THE IMPACT OF NIGERIA'S RICE IMPORT POLICY ON HOUSEHOLD WELFARE

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Abstract

I examine how increases in the tariff rate impacted market prices and household consumption of imported rice in Nigeria during 2001-2018. I find that the country-level tariff pass-through for imported rice was 7 percent and occurred three-months after implementation. When faced with increases in the tariff-rate, households decrease their consumption of imported rice. Households that face greater exposure to the tariff rate decrease their consumption more than those that are less exposed. The relatively small tariff pass-through and the responsiveness of consumption to increases in the tariff rates are crucial pieces of information for informing Nigeria's future rice policy. *

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1. Introduction

During the past several decades, rice has become an increasingly popular grain in Nigeria, outpacing traditional staples like cassava in consumption and expenditure. Despite developments in the domestic rice industry, rising population and increasing per capita consumption of rice have contributed to the country's growing gap between domestic demand and supply. To meet domestic demand, Nigeria has become one of the world's largest importers of rice. The country's large rice import bill has become the face of Nigeria's food security problem, and thus has received a high degree of government and public attention. The Government of Nigeria (GON) has attempted to become self-sufficient in rice production through investments in the development of the rice industry and the implementation of protective trade tariffs and bans.

Since the 1980's, rice has faced varying levels of trade protection. Changes in the tariff rate have been frequent and large, ranging from a zero percent tariff rate during the 2008 Food Crisis to 110 percent in 2013-2014. Following trade literature, I expect tariffs to be passed through as higher market prices for imported rice and local rice. This assumption is complicated by the presence of tariff evasion and widespread smuggling of rice, particularly across the Nigeria-Benin border.

Utilizing data from Nigeria's National Bureau of Statistics Retail Prices for Select Goods and the General Household Survey (2010, 2012-2013, 2015-2016), this paper exploits the changes in the tariff rate to examine how shifts in the tariff rate impact domestic retail prices for imported and local rice and household welfare. This effect is analyzed through two main lenses. First, I examine the pass through of the tariff on state-level retail prices of imported rice. Second, I exploit heterogeneity in the baseline community-level consumption and production of rice to identify which regions in the country are more exposed to changes in the tariff rate. Thus, I can examine the relative changes in the consumption and production of rice in comparison to the national trend due to tariff changes.

I find that the tariff pass-through for imported rice is relatively small, around 7 percent, and non-instantaneous. The pass-through rate is lower than that found in other countries (Nacita 2009, Jara and Ganoza (2013)). The household level regressions find that households decrease their consumption of imported rice and total when faced with higher tariff rates. There is weak evidence that households consume more local rice when faced with higher tariffs.

This paper is organized as follow. Section 2 reviews the relevant literature. Section 3 provides a background on Nigeria's rice industry, domestic consumption and production patterns, and rice

import policy. Section 4 develops the theoretical framework. Section 5 introduces the data. Section 6 provides the empirical strategy. Section 7 discusses the results and the implications for future policy.

2. Literature Review

My paper is related to the following fields of literature 1) the effectiveness of trade policy in protecting domestic industry, 2) tariff pass through, 3) the effects of changes in food prices on household welfare.

Research has generally concluded that when tariff rates on agricultural commodities are increased, rural producers benefit from the decreased competition of imported products with local production, while urban households lose due to the higher prices of imported products (Taylor et al. 2007). An opposing argument is that agricultural support given to developing countries negatively impacts rural welfare by depressing the world price for locally produced goods (World Bank 2003). The main argument for why protective trade policy is beneficial for less-developed countries (LDCs) is that developed countries have a comparative advantage in grain production, thus, without protective trade policy, producers in LDCs are left vulnerable to competition from foreign producers. There is no clear-cut argument in support of this claim because rural households that are net producers benefit while net consumers lose from the higher prices. Taylor et al. 2007 examines the potential impact of the Central American Free Trade Agreement (CAFTA) on rural welfare in El Salvador, Guatemala, Honduras, and Nicaragua. The authors find that lower tariffs for agricultural products reduce nominal incomes for almost all households, but the lower tariffs also reduce food prices and consumption costs. The net impact on households is positive, suggesting that the pre-CAFTA protective agricultural import policy has a detrimental impact on rural household welfare.

Kareem (2014) finds that the Common External Tariff of the Economic Community of West African States has a positive impact on household welfare in Nigeria. Reductions in domestic prices outweigh income losses, the benefits are disproportionately felt by poor households and those who live near the ports. A small field of research has studied the impact of Nigeria's import bans on household welfare. Treichel et al. (2012) finds that the removal of import bans will decrease poverty in Nigeria by 9.4 percent and lift 3.3 million people out of poverty. Dabalen and Nguyen (2016) find a more conservative estimate for the removal of import bans quantified as a 2.6 percentage point decrease in the poverty rate. Bensassi et al. (2016) finds that when agricultural import bans are implemented prices increase; price increases are larger in non-border areas than border areas that have better access to smuggled goods.

The degree to which households are impacted by changes in the tariff rate depends on what percentage of the tariff rate passes through to market prices. Tariff pass-through is highly variable across countries and products. Nacita (2009) finds a 33 percent pass-through of tariffs on agricultural products in Mexico. Jara and Ganoza (2013) find a 74 percent pass-through of tariffs on imported yellow corn to wholesale prices of yellow corn in Peru, and a 22 percent pass-through to chicken meat. Chicken producers are the largest consumers of yellow corn in Peru. Duran and LaFleur (2008) find an 8 percent pass-through of tariffs for a group of food products in Chile. In sum, these papers find wide variation of tariff pass-through.

I expect the tariff pass-through in Nigeria to be on the lower-end of the pass-through rates found in other research because of the presence of tariff evasion and smuggling in Nigeria. Dorosh and Malek (2016) examine how changes in the rice tariff rate are passed on to consumers in Nigeria between 2008 and 2013. Their analysis focuses solely on the state of Enugu. The authors do not find a specific pass-through rate, they only state that the pass-through rate is partial and decreasing from 2008 to 2013. Their conclusion is drawn from a single state, and therefore may not be respresentative of the country-wide tariff pass-through rate. This paper thus expands our understanding of pass-through rates in Nigeria.

Takeshima and Masias (2013) find that a 1 naira increase in the border price of rice increases the price of local rice by 0.20 naira, suggesting that local rice is an imperfect substitute for imported rice and therefore domestic producers benefit marginally from tariff increases. This implies that households consuming imported and local rice are impacted, and that households may substitute a portion of their consumption of imported rice for local rice. My paper is most similar to Takeshima and Masias (2013) in that we both examine the impact of changes in the tariff rate on prices of rice, but our time frame of interest and empirical techniques differ.

3. Statement of the Problem

The development of Nigeria's oil industry in the 1960's and 1970's created attractive wages drawing workers away from the agricultural sector and slowing food production. To meet demand for food, Nigeria began importing foodstuff. The country's exports of a single product contributed to the development of a "resource curse," making food imports even more attractive.[1] Since the 1980's,

[1] Nigeria's petroleum exports have created a "resource curse" for the country. Resource curses impact countries that export a single commodity, leading the countries to amass large foreign-

food imports have grown at an annual rate of 3.4 percent, out-pacing population growth (Onwuka 2017). Rice imports have accounted for a large proportion of food imports. Population growth, higher incomes, rapid urbanization, and shifting grain preferences, coupled with slow transformation in the domestic rice industry drastically increased Nigerian demand for rice and, in turn, imports (Cadoni and Angelucci 2013). Rice's importance in the modern Nigerian diet and its large import bill has led to rice becoming the face of the country's food security issues.

3.1 Domestic Production and Consumption of Rice

Although Nigeria is the largest producer of rice in West Africa, the country has a shortage in domestic production due to the country's growing population and per capita consumption and the local industry's low productivity. Nigeria's rice production is centered in the country's subhumid middle belt, with some additional production in the humid south and semiarid north. **Map 1** illustrates the geographic distribution of rice production in 2001, highlighting the dominance of the middle belt and some of the northern regions in rice production.

The Government of Nigeria has made investments to augment the sector's productivity, although the investments are relatively small in comparison to investments in neighboring countries.[2] In response to the food crisis in the 1980's, Nigeria introduced structural adjustment programs (1985) to create state-level programs that focused on small-scale agricultural production. For rice, the priority area was investment in irrigation systems. In 1999, the National Economic Empowerment and Development Strategy (NEEDS) was created to boost social and economic growth in the country. The agricultural component of NEEDS focused on generating 6 percent annual economic growth in agricultural GDP and becoming 95 percent self-sufficient in food production (Gyimah-Brempong et al. 2016). In 2002, the Presidential Initiative on Rice was announced with the goal of becoming completely independent in rice production by 2005. To achieve self-sufficiency, the GON focused on supplying subsidized rice technology to increase the productivity of farmers. Increased technology was coupled with the proposal of new milling plants, the dissemination of higher quality seeds, and an

exchange reserves during global prices increases or export spikes. Large foreign exchange reserves and temporary increases in export volume appreciate the domestic currency, making food imports more attractive. Cheaper imports undercut domestic producers, reducing the profitability of the domestic agricultural industry. Nigeria has struggled with its "resource curse" since the development of the oil industry due to the country's poor governance (Gyimah-Brembong et al. (2016)).

[2] During the 2000's, Nigeria lagged behind Benin, Ghana, and Niger in yield per hectare. Nigeria's yield has tended to be similar, but slightly above, Cameroon and Chad (Cadoni and Angelucci 2013).

increased import tariff on foreign white rice (Cadoni and Angelucci 2013). The Presidential Initiative on Rice was followed by a wave of investments into the domestic rice industry, including the World Bank's National Fadama Development Project (2005), the National Rice Development Strategy and Market Stabilization (2008-2010), the Presidential Transformation Agenda (2011), and the Agricultural Promotion Policy (APP) (Gyimah-Brempong et al. 2016).

Rising demand and government investments have contributed to the growth of the domestic industry. **Figure 1** illustrates the change in Nigeria's rice paddy production and area harvested from 1970 to 2015. The growth has generally followed an upward trend, with some points of acceleration and deceleration. In the mid-1980's, when the government created the structural adjustment programs and implemented a complete import ban on rice, there was a rapid growth in production. In the early 2000's, when the Presidential Initiative on Rice was enacted, there was another acceleration in production. Yield across the time period has not followed an upward trend; however, it is possible that declines in average yield occurred due to the addition of new, more marginal rice farming land.

