclassification or to rural-urban migration*) leads to more than proportionate increase in both volume and value of rice imports. A 10% increase in this index (based on the definition in equations 4 and 5) leads to a 37.39% increase in volume and 20.90% increase in value of rice imports. The former effect is significant at the 1% level, while the latter is significant at the 5% level. Through its primary attributes of enhancing reduction in price of imported rice (and other imported goods), thereby increasing real income, and its capacity of facilitating removal of barriers to foreign investment in distribution of imported foods (including rice), trade liberalization has played quite a significant role in the persistent increase in import demand for rice. Per the estimated coefficient for the dummy, trade liberalization has led to significant increments in both volume and value of rice imports in the country. The effect on volume of imports is found significant at the 5% level, while that on value of imports is significant at the 10% level. The only variable (besides the intercept term) with a significant negative effect on volume of rice imports (but not on value of rice imports) is domestic (beginning) stock. Although marginal, the negative effect yielded by increments in domestic stock on volume of rice imports is in line with our a priori expectation. A 10% increase in the beginning stock for each year leads to a 0.00248% decrease in volume of rice imports. This decrease is significant only at the 10% level. To ascertain whether the joint effect of variables emphasized in current rice policy (basically, local rice production, consumer tax (tariffs) and minimization of cost of imports) is statistically different from zero, the Wald test was carried out for different combinations of these variables (*with the relative rice price ratio added in some combinations*). As shown in Table 3, given current quality gap between the two brands of rice, the joint effect of local production, tariff on rice imports and efforts to reduce cost of imports is not statistically different from zero.

None of the combinations considered yielded a different result. This shows that, should policy makers continue to place much emphasis solely on these measures (*instead of looking beyond them by improving quality of local rice, and factoring dynamics for other economic, demographic and price variables in policy formulation*), rice import reduction targets would never be met, but rather imports would continue to increase with increasing real per capita income, increasing millet price, increasing demand for meat, urbanization and with openness of the country to trade by virtue of trade liberalization.

In addition, the insignificant effects of local rice production, consumer tax equivalent of tariff on rice imports, relative price ratio for imported and local rice, and lagged value of rice imports convey the following policy relevant messages

- Imported and local rice in Ghana are not (*by current standards and based on specific definitions in this study*) even *close to being* true substitutes (*an elasticity estimate of -0.132 for the relative price ratio is observed for eq(4)*), probably due to high quality gap between the two brands. This is as well backed by the insignificant response of import demand towards increment in consumer tax equivalent of tariff on rice imports and the poor adjustment of the country to increasing cost of rice imports.

- Although import tariffs are imposed as indirect measures to stimulate domestic production, observed estimates from Table 2 shows that, besides the insignificant importer / consumer response towards increment in such tax, response from local rice producers (*and production thereof*) has not been strong enough to yield significant import reduction effect (possibly due to price transmission challenges, other production challenges and more importantly a strong consumer preference for imported rice). Continuous implementation of tariffs, given the insignificant effect of domestic production on rice imports and poor substitutability between the two brands could lead to a general welfare loss (if quality of local rice is not highly improved upon to ensure substitutability between the two brands, and dynamics in other relevant economic, policy and price variables factored in rice policy decisions / formulation).

As reflected by the F-statistic, the joint effect of all predictors is significant at the 1% level for the respective equations. Based on the adjusted R^2 figure, predictors in the two equations jointly explain approximately 76% of the total variation in both volume and value of rice imports.

Table 3. Wald test on joint effect for emphasized variables in current rice policy of Ghana

