Online supplement– S1

1. Rice supply

Total domestic rice supply consists of production and beginning stocks. Production is estimated by multiplying total area planted and yield. The area planted and yield equations are symbolized as ap_t and y_t as shown in Equation (1) and (3).

$$ap_t = \beta_0 + \beta_1 \frac{(expr_t + subs_t * y_t)}{pi_{t-1}} + \beta_2 ap_{t-1}. \quad (1)$$

Where $expr_t$ is the expected return in period t, calculated by multiplying expected price and expected yield in t. Expected price is the average rice price in the period $(t-1)$ and $(t-2)$. Expected yield (ey) is the trend yield as shown in Equation (2):

$$ey = \beta_0 + \beta_1 trend. \quad (2)$$

Fertilizer subsidy ($subs_t$) by GoB is multiplied by yield to express it in terms of per unit of output. In this and later equations, pi indicates the consumer price index of Bangladesh. Lagged area planted (ap_{t-1}) indicates a partial adjustment approach.

Rice yield (Equation 3) is estimated as a function of the trend, the real price of milled rice per ton in Bangladesh and subsidy in t:

$$y_t = \beta_0 + \beta_1 trend + \frac{\beta_2 (p_t + subs_t)}{pi}. \quad (3)$$

Beginning stock (Equation 4) in the period t has been modeled as equal to the ending stock in the period $(t-1)$:

$$bs_t = es_{t-1}. \quad (4)$$

2. Rice demand

Domestic demand, seed, feed, and wastage, ending stock and export supply determine the total rice demand of Bangladesh. In this study, we divided net domestic demand (domestic demand

minus seed, feed, and wastage) by the total population to obtain the per capita net domestic demand for rice.

Per capita net domestic is estimated as follows:

$$per\ capita\ net\ domestic\ demand_t = \beta_0 - \beta_1 \frac{price_t}{pi_t} + \beta_2 \frac{per\ capita\ bd\ gdp_t}{pi_t}. \quad (5)$$

Ending stock is a behavioral equation estimated as:

$$es_t = \beta_0 + \beta_1 \frac{1}{(\frac{price_t}{pi_t})}. \quad (6)$$

As discussed earlier, GoB has a minimum public stock holding policy. Thus, the curvilinear specification is necessary to partly describe this policy. Also, it generates a reasonably shaped stock demand curve in that the curve gets steeper as price increases and flatter if the price is low.

3. Model closure

In this section, we discuss the trade and price component of the model that are used to reach equilibrium.

3.1 Trade

Import demand has been estimated from an identity consisting of net import (import minus export in period t) and

The export supply (exp_t) in period t (Equation 7) is a behavioral equation specified as:

$$exp_t = \beta_0 - \beta_1 \left(\frac{\frac{price_t}{ex.rate_t}}{uspi_t} \right) + \beta_2 \left(\frac{thai.p_t}{uspi_t} \right). \quad (7)$$

Here, $ex.rate_t$ is the average exchange rate of United States dollar to Bangladeshi Taka in year t, deflated by United State General Price index ($uspi_t$). The other external price, $thai.p_t$, is the export parity price of 5% parboiled Thailand rice price.

3.2 Price and model closure

The model has two closure options namely import parity and autarky. Domestic price is estimated independently based on the given market conditions.

The import parity closure is based on the notion that there is a flow of trade between Bangladesh and the rest of the world rice markets. The use of the price linkage equation (Equation 8) formalizes this interaction and defines the degree of price transmission (Devadoss & Meyers, 1990).

$$price_t = \beta_0 + \beta_1(thai.p_t * tariff_t * ex.rate_t). \quad (8)$$

Thus, the domestic price is a function of the Thai rice export price (*thai.p*), the tariff Bangladesh imposes on rice imports (*tariff*), and the exchange rate (*ex.rate*).

The estimated model closes on net trade (Equation 9) and the equilibrium condition is met when total market supply equals total market demand at the prevailing price. Thus,

$$net\ trade = total\ domestic\ demand + ending\ stock - production - beginning\ stock. \quad (9)$$

Under the autarky trade regime, price is used to close the model without imports. We use a price equilibrator framework to simulate equilibrium price by setting domestic demand equal to domestic supply, defined as follows:

$$total\ domestic\ demand\ +\ ending\ stock = production +\ beginning\ stock. \quad (10)$$

Online supplement– S2

Table S1. Augmented Dickey–Fuller test for unit root.