Investments in the domestic rice industry have aided in production growth, but they have failed to create independence in production. **Figure 2** illustrates domestic production, foreign imports, and population growth from 1961 to 2015. In line with **Figure 1,** production has increased throughout the time period; however, growth in production has occurred at a slower rate than population growth. To meet demand, rice imports were introduced in the mid-1970's and have generally experienced positive growth since then. While the rice availability, the sum of imports and production, has trended up at a slightly slower pace than population, per capita demand for rice has also steadily grown throughout the time period. Therefore, **Figure 2** fails to capture the rising per capita demand, and, in turn, the true gap between supply and demand.

The inability to keep pace with the domestic demand for rice is rooted in the low productivity of rice farming throughout the country. To reduce Nigeria's rice yield gap, there needs to be increased investment and uptake of technology mixed with better access to seeds, fertilizers, irrigation, and protection of crops ("Nigeria seeking" 2019).

3.2 Imports of Foreign Rice

At present, Nigeria is Africa's largest importer of rice, and one of the world's biggest importers. The majority of the country's rice imports come from Thailand, Vietnam, and India (Gyimah-Brempong et al. 2016). Imports are mainly brought in through Nigeria's largest ports: Port Lagos and Port Harcourt.

How much rice Nigeria actually imports is a point of discrepancy. **Table 1**, adapted from Dorosh and Malek (2016) portrays imports from five different sources. Between 2008 and 2010, Nigeria's officially reported imports (column 1) are substantially lower than the Food and Agriculture Organization (FAOSTAT) and the United States Department of Agriculture (USDA) import levels (columns 2 and 3). During this period, official imports are only 30 percent of FAOSTAT's imports (column 6). There is also a discrepancy between the United Nation's COMTRADE mirror trade data during the 2008-2010 period. Exports to Nigeria (column 5), as reported by rice-exporting countries like Thailand and Vietnam, are about four times larger than reported imports (column 4). The discrepancies in the COMTRADE mirror data and the low-level of officially reported imports are suggestive of tariff evasion.

Inconsistencies between the stated and the calculated tariff also point to tariff evasion. **Table 2**, taken from Dorosh and Malek (2016), utilizes government reported imports, gross tariff revenue, and import prices to calculate the average tariff collected for the 2007-2011 time period. Across all rice varieties in 2007 and 2008, the calculated tariff is nearly four times the stated tariff rate, suggesting that official imports grossly underreport actual imports. The discrepancies between the calculated average tariff (column 6) and the stated tariff rate in combination with the large annual fluctuations draw into question the validity of government reported imports and tariff revenue. When Dorosh and Malek (2016) recalculate the average tariff collected utilizing the COMTRADE exports to Nigeria instead of official imports, they find that the applied tariff rate is actually much lower than the official tariff rate. Qualitative evidence illustrating the existence of tariff evasion is limited; however, quantitative evidence highlights the extensiveness of the problem. Legal cases brought against former Nigerian Customs Service officers and major rice importers provide a qualitative backing for this argument.[3]

Nigeria also suffers from smuggling, mainly across its long and historically porous borders with Benin and Nigeria (Golub 2012). Like tariff evasion, it is inherently difficult to quantify the rate at

[3] In 2009, Nigerian police officers brought a case against the former Nigerian customs chief for aiding three Indian businessmen in evading $17 million, or 2.5 billion naira, in rice import duties. The three businessmen, the Vaswani brothers, operated under the Stallion Group brand ("Nigeria charges"). The Stallion Group has faced several lawsuits for their refusal to pay duties on rice imports. In 2014, the Stallion Group and three other major rice imports abused a special quota that allowed approved imports of rice up to a certain quota to pay a lower 10% duty and 20% levy in comparison to the 10% duty and the 60% levy that was normally to be paid. In 2015, customs sealed the premises of the four importers after they refused to pay back 23.6 billion naira in unpaid tariffs ("Customs seals").

which rice is smuggled into Nigeria and if smuggled rice is disseminated across the country. Benin, Nigeria's western neighbor, is known to import many goods which face high tariffs or bans in Nigeria. Golub (2012) finds that Benin imports 10 times as many products that are banned in Nigeria than its neighboring country of Togo, despite similar population sizes and demographics.

Benin also appears to import large quantities of rice to be smuggled into Nigeria. **Figure 3** illustrates imports to Nigeria and Benin from 2001 to 2010. Nigeria and Benin's import quantities move in almost perfect opposition. From 2001 to 2006, Nigeria's imports fell by approximately 800,000 tons and Benin's increased by 650,000 tons, suggesting that reductions in imported rice in Nigeria are met with increases in smuggled rice from Benin.

The parboiled rice imported to Benin, dubbed "Cotonou Rice," is re-exported to areas facing shortages in Nigeria, particularly border regions and Lagos (Hashim and Meagher 1999). Between 2004 and 2006, Benin's rice imports nearly doubled. In this period, Nigeria's tariff rate was 100 percent in 2004 and 2005 and 50 percent in 2006, while Benin's tariff rate was only 8.75. From 2004 to 2006, Benin imported enough rice to meet demand for a population of approximately 130 million people, despite only having a population of 10 million (Ogunkula 2010). News and government reports of seizures of smuggled rice are further evidence of the problem.[4]

The widespread tariff evasion and smuggling lead to underreporting of imports and reduce the average tariff collected on rice. If rice is passing into the country without paying the stated tariff rate, I expect the average tariff rate to be a fraction of the stated tariff rate. A lower average tariff rate, is translated into a smaller increase in market rice prices. Thus, tariff evasion and smuggling undermine the goal of protective tariff policy.

3.3 Import Tariff Rate

Since the 1980's Nigeria has pursued protective import policy for rice. **Figure 4** illustrates the country's rice imports and bans from 1990 to 2018, as reported by the United Nations TRAINS database and United States Department of Agriculture's GAIN reports. The UN TRAINS database

[4] In April of 2019, the Chairman of the Rice Processors Association of Nigeria (RIPAN), Mohammed Maifata, claimed that one million metric tons of rice had been smuggled into Nigeria over a three-month span. Maifata cried for the government to combat smuggling, stating that the rice processing companies cannot survive with the inflow of cheap foreign rice, and without millers, paddy farmers will no one to sell their rice to. RIPAN worries that if action is not taken, the country will eventually fall victim to a national food crisis and will not have a domestic agricultural industry ("Over 20 Million" 2019).

reported a lower tariff than the USDA GAIN reports for the 2010 to 2014. I utilize the higher tariff rate report by the USDA GAIN report because the UN TRAINS database has a reputation of not reporting special tariffs applied on products (Anderson and van Wincoop 2004).

As shown, the GON has been widely inconsistent with its policy regarding rice imports, often enacting policy at the influence of internal or external businesses involved in the rice industry. Following the removal of the 1986 ban on rice in 1995, the tariff rate hovered around 100 percent before being reduced to 50 percent in 2005. Between May and September of 2008, the tariff on rice was dropped to zero in an attempt to mitigate high food prices resulting from the 2008 Food Crisis. Since the food crisis, the tariff rate has experienced a series of increases. In July 2014, the rice import tariff rate was lowered to 20 percent for mill owners and 60 percent for traders, with an additional 10 percent special tariff. In July of 2015, rice was removed from the foreign exchange market, along with 40 other items, meaning that traders cannot access the foreign exchange market to fund their purchases of rice.[5] In October of 2015, the Forex ban was lifted for land imports. The full ban was put back in place in February 2016 due to the increased presence of rice smuggling across land borders.

The inconsistency of the government's trade policy, draws into question how effective tariffs are, especially if their intention is to provide protection to and grow the domestic rice industry. In the next section, I develop a theoretical model of trade to examine the implications of tariffs.

4. Theoretical Framework

The impact of tariffs on domestic retail prices depends on the cost of legally and illegally imported rice, the substitutability of imported rice with local products, and the cost of these substitutes. The cost of local rice and imported rice will vary across states depending on the proximity to rice producing regions and to the main importing regions, the southern Port Lagos and Port Harcourt. Assuming Nigeria is a small open economy, the price at the port in Nigeria is the world rice price. Because Nigeria imports about 60 percent of its rice from Thailand, I will utilize the White Broken Thai rice price to represent the world price. At the market-level, consumers face an imported rice price that is a function of the world price, the tariff rate, trade-costs, and a market-specific mark-up. Local rice is an imperfect substitute for imported rice (Dorosh and Malek 2016, Akaeze 2010).

[5] Decreasing oil prices have limited Nigeria's revenue, making it more difficult for the country to repay its financial commitments. To secure the availability of foreign currency, President Buhari placed a restriction on foreign exchange access for 41 imports goods. The president deemed these goods to be easily substitutable with domestically produced goods (Grain Report 2016).

When the GON increases the tariff rate, I expect a portion of the tariff to be passed on to consumers in the form of higher market price for imported rice. Since local rice is a close, but imperfect substitute for imported rice, a proportion of consumers will substitute some or all of their consumption of imported rice for local rice. As demand for local rice rises, the price of local rice will also rise. Net producers of local rice will benefit from the increase in the price of local rice. Higher prices for local rice may incentivize increased domestic production of rice.

The model is complicated with the introduction of the possibility of tariff evasion and smuggling. Tariff evasion lowers the average tariff rate being paid on rice, and thus the pass-through to imported and local prices. Smuggling introduces a third option where consumers have the choice between consuming legally imported rice, illegally imported rice, and locally produced rice. Assuming consumers cannot differentiate between illegally and legally imported rice, smuggled rice is a perfect substitute for legally imported rice.

The theoretical model can be extended to look at the impact of high tariffs on households. The impact of tariffs on households depends on whether they are net producers or consumers, the price of imported and local rice, and the substitutability of imported rice with other products. If tariffs pass-through to domestic prices, we would expect net producers to benefit from tariffs and net consumers to lose. Net producers benefit as the price of imported rice rises leading consumers to substitute imported rice with locally produced rice, causing the price of local rice to increase. Net consumers lose as the price of imported rice rises. Households substitute a portion of their consumption to close substitutes, but the rise in prices causes household real income to fall, leading to a reduction in welfare. As the theoretical discussion has shown, the impact of tariffs is dependent on a number of factors. I will test if these theoretical models hold in the following sections.

