rice price instability in bangladesh

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List of Acronyms

ADF Augmented Dickey-Fuller

BBS Bureau Bangladesh Statistics

DF Dickey-Fuller

DFID Department for International Development

DWH Durbin-Wu-Hausman

EP Essential Priority

FAO Food and Agriculture Organization

FFW Food for Work

FPC Fair Price Card

FPMU Food Planning and Monitoring Units

FY Fiscal Year

GDP Gross Domestic Product

GOB Government of Bangladesh

HYV High-Yield Varieties

MEP Minimum Export Price

MMT_S Million Metric Tons

MOA Ministry of Agriculture

OMS Open Market Sales

PFDS Public Food Distribution System

RR Rural Rationing

SR Statutory Rationing

VFG Vulnerable Group Feeding Program

VGD Vulnerable Group Development

2SLS Two Stage Least Square

Abstract

In the 2000s, the global attention was concentrated at the food price stability because of the rapid increase in cereal and other food prices. This rapid increase of food price has become a burden for the developing countries as well as for Bangladesh where households spend a large share of their income on food. Among the cereals rice has a strategic importance because it is the central to food security and economic and political stability of the country. Fluctuation in rice prices is not rare in Bangladesh. This paper examines the market factors influencing rice price instability in Bangladesh over the period of 1980- 2010. Using annual data series of domestic rice price, production, consumption, stocks, fertilizer prices, import price, trade policy and natural calamities, a Two Stage Least Square (2SLS) method were applied. The results reveal that rice production, stocks and liberalized trade policy can reduce domestic rice price. On the other hand, more domestic consumption, higher import price and natural calamities increase rice price. The study suggests some policies on the basis of research findings.

Keywords

Rice, Price instability, Bangladesh

Chapter 1: Introduction

Food price stability has become a central issue all over the world because of the sharp increase in world food prices between 2004 and 2010. The United Nations FAO food price index increased sharply from 2002 to 2010, the only exception being 2009. However, from 2006 to 2008 the price index increased by 57% (FAO, 2011), with a large increase in the prices of cereals, dairy, meat, oil and fats, and sugar. Within the cereals category, rice prices have increased approximately 115% (FAO, 2011).

According to FAO (2010), between 2006 and 2008 the prices of maize, wheat and rice reached their highest level in 30 years. Price spikes in the international market spur fears of economic and political instability in developing countries because increases in international prices can influence domestic prices. It can also threatened a nation`s food security.

Price stabilization, in particular for the major food grains is a serious concern because households in developing countries spend a large share of their income on food. Bangladesh is no exception. Rice is the principle food grain of Bangladesh and rice price stabilization has always been the top priority of every government. Almost 75% of the total cropped area is dedicated to rice production. It provides 70% of total caloric intake and nearly 50% of total protein intake for the average person (Ali, 2010). According to FAOSTAT (2011), Bangladesh is the fourth largest rice producing country in the world and ranks as the world's fourth largest rice consumer as well (Kabir, 2010).

Controlling the instability in rice prices has always remained the burning issue for Bangladesh. However, the supply and demand of rice do not move together to stabilize the price in the rice market. When the supply and demand moves in opposite directions, it tends to destabilize prices. Imports and domestic production exhibit supply-side influences and domestic demand and export depict demand-side influences, on prices of rice. Rice has rarely been exported from Bangladesh, which means the country is a net importer of rice. Thus, only domestic consumption represents demand force (Ahmed and Bernard, 1989). Even though there has been an uptrend in rice production in Bangladesh, fluctuations in prices have continued. Bangladesh is a disaster and flood prone country. The country has no control over the water that flows into its territory because of its geographical location. Climate change, drought, cyclone, floods, pest and diseases greatly influence the rice production level from

year to year. Fluctuations in production between years were remarkable in the 1970s but fluctuated less in the early 1980s to mid 1990s before become more fluctuating since then (Murshid,et.al. 2009). However, the rice price does not only depend on domestic production but also on other factors including stock behavior, the national public food distribution system (PFDS), seasonality in production and rising demand for rice. Policy (export restrictions, export bans, minimum export prices etc.) and actions of rice exporters also influences rice prices. For example, in 1990s, the reduction of the size of PFDS which is mainly targeted to the poor reduced the government`s share to total food grain sales and consumption which influenced the domestic market price (Dorosh and Shahabuddin, 2002). The price of agricultural input has a positive correlation with the rice price. The increased price in inputs push up production costs and this increased cost is reflected higher rice prices on the domestic market. There is also interaction between the rice price and energy prices because rice production depends heavily on energy inputs. For example, rice production depends on chemical fertilizer which is fuel intensive. Increases in the fuel price will increase the rice price as well. The Department for International Development (DFID) (2008) reported that price increases in both fertilizer and fuel increased rice prices in Bangladesh.

Rapid economic growth of large countries (e.g. India, China) put pressure on prices oil, fertilizer and other natural resources. So, international price increases in oil, fertilizer, and raw materials, and internal production shocks due to climate related factors, domestic supply distortions and pre-caution measures against these distortions and price increases further exacerbated the pressure on prices. Exchange rate depreciation also greatly influences the domestic price increase because depreciation increases the border prices in terms of local currencies. Half of the world population consumes rice and it is the critical diet for many consumers. So, a world rice price increase has a detrimental impact on rice consumers. This can led to panic buying by the importers in fear that price will become even higher in future; countries try to re-build their national rice stocks. These reactions increase the price level, causing volatility and distorting the price signals to the farmers (Hussain and Zaman, 2008).

Objectives and Research Questions of the study:

The objective of the study is to analyze the rice market in Bangladesh with special focus on the market factors which are responsible for domestic rice price instability, over 1980-2010.

In the view of the dependence on rice as a staple good and the increasing price instability, the research questions of the study are two-fold:

(1): How do market factors influence the price instability? , and

(2): What is the policy in response to the price instability?

To answer these research questions the study used econometric estimation where rice price instability is explained by a number of key variables. The study used 30 years annual data. Since the data are time series, a unit root test is conducted at the first step to examine the variables are stationary or not. After that the study proceeds with further estimation and final results come through the 2SLS method. Based on the research findings the study provided some policy suggestions.

Organizations of the study:

The rest of this study is arranged as follows. Chapter two depicts the background information of rice price instability in Bangladesh. Theoretical and empirical reviews highlight in chapter three. The data sources and methodology are presented in chapter four. Chapter five provides the result and discussion of the analysis. The thesis ended with the conclusion and policy implication in chapter six.

Chapter 2: Background

2.1 Background information on Bangladesh

Bangladesh is a densely populated country. The total area of Bangladesh is 147,570 km2. According to the 2001 population census, the total population of Bangladesh is 150 million. The amount of arable land in production has been reduced by 1% for more than one decade, as the demand for residential houses as well as commercial and industrial structures is rising at an increasing scale. This threatens the food security. In Bangladesh livelihoods mainly depend on agriculture. About 75% of the total population of the country is engaged in agriculture. Millions of farmers planted their land to rice throughout the regions. It is also important for the landless workers who earn income from working on these lands. This sector provides 50% of the agricultural GDP and one sixth of the national income.

2.2 Importance of rice in Bangladesh

Rice is the food grain that shaped the country`s life style, culture, and tradition and food security. The population of the country mainly depends on rice for survival. Rice is consumed at every meal and it is common to consume rice three times in a day.

Ensuring a stable price of rice is one of the major challenges for Bangladesh. The problem intensifies if and when the country is hit by natural disasters. Recently in FY 2007/2008, the loss in rice production was about 1.5 to 2.0 million tons, due to the natural disaster (Deb, 2009). This kind of loss could easily be offset by the imports from international markets but restrictions from the exporting countries made the situation critical. For example, Bangladesh`s position was further aggravated when India, the largest exporter of rice to Bangladesh, imposed restrictions on exports. This exporting ban caused a severe price hike in the country.

Normally the rice growers and the consumers are considered to be poor. The producers always try to keep the price as high as possible and opposite are the intension of the consumers. This is a very common constant pressure for the rice growing countries, particularly in poor countries like Bangladesh.

2.3 Features of rice production in Bangladesh

Rice production is mainly based on land types and the different ecosystems, e.g., irrigated, rainfed and floating or deepwater. Depending on the ecosystems all rice varieties produced in the country are in different groups: upland Aus is a pre-monsoon direct-seeded variety; transplanted Aman is mainly planted during the monsoon season under a rainfed ecosystem; and, Boro is dry season rice grown under irrigation. The area planted to Aus, Aman and Boro is respectively 9%, 51% and 40% of the total rice area (Abedin et al. 2010). Management practices such as irrigation, modern technology, use of new high-yield varieties (HYVs), fertilizer applications, pest and crop management practices are also important for rice cultivation. In table 1, the production patterns of different rice varieties are shown.

