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Production Shocks, Exports and Market Prices

An Analysis of the Rice Sector in Myanmar

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ABSTRACT

Since 2012/13, rice exports to China (which may have reached two million tons in 2015/16) boosted total demand for Myanmar's rice and rice prices. In mid-2016, however, China stopped rice imports through the main land entry point, putting substantial downward pressure on prices. Analysis presented in this paper, based on econometric estimates of consumption parameters and a simple model of Myanmar's rice supply and demand, suggests that market prices would fall by 26 to 43 percent or more (in real terms) in the absence of increased exports to the world market and/or government domestic procurement. Such a decline in prices could have seriously harmed Myanmar's rice producers, including many poor farmers with marketable surpluses. Model simulations suggest that government procurement of about one million tons would limit the estimated price decline to only 17 to 30 percent. Further refinements in the simulations are needed to take account for the seasonal nature of paddy production in Myanmar, possible price-responsiveness of export demand and the effects of changes in paddy incomes on farmer demand for rice. Medium-term analysis of procurement, storage and future sales is needed to analyze fiscal costs under various scenarios, as well, covering alternative shocks to production, export demand and world prices. Nonetheless, the main results are clear: without substantial market interventions on the order of one million tons (milled rice equivalent), the paddy (rice) price could fall dramatically when production increases or export demand declines.

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1. INTRODUCTION

Myanmar, once the world's largest exporter of rice, saw its exports decline dramatically from a peak of nearly three million tons per year in the 1930s, to 1.2 million tons per year in the 1960s, to only 500 to 600 thousand tons per year in 1970s and 1980s and to just 400 thousand tons per year in the first decade of the 2000s. Several factors contributed to this decline, including a steady appreciation of the kyat that raised the price of Myanmar (Burma) rice in dollar terms, improved quality of rice in international markets while Burmese rice quality stagnated or worsened, insufficient investment in rice production technology and irrigation infrastructure, and state control of markets that provided little incentives for private investment in rice milling. While the competitiveness of the rice sector in Myanmar slowly deteriorated, Cambodia and Vietnam modernized their rice industries and captured a significant share of the international market (Wong and Wai, 2013; World Bank, 2014).

Since 2012, however, a new export channel of lower quality rice across land borders to China opened enabling total exports, (including both formal exports by ship through Yangon, as well as informal exports through land borders to surge to 1.5 million tons per year from 2012/13 through 2015/16. In mid-2016, however, China placed restrictions on imports of rice from Myanmar, sharply reducing demand for Myanmar's rice. Given that paddy production was expected to increase by about 10 percent in 2016/17 relative to 2015/16 (due largely to improved weather), domestic rice prices in the country could have dropped dramatically.

This note explores the implications of these shocks to export demand and domestic production for domestic rice prices in Myanmar. We also examine the potential impacts of domestic rice procurement on market prices under alternative scenarios.

The plan of the paper is as follows. Section two presents a discussion of the rice economy of Myanmar, covering production, consumption, exports and price movements. Section three presents an analysis of the production and demand shocks on domestic rice prices using a simple partial equilibrium model of Myanmar's rice sector. We then use the model to estimate the effects of various levels of procurement on domestic rice prices under alternative assumptions regarding price-responsiveness of producers and consumers of rice. Implications for procurement policy and suggestions for further work are presented in the final section.

2. OVERVIEW OF THE MYANMAR RICE ECONOMY

Paddy Production and the Supply-Demand Balance

Estimates of Myanmar rice production vary widely. Official production estimates by the Ministry of Agriculture, Livestock and Irrigation (MOALI) indicate that paddy production in 2014/15 was 29.37 million tons; alternative estimates by the US Department of Agriculture (USDA) are 33 percent lower – 19.7 million tons (Table 1).

This discrepancy is due mainly to a difference in yields, as area harvested estimates from the two sources are nearly the same: 7.15 million hectares (MOALI) and 7.03 million hectares (USDA). The large difference in yields, however, (4.11 tons/ha for MOALI as compared to 2.80 tons/ha for USDA. Up until the late 1990's USDA and MOALI yield estimates were similar. However, growth rates in yields and production differed sharply across sources in the 1999/2000 to 2010/11 periods (Figure 1). Since 2011/12, both sources indicate a declining trend in area, modest yield growth of 1.3 percent per year, and slow increases in production – 0.2 percent per year for MOALI and 1.0 percent per year for USDA.

Survey data on consumption and information on the level of exports from the Myanmar Rice Federation (MRF) provide a consistency check for production numbers and suggest that paddy production in Myanmar is closer to the lower (USDA) figure. The MOALI figure of 27.49 million tons of paddy production in 2015-16[1] implies net rice production of 16.72 million tons. Given MOALI consumption estimates of 150 kgs/person in urban areas and 187 kgs/person in rural areas, national rice consumption is 9.00 million tons (Table 2). Assuming no change in private stocks, the official production numbers and these per capita consumption estimates imply net exports of 7.72 million tons (calculated as the difference between net production and consumption), a figure far higher than the official figure of 1.5 million tons reported by the Ministry of Commerce or even informal estimates of perhaps as high as 2.5 to 3.5 million tons suggested by some traders (see below). USDA estimates place consumption at essentially the same level as MOALI (9.92 and 9.00 million tons, respectively), but given the lower production estimate, the residual (net exports) is only 1.5 million tons.[2]

Using alternative estimates of consumption based on the Integrated Household Living Conditions Assessment II (IHLCA) 2009-2010 data on per capita consumption and updated figures for population, national rice consumption is only 7.31 million tons. Assuming net production of rice of 11.42 million tons (the USDA estimate), exports would total 4.1 million tons. This latter figure for exports is relatively close to informal estimates of the Myanmar Rice Federation (about 2.5 to 3.5 million tons).

The 2016 survey by Myint et al. (2016) provides yet another estimate of consumption (7.95 million tons). Using this figure and assuming net exports of 2.5 or 3.5 million tons implies net rice production of 10.45 or 11.45 million tons, equivalent to 92 or 100 percent of the USDA rice production figure.

Thus, although there is considerable uncertainty with regard to the quantity of paddy and milled rice production, consumption and exports, household survey based data on production and consumption, along with estimates of export data from traders suggest that production of rice may be considerably less than the MOALI figure.

[1] Assumes that 2015-16 production is equal to 2014-15 production.

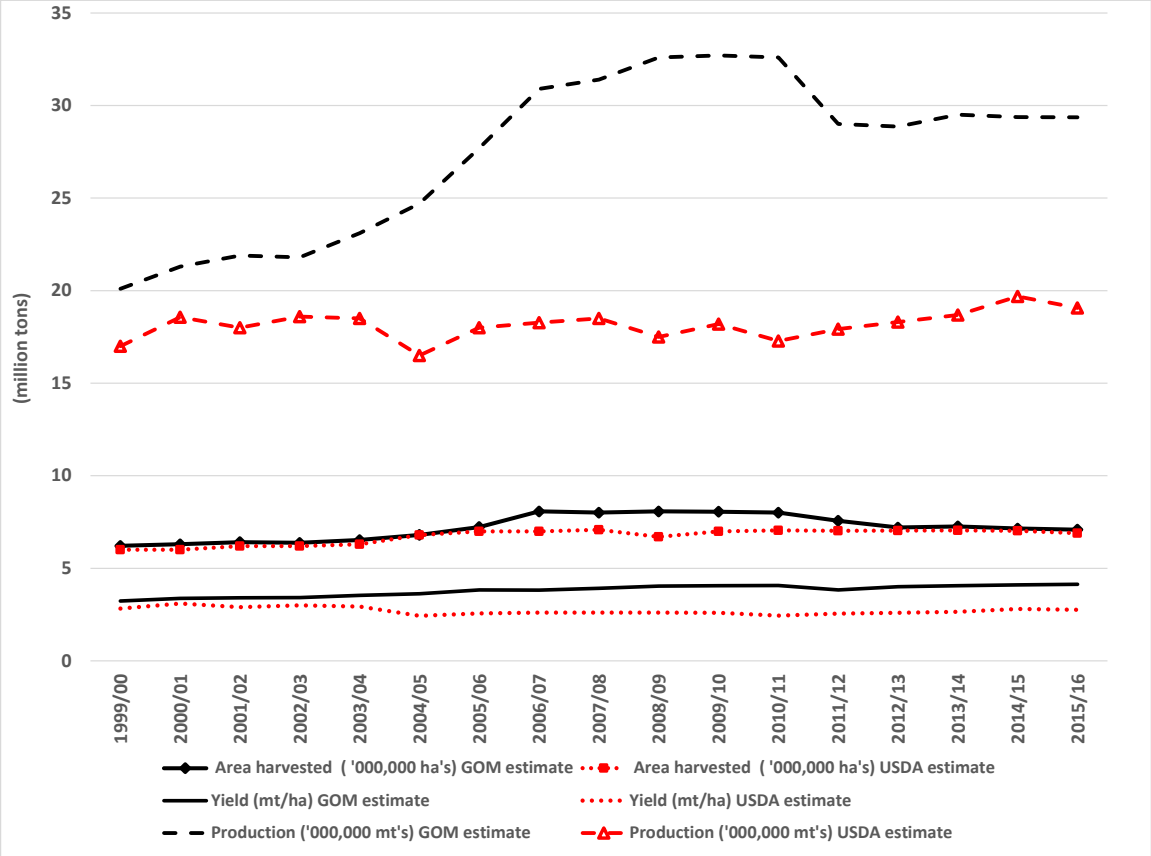
[2] The monsoon season accounts for 87 percent of paddy area harvested, but only 84 percent of production since summer season yields are 25 percent higher than those in the monsoon season (2014-15 data).