5. Data

This paper utilizes two main sources of data: National Bureau of Statistics' (NBS) Retail Prices for Select Goods (2001-2018) and the Nigerian General Household Survey (2010, 2012-2013, 2015-2016). The NBS retail data provides monthly, state-level market prices for select food and retail items. An urban data line is available from 2001 to 2018 and a rural line is available from 2006 to 2010. Given

the missing data for the rural line, only the urban data series is utilized.[6] The retail goods analyzed varies across the years; however, prices for imported and local rice, maize, gari, cassava, and yams are collected for all of the years. I also collected additional data on the rice tariff rate (UNCTAD TRAINS database and USDA GAIN Reports), exchange rate (FRED), Thai rice prices (FAO), and travel distances (Globe Feed Distance Calculator).

The General Household Survey (GHS) is a panel of 5,000 households that collects detailed information on household food consumption, food purchases, and agricultural production, along with demographic information, market food prices, and community-level variables.[7] Households are selected in a multi-stage random sampling procedure from the 36 states and the Federal Capital Territory. Three waves of the survey have been produced, in 2010, 2012-2013, and 2015-2016. For each wave, surveys were conducted during the post-planting and post-harvest period.

5.1 Rice Prices

The NBS Retail Prices for Select Goods includes prices for imported and local rice, as well as other grain substitutes like gari, maize, and yams, for each of Nigeria's 36 states and the Federal Capital Territory. Summary price statistics are shown in **Table 3.** The average nominal price of imported rice has risen from 64 naira per kilogram in 2001 to 287 in 2016. Nominal local prices have also increased, but at a slower rate than imported prices. The average nominal price of local rice was 51 naira per kg in 2001 and 195 in 2016. Competing grains like white and yellow gari have followed similar price patterns, while maize, yams, and brown beans followed similar growth until 2015 when they experienced large price hikes.[8]

Generally, the prices of imported, local, and Thai rice track each other closely, as shown in **Figure 5**. While market import prices appear to be rooted in the world price, the large gap between the world price and the market price is suggestive of large transport, tariff, and mark-up costs. Research has found that price transmission for world rice prices to Nigerian urban prices for imported and local

[6] Regressions run utilizing the NBS price data will only examine the rice tariff pass-through to urban retail rice prices. The impact of the tariff rate on rural areas will only be examined using the GHS data.

[7] The General Household Survey is an annual cross-sectional survey of 22,000 Nigerian households. In 2010, a sub-sample was selected and given a more extensive survey. This sub-sample now forms the panel survey.

[8] It would be ideal if the NBS price data tracked the same products during the 2001-2018 period so that a state-specific food index could be constructed to control for changes in state-level food inflation.

rice is strong (Hatzenbuehler et al. 2017). In the graph, Thai prices tend to lead the local and imported prices, which is to be expected given that it takes time for local markets to price in world changes.

5.2 Household Data

The GHS panel survey includes surveys at the household, agricultural, and community level. The household level survey includes sections on expenditures, education, income, and demographics. **Table 4** shows baseline household summary statistics at the rural and urban levels. 42 percent of all households consume local rice and 55 percent consume imported rice. A higher proportion of urban households report consumption of imported rice than rural households, and the opposite trend exists for local rice. Only 5 percent of households report consumption of imported and local rice in the previous seven days, this is likely a lower bound of the number of households that consume both imported and local rice. Approximately 9.2 percent of rural households and 1.8 percent of urban households report consuming some of their own production.

The expenditure surveys include a seven-day recall of food purchases, spending, consumption, and consumption of own production. Rice also accounts for a large proportion of household food expenditure (see **Table 5**). Household expenditure on local rice as a percentage of total expenditure increased from 2010 - 2015 in both rural and urban areas, while imported rice decreased. For both rural and urban households, food expenditure is the majority of total household expenditure; food is 73 percent of rural expenditure and 62 percent of urban expenditure.

5.3 Data Limitations

There are concerns about the validity of the seven-day food recall from the GHS. In the first survey, 2010 Post-Planting, surveyors were not given any standards to utilize when measuring the food items. Rough conversions were provided to convert the measurements into a standard unit, grams. Since the first survey, a list of units, photo guides, and a conversion file have been added. In the 2015-2016 survey, state specific conversion rates were included. Even with more steps taken to standardize measurements, there are still concerns about measurement error. **Image 1** shows three different sizes of a local Nigerian measurement, a kobiowu, and highlights my concern about how the food was measured.

I initially wanted to use price data from the household and community surveys.[9] The utilization of prices faced by communities would allow for a better analysis of the impacts of changes in the tariff rate on household real income and welfare. However, when the community-market prices for rice were calculated utilizing the provided conversions, there was an unreasonable and unrealistic variation in prices. The average community market price was in line with the prices in the NBS data; however, the variation in the community level market prices would introduce large measurement errors in my models. The variation in prices is likely coming from differences in the way food was measured, errors with the conversion rates, discounts from bulk purchases, and data entry problems. Due to the measurement issues, the price data will not be utilized for any major analysis. A similar concern exists for the consumption data; however, there was less variation in the household per capita consumption of rice.

6. Empirical Strategy

In this section, the objective is to estimate the extent to which the rice tariff passes through to state-level, market prices of imported rice between 2001 and 2018. Given the importance of rice in the Nigerian diet, I will also measure the degree to which tariff increases translate to changes in household consumption.

6.1 Tariff Pass-Through Model

This paper will follow the theoretical framework utilized by Nicita (2009). The market price (P_{st}) faced by households in state *s* at time *t* can be modeled as a function of local substitutes prices (L_{st}), the world price (W_t), the tariff (τ_t), and trade costs (C_{st}).

$$(1)\ P_{st} = L_{st}^{\alpha}(W_t(1+\tau_t)C_{st})^{1-\alpha}$$

$1-\alpha$ represents the degree to which world prices, tariffs, and trade costs pass through to market prices. In other words, $1-\alpha$ represents the tariff pass-through. Equation 1 rewritten utilizing logs is shown below.

$$(2)\ \ln(P_{st}) = \alpha \ln(L_{st}) + (1-\alpha) lnW_t + (1-\alpha)\ln(1+\tau_t) + (1-\alpha) lnC_{st}$$

Following Nicita (2009) and Jara and Ganoza (2013), I utilize distance from the ports to estimate trade costs. Nigeria has two main ports of entry, Port Lagos and Port Harcourt. I construct

[9] For each wave, two markets from each community were surveyed to gather prices on selected goods.

trade cost as the shortest distance between each state's capital and the nearest port, either Port Lagos or Part Harcourt. Nicita (2009) assumes that trade costs are constant across the time period of interest. Given my wide period of interest, 2001 to 2018, the same assumption may not be appropriate. However, I assume that trade costs are constant across the period of interest, and the inclusion of a state-time trend captures any trade costs, allowing me to drop the trade costs from the model.

A flexible form of equation (2), which allows 1- α to differ in both sign and magnitude is represented as

$$(3)\ \ln(P_{st}) = \beta_0 + \beta_1 \ln(L_{st}) + \beta_2 \ln(W_t) + \gamma \ln(1+\tau_t) + \beta_3 lnC_{st} + \delta_S + \delta_t + \delta_s t + \varepsilon_{st}$$

where δ_S is state fixed-effects, δ_t is time fixed-effects, $\delta_s t$ is a state-time trend and ε_{ts} is the error term. The main coefficient of interest is γ which is the tariff pass-through elasticity. If there is perfect pass-through, γ will equal 1. If $\gamma < 1$, then the pass-through is only partial.

One concern with the above regression is that the local substitute prices may be endogenous. Following Nicita (2009), I use the two-year lagged values as an instrument for the local price. While using lagged values is not an ideal instrument, the use of the instrumental variable will reduce some of the endogeneity concerns. I will run specification (3) using both ordinary least-squares (OLS) and two stage least-squares (2SLS).

There is significant heterogeneity in state production of rice across Nigeria. Depending on a state's share of the national rice production in the period before my time-frame of interest, states are exposed to changes in the rice tariff rate differently. I utilize this variation in exposure by first calculating each state's share of total area under rice cultivation in the year 2000 as follows:

$$(4)\ \frac{C_S^{2000}}{\sum_s C_S^{2000}} \times \frac{A}{A_S}$$

where C_S^{2000} is the quantity of rice production (thousand tons) in state *s* in the year 2000, $\sum_c C_S^{2000}$ is the production of rice across the country in the year 2000 measured in thousand tons, A is the total area of the country (km^2), and A_S is the total area of state *s* (km^2).

Then, I interact the state's share of total rice production (weighted by the area of the state) calculated above with the tariff rate levied on imported rice in time *t*, τ_t, to construct a measure of tariff exposure for state *s* in time *t*.

$$(5)\ T_{st} = \left(\frac{C_S^{2000}}{\sum_s C_S^{2000}} \times \frac{A}{A_S}\right) \times \tau_t$$

I use this new measure of tariff exposure to run the following OLS specification:

$$(6)\ \ln(P_{st}) = \beta_0 + \beta_1 \ln(L_{st}) + \beta_2 \ln(W_t) + \gamma \ln(1+T_{st}) + \delta_S + \delta_t + \delta_s t + \varepsilon_{st}$$

where L_{ts} is the local substitute price for state *s* at time *t*, W_t is the world price at time *t*, δ_S is state fixed-effects, δ_t is year fixed effects, and $\delta_s t$ is a state time trend. The standard errors are clustered by states.

I reshape the NBS Retail Prices for Select Items into a state-month panel of 36 states and the Federal Capital Territory for 216 months (18 years). State-level fixed effects account for all state-specific time-invariant characteristics while year-fixed effects control for time variation in variables that do not differ by state. Each model is also run with the stated tariff rate, the one-month lagged tariff rate, the two-month lagged tariff rate, and the three-month tariff lag. Changes in the tariff rate take time to implement, and there is likely a lag in when changes in the tariff rate impacts consumers. Thus, I believe the three-month lagged tariff rate is the best measurement of the tariff rate.

6.2 **Measurement of Exposure to Tariff Changes**

Rice import tariffs are implemented on the national level; however, there is substantial heterogeneity in per capita rice consumption across the states. Depending on a state's per capita consumption of rice, some states are more exposed to changes in the tariff rate. If the national tariff rate for imported rice is utilized, I do not capture the true variation in exposure to tariff rates.