Table 1: Rice cropping calendar of Bangladesh

	jan	feb	mar	apr	may	june	july	aug	sep	oct	nov	dec
Aus rice												
Aman rice												
Boro rice												

Planting harvesting

In table 2, the area planted to the three rice types, production, and yields are presented. The table portrays that the area cultivated under Boro, production and yield has an increasing trend compare to the Aus and Aman varieties. It is interesting that most of the Aus cultivated land shifted to Boro rice and area planted to Aman to some extent declined overtime but is still higher than others. The reason behind this could be the less varietal improvement of Aus and Aman and more affected by natural calamity than Boro rice. During the 1980s and the 1990s the contribution of Aman rice to total rice production was 52% and 49% which was higher than the other two varieties. But afterward adapting the new technology, HYV varieties and less affected by natural calamity Boro rice alone contributed 57% to total rice production. Meanwhile Aus rice production declined overtime due to its traditional varieties and cultivation method and the replacement by Boro rice.

Table 2: Rice Area, Production and Yield by Varieties (000 acres, 000 tons, ton/acre)

	Aus			Aman			Boro		
Year	Area	Production	Yield	Area	Production	Yield	Area	Production	Yield
1981-82	7770	3270	0.420	14845	7209	0.485	3216	3152	0.980
1982-83	7800	3065	0.392	14803	7516	0.507	3539	3548	1.002
1983-84	7753	3222	0.415	14837	7843	0.528	3461	3350	0.967
1984-85	7256	2783	0.383	14104	7930	0.562	3889	3909	1.005
1985-86	7030	2828	0.402	14876	8540	0.574	3789	3670	0.969
1986-87	7175	3129	0.436	14958	8267	0.553	4082	4010	0.982
1987-88	7091	2993	0.422	13817	7689	0.556	4082	4731	1.159
1988-89	6633	2856	0.431	13815	6857	0.496	6026	5831	0.968
1989-90	5593	2487	0.445	14093	9202	0.653	6205	6167	0.994
1990-91	5216	2328	0.446	14373	9167	0.638	6297	6357	1.010
1991-92	4735	2179	0.460	14068	9269	0.659	6511	6804	1.045
1992-93	4287	2075	0.484	14441	9680	0.670	6423	6586	1.025
1993-94	4076	1850	0.454	14209	9419	0.663	6378	6772	1.062
1994-95	4111	1791	0.436	13824	8504	0.615	6582	6538	0.993
1995-96	3810	1676	0.440	13953	8790	0.630	6804	7221	1.061
1996-97	3935	1870	0.475	14339	9552	0.666	6876	7460	1.085
1997-98	3868	1875	0.485	14353	8850	0.617	7138	8137	1.140
1998-99	3519	1617	0.459	12762	7736	0.606	8715	10552	1.211
1999-00	3339	1734	0.519	14097	10306	0.731	9024	11027	1.222
2000-01	3275	1916	0.585	14110	11249	0.797	9296	11921	1.282
2001-02	3070	1808	0.589	13955	10726	0.769	9319	11766	1.262
2002-03	3073	1851	0.602	14041	11115	0.792	9501	12222	1.286
2003-04	2972	1832	0.616	14030	11521	0.821	9745	12837	1.317
2004-05	2532	1500	0.593	13047	9820	0.753	10042	13837	1.378
2005-06	2556	1745	0.683	13416	10810	0.806	10047	13975	1.391
2006-07	2759	1512	0.548	13382	10841	0.810	10522	14959	1.422
2007-08	2850	1507	0.529	12738	9662	0.759	9050	17761	1.963
2008-09	3462	1895	0.547	13439	11152	0.830	9786	18270	1.867
2009-10	2643	1709	0.647	13536	11152	0.866	11658	18059	1.549

Source: FPMU, BBS

2.4 Rice Production, Consumption, Trade and Stock in Bangladesh

It is assumed by common people that the sharp increase in rice production will reduce the country's hunger and poverty. In FY 1975-76 the total rice production was 10.32 million tons with 79.90 million population and 10.32 million ha rice cultivated area. Rice production substantially increased during the 1990s and 2000s by adapting the modern technologies and rice varieties. Rice production has trended upward from the1980s. During the 1980s the share of rice to total food grain was 93% which was 95% in the 1990s and more than 97% in the 2000s (BBS, 2010).

Despite the increasing trend in rice production Bangladesh has experienced a continued annual shortage of food which is nearly 1.5 million tons and it will continue even if the current population growth is maintained (Karim, 1999). In this situation, rice production has to be increased by 60% by 2020 to fulfill the countries rice requirements (Bhuiyan and Karim, 1999). An increase in rice production is quite difficult due to the reduction of arable land.

Table 3, represents the production, consumption, import, import price, domestic price and average annual stock of rice in Bangladesh. About 90% of the total rice production of the country in any given year is consumed as food and the rest is used for other purposes. Rice production during the 1990s was 25% higher than that of 1980s and 45% higher in 2000s in comparison with 1990s. The increased production resulted in more rice being available for consumption. In the 1980s and 1990s consumption exceeded production because of high population growth rate and supply shocks due to floods and cyclone. The gap between production and consumption was filled by releasing stocks.

In the 2000s the situation changed as production exceeded consumption. The increase in rice production is mainly due to the increased Boro production, using the HYVs, efficient use of irrigation, fertilizer and pest management methods. This occurred even as consumption continued to increase. For example, rice consumption in 2009-10 was 1.42% higher than in 2008-09. This is due to the population growth and some government activities like Vulnerable Group Feeding Program (VGF), Open Market Sales (OMS) of rice and expanding public distribution.

Table 3: Rice Production, Consumption, Import, Import prices and Stocks, (1980-81 to 2009-10)

Year	Total production (`000`m.t)	Consumption (`000`m.t)	Import (`000`m.t)	Import Price (Taka per m.t)	Average annual stocks (`000`m.t)
1980-81	13883	14010	78	3852	453
1981-82	13630	14356	255	4396	481
1982-83	14129	14701	196	5254	312
1983-84	14415	15047	170	5604	213
1984-85	14622	15393	388	5800	268
1985-86	15041	15738	52	6406	400
1986-87	15407	16084	260	4963	215
1987-88	15414	16445	674	4991	386
1988-89	15544	16775	61	5161	490
1989-90	17710	17105	300	5953	660
1990-91	17785	17434	11	5785	549
1991-92	18255	17749	39	5740	491
1992-93	18341	18063	20	6644	594
1993-94	18042	18377	74	8566	258
1994-95	16832	18690	814	8385	177
1995-96	17687	19005	1141	8529	401
1996-97	18880	19319	34	8999	551
1997-98	18862	19633	1085	9428	297
1998-99	19905	19947	3068	11627	424
1999-00	23067	20261	432	11700	666
2000-01	25085	20575	561	12570	643
2001-02	24300	20890	126	13366	478
2002-03	25168	21204	1557	13975	438
2003-04	26189	21603	801	15528	589
2004-05	25157	21995	1295	15800	529
2005-06	26530	22272	532	14060	534
2006-07	27312	22603	721	16850	565
2007-08	28930	22932	2050	23840	481
2008-09	31317	23262	602	19238	995
2009-10	31496	23591	400	21390	823

Source: FPMU & BBS for several years

Prior to 1994, only the GoB could import rice from abroad. Following the policy change in 1994, the private sector played a vital role in the rice import sector. According to the FPMU (2009), rice import was recorded high in the mid-to late 1990s because of the production shortfall during the Aman season. The private sector`s contribution was remarkable during those crisis periods. It was needed to augment market supplies quickly and cheaply that time.

2.4 Million Metric Tonn (MMT) of total rice was imported by private sectors within nine months in 1998-99 (Chowdhury et al. 2006). Countries that export rice to Bangladesh are India, Myanmar, Pakistan, Thailand and Vietnam. Among them India has become the main importing source for Bangladesh because of its geographical location. Throughout the 1980s and early 1990s Thailand was the main rice import source for Bangladesh. In 1994, Bangladesh trade liberalization was coincided with India`s rice trade liberalization and it dramatically changed the rice import trade. For example, in the mid-to late 1990s 92% rice import came from india and in the 2000s it became 97% (BBS, 2010). India continues to remain the single largest import source for Bangladesh but now Bangladesh diversified the importing source following the export ban of India in late 2007 and early 2008.