Table 1—Myanmar Paddy (Unmilled Rice) Area, Yield and Production, 1999/2000 – 2015/16

	Area Harvested (mn ha) MOAI	Yield (tons/ha) MOAI	Production (mn tons) MOAI	Area Harvested (mn ha) USDA	Yield (tons/ha) USDA	Production (mn tons) USDA	Production USDA / MOAI (percent)
1999/00	6.21	3.24	20.10	6.00	2.83	17.00	84.6%
2000/01	6.30	3.38	21.30	6.00	3.10	18.57	87.2%
2001/02	6.41	3.41	21.90	6.20	2.90	18.00	82.2%
2002/03	6.38	3.42	21.80	6.20	3.00	18.60	85.3%
2003/04	6.53	3.54	23.10	6.30	2.94	18.50	80.1%
2004/05	6.81	3.63	24.70	6.80	2.43	16.50	66.8%
2005/06	7.23	3.83	27.70	7.00	2.57	18.00	65.0%
2006/07	8.07	3.83	30.90	7.00	2.61	18.28	59.1%
2007/08	8.01	3.92	31.40	7.09	2.61	18.50	58.9%
2008/09	8.08	4.04	32.60	6.70	2.61	17.50	53.7%
2009/10	8.06	4.06	32.70	7.00	2.60	18.19	55.6%
2010/11	8.01	4.07	32.60	7.05	2.45	17.28	53.0%
2011/12	7.57	3.83	29.00	7.03	2.55	17.93	61.8%
2012/13	7.21	4.00	28.86	7.04	2.60	18.31	63.4%
2013/14	7.26	4.06	29.51	7.05	2.65	18.68	63.3%
2014/15	7.15	4.11	29.37	7.03	2.80	19.69	67.0%
2015/16	7.09	4.14	29.37	6.90	2.76	19.06	64.9%
1999/00-04/05	6.44	3.44	22.15	6.25	2.87	17.86	81.0%
2005/06-10/11	7.91	3.96	31.32	6.97	2.58	17.96	57.6%
2011/12-15/16	7.26	4.03	29.22	7.01	2.67	18.73	64.1%
Annual Average Growth							
1999/00-04/05	1.8%	2.3%	4.2%	2.5%	-3.0%	-0.6%	---
2005/06-10/11	2.1%	1.2%	3.3%	0.1%	-1.0%	-0.8%	---
2011/12-15/16	-1.1%	1.3%	0.2%	-0.3%	1.3%	1.0%	---

Source: MOAI, USDA, IHLCA, Myint et al. (2016) and authors' estimates.

Figure 1—Myanmar Paddy (Unmilled Rice) Production Estimates, 1999/2000 – 2015/16



Source: Government of Myanmar (MOAI) and USDA data.

Table 2— Alternative Estimates of Myanmar Rice Production, Consumption and Trade, 2015/16

Rice Estimates	Paddy Production (mn tons)	Rice Production (mn tons)	Percentage of USDA Production	Rice Net Production (mn tons)	Rice Exports (mn tons)	Rice Consumption (mn tons)
1. MOAI	27.49	17.87	146.4%	16.72	7.72	9.00
2. USDA	18.77	12.20	100.0%	11.42	1.50	9.92
3. USDA - IHLCA	18.77	12.20	100.0%	11.42	4.10	7.31
4. Myint et al., (2016)a	17.17	11.16	91.5%	10.45	2.5	7.95
5. Myint et al., (2016)a	18.81	12.23	100.2%	11.45	3.5	7.95

Source: MOAI, USDA, IHLCA, Myint et al. (2016) and authors' estimates.

Notes: MOAI consumption figure assumes per capita consumption of 150 kgs (urban) and 187 kgs (rural).

These calculations us a rice/paddy milling ratio of 0.60 and 6.4 percent losses for seed, feed and waste. kgs of rice from 1.0 kgs.

[a] Using Myint et al., consumption estimate and authors' rice export figures; production is calculated as a residual.

MOALI data on production by season indicate that 83 percent of production in 2016-17 derived from the main monsoon season, with nearly half of this harvested in the Delta region (Ayeyarwaddy, Bago and Yangon regions), (Table 3 and Figure 2). Production in the summer season, during which water is often a binding constraint (due to lower rainfall and lack of irrigation), is even more heavily concentrated in the Delta region (71 percent of the season's production). Overall, the Delta region accounted for 52 percent of production in 2016/17 according to the MOALI data, followed by the dry zone (Magway,

Mandalay, NapyPyiTaw and Sagaing) with 22 percent. The coastal (Thahnintharyi, Mon and Rakhine States) and the remaining Mountainous regions accounted for 11 and 15 percent of production, respectively.

Table 3— Myanmar Rice Production Estimates by Season, 2016-17

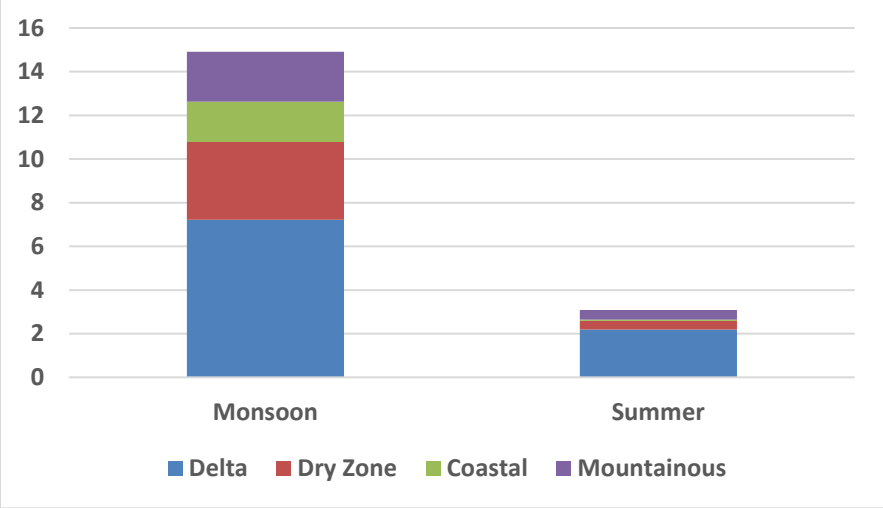
	Area Cultivated ('000 ha's)	Area Harvested ('000 ha's)	Yield[a] (tons/ha)	Production[a] (mn tons)	Season Share	Total Share
Monsoon						
1. Delta	3,089	2,998	2.41	7,218	48.4%	40.1%
2. Dry Zone	1,295	1,292	2.76	3,564	23.9%	19.8%
3. Coastal	825	825	2.22	1,836	12.3%	10.2%
4. Mountainous	957	956	2.40	2,296	15.4%	12.8%
Total	6,167	6,071	2.46	14,914	100.0%	82.9%
Summer						
1. Delta	697	697	3.13	2,184	70.9%	12.1%
2. Dry Zone	205	203	1.97	400	13.0%	2.2%
3. Coastal	25	25	2.57	65	2.1%	0.4%
4. Mountainous[b]	70	66	6.54	432	14.0%	2.4%
Total	994	992	3.11	3,082	100.0%	17.1%
Total (2 Seasons)						
1. Delta	3,787	3,695	2.54	9,403	52.2%	52.2%
2. Dry Zone	1,500	1,495	2.65	3,964	22.0%	22.0%
3. Coastal	851	850	2.23	1,901	10.6%	10.6%
4. Mountainous	1,023	1,022	2.67	2,729	15.2%	15.2%
Total	7,161	7,063	2.55	17,996	100.0%	100.0%

[a] Milled rice equivalent (using a milling ratio of 0.65 kgs of milled rice per 1.0 kg of paddy).

[b] The high figures shown here may be a result of typographical errors: alternative calculations suggest area of 70 000 hectares, yield of 2.76 tons/ha and production of 193 thousand tons.

Source: Government of Myanmar (MOALI) data.

Figure 2—Myanmar Rice Production Estimates by Season, 2016-17



[a] Milled rice equivalent (using a milling ratio of 0.65 kgs of milled rice per 1.0 kg of paddy).

Source: Government of Myanmar (MOALI) data.

Household Rice Consumption Patterns

The most recent source of detailed information on national consumption patterns in Myanmar is the Integrated Households Living Condition Assessment-II (ILHCA), carried out from 2009 to 2010 with a nationwide representative sample of 18,660 households.