To try to account for variation in state-level exposure to rice import tariffs, I measure exposure as the relative per capita rice consumption in state *s* relative to the per capita rice consumption of the whole country, represented as:

$$(7)\ \frac{\sum_h R_h^s}{\sum_h R_h} \times \frac{N}{N_S}$$

where $\sum_h R_h^s$ is the sum of household rice consumption of all households *h* in state *s* during the baseline year, $\sum_h R_h$ is the sum of household rice consumption of all households *h* in the country, N is the population of the country in the baseline, and N_S is the population of the state in the baseline.

I interact the per capita rice consumption in state *s* relative to the whole country with the tariff rate faced by imported rice in time *t*, τ_t to construct a measure of tariff exposure for state *s* in time *t*:

$$(8)\ T_{st} = \left(\frac{\sum_h R_h^s}{\sum_h R_h} \times \frac{N}{N_S}\right) \times \tau_t$$

By using per-capita consumption shares from before the tariff changes of interest, my measure of tariff exposure is not impacted by endogenous changes in rice consumption that take place due to tariff changes.

A similar measure of tariff exposure is created utilizing the state's share of total rice production weighted by the total area of the state. This tariff exposure measurement is identical to the one developed in equations (4) and equations (5), except the state level rice production from 2006 was utilized. The 2006 rice production data was the most recent data available. I assume that the distribution of rice cultivation across states remained the same from 2006 to the period right before the first GHS survey was conducted in 2010.

6.3 **Effect of tariff exposure on household consumption**

The research question I seek to answer is how changes in the tariff rate affect household consumption of rice. My regression framework relies on comparing households in states that are more or less exposed to changes in the tariff rate.

I start by reshaping the data from GHS to create a household-survey panel dataset, utilizing the three waves of surveys conducted at both the post-planting and post-harvest time period. I utilize the household seven-day recall of food consumption to construct a measure of household consumption of imported, local, and total rice; $consumption_{ihst}$ is the consumption of item *i* for household *h* in state *s* at time *t*.

I start by running a base specification ordinary least-squares (OLS) using the national tariff, τ_t, for imported rice:

$$(9)\ consumption_{ihst} = \alpha + \rho\tau_t + \theta X_{ht} + \gamma_s + \varepsilon_{hst}$$

the main coefficient of interest is ρ, which shows the average change in seven-day per capita consumption of rice item *i* when the tariff changes. I include a vector of household covariates, X_{ht}, that may impact household rice consumption, including household per capita expenditures, religion[10], if the head of the household has a higher education[11], if the house produces any of the rice it consumes, rainfall, and a rural dummy. The state fixed-effects, γ_s, control for time-invariant differences across states.

[10] The religion categories are Christian, Islam, and Other Religion. According to the 2010 Post-Planting survey, the Christian, Islam, and Other Religion shares are, respectively, 55 percent, 43 percent, and 1.5 percent.

[11] Higher education includes any individual with teacher training, vocational/technical school, NCE, polytechnical school, first degree, or higher degree.

A similar specification is run using the level of tariff exposure experienced by state *s* in time *t,* T_{st}, instead of the stated tariff rate, τ_t. This allows me to compare households in states that were more or less exposed to changes in the tariff rate. I estimate the following specification using OLS:

$$(10)\ consumption_{ihst} = \alpha + \beta T_{st} + \theta X_{ht} + \gamma_s + \delta_t + \varepsilon_{hst}$$

Similar to the previous specification, I control for a vector of household covariates, X_{ht}, state fixed-effects, γ_s, and year fixed effects, δ_t. I also run the same specification but include state-specific time trends. The specification with state-specific time trends is:

$$(11)\ consumption_{ihst} = \alpha + \beta T_{st} + \theta X_{ht} + \gamma_s + \delta_t + \delta_s t + \varepsilon_{hst}$$

I assume that changes in the tariff rate are uncorrelated with state and time specific, unobservable shocks that would influence household consumption of rice. Since I utilize household per capita rice consumption from the baseline period and state rice production from 2006 to construct my tariff measure, any bias impacting T_{st} would need to be correlated with the relative per capita rice consumption in the baseline period and the change in the rice tariff rate.

The household per capita consumption is likely to suffer from measurement error. First, the household per capita consumption is calculated by a seven-day expenditure recall survey. Households that do not consume rice daily may have worse recall than house that regularly consume rice for meals. Secondly, all per capita consumption is measured in grams (g); however, households reported their consumption in different units. Even though unit conversions were provided, it is likely that the conversions are imprecise.

7. Results

7.1 Tariff Pass-Through

Table 6 and 7 report the estimates for the tariff pass-through model. First, an OLS model following equation (3) is run. To address the concern that the local substitute prices are endogenous, the same model is running utilizing the two-year lagged values of the local substitute price. While it would be ideal to utilize other data to instrument for the local substitute prices, the first-stage results indicate that the two-year lagged values are a valid instrument. Results are given for the tariff rate, and for each of its one month lags.

Column 4 of **Table 6** shows that there is a 7 percent pass-through of the rice tariff rate to imported rice prices. The two stage least-squares (2SLS) model, as reported in **Table 7**, finds a similar tariff

pass-through of 7.9 percent. In both models, local substitute price and the world price have significant, positively correlated relationships with the imported rice price.

The 7 to 8 percent rice tariff pass-through is smaller than the tariff pass-through found for agricultural products in other countries. Nicita (2009) finds a 33 percent pass-through rate for agricultural products in Mexico. Duran and LaFleur (2011) find a tariff pass-through rate of 8 percent for a cluster of food products in Chile. Given the evidence of tariff evasion and smuggling in Nigeria, a tariff pass-through of 7 percent is reasonable.

Table 8 reports the OLS results utilizing the production-based measure of tariff-exposure. The results indicate a positive and significant relationship between the state-level tariff measure and the change in the state price of imported rice. The positive coefficient suggests that districts that are more exposed to tariff changes (based on their 2000 production of rice), experience a larger increase in the price of imported rice than the national trend. States that experienced the average change in tariff protection have a tariff pass-through 4.6 percent greater than the national baseline, as shown in column 4 of **Table 8.** Similar to **Table 6** and **Table 7**, local rice and Thai rice prices have a positive and significant relationship with the price of imported rice.

7.2 Household Consumption

After demonstrating that changes in the tariff rate have a positive and significant impact on the price of imported rice, I seek to show that household consumption of rice is also impacted by the changes in the tariff rate and the related price changes. I utilize household seven-day consumption of imported rice measured in grams, as reported in the seven-day food expenditure survey of the GHS, as my dependent variable.

I start by running my base OLS specification, as reported in **Table 9**. Across all four tariff variables, I find that increases in the tariff rate are negatively associated with household consumption of imported rice. For the tariff rate (column 1), the tariff rate lagged one month (column 2), and the tariff rate lagged two months (column 3), a one percentage point increase in the tariff rate is associated with a 3.2 to 3.6-gram reduction in a household's seven-day consumption of imported rice. For the tariff rate lagged three months (column 4), a one percentage point increase in the tariff rate is associated with a 23-gram reduction in a household's seven-day consumption of imported rice. The average household consumes approximately 2.5 kilograms of rice over a seven-day period. Thus, a one percentage point increase in the tariff rate on rice is associated with a .9 percent reduction in a household's seven-day consumption of imported rice.

I utilize the same specification to examine how changes in the tariff rate impact household consumption of local rice (**Table 10)** and total rice (**Table 11)**. Using the tariff rate (column 1), tariff rate lagged one month (column 2), and the tariff rate lagged two months (column 3), I find that a one percentage point increase in the tariff rate is associated with an approximately 7.5 gram increase in household seven-day local rice consumption (**Table 10**). Following the theoretical framework, I expect that as the tariff rate on imported rice increases household consumption of local rice increases. The results from columns 1-3 of **Table 10** support this argument. However, when the three month lagged tariff rate is utilized, there is a negative coefficient on the tariff rate. This indicates that as the tariff rate increases household consumption of local rice declines. The negative coefficient on the tariff rate may be a sign that there are changes occurring in Nigerian rice consumption that are not accounted for in this model.

Household total rice consumption decreases in response to an increase in the tariff rate (see column 4 of **Table 11**). When the tariff rate rises, part of the higher tariff rate is passed on to consumers in the form of higher imported rice prices. Households lower their total rice consumption when faced with higher rice prices.

I run the same specification again, but instead of using the national tariff level, I utilize the state-specific tariff exposure, as specified in equation (10). The OLS results in **Table 12** indicate a negative and significant relationship between the three-month lagged, state-level tariff measure and the household per capita consumption of imported rice (g). The negative coefficient found in column (4) suggests that households in states more exposed to changes in the rice import tariff rate decrease their per capita consumption of imported rice more than the national-trend.

The same specification is run using household per capita consumption of local rice and total rice. I find that households in states that are more exposed to changes in the rice import tariff rate increase their per capita consumption of local rice more than the national trend (**Table 13**) and decrease their total per capita rice consumption more than the national trend (**Table 14**). These results suggest that households in regions that are the most exposed to rice tariff changes based off of baseline rice consumption substitute a portion of their imported rice consumption for local rice, but their overall rice consumption falls.

To account for any state specific time trends, I add a state time trend to the tariff exposure model (as shown in equation (11)). When the state-specific time trend is added, the coefficient on the three-month lagged tariff exposure becomes insignificant but remains negatives (**Table 15**).

I also run the tariff exposure model using a rice production based tariff measure. The results for the production based tariff exposure model are presented in **Table 16**. I find that states that are more exposed to changes in the tariff rate based on their production decrease their consumption of imported and total rice more than the national trend. These results are in agreement with my findings of tariff pass-through. As shown in **Table 8**, states that have a higher production based exposure to tariff changes experience a larger pass through of tariffs to the price of imported rice.

8. Conclusions

This paper analyzes whether changes in Nigeria's tariff rate pass-through to market prices of imported rice and household consumption. To identify the tariff pass-through, I utilize a standard tariff pass-through model, more specifically I follow the model of Nicita (2009). I find that there is a 7 percent pass-through of the tariff rate to imported rice prices. Tariff pass-through is greater in areas that are more exposed to changes in the tariff rate based off of their production. The tariff pass-through is lower than that found in Takeshima and Masias (2013) and Nacita (2009), but in line with Duran and LaFleur (2011). Given Nigeria's issues with tariff evasion and smuggling, the tariff pass-through is reasonable.

I also show that household consumption of imported rice decreases in response to an increase in the rice tariff rate. Household total rice consumption also falls, although total rice consumption declines by less than imported rice consumption. Households that are relatively more exposed to changes in the tariff rate based off of their state's baseline rice consumption and production decrease their consumption of imported rice and total rice more than the national trend but increase their consumption of local rice more than the national trend. These findings suggest that households substitute a portion of their consumption of imported rice to local rice.