Stock levels are not same in all periods. The average annual rice stocks were 387.8-000 mt in the 1980s while in the 2000s it was 607.5-000 mt, 38% higher than that of 1990s. Stocks were recorded low in the 1980s due to production loss occurred by floods. During the 1990s, stock levels were excessively low (177-000 mt) in FY 1994-95 because of the low Aman procurement when Aman crop harshly damaged by drought. The exporters failed to deliver the crop according to the contract schedule, so government commercial imports were also delayed (up to nine months) at the same time. Rice stocks were also low from December 1997 to april 1998 following the poor aman harvest in November- December, 1997. Stocks recorded from august to October in 1998, devastatingly low because flood destroyed the Aman seedlings badly (Dorosh and Farid, 2003).

In 2000s, stocks were noticeably low in 2007-08 because of the rice production loss following the consecutive floods, cyclone sidre and export ban from the major rice exporting country. In response to this situation rice stocks were excessively high in 2008-09 and 2009-10 because of the panic buying of rice by the government. For example, In 2009/10 the beginning stock of rice was 1.1 million tons. Government stocks on December 31, 2010, were 540,000 tons and 983,000 tons in December 31, 2009. On December 31, 2008, the rice stock was 842,000 tons compared to 434,000 tons on December 31, 2007 (Bangladesh Grain and Feed Annual, several years).

2.5 Policy and Prices

As in other developing countries, the policy makers of Bangladesh face the dilemma to keep low rice prices for consumers (especially the poor) and prices high enough to incentivize producers to produce more rice.

Increased price volatility, uncertain rice trade policies of India and other major exporting countries caused policy makers in Bangladesh to re-emphasize self sufficiency in rice for food security. The National Food Policy Plan of Action: 2008-2015 established a target of self-sufficiency to keep low prices for consumers through price stability and to increase the volume of PFDS. However, the rice policy in Bangladesh is described below,

In between 1980 and 1993 Bangladesh was aimed at self-sufficiency to achieve food security. In 1994, the policy changed into self-reliance following the strategy to import rice from world market at a cheaper rate than it growing at home, this strategy broke down in FY 2007-08 when the food price crisis was made worse when India and other major rice exporting country imposed export bans on rice. The country then returned to its earlier policy. This policy approach remained unchanged even if the international price decreases and the country follow an expansionary rice production policy.

Since early 1990s the government has reduced its direct intervention in the rice sector, but every government has the target of rice self-sufficiency to secure adequate supplies. To achieve the objective of the government`s strategies, the instruments used to support the sector included:

- research in new varieties;
- provision of irrigation targeted specially to the drought prone areas and to the dry season Boro crop;
- development of HYV which is suitable in rainfed conditions;
- timely and efficient use of fertilizer;
- increased participation of private sector in the area of irrigation, production and import and marketing of hybrid rice seeds; and
- producer price support policy through the input subsidies and procurement purchase by the government. Domestic procurement plays an important role to build up public stock and to stabilize market prices.

Consumption policy was mainly designed to secure poor consumers or to reduce the impact of price instability. Direct consumer subsidies, price subsidies, tax reductions, social- safety net

programs and distribution from public stocks are the policy measures to support consumers and vulnerable groups (Zolin et al. 2010).

After independence (1971) the GoB adapted a rural rationing (RR) and statutory rationing (SR) system in rice as consumption policy. This policy continued to operate up until 1993. Under SR the government issued ration cards to the inhabitants (especially to civil servants and urban residents of 20 years, i.e., excluding the newly immigrated) of the large cities. This SR entitled to each card holder to purchase a weekly ration of rice at subsidized ration price. On the other hand, RR was designed to distribute rationed rice to low-income families in rural areas at a concessionary price.

Both the RR and SR for rice were abolished in 1994. However, the government continued to distribute rice mainly under PFDS and poverty alleviation programs. There are monetized and non-monetized channels under the PFDS. For example, the OMS (Open Market Sales), FPC (Fair Price Card), EP (Essential Priority) are monetized channels and VGD (Vulnerable Group Development), FFW (Food for Work) are non-monetized channels. The objectives of these channels are to ensure more rice available for the vulnerable group throughout the year.

Maintaining food grain stocks is a common feature of food policies in Bangladesh because production is seasonal but consumption is continuous. The government maintained food stocks to: provide emergency relief during natural calamities and floods, as a security stock; to stabilize market prices, especially rice prices; and to alleviate food insecurity of the poor households through the PFDS. The government policy change in the late 1990s shifted to increase the food grain stocks. The official minimum stocks target was set at 1.0 to 1.2 mmt while the operational target was 700 to 800 000 tons in the early 1990s (Dorosh and Farid, 2003). In late 2008, the official stocks target was set at 1.52 mmt of rice and wheat. The target changes depending on the market situation.

Usually the same amount of stocks serves as different ways at the same time depending on the situation, e.g. the same stocks can provide as working stocks for distribution programs, as security stocks at emergency time and as buffer stocks to stabilize prices. Bangladesh maintains buffer stocks of rice are to stabilize market prices or the entire economy since 1980s. In a buffer stock scheme rice is bought and stored during the time of surplus and sold and distributed (under PFDS) during the time of shortage. But the cost of rice procuring and storing is very high in Bangladesh since it cannot be stored for more than six months (Shahabuddin et al. 2009). However, the deterioration of the high rice stocks could be solved through the PFDS. The country released rice from stocks in order to lessen price increase.

During the 1970s and 1980s only the public sector could import rice since private imports were banned. Public rice import come through the commercial imports and food aid by the developed countries. Up until 1994, the GoB highly dependent on food aid and commercial imports to achieve the price stabilization objective. Bangladesh adapted a liberalized rice trade policy since 1994. Following the policy change, private sector showed it mettle to augmented market supplies and to keep prices within an acceptable range during domestic production shortfall. Government also continued to import to enlarge the security stock and to meet the quantities for safety net programs. Following the upward trend in domestic prices the government removed all the import restrictions in the 1997-2002.

Duty- free rice imports have been permitted since 2008 and there is no quantitative restriction in rice imports. An export has been imposed since May 2008. On February 13, 2011, the GoB has took a decision to reduce the days from 25-30 to 7-10 to simplify the approval process for rice tenders (Bangladesh Grain and Feed, 2011).

As rice price stabilization is a major concern for the policy makers and GoB, policies have taken in account meeting this objective. Buffer stock policy or the combination of trade policy and buffer stock policy is a common price stabilization policy in developing countries (Islam and Thomas, 1996). The logic behind buffer stock scheme is that when there is surplus in production producers get low prices; government buys stocks for the next period and the time of shortage prices go up, consumers have to pay higher prices and that time government sell stocks to augment the supply to trade rice at a lower price. That is how stocks help to stabilize price in a desire limit between periods.

Rice production policy also help to stabilize price through enlarge the supply of rice. GoB and policy makers have a hope that investment and research in rice sector will increase productivity which can increase rice supply and reduce the price volatility and improve food security.

2.6 Background of rice price instability

Internal rice price instability can be explained as annual (inter-year) and seasonal patterns (intra-year). Annual price fluctuations occur due to production shortage, which is the result of adverse climate change, flood, drought etc and this fluctuation, is unpredictable because no one knows when a devastating flood will occur. After trade liberalization (1994), both public and private import and stock is considered as the important policy instruments to keep the price rise within an acceptable limit. On the other hand, seasonal price fluctuations arise from

seasonality in production and it is predictable. Normally it is likely to be low price in harvesting period and higher prices in lean period. Domestic procurement, OMS and other sales channels are used as a policy instrument to achieve the seasonal price stability. Domestic procurement raises average prices and farmer incomes, and OMS and other sales channels moderate prices to consumers to face the severe upward pressure on prices (Dorosh and Shahabuddin, 2002).

Annual rice prices variability is presented in table 4. The range of price fluctuations during the 1980s and the 1990s was from 0.61 to 31.04% and 1.56 to 28.59% respectively. During 2000s, it was again increased ranging from 1.43 to 46.27%.