According to the ILHCA data, average consumption of rice was 156 kgs per person per year in 2010 and 99 percent of households in Myanmar consumed rice. Regionally, annual per capita consumption of rice was highest in the delta region (184 kgs/person/year) -- about 23 percent higher than consumption in the Dry Zone and other Myanmar regions (including both Coastal and Mountainous regions) (all at about 151 kgs/person/year). There is also a substantial difference between levels of rural and urban rice consumption (163 and 137 kgs/person/year, respectively), but less variation between poor and nonpoor individuals (151 and 165 kgs/person/year, respectively).[3]

On average, expenditures on rice (including the value of consumption of the household's own production of rice) accounted for 19.0 percent of total household expenditures, 20.0 percent in rural areas and 16.0 percent in urban areas (Table 4 and Figure 3). There was little difference between expenditure shares in rural regions, however: 20.4 percent in the Delta region, 19.9 percent in the Dry Zone and 19.2 percent in Other Rural Myanmar. Overall, the poorest 60 percent of the Myanmar population spent a far greater share of its total expenditures on rice (21.6 percent) than did the top 40 percent (14.2 percent).

Table 4— Myanmar Yearly Cereal Consumption and Expenditures, 2010

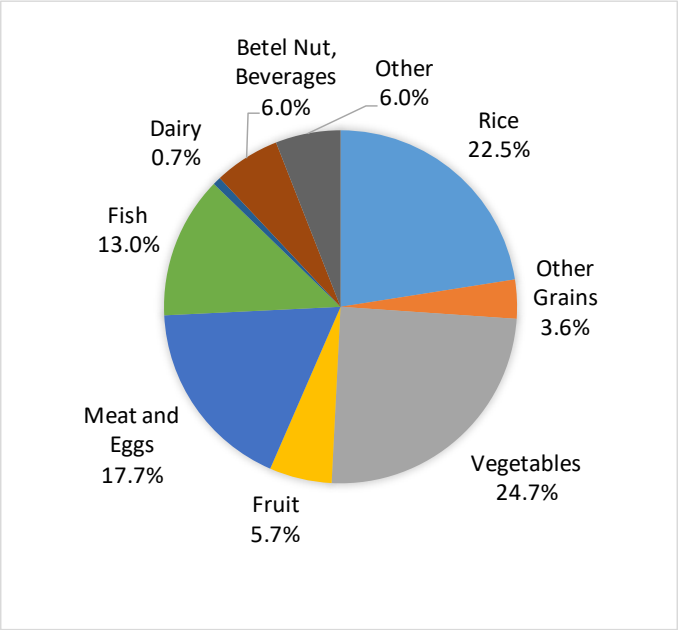
		Delta	Upper Basin	Other Rural Myanmar	Rural	Urban	Myanmar
Number of People (millions)	Bottom 60%	7.4	8.4	6.9	22.7	5.6	28.3
	Top 40%	2.7	2.6	2.4	7.6	5.1	12.7
	Myanmar	10.1	11.0	9.3	30.3	10.7	41.0
% Rice Consumers	Bottom 60%	100%	97%	97%	98%	99%	98%
	Top 40%	100%	99%	99%	99%	100%	99%
	Myanmar	100%	98%	98%	99%	100%	99%
Rice Consumption (kg per capita)	Bottom 60%	178	144	145	178	128	151
	Top 40%	198	167	165	156	144	165
	Myanmar	184	151	151	163	137	156
Budget Share	Bottom 60%	23%	22%	21%	22%	19%	22%
	Top 40%	16%	14%	14%	15%	13%	14%
	Myanmar	20%	20%	19%	20%	16%	19%
Total Rice Consumption ('000 tons)	Bottom 60%	1319	1216	997	4053	714	4268
	Top 40%	524	437	391	1192	732	2094
	Myanmar	1854	1662	1398	4943	1458	6394

Source: Authors' calculations from IHLCA data.

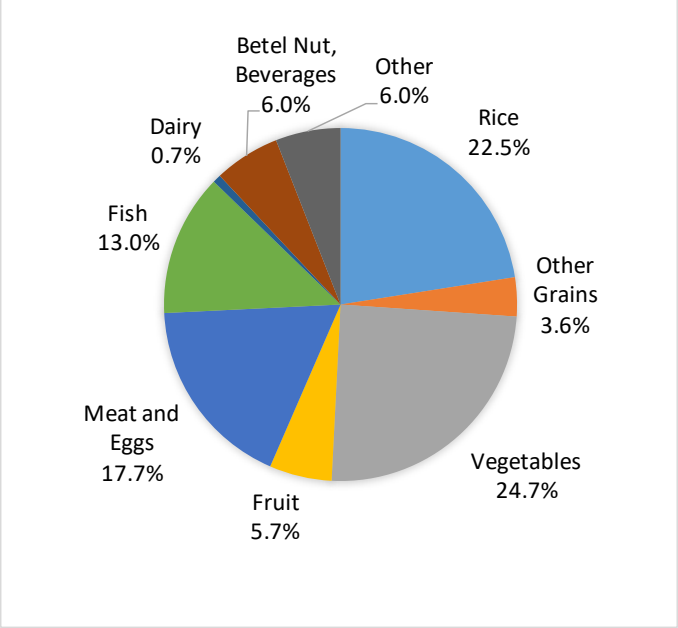
[3] Nonpoor are characterized as individuals belong to the top 40 percent of per capita household expenditure distribution, whereas poor are characterized as those belong to the bottom 60 percent of the distribution.

Figure 3—Myanmar Budget Shares by Food Group, 2010

Urban Households



Rural Households



Source: Authors' calculations from IHLCA data.

Rice Varieties and Forms of Rice Consumption

Rice noodles are the most common form of rice consumption in Myanmar. According to IHLCA survey data, 54 percent of the population reported consumption of rice noodles in the week preceding the

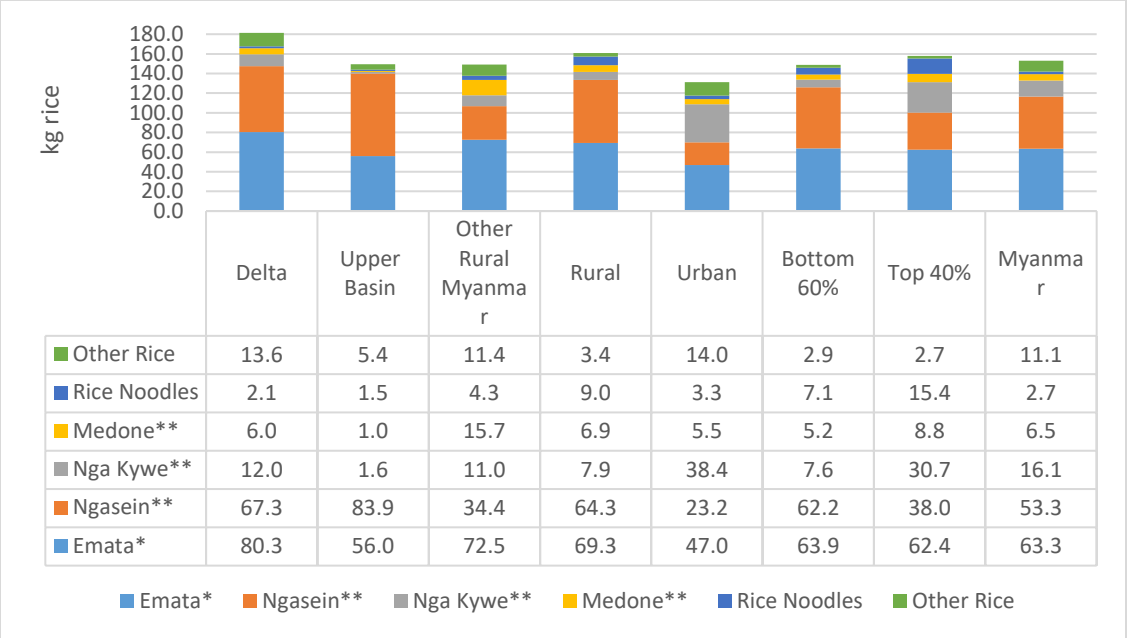
survey.[4]) In general, noodles are consumed more often by the non-poor than the poor. Nationally, only 46 percent of poor households consumed rice noodles whereas 68 percent of non-poor households consumed rice noodles (Table 5). Rice noodles are especially popular in urban areas: 69 percent of the urban population reported some rice noodle consumption, as compared to only 49 percent in rural areas. However, rice noodles made up only seven percent of national rice consumption (Figure 4).

Table 5—Myanmar percentage of rice consumers by rice type and region, 2010

	Delta	Upper Basin	Other Rural Myanmar	Rural	Urban	Bottom 60%	Top 40%	Myanmar
Ngasein	40%	55%	22%	41%	18%	41%	24%	35%
Emata	48%	38%	48%	44%	39%	43%	42%	43%
Medone	4%	1%	12%	5%	5%	4%	6%	5%
Nga Kywe (round)	9%	1%	9%	6%	37%	7%	27%	15%
Kaukhnyin (Sticky Rice)	5%	5%	7%	6%	2%	5%	5%	5%
Other Rice	12%	11%	24%	15%	19%	14%	20%	16%
Rice Noodles	61%	36%	50%	49%	69%	46%	68%	54%

Source: Authors' calculations from IHLCA data.