	Bangladesh price	**Thai 5% parboiled price**
Exogeneous	Constant	Constant
Lag length (max lag 10)	4	8
P Value– Level	0.00	0.00
t– Statistics	–7.84	–6.44
1% level	–3.46	–3.46
5% level	–2.87	–2.87
10% level	–2.57	–2.57

Table S2. Lag length selection

Endogenous: Bangladesh price, Thai 5% parboiled price
Exogeneous: Constant

Lag	**LL**	**LR**	**AIC**	**HQIC**	**SBIC**
0	–1322.43		22.64	22.66	22.69
1	–1292.05	60.77	22.19	22.25	22.33
2	–1270.89	42.32	21.90	21.99	22.13
3	–1218.16	105.45	21.06	21.20	21.39
4	–1217.11	2.10	21.11	21.29	21.54
5	–1197.46	39.32	20.85	21.06	21.36
6	–1151.17	92.58	20.12	20.37	20.74
7	–1118.53	65.27	19.63	19.92	20.34
8	–1109.41	18.23	19.55	19.87	20.35
9	–1079.80	59.21*	19.11	19.47*	20.00*
10	–1075.62	8.38	19.10*	19.51	20.10

*Indicates lag order selected by the criteria at 1% level

Table S3. Co–integration test: Bangladesh price & Thai 5% parboiled price

Trend: constant			Number of observations: 239	
Sample: 2000m1 – 2020m10			Lags: 9	
	Trace test		**Maximum eigenvalue test**	
Ho: Rank=p	Trace statistic	1% critical value	Max test statistic	1% critical value
P=0*	112.16*	19.94	88.63	18.52
P=1*	23.53*	6.63	23.53	6.63

Note: *Denotes rejection of the hypothesis at the 1% level
Trace test indicates 2 cointegrating equations at the 1% level
Max–eigenvalue test indicates 2 cointegrating equations at the 1% level

Online supplement S3

Table S4. Hypothetical future pandemic – no policy changes (% change relative to baseline)

	2027/28	2028/29	2029/30	2030/31
Area	0%	–1%	–2%	–2%
Yield	0%	0%	0%	0%
Production	0%	–1%	–2%	–2%
Net import	0%	–100%	–100%	–100%
Total domestic demand	0%	–2%	–5%	–6%
Ending stocks	1%	1%	0.2%	–0.5%
Price/KG	–5%	–9%	–2%	3%
Food security indicators (absolute change)				
Per capita consumption ratio	0.00	–0.02	–0.06	–0.08
Real price ratio	–0.05	–0.09	–0.02	0.03
Self–sufficiency ratio	0.00	0.01	0.03	0.05
Stocks–to–consumption ratio	0.00	0.00	0.00	0.00

Source: Authors' calculation

Table S5. Hypothetical future pandemic– with pre–existing public stock policy (% change relative to baseline)

	2027/28	2028/29	2029/30	2030/31
Area	0%	–1%	–2%	–2%
Yield	0%	0%	0%	0%
Production	0%	–1%	–2%	–2%
Net import	0%	–100%	–100%	–100%
Total domestic demand	0%	–2%	–5%	–7%
Ending stocks	138%	155%	170%	186%
Price/KG	–4%	–8%	–1%	4%
Food security indicators (absolute change)				
Per capita consumption ratio	–0.01	–0.02	–0.06	–0.09
Real price ratio	–0.04	–0.09	–0.01	0.04
Self–sufficiency ratio	0.00	0.01	0.03	0.05
Stocks–to–consumption ratio	0.04	0.04	0.05	0.05

Source: Authors' calculation

Table S6. Impacts of a hypothetical future pandemic– with pre–existing yield gap closure policy (% change relative to baseline)

	2027/28	2028/29	2029/30	2030/31
Area	–2%	–3%	–4%	–4%
Yield	4%	4%	4%	5%
Production	2%	1%	0%	0%
Net import	0%	–100%	–100%	–100%
Total domestic demand	2%	0%	–3%	–4%
Ending stocks	2%	2%	1%	0%
Price/KG	–10%	–14%	–7%	–2%
Food security indicators (absolute change)				
Per capita consumption ratio	0.02	0.00	–0.03	–0.06
Real price ratio	–0.11	–0.15	–0.07	–0.02
Self–sufficiency ratio	0.00	0.01	0.03	0.05
Stocks–to–consumption ratio	0.00	0.00	0.00	0.00

Source: Authors' calculation