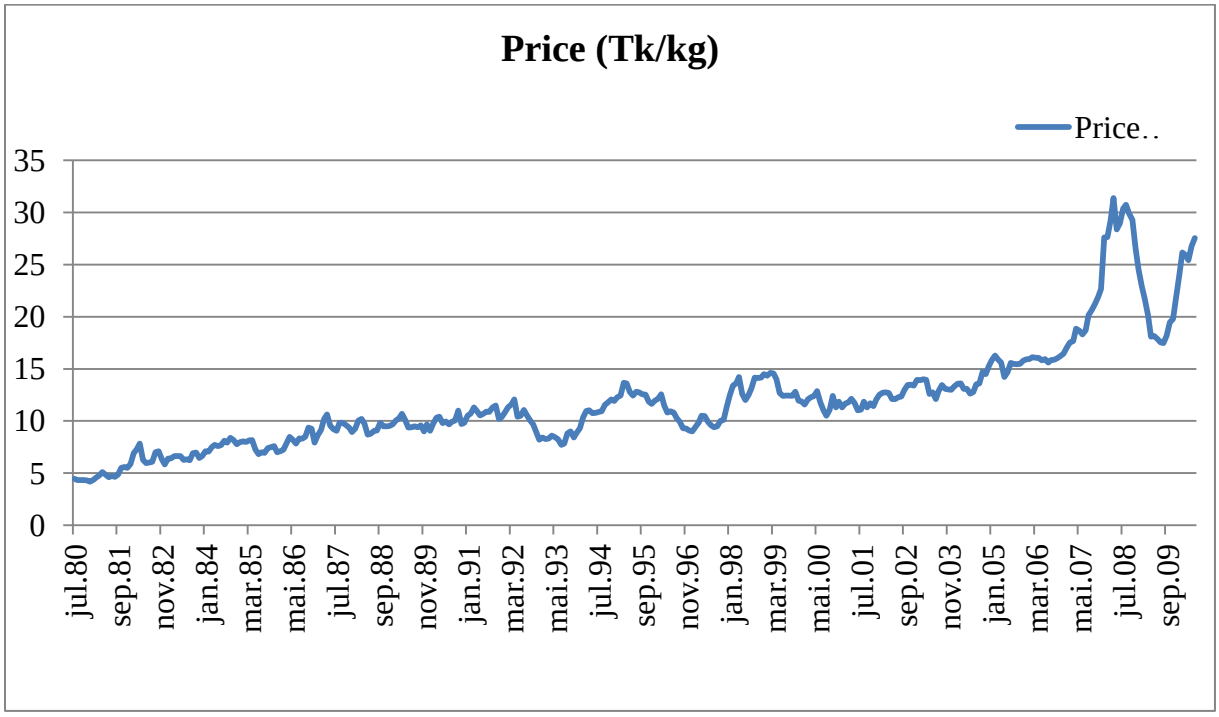
Table 4: Variability of annual rice prices, 1980/81 to 2009/10

Year	Actual Price (Tk/kg)	Percentage changes from previous year
1980-81	4.51	-
1981-82	5.91	31.04
1982-83	6.44	8.97
1983-84	7.01	8.85
1984-85	7.89	12.55
1985-86	7.51	-4.82
1986-87	9.07	20.77
1987-88	9.44	4.08
1988-89	9.71	2.86
1989-90	9.65	-0.61
1990-91	10.41	7.88
1991-92	10.99	5.57
1992-93	9.06	-17.56
1993-94	9.48	4.64
1994-95	12.19	28.59
1995-96	12.00	-1.56
1996-97	9.82	-18.17
1997-98	11.50	17.11
1998-99	13.77	19.74
1999-00	12.23	-11.18
2000-01	11.48	-6.13
2001-02	12.02	4.70
2002-03	13.26	10.31
2003-04	13.07	-1.43
2004-05	14.74	12.78
2005-06	15.80	7.19
2006-07	17.01	7.66
2007-08	24.88	46.27
2008-09	24.19	-2.77
2009-10	21.56	-10.88

Source: MOA, FPMU and author`s calculation.

Prices were unstable during these periods due to rice production shortfalls caused by drought and floods. In the 2000s rice prices were registered high because of the severe rice shortage caused by twin flood, devastating cyclone sidre, and export ban from the major rice exporting country. The range of price fluctuations declined during the post rice import trade liberalization period (1993/94- 2005/06) with compare to pre-trade liberalization period (1981/82-1992/93), 1.43 to 28.59% and 0.61 to 31.04%.

Figure 2.1 Fluctuations in monthly rice prices in Bangladesh



Source: FPMU

Figure 2.1 depicts the monthly price fluctuations for 1980s, 1990s and 2000s. The range of monthly price fluctuations was quite small in 1980s compared to 1990s. In 2000s, the range of monthly price fluctuations displayed stability for the first years (from 2001 to may 2007). A greater degree of price instability was registered for June 2007 to December 2009. Price hike was severe in September 2008.

Seasonality of rice prices in Bangladesh:

In table 5, seasonality indices of rice prices are shown. Seasonality of rice prices defined as the seasonality in production which is repeated from year to year. The ratio of the highest price and lowest price decreased overtime, 1.18 in the 1980s, and 1.13 in both the 1990s and 2000s.

Table 5: Seasonality indices* of rice prices

	1980/81-1989/90	1990/91-1999/2000	2000/01-2009/10	1983/84-1992/93	1993/94-2009/10
January	0.98	0.99	1.04	0.98	1.02
February	1.03	1.03	1.05	1.01	1.05
March	1.08	1.06	1.05	1.05	1.06
April	1.11	1.07	1.05	1.07	1.07
May	1.03	1.01	0.99	1.00	1.01
June	0.99	0.99	0.99	0.98	0.99
July	0.94	0.98	0.93	0.98	0.94
August	0.94	0.97	0.95	0.98	0.95
September	0.99	0.99	0.97	1.01	0.97
October	1.00	1.00	1.00	1.02	0.99
November	0.97	0.95	0.98	0.97	0.97
December	0.94	0.96	1.00	0.95	0.99
Highest price	1.11	1.07	1.05	1.07	1.07
Lowest price	0.94	0.95	0.93	0.95	0.94
Ratio	1.18	1.13	1.13	1.13	1.14

Note: * The seasonal price index is the average for each month, of the ratio of the price to a twelve months average.

Source: FPMU and author`s calculation

June was the highest price month in the 1970s which changed to April in the 1980s, 1990s and 2000s due to the earlier and larger arrival of Boro and Aus rice varieties. In the 1980s there was a small drop in prices from April to May, after that price was stable up to September. In 1990s, after April prices continued to decline till August. Prices were stable from February to April in the 2000s. After a small drop from April to May prices remained same on average the rest of the months. The increase share of Boro and Aus rice varieties to the total production of rice changed the sharp seasonal increase in prices in June (observed in late seventies) and resulted stable prices from May to September.

Comparing with the pre-trade and post-trade liberalization period, the highest and lowest price ratio is almost same (1.13 in pre-trade and 1.14 in post-trade liberalization period). This is because of the export restrictions from major rice exporting country in 2007. The magnitude depicts that trade liberalization did not change the seasonal price fluctuations significantly.

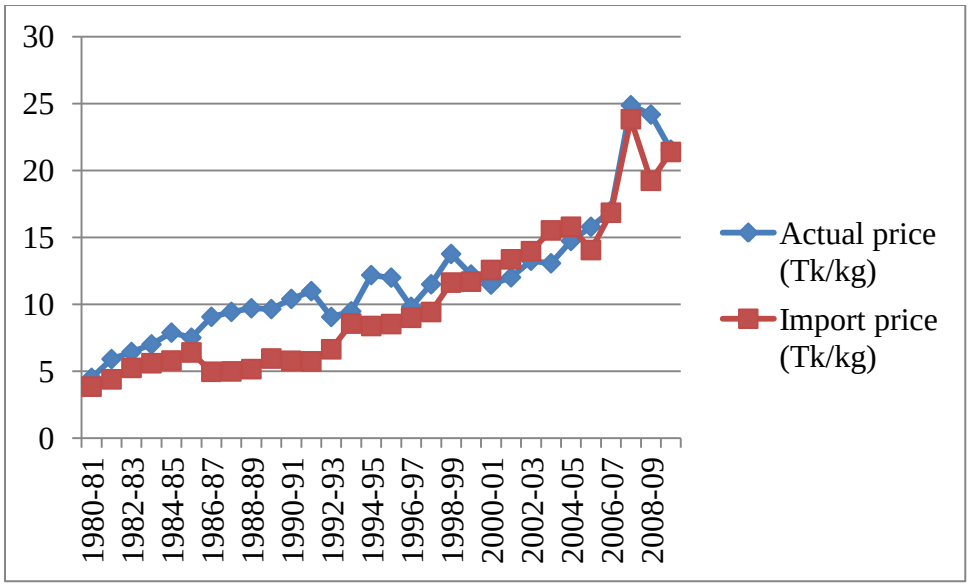
The global rice market is very thin in terms of volume, only seven percent of global rice production is traded on average (Deb et al. 2009). The global rice market is concentrated among the US and several Asian countries. This market is arranged as Thailand, Viet Nam,

India, US and Pakistan based on their export share. With the exception of the US, the other countries economic and political stability depends on rice like Bangladesh. Therefore, rice policies of large exporters (e.g. India) and importers (e.g. the Philippines) could easily influence world rice prices. Jha and Srinivasan (1999) showed that the 4.7% decrease in world rice prices was due to one million tons of additional increase in rice export or import by India. India`s export restriction increased world prices from $433.7 per ton to $1300.71 per ton (by using the same study period) compare to no export restriction (Mitra And Tim Josling, 2009). What happened on the international market affected the domestic market. So, both exporting and importing countries carefully monitor international prices and take measures to stabilize domestic market prices. Interventions in domestic sector can be a short-term solution to reduce price fluctuations, but global rice price fluctuations influence domestic market eventually.