Figure 4—Myanmar Rice Consumption (kg) by type



	Delta	Upper Basin	Other Rural Myanmar	Rural	Urban	Bottom 60%	Top 40%	Myanmar
Other Rice	13.6	5.4	11.4	3.4	14.0	2.9	2.7	11.1
Rice Noodles	2.1	1.5	4.3	9.0	3.3	7.1	15.4	2.7
Medone**	6.0	1.0	15.7	6.9	5.5	5.2	8.8	6.5
Nga Kywe**	12.0	1.6	11.0	7.9	38.4	7.6	30.7	16.1
Ngasein**	67.3	83.9	34.4	64.3	23.2	62.2	38.0	53.3
Emata*	80.3	56.0	72.5	69.3	47.0	63.9	62.4	63.3

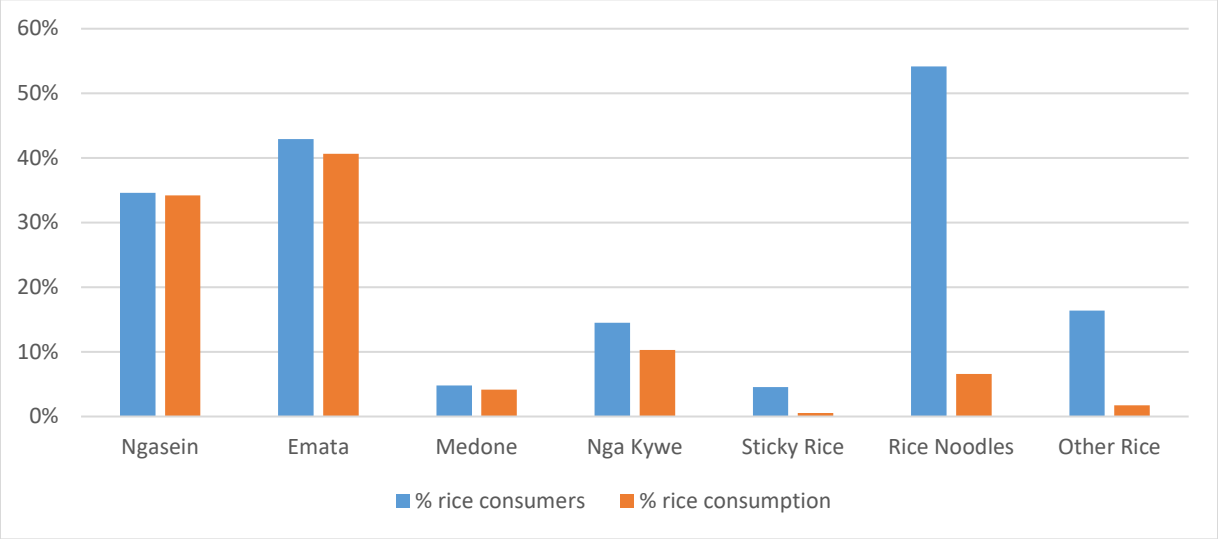
Source: Authors' calculations from IHLCA data.

The most popular varieties, *Emata* and *Ngasein,* (both long grain varieties) were consumed by 43 and 35 percent of the population, respectively. *Emata* was also the most widely consumed variety in the Delta and Other Rural Myanmar regions; *Ngasein* was the most popular in the Upper Basin. *Nga Kywe* rice was also very popular in urban areas, with almost as many consumers (37 percent) as emata (39 percent). Around 42 percent of both poor and non-poor households consumed Emata. However, while 41 percent of poor households consumed Ngasein and seven percent consumed Nga Kywe, only 24 percent of non-poor households consumed Ngasein, while 27 percent consumed Nga Kywe.

[4] In ILHCA survey, five types of rice were specified: Ngasein, Emata, Medone, Nga Kywe, and Kaukhnyin. Participants were also asked to list other types of rice they consumed (which we have reported here as "other rice"), as well as their consumption of rice noodles.

Although "other rice" was the most widely consumed rice type, Emata was the leading rice consumed in terms of quantity consumed (Figure 5). Nationally, 63.3 kilograms of Emata per capita per year were consumed in Myanmar in 2010, followed by 53.3 kilograms of Ngasein, 16.2 kilograms of Nga Kywe and 15.84 kilograms of other rice. Per capita consumption of *Emata* in rural areas was higher than in urban areas. The most widely consumed rice variety in urban areas was Nga Kywe.

Figure 5—Myanmar Consumers and Consumption by Rice Type, 2010



Source: Authors' calculations from IHLCA data.

One reason for the dominance of Emata and Ngasein in rice consumption is that these are the least expensive types of rice (as recorded in the IHLCA survey), with average national prices of 385 and 360 kyat per kilogram respectively. By comparison, the average price of "other rice" in May and June 2010 was nearly twice as high -- 760 kyat per kilogram (Table 6). Nga Kywe was the second most expensive rice type with a national average price of 506 kyat in 2010.

Table 6—Myanmar average rice prices kyat/kg, 2010

	Delta	Upper Basin	Other Rural Myanmar	Urban	Myanmar
Lower 60 %	425	488	499	536	481
Upper 40 %	473	525	606	627	567
Ngasein	317	386	323	409	360
Emata	329	423	384	416	385
Medone	416	436	442	452	439
Nga Kywe	479	458	494	517	506
Other Rice	576	458	448	630	540
Rice Noodles	699	971	941	870	850
Myanmar	441	498	533	586	513

Source: Authors' calculations from IHLCA data.

Regionally, for every rice type identified in the survey, the price was lowest in the Delta, second lowest in the Upper Basin, third lowest in other rural Myanmar, and highest in urban areas. Only for "other rice" did prices not follow this pattern, as "other rice" was more expensive in "other rural areas" than in urban areas. Not surprisingly, the bottom 60 percent of the population purchased lower priced rice (with an average price of 481 kyat per kilogram), compared with the average price of rice for the top 40 percent of the population (average price of 567 kyat per kilogram).

Price Trends

Market prices of rice have generally been quite stable over time, particularly in real terms (i.e. when adjusted for overall macro-inflation). As shown in Table 7 and Figure 8, prices of *emata* and *pawsan* rose by 12.5 and 13.3 percent per year from 2004 through 2010, In real terms, the annual price increases of these varieties were only 2.5 and 3.3 percent per year, respectively. Since 2010, prices have been even more stable, with nominal increases of 7.1 percent per year for *emata* and 4.2 percent per year for *pawsan.* In real terms, *emata* prices rose by 1.2 percent per year, while *pawsan* prices actually declined by 1.5 percent per year (Table 8 and Figure 9).

Note that although domestic prices of emata rice in Yangon have generally been below FOB (free on board) Bangkok prices (25% brokens), domestic prices of pawsan rice have been substantially higher than the FOB Thailand prices, by an average of 20 to 60 percent from 2015 to 2017.

Table 7—Nominal Domestic and Export Rice Prices

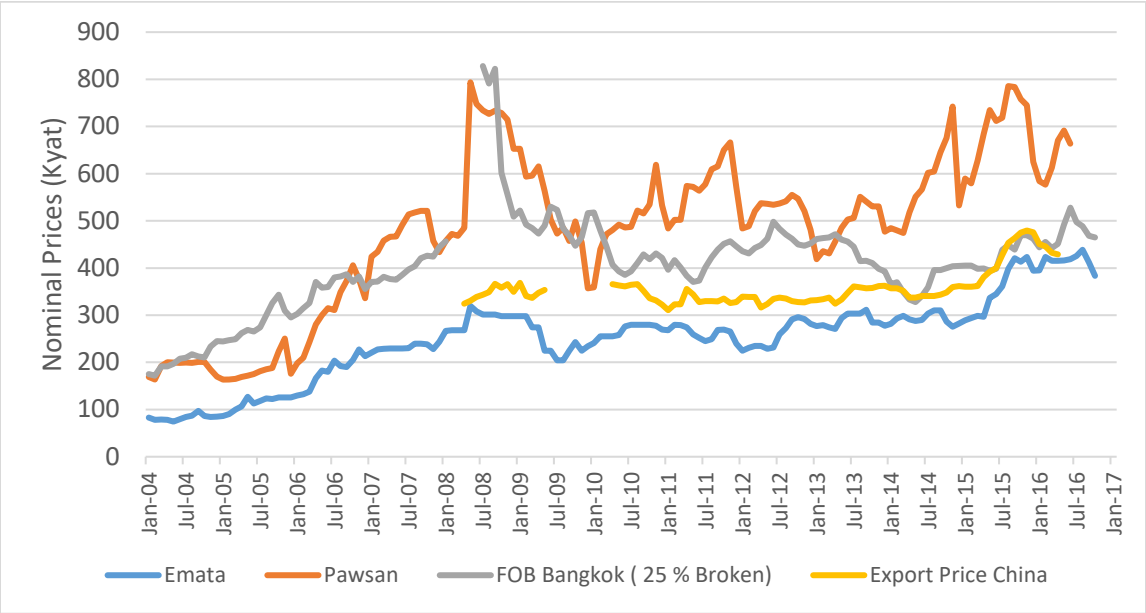
	Emata	*Pawsan*	FOB Bangkok (25% broken)	Export Price (Land Border)	*Pawsan* / *Emata*	*Pawsan* / FOB Bangkok
2004	83.0	189.9	205.3	---	2.30	0.93
2005	113.7	184.4	282.0	---	1.63	0.65
2006	180.1	308.1	357.4	---	1.70	0.85
2007	232.1	475.5	398.0	---	2.05	1.20
2008	291.4	643.0	652.1	347.3	2.19	---
2009	244.1	520.7	491.2	341.7	2.14	1.06
2010	267.2	494.9	427.8	330.3	1.85	1.17
2011	259.6	567.0	415.0	294.8	2.19	1.37
2012	259.4	527.2	458.9	343.3	2.05	1.15
2013	288.5	488.8	437.9	367.4	1.69	1.13
2014	292.6	573.2	370.4	361.4	1.96	1.55
2015	355.9	695.2	427.3	413.2	1.97	1.63
2016	419.7	618.0	470.6	413.3	1.48	1.31
2017*	357.3	622.1	519.6	450.1	1.74	1.20
Growth Rates						
2004-10	12.5%	13.3%	10.2%	---	0.8%	---
2010-17	7.1%	4.2%	1.6%	5.7%	-2.7%	2.6%

* 2017 prices are through July 2017 (except China: through March 2017).