For $\log(IQua_t)$		For $\log(IVal_t)$	
Null H_0: $\beta_{\log(MRpro_t)} = \beta_{(Contaxeq_t)}$ $\quad = \beta_{\log(IPLRP_t)}$ $\quad = \beta_{\log(IVal_{t-1})}$ $\quad = 0$ Alternative H_A: At least one is non-zero	F(4, 32)= 0.74 Prob>F= 0.540	Null H_0: $\beta_{\log(MRpro_t)} = \beta_{(Contaxeq_t)}$ $\quad = \beta_{\log(IPLRP_t)}$ $\quad = \beta_{\log(IVal_{t-1})}$ $\quad = 0$ Alternative H_A: At least one is non-zero	F(4, 32)= 1.02 Prob>F= 0.410
Null H_0: $\beta_{\log(MRpro_t)} = \beta_{(Contaxeq_t)}$ $\quad = \beta_{\log(IPLRP_t)} = 0$ Alternative H_A: At least one is non-zero	F(3, 32)= 1.04 Prob>F= 0.389	Null H_0: $\beta_{\log(MRpro_t)} = \beta_{(contaxeq_t)}$ $\quad = \beta_{\log(IPLRP_t)}$ $\quad = 0$ Alternative H_A: At least one is non-zero	F(3, 32)= 1.30 Prob>F= 0.290
Null H_0: $\beta_{\log(MRpro_t)} = \beta_{(Contaxeq_t)}$ $\quad = \beta_{\log(IVal_{t-1})}$ $\quad = 0$ Alternative H_A: At least one is non-zero	F(3, 32)= 1.02 Prob>F= 0.397	Null H_0: $\beta_{\log(MRpro_t)} = \beta_{(Contaxeq_t)}$ $\quad = \beta_{\log(IVal_{t-1})}$ $\quad = 0$ Alternative H_A: At least one is non-zero	F(3, 32)= 1.07 Prob>F= 0.376
Null H_0: $\beta_{\log(MRpro_t)} = \beta_{(Contaxeq_t)} = 0$ Alternative H_A: At least one is non-zero	F(2, 32)= 1.50 Prob>F= 0.238	Null H_0: $\beta_{\log(MRpro_t)} = \beta_{(contaxeq_t)} = 0$ Alternative H_A: At least one is non-zero	F(2 , 32)= 1.54 Prob>F= 0.231
Null H_0: $\beta_{\log(MRpro_t)} = \beta_{\log(IPLRP_t)} = 0$ Alternative H_A: At least one is non-zero	F(2, 32)= 0.12 Prob>F= 0.890	Null H_0: $\beta_{\log(MRpro_t)} = \beta_{\log(IPLRP_t)} = 0$ Alternative H_A: At least one is non-zero	F(2 , 32)= 0.67 Prob>F= 0.519
Null H_0: $\beta_{\log(MRpro_t)} = \beta_{\log(IVal_{t-1})} = 0$ Alternative H_A: At least one is non-zero	F(2, 32)= 0.33 Prob>F= 0.723	Null H_0: $\beta_{\log(MRpro_t)} = \beta_{\log(IVal_{t-1})} = 0$ Alternative H_A: At least one is non-zero	F(2 , 32)= 0.50 Prob>F= 0.611

7. CONCLUSION

This study was prompted by the persistent increase in rice imports (*with surges noted in the years 2001, 2003, 2004 and 2011*) amidst implementation of various import-reduction policies in Ghana, increasing rice import bill of the country (*and consequent drainage of foreign exchange*), adverse implications yielded by influx of imported rice on local rice producers, and information gap on plausible causes of increasing rice imports. Through the use of multiple regression technique (*based on an extension of the traditional import demand model*), we sourced assessment of the determinants of volume and value of rice imports in Ghana.

We found that both volume and value of rice imports increase significantly with increasing real per capita income, increasing millet price (keeping that for imported rice unchanged),

increasing demand for meat, urbanization and with trade liberalization. Although increments in beginning stock of the country has a negative marginal effect (significant at the 10% level) on volume of rice imports, the effect on value was not significant. Among these variables, increments in the price ratio between millet and imported rice, and urbanization yield relatively higher impacts on both volume and value of rice imports, and are therefore deemed the two most important determinants of rice imports. The effects of local rice production, relative price ratio between imported and local rice, relative price ratio between maize and imported rice, consumer tax equivalent of tariff on rice imports, and lagged value of rice imports were not significant in either equation. The two brands of rice (foreign and local) are not even *close to being* true substitutes, probably due to high quality gap between them, and response of local rice producers to production incentives (*in the form of import tariffs and production subsidy as*

captured by increment in consumer tax equivalent of tariff on rice imports) has not been strong enough to yield significant import reduction effect (*possibly due to price transmission challenges, other production challenges, and more importantly a strong consumer preference for high quality foreign rice*).

In addition, the country has poor adjustment towards increasing cost of imports. This indirectly indicates that the country is either highly challenged/constrained in production and quality management of rice or that consumers in the country have an extremely high preference for imported rice thereby making them generally irresponsive to increment in cost of imports or a combination of these.

Given poor substitutability between local and foreign rice and the insignificant effect of domestic production on rice imports, a continuous implementation of import tariffs (consumer tax equivalent) may lead to a general welfare loss. Besides a need to intensively pursue high quality improvement (management) of local rice, policy makers need to look beyond current variables emphasized in the country's rice policy. Effort should be made to incorporate dynamics in other relevant economic, policy and prices variables in country's rice policy. Based on findings from this study, we advise incorporation of dynamics in real per capita income, millet price (relative to price of imported rice), demand for meat, and urbanization (not however forgetting the effect of trade liberalization). Means by which such dynamics can be incorporated in future agricultural and rice policy are proposed in the policy prescriptions (section 8) below.