Further work should be done to identify if the net losses faced by households outweigh the net gains received by rice producers. If the tariffs are effective in protecting and promoting the domestic industry, a slight decline in household welfare may be permitted to avoid large food security issues in the future. Nigeria should consider reducing its tariff rate to the 30-40 percent range, as suggested by Johnson and Dorosh (2015), to reduce the lucrativeness of smuggling rice. A reduction in the tariff rate needs to be coupled with further investments in increasing the productivity per hectare. Reducing Nigeria's food importation bill is important for protecting Nigeria against future fluctuations in global commodity prices and world food crises.

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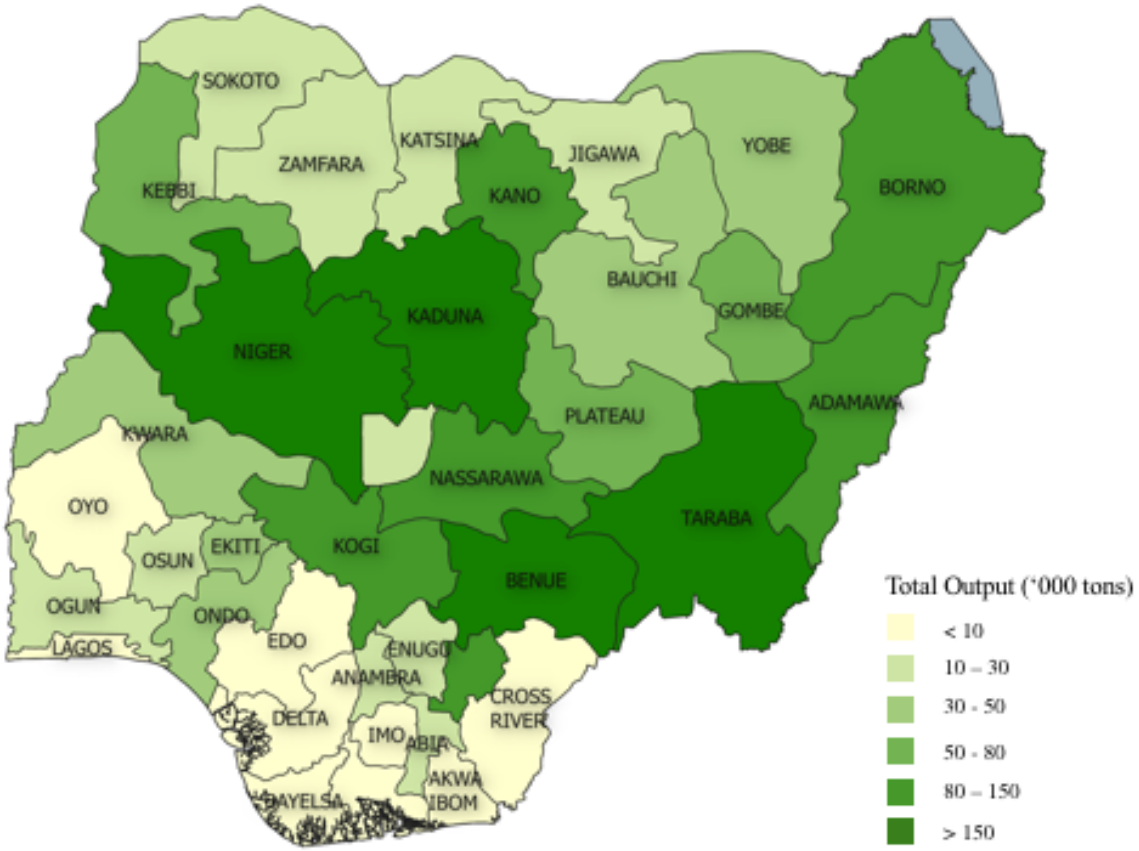
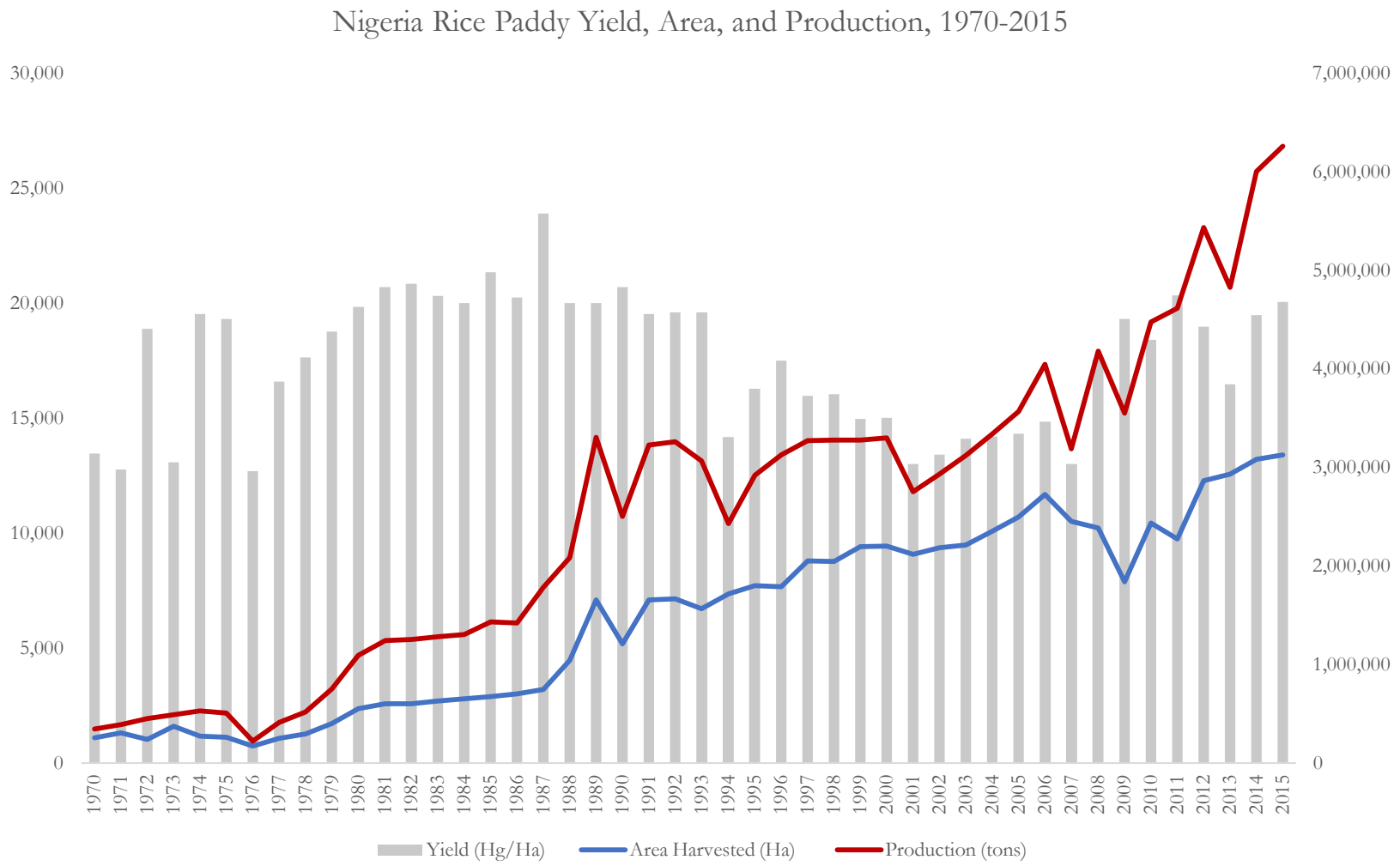
Map 1: Rice Production (2001)



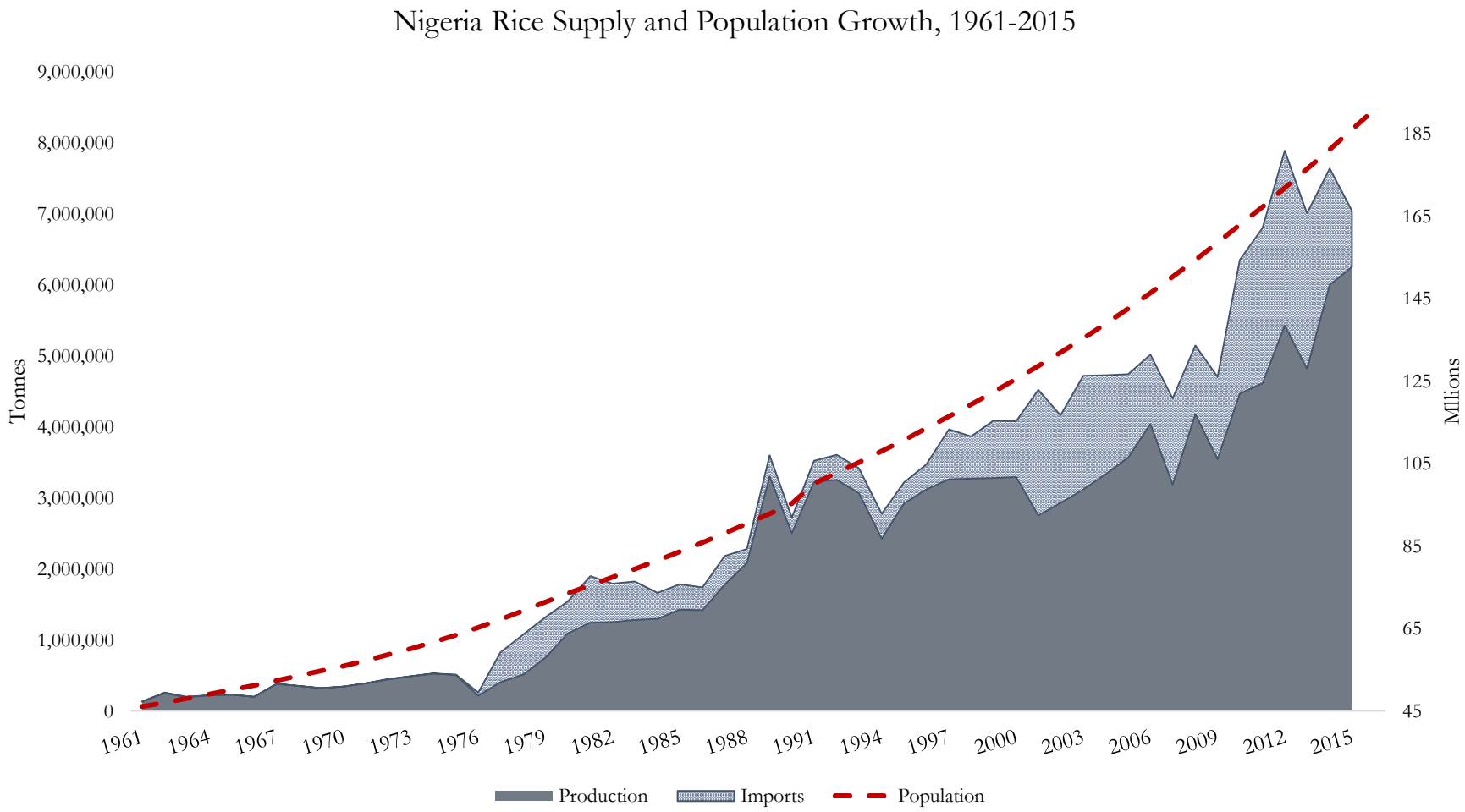
Source: Data taken from Akpokodje et al. (2001)