For example, world rice prices started increasing slowly from 2004 and it rose to record high in the spring 2008. Rice trading prices (Thailand`s high quality 100% grade B milled rice is the benchmark for trading price) exceeded $1000 per ton in April 2008 which is tripled what it was in November 2007. When food price started to increase dramatically, the major rice exporting country implemented export ban, restrictions and set minimum export price (MEP) to secure domestic rice prices, a major food staple most of the Asian countries. This drastic price increase led to panic buying by rice importing country as fear that prices will be even higher in future (Childs and Kiawu, 2009). These factors combine with others make the world rice market instable. Rice prices rose and fell in Bangladesh in accordance with the world market, in late 2007 and early 2008 (Mohanty et al.2010).

Bangladesh found its difficulty to import rice it needed because of the export restriction policy of India and other major rice exporting countries. For example, Thailand and Vietnam raised prices to the same level of India at the crisis period (2007-2008). Traders, producers and consumers of Bangladesh started to hoar rice anticipating that prices would become higher in future. Thus the policies and actions of other countries led to rice price instability in domestic market.

Figure 2.2 Average import prices versus domestic prices of rice



Average import price versus domestic price:

In figure 2.2, the average import price and domestic price of rice are shown. Figure shows that before trade liberalization the difference between domestic prices and import prices were high. The reason behind this, during that period only public sector could import rice and it was not enough to stabilize the supply and price of rice in the market. After trade liberalization gap between this two prices started to decrease as the private sector played an important role to stabilize prices by increasing the rice supply. From the early to mid 2000s import price was higher than domestic price because since January 2000 the GoB set a 5% rice import tax to protect the domestic producers and to reduce the misuse of customs declaration e.g., commodities with higher tariff were imported by the name of rice (FPMU, 2000). At the end of 2000s this two prices were almost same. During this time both prices were greatly influenced by the world food price crisis, policies of the major rice exporting countries and natural calamities that caused rice production shortage in Bangladesh.

This chapter presents an orientation of the rice sector and the background information of rice price instability. In this section I present the importance of rice, features of rice production, scenario of rice consumption, stock and trade, the policy related to rice price and the information about price instability. As well, variability in annual and monthly rice price, seasonality of rice prices being discussed here. Import price and domestic price relationship also presented. The next chapter will go on the literature review of rice price instability.

Chapter 3: Review of Literature

This chapter will highlight the theoretical frameworks and the empirical findings of the previous research works in the arena of rice price instability. The simple price formation model for the important staples (rice, wheat and corn) will be presented in the first part of the literature review and after that I will provide the empirical evidence of the factors that affecting the rice price instability. Since the objectives of the study is to analyze the market factors that affecting rice price, the literature review will help to figure out the factors and the relationship between market factors and price instability.

3.1Theory

Timmer (2009) developed a price formation model to identify the causes of high prices of three important staples: rice, wheat and corn. Both exogenous (weather shocks or bio-fuel usage) and endogenous (producers` and consumers` response to price and government`s policy response to price) causes an effect on prices. The price formation model incorporate the factors to answer the question: "what caused the recent run-up in world market prices for these basic commodities?" The basic model described as below:

$$D_t = f(a_t, P_t, sr_d, P_{t-n}, l_{rd}) = a_t P_t^{sr_d} P_{t-n}^{lr_d} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

$$S_t = g(b_t, P_t, sr_s, P_{t-n}, lr_s) = b_t P_t^{sr_s} P_{t-n}^{lr_s} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

where D_t and S_t denotes the demand and supply of the commodity at time t. a_t and b_t are the time dependent demand and supply curve shifters. P_t is the equilibrium market price. P_{t-n} represents a lagged market price. sr_d, sr_s, lr_d and lr_s indicates the short-run and long-run demand and supply elasticities.

Cobb-Douglas demand and supply functions are assumed for the simplicity and the equilibrium is,

$$\log a_t + sr_d \log P_t + lr_d \log P_{t-n} = \log b_t + sr_s \log P_t + lr_s \log P_{t-n} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (3)$$

The equilibrium price solution is,

$$\log P_t = (\log b_t - \log a_t) / (sr_d - sr_s) + \log P_{t-n} (lr_s - lr_d) / (sr_d - sr_s)$$

The price instability factors from time period t-1 to t revealed by taking first differences,

$$d \log P_t = \{(\log b_t - \log b_{t-1}) - (\log a_t - \log a_{t-1})\} / (sr_d - sr_s) + (\log P_{t-n} - \log P_{t-(n+1)}) + (lr_s - lr_d) / (sr_d - sr_s).$$

where, d log P_t is the percentage change in price from t-1 to t and it helps to answer the question "what causes changes in d Log P_t?"

To answer the question simplifies the equation as SR = sr_d - sr_s (net short-run supply and demand response) which is always negative as $sr_d < 0$ and $sr_s > 0$, and LR = lr_s - lr_d (net long-run supply and demand response) which is positive for the same reason. The term d log a_t = log a_t – log a_{t-1} and d log b_t = log b_t – log b_{t-1} is the small percentages in demand and supply shifters respectively.

Finally, d log P_{t-n} = log P_{t-n} – log $P_{t-(n+1)}$ is the small percentages in the commodity price (for some specified period of time).

Combining all of these terms the simple equation of percentage changes in commodity prices is,

$$\%\Delta P_t = [\%\Delta bt - \%\Delta at]/SR + [\%\Delta P_{t-n}] LR/SR \quad \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Gilbert (2008) recommended that in almost all circumstances the rightward shifting of demand curve will lead the price to go up, but how much the price will increase depends on the slope of the supply curve. For example, in the case of very elastic supply curve the price increase is modest and the extent of price increase is quite substantial when supply curve is less responsive. If the supply curve is very inelastic, a small shift in demand curve will lead to a large price impact.

Normally inelastic supply curve causes price boom because booms come after low investment in agriculture which resulted low productivity growth and decreased the capacity of world agriculture responsiveness towards shocks. The other cause that limits supply responsiveness is the inter-linkage of factor markets. Figure 3.1 represents the case. Suppose a demand shock from $D \rightarrow D`$ is specific to a particular agricultural market and the supply curve is S, which is elastic. The small price change from $P_0 \rightarrow P_1$ occurs from the demand shock. The situation becomes more complicated when the demand shock is common across all agricultural markets. For example, output from one sector is used in others (energy used in agricultural production) increases cost of rice production. As a result the supply curve shifts from S to S`. The other problem is that in the case of a common demand shock it is difficult to reallocate land and other inputs across crops. Additional factors are only available at a very high cost which may lead supply curve inelastic. In figure 3.1, if supply were inelastic, then the supply curve would rotate to S``. The same demand shock would result in higher price instability, i.e., a price change from $P_0 \rightarrow P_2$.

Commodity price movements are the responsiveness of supply and demand shocks. The price boom appears unevenly large compare to normal time if the response coefficient is constant throughout the sample. In this situation price changes could be explained by the market specific factors and also by the macroeconomic factors which affect the whole commodity markets.