Notes: Growth rates are January 2004 to January 2010 and January 2010 to August 2017.
China price is based on annual average prices.

Source: Authors' calculations from MOAI and World Bank Data.

Figure 8 —Nominal Domestic and Export Rice Prices



Source: Authors' calculations from MOAI and World Bank Data

Table 8—Real Domestic and Export Rice Prices

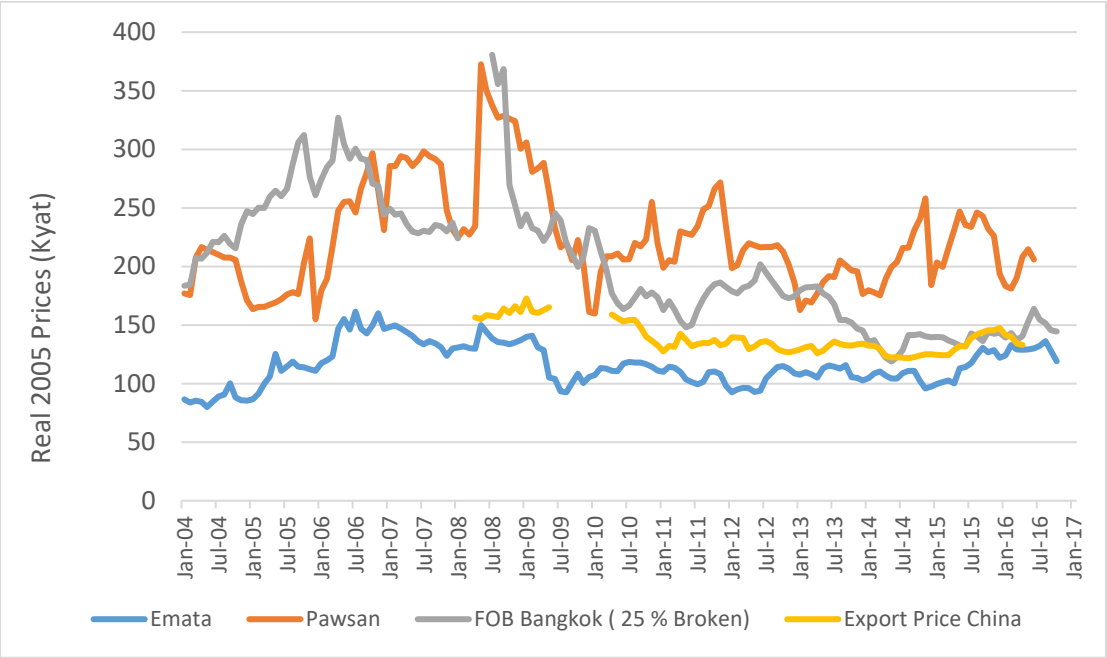
	Emata	*Pawsan*	FOB Bangkok (25% broken)	Export Price (Land Border)	*Pawsan / Emata*	*Pawsan* / FOB Bangkok
2004	203.8	466.8	503.5	---	2.30	0.93
2005	254.7	413.0	632.1	---	1.63	0.65
2006	335.1	571.9	671.5	---	1.70	0.85
2007	323.0	660.8	552.4	---	2.05	1.20
2008	318.4	699.6	697.5	159.6	2.19	---
2009	263.6	562.8	529.6	157.1	2.14	1.06
2010	267.1	493.9	428.7	146.6	1.85	1.17
2011	247.4	540.3	395.7	119.8	2.19	1.37
2012	242.5	493.9	429.9	137.2	2.05	1.15
2013	256.6	434.2	390.1	139.5	1.69	1.13
2014	246.8	482.4	312.1	130.1	1.96	1.55
2015	269.6	528.5	324.9	133.9	1.97	1.63
2016	301.0	442.4	337.0	126.4	1.48	1.31
2017*	247.1	430.1	359.2	133.4	1.74	1.20
Growth Rates						
2004-10	2.5%	3.3%	0.4%	---	0.8%	---
2010-17	1.2%	-1.5%	-4.0%	-1.4%	-2.7%	2.6%

* 2017 prices are through July 2017 (except China: through March 2017).

Notes: Growth rates are January 2004 to January 2010 and January 2010 to August 2017.
China price is based on annual average prices.

Source: Authors' calculations from MOAI and World Bank Data.

Figure 9—Real Domestic and Export Rice Prices



Source: Authors' calculations from MOAI and World Bank Data.

Household Demand Behavior and Parameters

Econometric estimates of the determinants of consumer rice demand for rice utilizing the IHLCA data suggest both own-price and total expenditure (income) elasticities of demand. We estimate a two-stage regression utilizing various sub-samples of the data.

In the first stage, we estimate a probit model:

$$d_{ih} = \beta 1*(\ln\hat{E}_h) + \beta 2*(\ln\hat{E}_h)^2 + \beta 3*\ln(hhsize_h) + \beta 4*(rural_h) + {}_k\sum\beta_{5,k}*state_{k,h} + e_h . \quad (1)$$

where d_{ih} indicates whether a household consumed a certain type of rice (with $d_{ih} = 1$ if household h consumed rice of type i), $hhsize_h$ is the logarithm of household size, $rural_h$ is dummy variable rural residence and $state_{k,h}$ are state/regional dummy variables.

To correct for endogeneity of household expenditures, we use the fitted values of expenditures of total expenditures ($\hat{E}_h$) from an instrumental variable regression:

$$\ln E_h = {}_i\sum \beta_i X_{i,h} + e_h \quad (2)$$

where the independent variables X_{ih} include the logarithm of household size, age of the household head, location of the house, education level of the household head and dummy variables for female headed households, marital status of the household head, whether the household head was employed, whether the household took out loans, whether the household had a bank account, and state or regional dummies.

Finally, we use the computed inverse Mills ratio, IMRh, derived from the first regression as an explanatory variable in equation 3:

$$\ln E_{i,h} = \beta_1 * \ln\hat{E}_h + \beta_2 * (\ln\hat{E}_h)^2 + \beta_3*(rural_h) + {}_k\sum\beta_{4,k}*state_{k,h} + \beta_5 * IMR_h + e_{i,h}. \quad (3)$$

Using the entire rural sample, the estimated coefficients imply expenditure and own-price elasticities of 0.70 and -0.46, respectively. Using an urban sample, the estimated expenditure (income) elasticity is 0.55 and the estimated own-price elasticity of demand is -0.42 (Table 9). In general, own-price elasticities of demand for the top 40 percent of households in terms of per capita expenditures are

somewhat lower than those for the poorer 60 percent of households. There is little difference in expenditure elasticities across regions or income groups, however.

Table 9—Econometric Estimates of Myanmar Rice Demand Parameters

		Myanmar	Rural	Urban	Rural: Delta	Rural: Upper Basin	Rural: Other Myanmar
Predicted Logged Total Per Capita Expenditure	Overall	12.79	12.72	12.99	12.74	12.69	12.72
	Bottom 60%	12.71	12.67	12.89	12.69	12.66	12.65
	Top 40%	12.92	12.83	13.08	12.84	12.78	12.86
Regression Coefficients	B1	0.66	5.99	4.63	6.35	6.21	2.80
	B2	-0.01	-0.22	-0.17	-0.24	-0.24	-0.08
Expenditure Elasticities	Overall	0.081	0.705	0.558	0.746	0.728	0.335
	Bottom 60%	0.081	0.703	0.553	0.744	0.726	0.333
	Top 40%	0.082	0.711	0.561	0.753	0.733	0.339
Own Price Elasticities	Overall	-0.367	-0.389	-0.294	0.010	-0.114	-0.737
	Bottom 60%	-0.333	-0.460	-0.416	-0.006	-0.165	-0.905
	Top 40%	-0.324	-0.341	-0.278	-0.047	-0.057	-0.569

Source: Authors' calculations using IHLCA data.