Figure 1: Rice Paddy Yield, Area, and Production



Source: FAOSTAT

Figure 2: Rice Supply and Population Growth



Sources: World Bank, FAOSTAT

Table 1: Rice Imports to Nigeria, 2001-2010

	(1) Official Imports (thousand tons)	(2) FAOSTAT Nigeria Imports (thousand tons)	(3) USDA Nigeria Imports (thousand tons)	(4) COMTRADE Nigeria Imports (thousand Tons)	(5) COMTRADE Exports to Nigeria (thousand tons)	(6) Official Imports vs. FAOSTAT Nigeria Imports
2001		1,770	1,906	1,100	1,660	
2002		1,236	1,897	1,233	1,291	
2003		1,600	1,448	2,457	777	
2004		1,396	1,369		1,141	
2005		1,174	1,777		1,314	
2006		975	1,600	2,552	1,027	
2007		1,216	1,550	1,014	611	
2008	318	971	1,800	160	1,020	32.75%
2009	330	1,161	2,000	398	1,415	28.42%
2010	551	1,883	2,000	711	2,035	29.26%
2001-2005		1,435	1,679	1,596	1,237	
2006-2010	400	1,241	1,790	967	1,222	

Source: National Bureau of Statistics (NBS), United States Department of Agriculture, FAOSTAT, COMTRADE United Nations Commodity Trade Statistics Database

Note: Adapted from Dorosh and Malek (2016)

Table 2: Official Rice Imports and Tariff Revenue

	Net Weight ('000 tons)	Value (bn Naira)	Revenue (bn Naira)	Price (Naira/kg)	Average Tariff Collected
Broken Rice					
2007	100	10	22	104	208%
2008	19	1	2	43	205%
2009	64	13	6	207	42%
2010	2	2	1	827	39%
2011	8	3	2	413	55%
Husked (brown) rice					
2007	41	1	1	13	210%
2008	10	0	1	40	202%
2009	3	4	1	1,211	22%
2010	32	12	2	370	15%
2011	7	10	1	1,335	10%
Other Milled Rice*					
2007	2,314	50	82	22	162%
2008	318	10	20	31	203%
2009	330	53	23	160	43%
2010	551	61	35	110	58%
2011	270	140	75	517	53%
All Rice**					
2007	2,455	61	105	25	171%
2008	348	11	23	32	203%
2009	398	70	29	176	42%
2010	585	74	38	127	51%
2011	286	153	78	536	51%

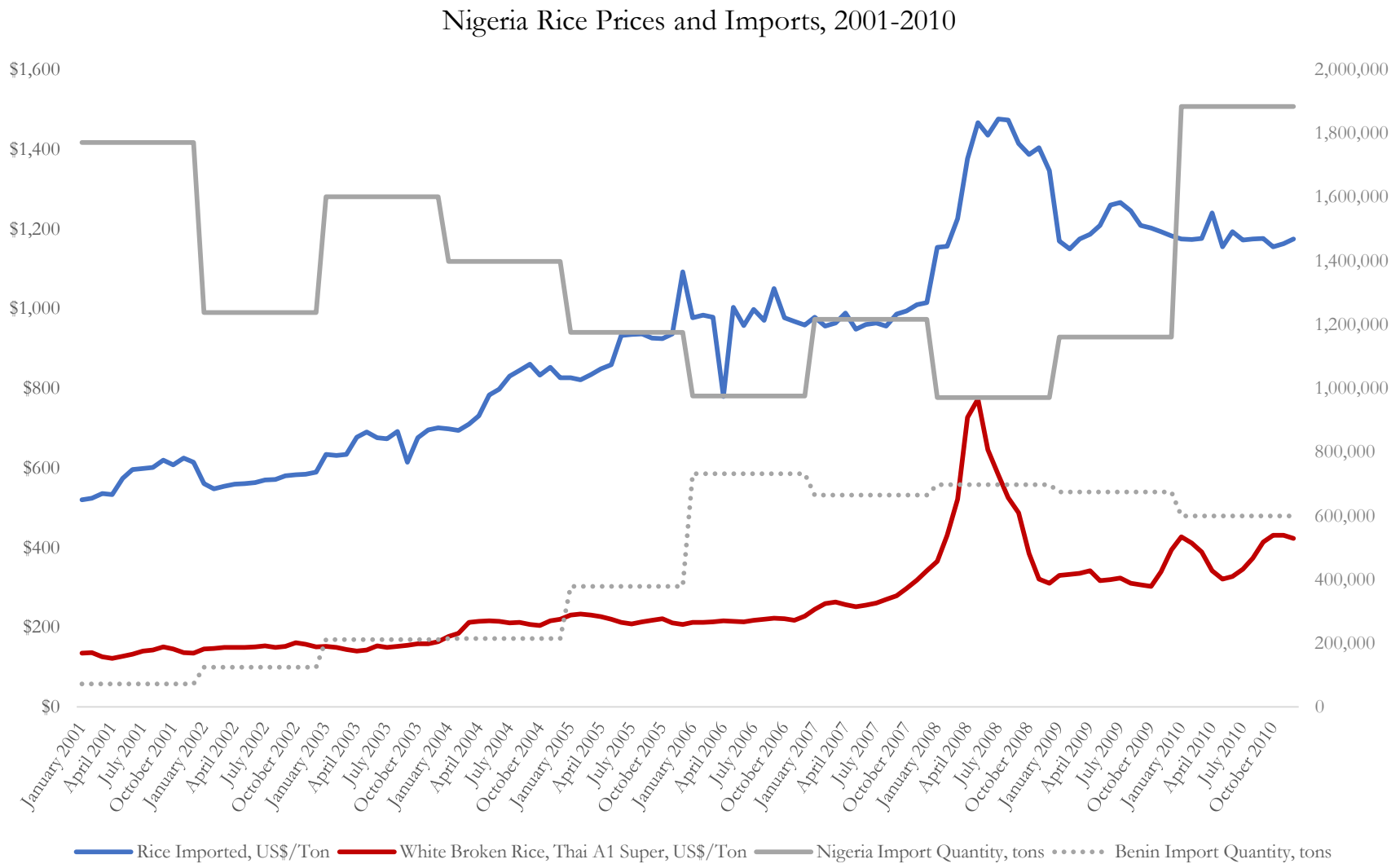
Taken from Dorosh and Malek (2016) and Johnson and Dorosh (2015)

Notes:

* "Milled and semi-milled rice".

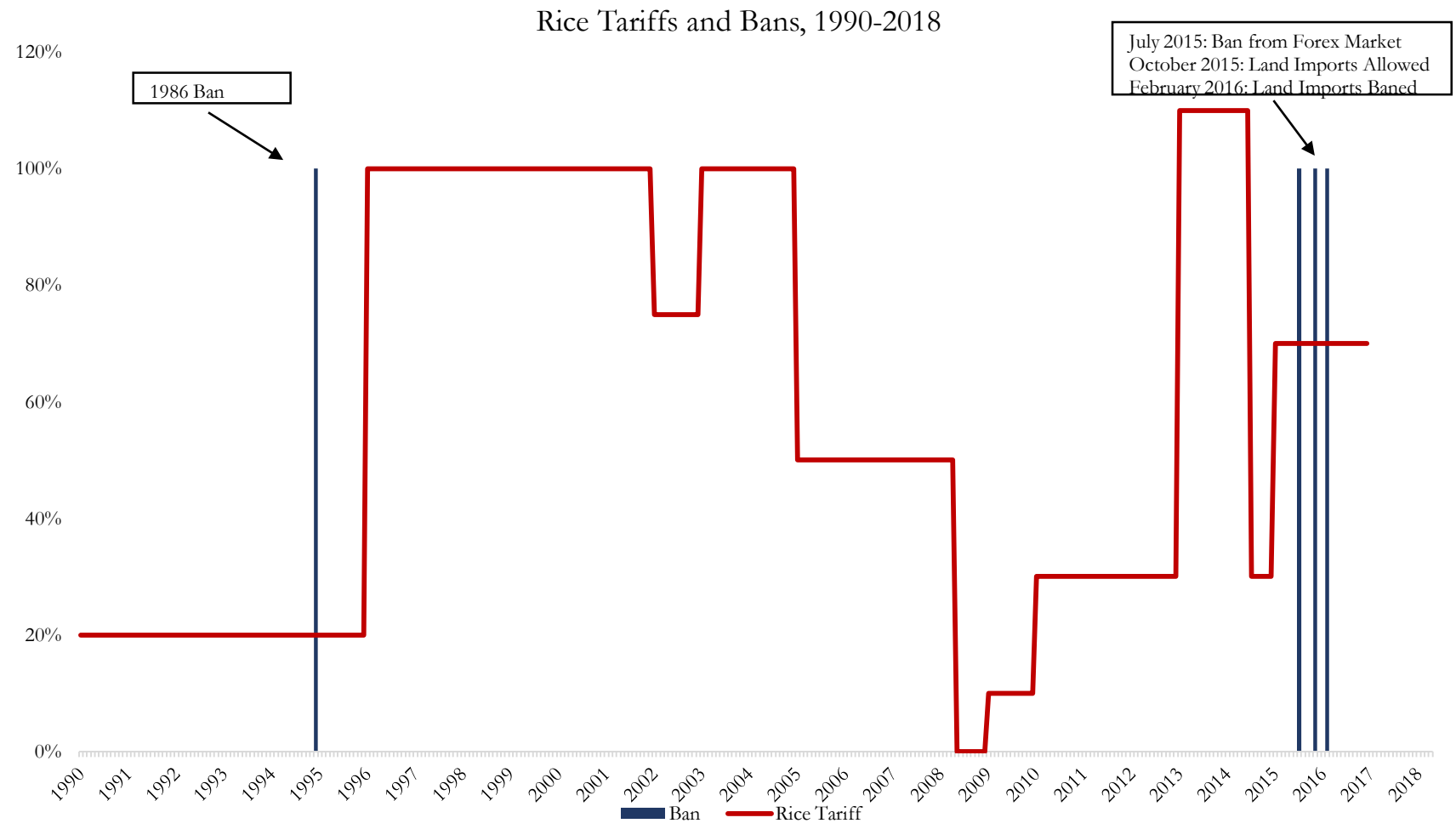
** Includes very small amounts of rice seed, rice in husk (paddy or rough rice) and "other rice".