8. FUTURE RICE POLICY PRESCRIPTIONS

Given the findings from this study, we make the following policy recommendations as means of incorporating (either directly or indirectly) dynamics for relevant determinants in future rice policy and correcting for price, economic and demographic shocks. Since price of imported rice (CIF) (*as a component of the respective relative price ratios defined in this study*) is exogenously given, efforts to minimize rice imports must be channeled primarily through domestic prices, economic and demographic indicators. By this,

1. Effort should be made to create a domestic buffer stock for millet to help correct for unexpected increments in millet price and to enhanced food security for both rural and peri-urban poor who mostly depend on the commodity for sustenance (*for consumption and to a lesser degree as a source of income through sales*). This could as well help minimize inconvenience (*on the part of local rice producers*) created through importation of proportionately higher volumes of foreign rice following unexpected increments in millet price.

2. Effort should be made to improve packaging and quality of millet to incite both domestic and foreign demand for millet in rural, peri-urban and urban areas (*as a means of initiating intra- and international trade in millet*) to most importantly minimize and correct for volatility/shocks in millet prices (*as a commodity and a pseudo-substitute for imported rice, which trigger surges in rice imports in times of millet price increments*).

3. Effort should be made to increase/stabilize rural incomes to boost production and consumption of local rice and improve transport infrastructure to facilitate transportation of improved (*in terms of quality*) local rice varieties from the remote areas where they are generally produced and processed to peri-urban and urban areas where foreign rice are majorly consumed.

4. Effort should be made to intensively pursue quality improvement of local rice for rural, peri-urban and urban markets, to enhance efficient promotion of local rice consumption. Emphasis could be placed on instilment of high quality grades and standards for local rice, and gradual (**yet regular**) supply of the relatively higher grades to urban and peri-urban markets (as well as foreign markets) as a measure to boost share of local (Ghanaian) rice on such markets, while sustaining and/or increasing the already encouraging share of local rice in rural markets (of Ghana). This could help bring back high-income consumers to locally-produced rice, and help reduce their preference and high demand for foreign rice

5. Measures should be put in place to promote commercial farming (*to enhance large-scale local rice production and efficient processing*) and to initiate pre-harvest (forward) contracts between government/other stakeholders and local rice producers as a means of inciting

appropriate farmer investment in production and processing due to presumed assurance of a ready market for their produce.

6. Measures should be initiated to ensure appropriate transmission of local rice price increments to local rice farmers through addressing of challenges along the domestic rice value chain and minimization of the number of intermediaries (middle-men) between producers and the final consumers, whose activities may have in a way impeded effective transmission of price increments to rice farmers. This could incite appropriate response of farmers to import restricting and productivity enhancing incentives like tariffs and subsidies for rice.

7. Effort should be made to create a firm buffer stock of improved (*in terms of quality*) local rice varieties for price stabilization and food security in periods of short-fall, and to ensure effective competition for market share in favour of local rice.

8. Effort should be made to effectively assess urban dietary patterns from time to time and to incorporate consumer rice expectations in development of new local rice varieties and improve upon the positive traits of existing local varieties.

9. There is a need for critical assessment of correlations between regional urbanization patterns and growth in real per capita income from time to time and to identify how changes in these steer dietary patterns and consequent importation of food items for which the country is highly constrained in production and processing, most notably rice.

10. There is a need for critical analysis of changes in domestic demand for meat from time to time and identification of shifts in domestic demand for rice (*and imports thereof*) and other pseudo-substitutes as demand for meat changes. This could inform timely drafting and implementation of appropriate (*and context specific*) policies to help meet increments in domestic demand for food and imports of rice in a more sustainable way.

In as much as attainment of the 30% rice import reduction target (by 2018) seems less feasible (given the post-liberalization trends in urbanization, per capita income, domestic demand for rice, prices of local rice and millet,

and price of imported rice; see Appendix B), efforts made towards addressing the aforementioned recommendations could help improve welfare of producers, consumers and government (*and other stakeholders, including agribusiness investors*) in the long-run and to a significant degree help minimize volumes and value of imported rice.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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APPENDIX

A. Residual normality Test

1. Residual normality test for equation (4)

Lawrence's iqr (inter-quartile range) residual normality test[16]

```
            . iqr e


      mean= -4.7e-09      std.dev.=  .6026        (n= 44)
    median= -.0153    pseudo std.dev.=  .5619     (IQR=   .758)
   10 trim=  -.007

                                        low        high
                                   ------------------
                           inner fences   -1.554     1.478
                       # mild outliers    1          0
                       % mild outliers    2.27%      0.00%


                           outer fences   -2.691     2.615
                       # severe outliers  0          0
                       % severe outliers  0.00%      0.00%
```