Regressions splitting rice into three types, round rice, long grain rice, and other rice produce broadly similar results for the price elasticities but widely varying expenditure elasticities, almost all of which are statistically insignificant. Imputing prices based on survey sampling group we obtain the most robust results, with national own–price elasticity of demand -0.20 for round rice, -0.50 for long grain rice, and -0.63 for other rice.

The Rice Export Trade[5]

Myanmar (Burma) was a major rice exporter from the 1930s through the 1960s, but by the 1990s, rice exports had declined to only 154.7 thousand metric tons. In recent years (since 2012/13), cross-border trade with China has accounted for about 70 percent of exports by volume. Official trade through Yangon port is relatively small, averaging 418 thousand tons per year from 2012/13 through 2015/16, i.e. 29 percent of the total quantity of recorded exports.

Cross-border trade increased dramatically beginning in 2012/13, when a total of 846 thousand tons were exported, to 2014/15 (1.34 million tons) and 2015/16 (1.23 million tons), (Table 10 and Figure 6). Overall exports (both by land and sea) for these latter two years were 1.81 and 1.47 million tons. Note, though, that these figures likely represent an underestimate of perhaps one million tons per year.[6]

[5] This section draws heavily on interviews with traders in meetings at the Myanmar Rice Federation in August, 2016.

[6] Discussions with traders indicated that perhaps 2.5 to 3.5 million tons of rice were exported, in total, in 2014/15.

Table 10—Myanmar Rice Exports, 2008-09 to 2016-17*

	Sea Quantity ('000 tons)	Sea Value (mn US$)	Sea Ave. Price (US$/ton)	Border Quantity ('000 tons)	Border Value (mn US$)	Border Ave. Price (US$/ton)	Total Quantity ('000 tons)	Total Value (mn US$)	Total Ave. Price (US$/ton)	Sea/Border Ave. Price
2008/09	667.2	197.1	295.5	42.1	12.2	290.1	709.3	209.3	295.1	1.02
2009/10	818.2	254.3	310.8	78.8	25.8	327.6	897.0	280.1	312.3	0.95
2010/11	536.4	198.1	369.3	0.0[c]	0.0[c]	---	536.4	198.1	369.3	---
2011/12	705.4	266.6	378.0	138.8	50.9	366.8	844.2	317.5	376.1	1.03
2012/13	608.8	212.7	349.3	845.5	352.0	416.3	1454.4	564.7	388.3	0.84
2013/14	390.8	133.8	342.4	842.6	326.9	387.9	1233.4	460.7	373.5	0.88
2014/15	470.7	150.7	320.2	1341.6	494.0	368.2	1812.3	644.7	355.7	0.87
2015/16	242.1	78.9	325.8	1231.6	438.7	356.2	1473.7	517.6	351.2	0.91
2016/17[a]	71.9	23.6	327.8	210.7	77.2	366.3	282.5	100.7	356.5	0.89
Average[b]	428.1	144.0	336.4	1065.3	402.9	378.2	1493.4	546.9	366.2	0.88

a From 1 April through 5 August, 2016.

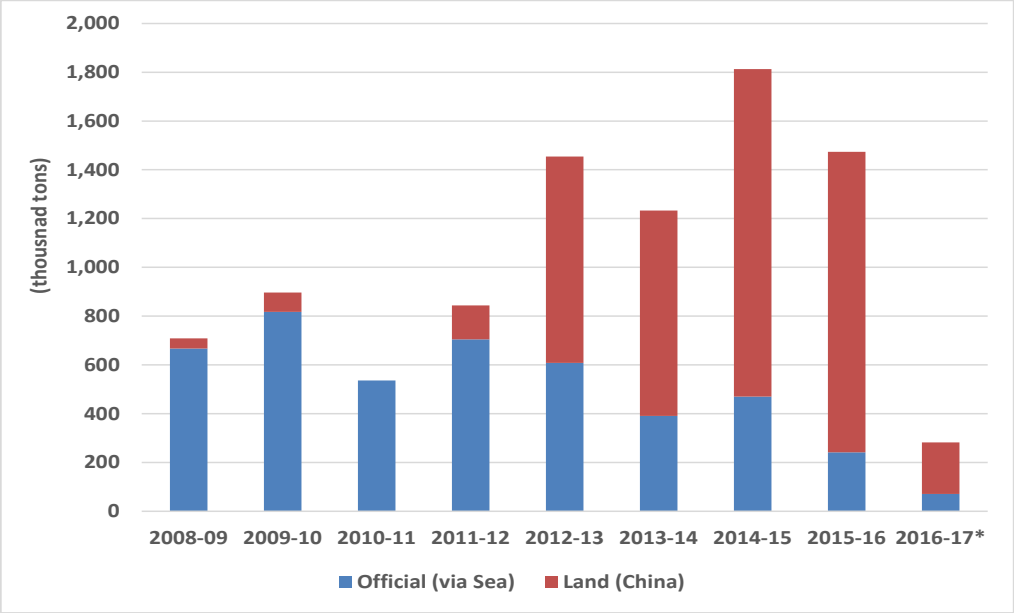
b Average for 2012/13 through 2015/16.

c Rice exports across land borders to China were banned by Myanmar in 2010.

Notes: Prices shown are based on indicative prices used for customs purposes.

Source: Ministry of Commerce and Customs (via Myanmar Rice Federation).

Figure 6—Myanmar Rice Exports, 2008-09 to 2016-17* (thousand tons)



* Data for April 1, 2016 through August 5, 2016.
Data shown are for April-March crop years

Source: Calculated from Ministry of Commerce and Customs Data obtained from the Myanmar Rice Federation.

Cross-border trade, though legal from the Myanmar side since 2012, is illegal in China since it evades a large (37 percent) import tariff. (Beginning in mid-2016, China began to more strictly enforce the import tariff and has greatly restricted the trade.) Almost all of the rice imported by China from Myanmar is used for making noodles (vermicelli), animal feed or alcohol (processed in distilleries), though some of the rice may be blended with local Chinese rice for direct human consumption.[7] Overall, 42 percent of Myanmar's rice exports were long-grain varieties in 2016-17; 32 percent were short-grain varieties and 24 percent were broken rice (Table 11 and Figure 7).

Exports of rice to China generally go through Mandalay in north central Myanmar via Lashio to Muse in Shan State and then on by (30 ton) truck to Ruili in Yunnan Province, China. Rice and other export goods are inspected at the mile 105 trade zone (customs checkpoint) where a 2 percent advance income tax is levied. (For the purposes of the tax on exports, the Ministry of Commerce sets an indicative price of rice.) There, logistic agents representing the Chinese buyer take possession of the rice and transport it across the border to China.[8]

Formal sector exports require more complicated contracts specifying payment terms, rice quality and other conditions not needed in the trades conducted at Muse. In particular, formal trade requires an AQSIQ (Administration of Quality Supervision, Inspection and Quarantine) quality check and certificate, along with traceability (certification for the locations where the paddy was planted and milled). Rice quality is an important consideration for formal rice exports on the international market and improvements in increasing the uniformity and quality of paddy, post-harvest drying, storage and milling are needed.

In recent years,[9] the government has put into place rice export bans following natural disasters or expected production shocks in order to ensure there would be no rice shortage in the domestic market.

[7] Rice quality, in terms of percentage of broken rice grains is not a major consideration for imports destined for industrial use.

[8] Trades are also arranged at the Musee commodity agent center. Myanmar traders send representative samples of their rice for display in a warehouse in Musee. Buyers from China negotiate the terms for sales with Myanmar agents (who may be supplied by several different traders).

[9] In April 2003, the government abolished the procurement system. Quotas were introduced in December 2007, along with a ten percent tax on rice exports. See Okamoto (2009).

These periodic export bans by the government in recent years have forced traders to postpone or cancel contracts. In principle, a public rice stock could be used to address emergency needs and avoid the negative effects on the rice export sector caused by cancellation or delays of contracts.[10]

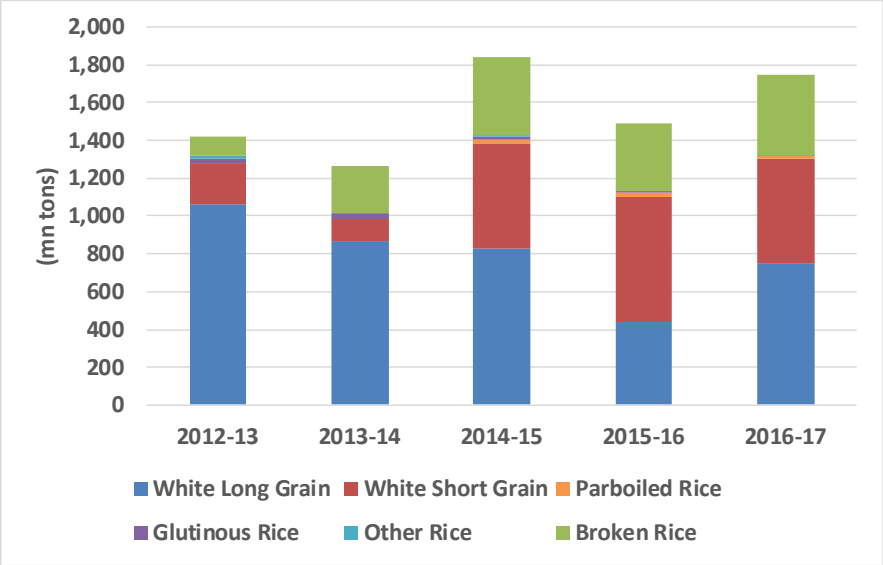
Table 11 --- Myanmar Rice Exports by Type of Rice, 2012-13 to 2016-17