Figure 3: Nigeria and Benin Rice Imports



Sources: FAOSTAT, NBS Select Prices for Retail Items

Figure 4: Rice Import Tariff Rate

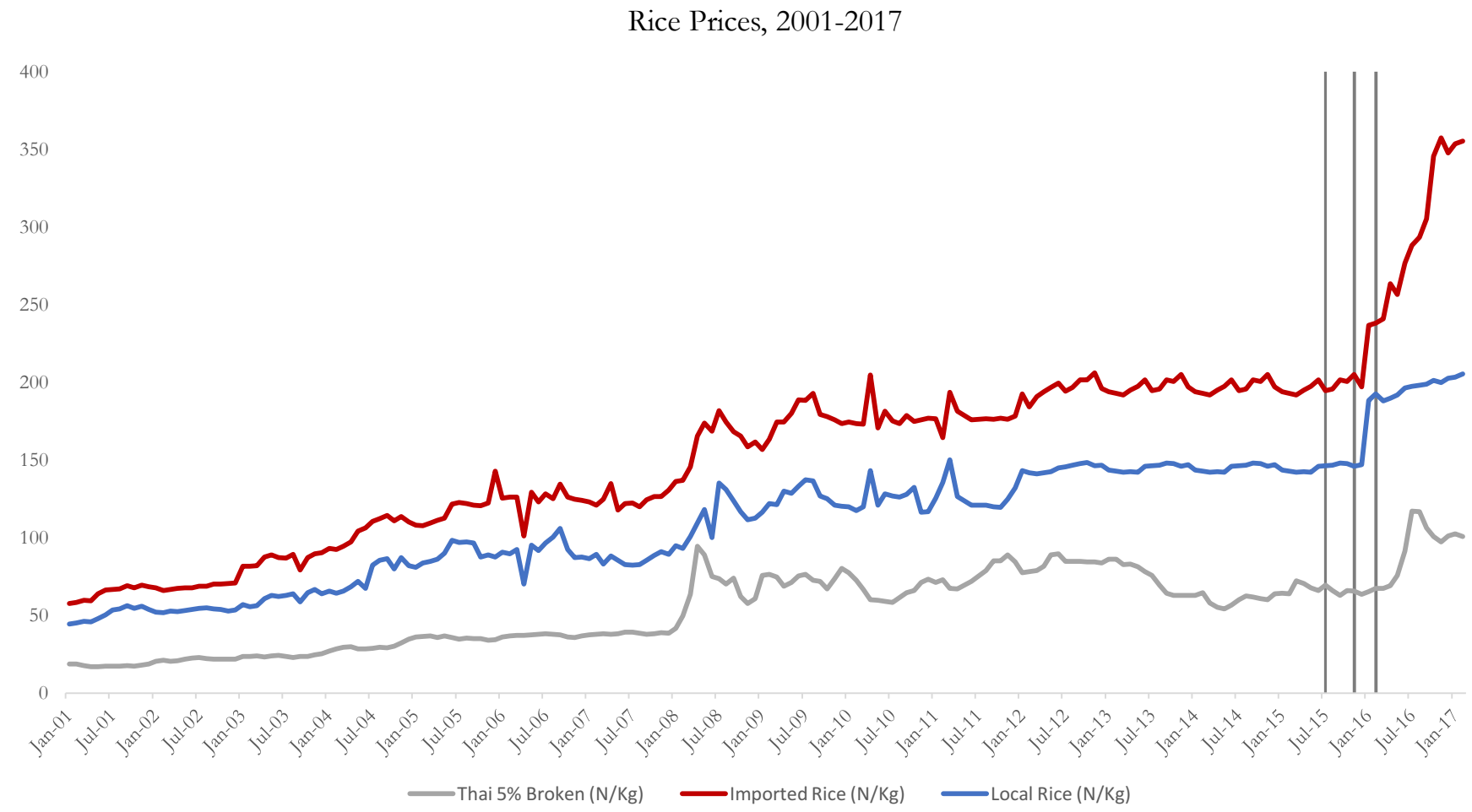


Sources: UNCTAD TRAINS Database, USDA GAIN Reports

Table 3: NBS Retail Prices for Select Items Summary Statistics

	Year	Mean	SD	Min	Max
Imported Rice	2001	64.36442	7.385941	48.92105	100
	2006	124.4728	16.47681	77.86	208.22
	2011	179.026	20.10073	117.681	342.8929
	2016	287.4878	72.61787	138.5005	819.25
Local Rice	2001	50.56087	8.020577	33.34182	80.002
	2006	91.58389	16.95929	50	184.66
	2011	126.4612	34.83507	78.02512	648
	2016	195.4344	39.08311	129.3925	327.0758
Maize	2001	36.64114	11.78456	16.782	111.1028
	2006	54.13322	19.92055	21.04	101.52
	2011	77.93328	52.77052	35	882.2287
	2016	401.6123	74.30313	268.66	713.42
White Gari	2001	54.41782	11.7473	21.67	81.55444
	2006	69.56665	12.6421	29.35	124.49
	2011	113.2626	55.96751	66.94	975
	2016	265.351	70.09396	133.9375	540.4478
Yellow Gari	2001	57.0271	16.97246	19.2	98.066
	2006	76.20892	14.92678	32.29	128.33
	2011	129.7898	61.90715	66.11	1037.5
	2016	332.4312	73.61312	182.6677	623.475
White Beans	2001	54.50836	14.75441	28.50154	118.6279
	2006	74.33254	18.47316	35.16	123.87
	2011	134.5308	99.41607	68.55	1748.851
	2016	128.4419	16.79228	100	307.2372
Brown Beans	2001	61.9322	14.3222	25.42333	91.66667
	2006	87.38184	22.63207	45	168.63
	2011	150.1702	26.43818	80	340.195
	2016	781.4214	279.4821	400	5000
Yams	2001	39.62634	12.69418	19.00286	93.1769
	2006	71.9336	18.9342	31.8	139.95
	2011	126.4695	68.4551	38.24333	750
	2016	722.7933	72.27069	520.2375	958.3548

Figure 5: Imported, Local, and Thai Rice Prices



Source: Author's calculations using NBS Retail Prices for Select Items, FAOSTAT

Table 4: Baseline Summary Statistics

Table: Baseline Summary Statistics of Households

	Rural		Urban		All	
	Mean	N	Mean	N	Mean	N
Consumption Local Rice	.563	2,314	.241	1,229	.421	3,543
Consumption Imported Rice	.405	2,314	.744	1,229	.554	3,543
Consume Own Production	.092	2,317	.018	1,229	.059	3,546
Consume Imported & Local	.050	2,317	.040	1,229	.049	3,546
Household Size	5.822	3,029	4.971	1,354	5.481	4,383
Number of Dependents	1.990	3,000	1.406	1,338	1.757	4,338
Christian	.512	3,052	.615	1,355	.553	4,407
Islamic	.463	3,052	.380	1,355	.430	4,407
Other Religion	.023	3,052	.004	1,355	.015	4,407
Higher Degree (Head of HH)	.048	3,042	.126	1,352	.079	4,394
Cultivate Land	.803	3,034	.213	1,348	.568	4,382
Work in Agriculture Sector	.732	3,050	.170	1,355	.508	4,405
Expenditure Per Person	83,027	3,000	147,208	1,338	108,613	4,338

Source: Author's Calculation using GHS 2010 Post-Planting Data

Notes: Consumption of local rice and consumption of imported rice are the average number of kilograms consumed per person over the last seven days. Number of dependents refers to the number of household members below the age of 15. Consume Own Production refers to the percentage of households that produced at least part of the rice they consumed. Consume Imported & Local is the percentage of households that consumed both imported and local rice during the past 7 days. Higher Degree (Head of HH) is the percentage of households that have a head of household with a Bachelor's degree or higher. Expenditure Per Person is measured in Naira.

Table 5: Household Expenditure Summary Statistics (2010 Post-Harvest)

Table: Summary Statistics of Household Expenditures from GHS (as Share of Total Expenditure)

	2010		2013		2015	
	Rural	**Urban**	**Rural**	**Urban**	**Rural**	**Urban**
Food Share	0.787	0.675	0.725	0.615	0.731	0.622
Grains and Flours	0.177	0.170	0.172	0.160	0.183	0.168
Rice - Local	0.070	0.032	0.093	0.035	0.099	0.043
Rice - Imported	0.036	0.065	0.036	0.064	0.030	0.058
Cassava	0.003	0.002	0.002	0.001	0.002	0.000
Meat	0.099	0.086	0.0947	0.084	0.081	0.081
Chicken	0.007	0.007	0.005	0.007	0.004	0.008
Fish	0.093	0.075	0.090	0.072	0.088	0.080
Nonfood	0.179	0.283	0.235	0.338	0.225	0.329
Education	0.034	0.043	0.040	0.047	0.043	0.114

Source: Author's calculations utilizing GHS 2010 Post-Harvest data
*Expenditures on rice are likely a lower bound as calculations are from the post-harvest data

Image 1: Food Measurement Example

Source: General Household Survey

Table 6: The Effect of Tariff Changes on State Prices of Imported Rice (OLS)

Dependent Variable: Log(Price of Imported Rice)	(1) Tariff	(2) Tariff Lag 1 Month	(3) Tariff Lag 2 Months	(4) Tariff Lag 3 Months
Local Rice	0.374***	0.378***	0.379***	0.376***
	(0.0203)	(0.0204)	(0.0207)	(0.0209)
Thai Price	0.211***	0.223***	0.232***	0.234***
	(0.0150)	(0.0150)	(0.0151)	(0.0152)
Tariff	-0.113***	-0.00921	0.0512***	0.0701***
	(0.0218)	(0.0159)	(0.0135)	(0.0121)
Constant	2.128***	2.015***	1.956***	1.945***
	(0.0917)	(0.0870)	(0.0882)	(0.0888)
Observations	6,780	6,744	6,708	6,672
R-squared	0.962	0.962	0.961	0.961
State Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
State Time Trend	Yes	Yes	Yes	Yes

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Notes: All variables are in log form.