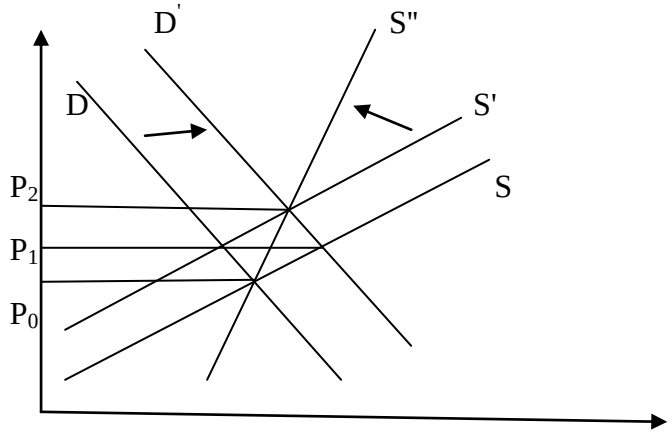


Figure 3.1 Price responses to idiosyncratic and common demand shocks (adapted from Gilbert (2008).

3.2 Review of empirical studies

Zolin and O'Callaghan (2010) analyze the variables that were responsible for price changes in the rice market by using a regression analysis with the data from January 1999 to December 2009. They separated the period into two: the first period is January 1999- December 2007 and the second period is 2008 and 2009 and they only focus on the long-run result. They used the logarithmic of rice price as dependent variable and population, rice production, ending stocks, rice exports, exchange rates (dollar-euro), GDP of developing countries (where rice has strategic importance), GDP of developed countries and biofuels as independent variables. The result of this study showed that biofuels, population, ending stocks and other cereal prices were not significant explanatory variables in the long-run. The significant variables in the first period were: GDP of developing countries with positive relation and GDP of developed countries with negative sign and the export of rice and rice production with negative relationship with price change. Developing countries' GDP and the dollar-euro exchange rates were statistically significant in the second period with a positive relationship.

Murshid et al. (2009) investigated whether there was any systematic relationship between the production movement and rice prices in Bangladesh for the period of 1994/95 to 2007/08. Their investigation results showed that there was no significant relationship between domestic production and rice prices in domestic market.

They also investigated this relationship in a multivariate framework by using simple linear and logarithmic regression. They estimated the price as the dependent variable and production, PFDS, import, international price and two seasonal dummies for the Aus and Aman rice types as independent variables. The results demonstrated that there was no significant relationship between the production and the rice prices. PFDS had a significant impact on prices in logarithmic regression but with the wrong sign. They concluded that an additional rigorous analysis was required to explore a robust conclusion for rice price instability. They left a hypothesis for further research as "domestic prices may be increasingly subjected to the influence of non-domestic factors" and raise the question: how external factors influences the domestic price shock?

Arshad and Hameed (2009) analyzed the long-term relationship between petroleum and cereals (maize, wheat and rice) prices. They estimated the relationship for the period of January 1980 to March 2008 through the bivariate co- integration approach of Engle-Granger two-stage estimation. The results represented the coefficients of the error-correction term (which measures the speed of adjustment of Granger causality test) of maize, rice and wheat prices are 0.05 and 0.02, 0.03 respectively, indicating a low speed of adjustment. The results confirmed that rice prices adjust at the lowest speed and the study denied the relationship between petroleum and cereals (maize, wheat and rice) prices.

Huda (2009) analyzed the factors that affecting Bangladesh food price instability by using a simple pair- wise model:

(i) The relationship between domestic food price and world rice price;

(ii) The relationship between domestic food price and petroleum prices; and

(iii) The relationship between domestic food price and exchange rate.

The study used the simple Engle and Granger (1987) residual-based co-integration method to test the hypothesis whether or not the world rice price, petroleum prices and exchange rate influenced the domestic food price for the period of July 2005 to the December 2009.

Simple regression analysis being used at the initial stage, then the study used both Dickey-Fuller (DF) and the Augmented Dickey-Fuller (Dickey and Fuller, 1981) unit-root tests to identify the integration order of the series. The existence of co-integration among the series was also tested by Augmented Dickey-Fuller (ADF) test. Finally, the causal relationship of each pair of series was tested by the Engle-Granger (1987) test within a bivariate framework. Results confirmed that there was a statistically significant relationship among the world rice price, petroleum prices, exchange rate and domestic food prices.

Balcombe (2009) studied the nature and the determinants of price volatility of 19 agricultural commodities (including rice) over the period of 1962-2008 to mitigate their effects, mainly in developing countries. The study used both monthly and annual FAO data. Two econometric methods were applied to explore the research problem.

First, it decomposed each of the price series into component and examined volatility for each component. Using this approach the study tried to figure out whether the volatility of each price series was predictable or not and whether the volatility of a given price depended upon stock, export concentration, yield and the volatility of others prices, e.g., oil prices, exchange rate and interest rate. Panel regression was used to explain volatility by some key variables, as a second approach.

The results showed that all the price series had persistent volatility. Exchange rate volatility and oil price volatility were found to be the significant determinants of the volatility for most of the series. Stocks and yield also had a significant influence on price volatility.

Valera et al. (2010) analyzed the consumer rice price volatility of Bangladesh, India and the Philippines, by using monthly data over the period of 2000 to 2010 through the multivariate error-correction approach. The study explored how exchange rate variability, trade restrictions and government stock policies affected rice price volatility. They regressed the following equation,

$$V_t = \beta_0 + \alpha_{kt} T_{kt} + \beta_1 \ln S_t + \beta_2 X_t + \varepsilon_t \quad \ldots\ldots\ldots\ldots\ldots\ldots (5)$$

where, V_t measures price volatility, T_{kt} depicts trade restrictions (k describes two possible restrictions: import tariff and export ban) at time t, S_t is for government stock and X_t represents exchange rate variability. The study argued that if trade restrictions reduce price volatility then α_{kt} would be negative and significant. The coefficient β_1 was expected to be negative and the expected sign for β_2 was ambiguous because it lacked a theoretical basis.

Before specifying the price volatility equation, the study used ADF unit root tests to discover whether the series are stationary or not and then the AIC (Akaike information criterion) was used to determine the lagged structure of the price volatility equation. The Johansen and Juselius (1990) approach was used to investigate the existence of co-integration. Finally the error-correction model (ECM) was conducted to estimate price volatility equations including the lagged residual from cointegrating regression. Dummy variables were included in the final equation for the period of extreme price volatility. Thus, the final specification is,

$$V_t = \beta_0+\alpha_{kt}T_{kt}+\beta_1 \ln\Delta S_{t-1}+\beta_2 X_t+ \mu R_{t-1} +\varepsilon_t \quad \ldots\ldots\ldots\ldots\ldots\ldots (6)$$

where, R_{t-1} is the lagged error-correction term and residual from cointegrating regression.

The results expressed that trade restrictions reduced price volatility but statistical evidence denied this findings for Bangladesh. The coefficient of stock changes for India and the Philippines had a negative sign but was not statistically significant. The exchange rate risk measure has negative sign for Bangladesh and the Philippines but effect was not statistically significant. The study suggested that a further analysis was required to explain the clear mechanism of the findings reported.

Islam (2008) specified both internal and external factors that affecting food price inflation in Bangladesh by using a simple descriptive analysis. The study argued that the country highly dependent on external markets for cereals (particularly wheat and rice), edible oil, pulse and other essentials.

Within the internal factors the researcher discovered a miss-match between domestic production and demand because of the country's growing population. He observed rice production and rice cultivated area declined over the period of 2000-01 to 2005-06, with the only exception being Boro. Crop failures due to non-market factors, for example, adverse weather, cyclones, flood etc., often create food shortages in Bangladesh. The exchange rate depreciation was also believed to intensify the inflationary pressures because of higher import bills (in terms of domestic currency) that had to be paid by the importers in Bangladesh, which are passed-through to the consumers.

In the case of the external factors the researcher viewed that need for energy was competing with direct human consumption, because of the increased use of staple foods and oil seeds in bio-fuel and bio-diesel production. The development of bio-fuel increased the prices of the

agriculture inputs and oil price hike increased the transportation cost. The export ban from India also played an important role in food price inflation in Bangladesh.

Summing up the previous empirical studies discussed above, rice price instability depends on rice production, yield, population, stocks, GDP, exchange rate, interest rate, PFDS, international price, petroleum price, rice export, trade policy and seasonal dummies. The significance of results varies from paper to paper depending on the period of study, method and variables. My research assumed to be having the similar path to answer my research questions.