2. Residual normality test for equation (5)

Lawrence's iqr (inter-quartile range) residual normality test

```
        mean= -1.7e-09       std.dev.=  .6007         (n= 44)
      median= -.0565    pseudo std.dev.=  .4616       (IQR=  .6227)
     10 trim= -.0031
                                          low         high
                                     -------------------
                             inner fences   -1.277      1.214
                         # mild outliers    1           1
                         % mild outliers    2.27%       2.27%


                             outer fences   -2.211      2.148
                         # severe outliers  0           0
                         % severe outliers  0.00%       0.00%
```

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[16] *This test basically assumes symmetry of the distribution. "Severe outliers consist of points that are either 3 inter-quartile ranges below the first quartile or 3 inter-quartile ranges above the third quartile. The presence of any severe outliers should be sufficient evidence to reject normality at a 5% significance level. Mild outliers are common in samples of any size." http://www.ats.ucla.edu/stat/stata/webbooks/reg/chapter2/statareg2.htm*

Appendix B: Trends in selected indicators

	Definitions	Statistic	1965-2009	1965-1982	1983-2009
			Annual growth rate[17] (%)		
$log(foodton_t)$	Log of local rice demand	Coef.	0.0580***	0.0046	0.0764***
		R^2	0.8394	0.0092	0.8384
		Growth rate	5.9715	0.4611	7.9394
$log(IQua_t)$	Log of quantity of rice imports	Coef.	0.0769***	-0.0415	0.0941***
		R^2	0.5109	0.0319	0.5844
		Growth rate	7.9934	-4.0651	9.8670
$log(IVal_t)$	Log of value of rice imports	Coef.	0.0854***	0.0281	0.1064***
		R^2	0.6350	0.0165	0.7339
		Growth rate	8.9153	2.8499	11.227
$log(MRpro_t)$	Log of local rice production	Coef.	0.0459***	0.0382**	0.0680***
		R^2	0.8066	0.3280	0.8478
		Growth rate	4.6970	3.8939	7.0365
$log(P_t^I)$	Log of price of imported rice	Coef.	0.0085**	0.0696***	0.0123*
		R^2	0.0911	0.6054	0.1168
		Growth rate	0.8536	7.2079	1.2376
$log(P_t^D)$	Log of price of local rice	Coef.	0.3101***	0.3002***	0.2501***
		R^2	0.9825	0.9285	0.9830
		Growth rate	36.356	35.013	28.415
$log(Ma_t^D)$	Log of price of maize (standard local currency)	Coef.	0.2823***	0.2917***	0.2296***
		R^2	0.9772	0.8818	0.9686
		Growth rate	32.618	33.870	25.810
$log(Mi_t^D)$	Log of price of millet (standard local currency)	Coef.	0.2859***	0.3054***	0.2442***
		R^2	0.9849	0.9153	0.9833
		Growth rate	33.096	35.717	27.660
$log\left(P_t^I / P_t^D\right)$	Log(price of imported rice /price of local rice)	Coef.	-0.3016***	-0.2306***	-0.2379***
		R^2	0.9690	0.8361	0.9543
		Growth rate	-26.037	-20.594	-21.172
$log\left(Ma_t^D / P_t^I\right)$	Log(price of maize / price of imported rice)	Coef.	0.2738***	0.2221***	0.2173***
		R^2	0.9648	0.7612	0.9487
		Growth rate	31.495	24.870	24.272
$log\left(Mi_t^D / P_t^I\right)$	Log(price of millet / price of imported rice)	Coef.	0.2775***	0.2358***	0.2320***
		R^2	0.9749	0.8165	0.9656
		Growth rate	31.983	26.592	26.112
$log(Yp_t)$	Log of real per capita income	Coef.	0.0017	-0.0139***	0.0201***
		R^2	0.0254	0.5205	0.9780
		Growth rate	0.1701	-1.3804	2.0303
$log(Meatkg_t)$	Log of per capita demand for meat	Coef.	0.0061***	0.0053	0.0063**
		R^2	0.4879	0.1553	0.2297
		Growth rate	0.6119	0.5314	0.6320
$log(Urbpop_t)$	Log of urban population	Coef.	0.0149***	0.0338***	0.0439***
		R^2	0.9817	0.9923	0.9988
		Growth rate	1.5012	3.4378	4.4878
$log(Rurpop_t)$	Log of rural population	Coef.	-0.0088***	0.0189***	0.0134***
		R^2	0.9431	0.9943	0.9842
		Growth rate	-0.8761	1.9080	1.3490

NB: $log(footon_t)$ demand for local rice expressed in log; ***1%, **5% , *10%; 1965-1982 (pre-liberalization period); 1983-2009 (post-liberalization period)

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[17] *Annual growth rate (%) =(exp (Coef) - 1)*100*