Table 7: The Effect of Tariff Cuts on Monthly, State-Level Market Prices for Imported Rice (IV)

7.1 First Stage

Local Rice	(1) Tariff	(2) Tariff Lag 1 Month	(3) Tariff Lag 2 Months	(4) Tariff Lag 3 Months
Local Rice 2 Year Lagged	0.367***	0.377***	0.376***	0.378***
	(0.0204)	(0.0203)	(0.0202)	(0.0202)
F-stat	321.76	342.73	345.56	338.28

7.2 IV

Dependent Variable: Log(Price of Imported Rice)				
Local Rice	0.460***	0.475***	0.486***	0.486***
	(0.0341)	(0.0329)	(0.0329)	(0.0333)
Thai Price	0.213***	0.218***	0.222***	0.224***
	(0.0175)	(0.0173)	(0.0174)	(0.0175)
Tariff	-0.0739***	0.00658	0.0621***	0.0790***
	(0.0265)	(0.0170)	(0.0144)	(0.0128)
Constant	1.808***	1.682***	1.596***	1.582***
	(0.152)	(0.138)	(0.138)	(0.138)
Observations	6,517	6,517	6,517	6,481
R-squared	0.944	0.944	0.944	0.943
State FE	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
State Time Trend	Yes	Yes	Yes	Yes

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Notes: All variables are in log form

Table 8: The Effect of Tariff Exposure on State Prices for Imported Rice

Dependent Variable: Log(Price of Imported Rice)	(1) Tariff	(2) Tariff Lag 1 Month	(3) Tariff Lag 2 Month	(4) Tariff Lag 3 Month
Local Rice	0.378***	0.373***	0.365***	0.366***
	(0.0287)	(0.0282)	(0.0284)	(0.0281)
Thai Price	0.212***	0.228***	0.244***	0.252***
	(0.0198)	(0.0191)	(0.0194)	(0.0185)
Tariff Exposure	0.0603	0.0387***	0.0439***	0.0462***
	(0.0603)	(0.00849)	(0.00727)	(0.00672)
Constant	2.282***	2.177***	2.185***	2.168***
	(0.297)	(0.130)	(0.131)	(0.125)
Observations	6,505	6,480	6,436	6,401
R-squared	0.964	0.963	0.963	0.963
State FE	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
State Time Trend	Yes	Yes	Yes	Yes

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Note: All variables are in log form. Standard errors are clustered by state

Table 9: Effect of Tariff Changes on Household Consumption of Imported Rice (OLS)

Dependent Variable HH Consumption of Imported Rice (g)	(1) Tariff	(2) Tariff Lag 1 Month	(3) Tariff Lag 2 Month	(4) Tariff Lag 3 Month
Tariff	-3.206**	-3.206**	-3.625***	-22.85***
	(1.259)	(1.259)	(1.254)	(2.023)
Constant	3,531***	3,531***	3,585***	5,183***
	(1,103)	(1,103)	(1,105)	(1,058)
Observations	18,872	18,872	18,872	18,872
R-squared	0.204	0.204	0.204	0.218
Enumeration Area Fixed Effects	Yes	Yes	Yes	Yes
State Fixed Effects	Yes	Yes	Yes	Yes

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Notes: Household controls include income, a dummy for if the head of household has a higher education, household members, religion, a dummy for if the household produces rice, and a rural dummy. Proper population weights are utilized.

Table 10: Effect of Tariff Changes on Household Consumption of Local Rice (OLS)

Dependent Variable: HH Consumption of Local Rice (g)	(1) Tariff	(2) Tariff Lag 1 Month	(3) Tariff Lag 2 Month	(4) Tariff Lag 3 Month
Tariff	7.646***	7.646***	7.466***	-4.509***
	(1.103)	(1.103)	(1.117)	(1.271)
Constant	910.6*	910.6*	914.4*	1,557***
	(479.4)	(479.4)	(480.6)	(477.4)
Observations	24,083	24,083	24,083	24,083
R-squared	0.156	0.156	0.156	0.154
Enumeration Area Fixed Effects	Yes	Yes	Yes	Yes
State Fixed Effects	Yes	Yes	Yes	Yes

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Notes: Household controls include income, a dummy for if the head of household has a higher education, household members, religion, a dummy for if the household produces rice, and a rural dummy. Proper population weights are utilized.

Table 11: Effect of Tariff Changes on Household Total Rice Consumption (OLS)

Dependent Variable: HH Total Rice Consumption (g)	(1) Tariff	(2) Tariff Lag 1 Month	(3) Tariff Lag 2 Month	(4) Tariff Lag 3 Month
Tariff	-1.637	-1.637	-2.288	-21.98***
	(1.419)	(1.419)	(1.418)	(1.996)
Constant	2,354***	2,354***	2,414***	3,969***
	(626.1)	(626.1)	(627.6)	(620.4)
Observations	18,872	18,872	18,872	18,872
R-squared	0.178	0.178	0.178	0.192
Enumeration Area Fixed Effects	Yes	Yes	Yes	Yes
State Fixed Effects	Yes	Yes	Yes	Yes

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Notes: Household controls include income, a dummy for if the head of household has a higher education, household members, religion, a dummy for if the household produces rice, and a rural dummy. Proper population weights are used

Table 12: Effect of Changes in Tariff Exposure on HH Per Capita Consumption of Imported Rice (g)

Dependent Variable: HH Per Capita Consumption of Imported Rice (g)	(1) Tariff	(2) Tariff Lag 1 Month	(3) Tariff Lag 2 Months	(4) Tariff Lag 3 Months
Tariff Exposure	-3.286	-3.286	-3.676	-28.27***
	(5.605)	(5.605)	(5.615)	(7.950)
Constant	401.1*	401.1*	404.2*	588.4***
	(215.5)	(215.5)	(215.9)	(220.0)
Observations	20,678	20,678	20,678	20,678
R-squared	0.170	0.170	0.170	0.172
Household Controls	Yes	Yes	Yes	Yes
State Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Notes: Standard errors are clustered by state. Household controls include income, a dummy for if the head of household has a higher education, household members, religion, a dummy for if the household produces rice, and a rural dummy. Proper population weights are utilized

Table 13: Effects of Changes in Tariff Exposure on HH Per Capita Consumption of Local Rice

Dependent Variable:	(1)	(2)	(3)	(4)
HH Per Capita Consumption of Local Rice (g)	Tariff	Tariff Lag 1 Month	Tariff Lag 2 Months	Tariff Lag 3 Months
Tariff Exposure	-1.056	-1.056	-1.635	7.436**
	(2.429)	(2.429)	(2.920)	(3.490)
Constant	-127.9	-127.9	-123.6	-191.1*
	(107.0)	(107.0)	(109.7)	(112.2)
Observations	20,678	20,678	20,678	20,678
R-squared	0.279	0.279	0.279	0.279
Household Controls	Yes	Yes	Yes	Yes
State Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Notes: Standard errors are clustered by state. Household controls include income, a dummy for if the head of household has a higher education, household members, religion, a dummy for if the household produces rice, and a rural dummy. Proper population weights are utilized.

Table 14: Effect of Changes in Tariff Exposure on HH Per Capita Consumption of Rice

Dependent Variable: HH Per Capita Consumption of Total Rice (g)	(1) Tariff	(2) Tariff Lag 1 Month	(3) Tariff Lag 2 Months	(4) Tariff Lag 3 Months
Tariff Exposure	-4.342	-4.342	-5.310	-20.84***
	(5.589)	(5.589)	(5.893)	(7.856)
Constant	273.2	273.2	280.6	397.3
	(234.8)	(234.8)	(236.6)	(242.1)
Observations	20,678	20,678	20,678	20,678
R-squared	0.096	0.096	0.096	0.097
Household Controls	Yes	Yes	Yes	Yes
State Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Notes: Standard errors are clustered by state. Household controls include income, a dummy for if the head of household has a higher education, household members, religion, a dummy for if the household produces rice, and a rural dummy. Proper population weights are utilized.

Table 15: Effect of Changes in Tariff Exposure on HH Per Capita Consumption of Imported Rice (g) (with State Time Trends)

VARIABLES	(1) Tariff	(2) Tariff Lag 1 Month	(3) Tariff Lag 2 Months	(4) Tariff Lag 3 Months
Tariff Exposure	-596.1**	-596.1**	-34.28	-0.0157
	(252.6)	(252.6)	(26.93)	(0.0282)
Constant	1,608***	1,608***	777.4***	3.116***
	(472.1)	(472.1)	(135.9)	(0.846)
Observations	20,603	20,603	20,603	20,603
R-squared	0.230	0.230	0.230	0.269
Household Controls	Yes	Yes	Yes	Yes
State Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
State Time Trend	Yes	Yes	Yes	Yes

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Notes: Standard errors are clustered by state. Household controls include income, a dummy for if the head of household has a higher education, household members, religion, a dummy for if the household produces rice, and a rural dummy. Proper population weights are utilized

Table 16: Effects of Changes in Production Based Tariff Exposure on HH Per Capita Consumption of Imported, Local, and Total Rice

Dependent Variables:	(1) Imported Rice (g)	(2) Local Rice (g)	(3) Total Rice (g)
Tariff Exposure	-0.293***	-0.185	-0.478***
(Lagged 3 Months)	(0.103)	(0.138)	(0.148)
Constant	1,194***	629.2***	1,823***
	(451.1)	(150.8)	(465.4)
Observations	22,337	22,337	22,337
R-squared	0.191	0.295	0.107
Household Controls	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
State Fixed Effects	Yes	Yes	Yes
State Time Trend	Yes	Yes	Yes

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Note: Standard errors are clustered by state. Household controls include income, a dummy for if the head of household has a higher education, religion, a control for if the household produces rice, and a rural control. Proper population weights are utilized.