Chapter 4: Data and Methodology

4.1 Data sources

This research covers the study period 1980-2010 to examine how market factors influences domestic rice price instability. The study used annual data. The main focus of this analysis is price instability of rice. To explore the research question, a time-series of 30 years on the production, consumption, stocks, fertilizer prices, population, import price and domestic price data have been used and the data are mostly secondary. Data were collected from Food Planning and Monitoring Unit (FPMU), statistical year book of Bangladesh of the BBS (Bureau Bangladesh Statistics) and Ministry of Agriculture (MOA). Two dummy variables (D_1 and D_2) were used here, one is for trade policy and the other one is for natural calamities. Data for dummies also obtained from BBS.

4.2 Empirical Model

In this research I used a simple model to examine the relationship between rice price instability and market factors. In other words, the model have been used here is to test the hypothesis whether or not market factors influences rice price instability. The specification of the model expressed as follows:

P_D = ∫ (Production, Consumption, Stocks, Price of fertilizer, Import price, dummy variable for trade Policy, Dummy variable for natural calamities)

$$P_{D\,t} = \alpha + \beta_1 Q_t + \beta_2 C_t + \beta_3 S_t + \beta_4 Pf_t + \beta_5 P_{Mt} + \beta_6 D_{1t} + \beta_7 D_{2t} + u_t \ldots\ldots (7)$$

where

P_D is the domestic price,

P_M is average import price,

Q is production,

C is consumption,

S is stocks,

Pf is the fertilizer price,

$D_1$is a dummy variable for trade liberalization taking on a value of one for the years when trade policy was liberalized and zero otherwise,

D_2 is a dummy variable for natural calamities taking on a value of one during the years when a natural calamity occurred and zero otherwise,

u_t is the error term at time t. The coefficients β_1, β_2, β_3, β_4, β_5, β_6 and β_7 are the respective regression parameters. The expected sign for β_1 is negative because production could augment the rice supply and help to reduce price, β_2 is expected to be positive because increased demand could push up the rice price. Stock could help to stabilize price by enlarging the rice supply, so one could expect β_3 is to be negative. The increase in fertilizer prices will increase the rice production cost and later on this will increase rice price, which means the expected sign of β_4 is positive. The expected sign for β_5 is positive because if the importers pay higher import bills for rice that ultimately pass through to the domestic rice market. If the liberalized trade policies speed up the rice supply, it will reduce the price instability. Therefore, β_6 is expected to be negative and the expected sign of β_7 is positive because of the production loss due to natural calamities will increase the price.

4.3 Unit root test

Before proceeding further with estimation of time series data, this study conducted unit root tests to examine whether the time series variables are stationary or not. This study applies Dickey-Fuller unit root test to decide the order of integration of the series. If the test detects a unit root, it deems the time series data to be non-stationary. Normally time series data are not often stationary. Data is said to be stationary if their mean, variance and co-variance remain the same or at least the mean is same across all time periods. A Dickey-Fuller unit root test is a very common method for stationary test. If a non- stationary time series data is differenced by a certain time order it often yields a stationary series.

We can explain this stationary process with the simple Autoregressive Moving-Average (ARMA) series. For example,

$$X_t = \alpha X_{t-1} + \varepsilon_t, \quad \text{.....(8)}$$

Where ε_t is white noise, assumed to be independent, having a constant mean and finite variance. Equation (8) will be stationary if and only if $-1<\alpha<1$. If $\alpha = 1$, the process will have

a unit root that is non stationary. But first differencing of the series will make it stationary, since it has a white noise,

$$X_t - X_{t-1} = \mathcal{E}_t$$

The Dickey-Fuller t-statistics conclude the result whether the time series data are stationary or not. The null hypothesis is

H_0: $\alpha = 1$ (i.e. the data needs to be differenced to make it stationary),

and the alternative hypothesis is

H_a: $-1 < \alpha < 1$ (i.e. the data is stationary, does not need to be differenced).

If the null hypothesis is rejected, one can conclude that the data are weakly stationary.

4.4 Endogeneity test:

Endogeneity is considered as one of the serious problems that gives inconsistent and biased estimators. In econometrics, endogeneity arise when independent variables are correlated with error term. Therefore it is necessary to do an endogeneity test before proceeding with the next step in this study. Endogeneity can be explained as,

$$A = XD + U$$

where $X = AB + V$. Since the current value of X depends on the current value of A, any shock in A must be influenced by X. Hence,

$A = (AB + V) D + U$, that means, X and U are correlated.

The model presented above (equation 7) may be subject to resulting endogeneity biased estimated coefficient. To investigate whether or not an endogenous relationship exists between the variable(s) (especially consumption) under study, the Durbin-Wu-Hausman (DWH test) test is applied. DWH test is an augmented regression test suggested by Davidson and MacKinnon (1993) that can easily be structured by including the residuals of each right-hand side endogenous variable as a function of all exogenous variables, in a regression of the original model. DWH test statistics determines whether the variables are exogenous or not, under the null hypothesis,

H_0: Regressor is exogenous. The variable being challenged, in this study is the "consumption" variable.

If the null hypothesis is rejected then there is endogeneity problem in the regression model.

Instrumental variable method is an excellent tool for testing and correcting endogeneity bias but the instrument should be strong or good. There are many methods for measuring good instrument, e.g. (i) coefficient evaluation, (ii) R^2 evaluation, (iii) through correlation matrix, (iv) Hausman specification test and (v) F- statistics.

This study applies F- statistics criterion to test the instrument is strong or weak, using the rule of thumb, i.e. if the F- statistics value is greater than 10 then the instrument is said to be strong. In the case of a good instrument it should be correlated with the endogenous variable and un-correlated with error term.

4.5 Two Stage Least Square (2SLS) Method

The 2SLS is a extend regression to cover the model in case of the violation of OLS assumption, especially in the model where the researchers suspect that the error term of dependent variable is correlated with the explanatory variables. Consider a linear regression model as,

$$Y_1 = \beta_0 + \beta_1 Y_2 + \beta_2 Z_1 + U_1 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (9)$$

where, Y_1 is the dependent variable, Y_2 and Z_1 are independent variables, β`s are regression co-efficient and u is the error term. The independent variable Z_1 is exogenous and suppose anyhow Y_2 is endogenous. In this situation the OLS estimation will give inconsistent and biased estimators. So, we need an instrumental variable for Y_2, which is uncorrelated with U_1 but correlated with Y_2, call it Z_2. 2SLS estimation process estimated by two step procedures as follows. In the first stage,

one regresses first Y_2 on the entire predetermined and instrumental variable in the equation to get rid of the correlation between Y_2 and U_1.

$$Y_2 = \hat{\pi}_0 + \hat{\pi}_1 Z_1 + \hat{\pi}_2 Z_2 + \hat{V}_2 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (10)$$

From equation (10) we obtain,

$$\hat{Y}_2 = \hat{\pi}_0 + \hat{\pi}_1 Z_1 + \hat{\pi}_2 Z_2 \ldots\ldots\ldots\ldots\ldots\ldots (11)$$

Now equation (10) can be expressed as,

$$Y_2 = \hat{Y}_2 + \hat{V}_2 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (12)$$

In the second stage, equation (9) can now be written as follows and can be estimated by OLS estimation,

$$Y_1 = \beta_0 + \beta_1 (\hat{Y}_2 + \hat{V}_2) + \beta_2 Z_1 + U_1$$

$$Y_1 = \beta_0 + \beta_1 \hat{Y}_2 + U^*_2 \quad [U^*_2 = U_1 + \beta_1 \hat{V}_2]$$

Thus, the estimators obtained from this estimation will be unbiased and consistent.

Chapter 5: Results and Discussion

5.1 Unit Root Tests

The study used the DF- test to examine the time series properties of the domestic price of rice. The DF- test statistics show that the null hypothesis about the "existence of unit-root" cannot be rejected in the levels, i.e. variable is non-stationary. However, after the first differencing the null hypothesis of "existence of unit-root" is rejected at 1% level of significance with critical value (-3.73) and computed value (-5.046). This indicates that the domestic price series become stationary after first differencing, i.e. series is integrated of order one, I (1).

5.2 Endogeineity Tests

The study assumes that consumption is an endogenous variable. A Durbin- Wu- Hausman test is used to test the endogeneity. The test results for endogeneity are satisfactory. Using the test, the result confirms that the residual of the consumption is statistically significantly different from zero ($p = 0.005$), which implies that consumption is an endogenous variable. The study used population as an instrument for consumption. The validity of the instrument is tested by F-test ($t=9.36$, therefore $F=87.61$), ensuring that the instrument is strong.