	2012-13	2013-14	2014-15	2015-16	2016-17	Average Growth
			('000 tons)			
White Long Grain	1065.8	864.5	830.7	441.5	749.4	-12.9%
White Short Grain	217.1	119.2	553.8	655.8	553.9	43.0%
Parboiled Rice	0.1	2.8	18.1	25.2	16.5	253.6%
Glutinous Rice	23.2	29.3	17.8	7.7	2.4	-44.4%
Other Rice	10.5	0.0	6.5	0.0	0.0	---
Broken Rice	107.0	246.9	413.7	363.0	427.3	37.1%
Total	1423.7	1262.6	1840.6	1493.2	1749.6	6.0%
			(mn US dollars)			
White Long Grain	415.7	330.7	311.3	160.2	237.8	-16.8%
White Short Grain	91.0	49.6	202.2	239.6	190.7	35.7%
Parboiled Rice	0.1	1.4	8.0	10.8	6.6	202.1%
Glutinous Rice	7.7	14.2	8.9	3.8	1.1	-40.3%
Other Rice	3.3	0.0	2.1	0.0	0.0	---
Broken Rice	33.1	79.0	128.3	111.7	118.7	33.7%
Total	550.9	474.9	660.8	526.0	554.9	1.2%
			(US$ / ton)			
White Long Grain	390.1	382.5	374.7	362.8	317.3	-4.6%
White Short Grain	419.3	416.0	365.0	365.3	344.2	-5.1%
Parboiled Rice	822.2	488.7	442.8	428.1	399.7	-14.6%
Glutinous Rice	329.9	484.4	497.6	487.8	469.8	7.4%
Other Rice	314.5	---	327.3	---	---	---
Broken Rice	309.2	320.2	310.2	307.7	277.9	-2.5%
Total (Average)	386.9	376.1	359.0	352.3	317.2	-4.5%
Vietnam (5% brokens)	410	399	389	364	357	-3.6%
White Long Grain / / Vietnam 5% brokens	95%	96%	96%	100%	89%	-1.0%
Myanmar Average / Vietnam 5% brokens	94%	94%	92%	97%	89%	-0.9%

Source: Government of Myanmar, Ministry of Commerce data, USDA (2017) and authors' calculations.

[10] In 2015, rice exports were banned for three months following a major flood. Market prices rose from 18,000 kyats to 25,000 kyats (per basket) as traders and consumers bought up rice for domestic consumption. This price rise made domestic rice too expensive for exports to China, as well. Providing more information regarding production estimates and policies could help to minimize rumors and speculation.

Figure 7--- Myanmar Rice Exports by Type of Rice, 2012-13 to 2016-17



Source: Government of Myanmar, Ministry of Commerce data.

3. IMPACTS OF SHOCKS AND DOMESTIC PROCUREMENT: MODEL SIMULATIONS

Falling domestic rice prices arising from a decline in export demand or weather-related production gains could have had important adverse effects on farmer incomes and future rice production in Myanmar. Government procurement could have mitigated the effects of these shocks to the rice market and rice farmer incomes. In order to quantify the effects of these shocks, we utilize a simple partial equilibrium model of the Myanmar rice market presented below.

Model Structure

In the model used in this paper, we model production, consumption and prices of only one commodity: rice (Table 12).[11] Production is modeled as the base level of production multiplied by an exogenous production shock, adjusted by the price effect on supply -- a function of the ratio of the simulated market price to the base (previous year's) market price and a constant own-price elasticity of supply (equation 1). Domestic supply is equal to production, net of a constant percentage deduction for seed, feed and wastage (equation 2). Household income is calculated as the base level of income, multiplied by an exogenous income shock (equation 3). Household demand of each of the four household groups is modeled as a log-linear function of household per capita income and market prices (equation 4). The quantity of exports is assumed to be exogenous. The domestic market price adjusts so that total supply is equal to total demand (equation 5). The base year for the model is 2015-16.

Table 12—Myanmar Rice Model Equations

Production	(1) $X_i = X0_i * xshock_i * (P_i/P0_i)^{ES_i}$
Domestic Supply	(2) $S_i = X_i * (1 - loss_i)$
Household Income	(3) $Y_h = Y0_h * (1 + yshock_h)$
Demand (Consumption)	(4) $D_{ih} = D0_{ih} *(P_i/P0_i)^{ED_{i,h}} * (Y_h/Y0_h)^{EY_{i,h}}$
Equilibrium	(5) $S_i = \sum_h D_{ih} + E_i$

$D0_i$ = base level demand (consumption) of commodity i (rice)
D_i = demand (consumption) of commodity I (rice)
E_i = exports
P_i = domestic price of rice
$P0_i$ = base price of rice
S_i = total supply of rice
X_i = total national production of rice
$X0_i$ = base level production of rice
Y_h = household income of household h
$Y0_h$ = base level household income of household h

Parameter names
ES_i = own price elasticity of supply of commodity i
ED_i = own price elasticity of demand of commodity i
EY_i = income elasticity of demand for commodity i
$loss_i$ = seed, feed and storage as a percentage of domestic production
$xshock_i$ = production shock to commodity i
$yshock_h$ = shock to income of household h

[11] The one commodity model used in this analysis is similar to the model of the Bangladesh rice economy in Dorosh (2001). Further analysis involving interactions with other agricultural sectors would require a multimarket model that explicitly models other crops (see Braverman and Hammer, 1985; Sadoulet and de Janvry, 1995; Croppenstedt et al, 2007).

Model Simulation Results

We simulate the effect of a production increase (SIM 1), a drop in exports accompanied by a production increase (SIM 2), and a drop in exports accompanied by a production increase, and domestic procurement of different amounts (SIM 3, SIM 4, SIM 5), (Table 13). We run our five simulations for both short-run (elasticity of supply equal to zero: procurement announced late in growing season) and medium-run scenarios (elasticity of supply equal to 0.3). Further, in both short- and medium-run scenarios we present a basic sensitivity analysis by presenting results for the five simulations using an alternate set of (more inelastic) demand parameters.

Table 13—Model Simulations: Impacts of Production Shocks and Public Procurement (short-run)

	Base	Sim 1	Sim 2	Sim 3	Sim 4	Sim 5
Base Parameters			(e_s= 0.0, e_Y = 0.672, e_d = -0.367)			
Production Shock (%)	0.0%	10.0%	10.0%	10.0%	10.0%	10.0%
Production (mn tons)	11.65	12.81	12.81	12.81	12.81	12.81
Exports (mn tons)	1.78	1.78	0.55	0.55	0.55	0.55
Consumption (mn tons)	9.87	11.03	12.26	11.76	11.26	10.76
Net Procurement	0.0	0.0	0.0	0.5	1.0	1.5
Production (% change)	0.0%	10.0%	10.0%	10.0%	10.0%	10.0%
Consumption (% ch)	0.0%	11.8%	24.3%	19.2%	14.2%	9.1%
Price change (%)	0.0%	-26.2%	-44.7%	-38.0%	-30.3%	-21.1%
Alternative (Inelastic) Parameters			(e_s= 0.0, e_Y = 0.3, e_d = -0.2)			
Production (% change)	0.0%	10.0%	10.0%	10.0%	10.0%	10.0%
Consumption (% ch)	0.0%	11.8%	24.3%	19.2%	14.2%	9.1%
Price change (%)	0.0%	-42.8%	-66.3%	-58.5%	-48.4%	-35.3%

Source: Model simulations
Elasticity of supply = 0 (short run model: procurement announced late in growing season)

Simulation 1 shows the effects of the expected rice production increase of ten percent due to improved weather conditions in 2016-17 relative to 2015-16. As a result of this shock, in the short-run, production increases from 11.65 million tons to 12.81 million tons. This increase in production results in a price drop of 26.2 percent and a consumption increase of 11.8 percent. In the short-run, a production increase with inelastic demand parameters results in a price fall of 42.8 percent, 16.6 percentage points greater than with base parameters. In the medium-term the price change is smaller, only -14.4 percent, resulting in a smaller increase in consumption.

Simulation 2 models the impact of a production shock combined with the expected fall in exports as a result of China's restrictions on Myanmar rice imports. In the short and medium-run, the combination of these two shocks would have huge impacts on price. In the short-run, rice prices would fall by 44.7 percent, or 66.3 percent with more inelastic parameters. (In the medium-run prices would fall by 27.3 percent or as much as 41.2 percent if income elasticity and price elasticity are more inelastic.) These extreme price falls would have disastrous impacts on rice farmer income.