5.3 2SLS Test Results

Finally the study used 2SLS estimation method for correcting endogeneity. In equation (7) consumption is treated as endogenous, which is instrumented by population. The 2SLS results are presented in the table 6. The test result shows that all the estimates of the interested co-efficient are both economically and statistically significant, except fertilizer price.

Table 6: 2SLS Regression Results with Population as Instrument

	Coefficient	Standard error
Constant	-6.9714	5.0207
Stock	-0.0073	0.0020***
fertilizer price	-0.0290	0.0199
Import price	0.5401	0.1605***
Trade libaralization	-4.0752	1.2721***
Natural calamities	0.7740	0.4498*
Production	-0.0005	0.0002**
Consumption	0.0013	0.0006**

Number of Observation = 30

R-squared = 0.6512

Wald chi2 = 55.13

Level of significance: *10%, **5%, ***1%

The results arise from the table are as follows: the sign of the co-efficient of production is negative, meaning an inverse relationship between domestic rice price and production. This result is expected and significant both economically and statistically (at 5% significance level). The value of the co-efficient is (0.0005), which is very less or according to the result I could say domestic rice price has less dependence on domestic production. The fact may be behind this rice price is not solely dependent on production, also on other observed and unobserved factors e.g. stock, input price, government policy etc.

The estimated co-efficient of rice consumption indicate significant positive relationship between consumption and domestic price. That means if consumption increases, it will increase the rice demand which later on put upward pressure on rice price. But from the result we can see that the value of response is low (.0013653), this because of the several initiative (e.g. OMS, FFW, VGF, PFDS etc) taken by the government to reduce the rice price as it is the main food. Stock may also be playing an important role for this low responsiveness as the government release stock to lessen price increases.

The results suggest that the domestic rice price significantly and negatively depends on rice stocks at the 1% significance level. Higher rice prices always create higher demand for stock. Stock helps to stabilize price by augmenting the supply of rice and it plays an important role as security stock, working stock and buffer stock depending on the situation. Holding rice stocks is necessary because production is seasonal but consumption is continuous. So, stocks help to meet the routine requirements through the PFDS, OMS channels. At the time of

production losses, the government releases stock to control the upward pressure on prices. In a buffer stock scheme, the government authorities import rice or procure rice from domestic production (at the harvesting period) and hold stock at a set price and distribute or release stock at a trigger price to the wholesale market or to the government owned or regulated shop (Knudsen and Nash, 1990). This is how stock help to stabilize price.

The response of the domestic price to import price is expected, it is positive and highly statistically significant. The responsiveness of domestic price with respect to import price is 0.54, implied that a 1 unit increase in import price will cause 0.54 unit increase in the domestic price. Bangladesh is a net importer of rice; therefore, the import price greatly influenced the domestic price. Any upward pressure in international price somehow passed through the domestic price by the import channel.

The result suggests that there is significant positive relationship between rice price and natural calamities. Bangladesh often faced natural calamities, e.g. floods, cyclone because of its geographical location. Rice production loss is very frequent in the case of floods rather than cyclone. Aus and Aman rice varieties are more vulnerable than Boro, depending on the production pattern. Thus, natural calamities cause fluctuations in rice availability and prices.

Results confirm that trade liberalization is a significant (at 1% level) factor of influencing domestic rice price. The study found a negative correlation between liberalized trade policy and rice price and the value of the co-efficient is (-4.075). Following the liberalization in 1994, the private sector rice trade played a vital role to accelerate supply of rice as well as stabilize prices. The post-liberalization period has witnessed the contribution of private sector to stabilize price at the period of production shortfalls in 1997/98 and 1998/99 (Dorosh and Shahabuddin, 2002; Chowdhury et al 2006; BIDS, 2011).

Chapter 6: Conclusion and Policy Recommendation

Both the rice market and rice price is the most sensitive issue for the GoB and policy makers. Stabilizing rice price is the key objectives of the National Food Policy. The objective is some extent ambiguous because the policy makers always in a dilemma that higher rice price will create adverse effect to the consumers and on the other hand lower rice price will do the same for the producers.

However, the objective of the study was to investigate the market factors influencing rice price instability. The study analyzed the factors of domestic rice price instability over the period of 1980- 2010. The findings from the model are expected and significant, except fertilizer price. The study reported a negative relationship between production and price. Rice production shortage is one of the possible causes of rice price spike. This shortage as well as price spike could be offset by releasing stock and higher production could lead to large stock. According to Deb (2007), increased rice production will increase the availability of rice and decrease the price increase.

To increase rice production GoB should have to invest more on the rice research and development. As a large rice consuming country it is expected that rice demand will continue to rise but rice cultivated area are not likely to expand. Required demand need to come from this existing area i,e. higher yield is demanded. So we need to do scientific research for developing new varieties which can give us higher yields with lower inputs, e,g. pesticides, fertilizer and can be consistent with less favorable ecosystem. Electrification in the rural areas should have to expand rapidly then it will reduce the irrigation (production) cost because diesel operated engines for irrigation is expensive or the government could provide subsidy on diesel in the short run.

The study underlines that consumption influences rice price positively. The growing population of the country creates higher demand for rice as it is the main food item in the consumer basket. This higher demand put upward pressure on prices and the problem intensifies during the time of production shock.

Stock appears to have negative impact on price change implied that low level of rice stock could exacerbate the price instability. On the other hand higher stocks of rice help to stabilize price through augmenting supply of rice when it is needed, e.g, at the time of major disaster (floods, cyclone) and production shortage or any restrictions from major rice exporting

countries. Policy makers also encourage holding stock to avoid the risk of price soar in international market. This result is similar with previous researchers, e.g., (Dorosh and Shahabuddin 2002).

The findings suggest the need for rice stock and the government should have to ensure timely and efficient management of stock. Timing of stock purchase and selling is important because inappropriate stock management could spoil the objective of holding stock.

The study indicates a positive relationship between rice import price and domestic price. Policies of major rice exporting countries influence the import price. If the import prices increase, the importers should have to pay higher import bill which later on reflect in the domestic market. That means, import price and trade policies of exporting countries influences domestic price and availability of rice. However, the findings suggest that this higher domestic price could give incentive to farmers to produce more rice. GoB could also encourage the famers for producing more rice by subsidizing farm inputs (fertilizer and fuel) or could regularly monitor the international prices and policies of the exporting countries and could take initiative in response to this.

Liberalized rice trade policy has negative impact on domestic rice price, meaning that domestic rice prices decrease under liberalized trade policy. As reported before, prior 1994 only public sector could import rice and that time private import was banned. Liberalization of the private sector rice import greatly contributed in the case of rice availability and price stabilization in the domestic market during the period of major domestic production shortfalls. Historical experiences show that during crisis periods (e.g., 1998, 1999, 2007, 2008etc) rice price rose rapidly in Bangladesh. By liberalized trade GoB was able to substantially augmented domestic rice supplies quickly and timely and stabilizes market price .This also played an important role for national food security. Ensuring food security may be not the goal of trade liberalization but Bangladesh experience shows that it also possible. Combined with public food distribution program (which enhance food access for the poor) private import helps to prevent food crisis and save government resources which could be invested in the productive sector in future (Dorosh, 2001). Deb (2007) also observed that liberalized trade policy decrease price increase by enlarging rice supplies.

Natural calamities show positive relationship with rice price. It impacted negatively on the rice production and supply, as a result prices shot up. This study underlines both releasing stock through PFDS or other safety net program and liberalized trade policy could moderate

this price increase by boost up rice availability. Also scientific research could introduce new rice varieties which is less responsive to the natural calamities and can be produced in the coastal areas (area under salinity). The government should have to increase investment for the expansion of stress tolerance varieties (floods, salinity, pests etc.)

Limitations of the study:

Although the research reached its aim, there are some limitations. Because of the limitations of time and resources this research could not cover all the factors of rice price instability. The study did not give attention to the rice exporters` behavior (to Bangladesh) that influences price instability.

The study found insignificant relationship (both economically and statistically) between rice price and fertilizer price. But it is a matter of concern because fertilizer is one of the most important inputs for rice production in Bangladesh. Fertilizer prices influence rice production costs which later reflect on rice prices.

Suggestions for future research:

Considering the limitations, the present study left the following research scope for future work.

The study could be carry on further by investigating "how do exporters` behaviors likely to be important on rice price instability in Bangladesh"

A much more rigorous analysis is required in the case of rice prices and fertilizer prices to get the significant results. Fertilizer prices should probably be redefined by deducting the government subsidies instead of adding that was used in this study.

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