Simulation 3 models the effects of a positive production shock, combined with a decrease in exports and a 0.5 million ton net procurement of rice. Simulation 4 models the effects of the combined production and export shock with 1.0 million ton net rice procurement, while simulation 5 models the same initial shocks, but instead with 1.5 million tons of rice procurement.

In the short-run, procuring 0.5 million tons of rice reduces the price fall resulting from the production and export shock by 6.6 percentage points, from a price decrease of 44.7 percent to a price decrease of 38.0 percent. Procurement of one million tons results in a price drop of 30.3 percent, 14.4 percentage points less than the price drop caused by the initial production and export shocks. Finally, in the short-run with procurement of 1.5 million tons, the price of rice falls by 21.1 percent (Figure 9). This is

5.1 percentage points lower than the price drop that results from a production shock, and 23.6 percentage points lower than the price drop resulting from the production and export shock.

When compared with the base scenario, the scenario with alternative demand parameters results in more extreme price drops. At the same time, however, in these simulations rice price is more responsive to net procurement levels. With procurement of 1.5 million tons of rice, price drops by 35.3 percent, 31 percentage points less than the price drop that results from increased production and lower exports (Table 14).

In the medium-run, simulation 3 results in a two percent increase in production, a 22.3 percent decrease in prices and a 9.7 percent increase in consumption. Simulation 4 results in a four percent increase in production, a 17.0 percent decrease in rice price, and a 7.1 percent increase in consumption. Finally, simulation 5 results in an 11.0 percent fall in prices despite a 6.1 percent increase in production. Simulations with alternative demand parameters result in more dramatic price falls, despite smaller production increases. These simulations illustrate the crucial role of rice procurement in maintaining rice price levels in Myanmar.[12]

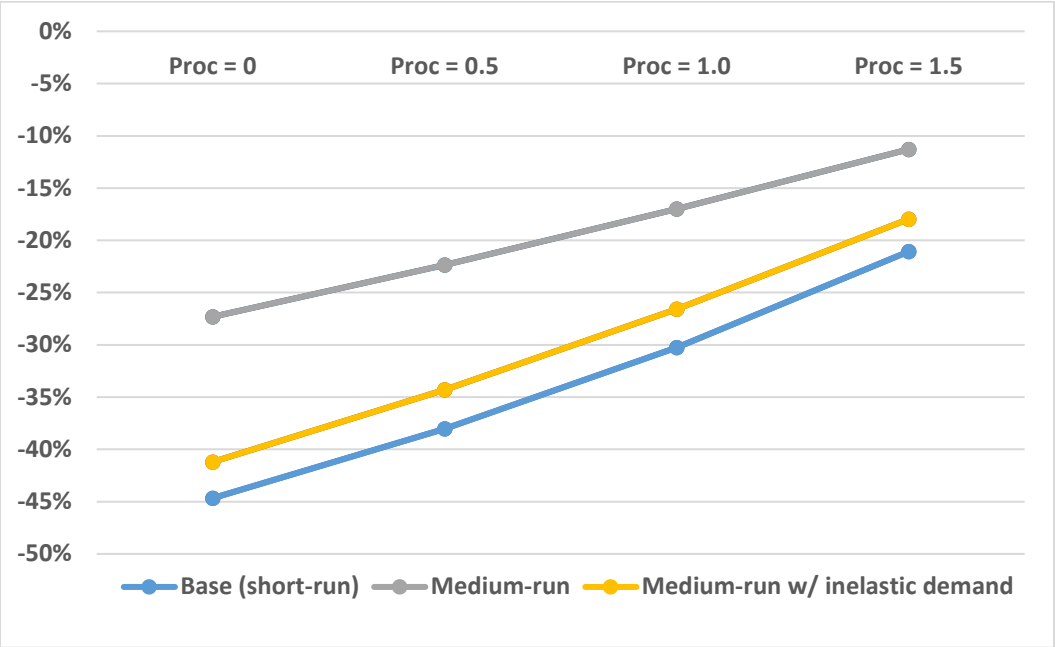
Table 14—Model Simulations: Impacts of Production Shocks and Public Procurement (medium-run)

	Base	Sim 1a	Sim 2a	Sim 3a	Sim 4a	Sim 5a
Base Parameters		**(e_s= 0.3, e_Y = 0.672, e_d = -0.367)**				
Production Shock (%)	0.0%	10.0%	10.0%	10.0%	10.0%	10.0%
Production (mn tons)	11.65	12.23	11.64	11.88	12.12	12.36
Exports (mn tons)	1.78	1.78	0.55	0.55	0.55	0.55
Consumption (mn tons)	9.87	10.45	11.09	10.83	10.57	10.31
Net Procurement	0.0	0.0	0.0	0.5	1.0	1.5
Production (% change)	0.0%	5.0%	0.0%	2.0%	4.0%	6.1%
Consumption (% ch)	0.0%	5.9%	12.4%	9.7%	7.1%	4.5%
Price change (%)	0.0%	-14.4%	-27.3%	-22.3%	-17.0%	-11.3%
Alternative (Inelastic) Parameters		**(e_s= 0.2, e_Y = 0.3, e_d =-0.2)**				
Production (% change)	0.0%	4.9%	-1.1%	1.1%	3.4%	5.7%
Consumption (% ch)	0.0%	5.8%	11.2%	8.8%	6.4%	4.0%
Price change (%)	0.0%	-21.1%	-41.2%	-34.3%	-26.6%	-18.0%

Source: Model Simulations
Elasticity of supply = 0.3 (medium run model: procurement announced or anticipated in time for farmers to adjust).

[12] Note that the simulations do not address the question of what is ultimately done with the rice stocks. If these stocks are sold on the domestic market in a later period, they would depress market prices by approximately as much in absolute value terms as the original procurement had raised prices. Another option would be to export the rice, perhaps at a loss. Such potential costs and effects also need to be considered in evaluating rice price stabilization. See Ahmed et al., (2000) for a discussion of similar multi-year rice price stabilization policy issues in Bangladesh.

Figure 10—Effects of Rice (Paddy) Procurement on Domestic Rice Prices (Model Simulations)



Source: Model simulations
Notes: Base simulation 2016-17

4. SUMMARY AND PRELIMINARY CONCLUSIONS

Since 2012/13, rice exports to China have boosted total demand for Myanmar's rice and helped keep farmer incomes stable and relatively high. Exports to China averaged about 1.0 million tons per year from 2012/13 through 2015/16, about two-thirds of official total exports (1.5 million tons). Other estimates of exports to China for 2015/16 suggest total exports of 2.5 million tons (of which 2.0 million tons are exports to China), a figure more consistent with production and per capita consumption estimates.

In mid-2016, however, China stopped rice imports through the main land entry point near Muse in Shan State. Moreover, with improved weather in 2016/17 relative to the previous year, paddy production could have increased by approximately 10 percent (about 1.2 million tons of milled rice). Combined, the total increase in production plus the decline in exports could have amounted to about 2.4 million tons, equivalent to about one-fourth of estimated 2015/16 rice consumption. As a result, there was likely to be substantial downward pressure on prices unless government procurement or exports on the world market raised demand.

Analysis presented in this note based on econometric estimates of consumption parameters and a simple model of Myanmar's rice supply and demand suggests that market prices would fall by 26 to 43 percent or more (in real terms) in the absence of increased exports to the world market and / or government domestic procurement. Such a decline in prices could have seriously harmed Myanmar's rice producers, including many poor farmers with marketable surpluses. Model simulations suggest that government procurement of about one million tons would limit the estimated price decline to only 17 to 30 percent. It is important to note, though, that such procurement would entail major losses for the government in storage or subsidized exports, particularly if the paddy was not properly dried, milled and stored.

The above estimates are preliminary. Further refinements in the simulations are needed to take account for the seasonal nature of paddy production in Myanmar, possible price-responsiveness of export demand and the effects of changes in paddy incomes on farmer demand for rice. Medium-term analysis of procurement, storage and future sales is needed to analyze fiscal costs under various scenarios, as well, covering alternative shocks to production, export demand and world prices. More broadly, incorporating other crops in a model with several regions (agro-ecological zones) would enable an analysis of the implications of rice policy on agricultural incomes in the context of overall agricultural policy. Nonetheless, the main results are clear: without substantial market interventions on the order of one million tons (milled rice equivalent), the paddy (rice) price could fall dramatically when production increases or export demand declines.

In the longer term, increases in the competitiveness of Myanmar rice exports on the broader international market could both help stabilize prices and provide a market for potentially large increases in domestic production. Achieving competitiveness in the broader international market will not be easy, however. Improved public services and an improved investment climate are needed to spur private investment in milling, trade and transport of rice. Investing productivity of paddy production is equally important, as yields in Myanmar average only about 2.5 tons per hectare, compared with 3 tons per hectare in Cambodia and 5.5 tons in Vietnam (World Bank, 2014).

Overall, the export channel to China has proven to be a significant benefit to Myanmar producers and exporters thus far, though possible future shifts in China's trade policies as in 2016 and 2017 remain a major potential risk. Improving the quality, and ultimately increasing the quantity of its rice production, however, could enable Myanmar to sell substantial quantities of rice in both the China and broader international markets, with far greater potential benefits, not only for Myanmar's rice sector but for the country's rural development, in general.

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