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Honors Seminar
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Factors Effecting Bangladesh Jute Prices
Introduction

Bangladesh is one of the five poorest countries in the world. Its primary export product has always been jute. As such, it has long been considered the engine for a possible export-led development in Bangladesh. Over the last three decades, Bangladesh has seen its competitive position in the world market being eroded by the entry of synthetic substitutes and fluctuations in supply due to internal crises and environmental disasters. In these circumstances, market forces should eliminate this efficiency by putting the jute industry out of business or by downsizing it. But in Bangladesh, the government is likely to intervene and attempt to keep the ailing jute industry afloat with subsidies. The reasons for the jute industry’s decline has been the focus of intense debate among Bangladeshi economists. This debate has been influential in shaping my interest in exploring the jute industry. In my paper, I will look at supply-side variables and demand-side variables that are hypothesized to have contributed to fluctuations in jute prices. On the basis of past results of other researchers, I expect to find that, supply variables will have a more significant effect on the prices received by jute exporters.

Bangladesh is particularly prone to recurrent natural disasters. While floods may damage significant amount of crops, cyclones in the coastal area of the Bay of Bengal do not have a similar effect. However, coastal disasters may have an adverse effect on jute export because of the damage done to communication and transportation links within the country and with the outside world. Sudden supply shocks of this nature may cause prices to go up suddenly. Particular points of reference are the 1965 and 1971 war. Another source of supply variation may be competing demands on land use. The individual farmer’s decision to grow jute is directly influenced by the price of the rice that he must buy at wholesale rates on the market. If the ratio between the two fluctuates favorably to rice, he may switch crops. I will attempt to look at several such sources of supply instability.

Twenty years ago, all synthetic substitutes for jute were considered far inferior in quality to pure jute fiber. Jute prices usually fell for reasons of excess supply, not from competition with substitutes. Mujeri (1980) demonstrated that jute first came under major threat in the 1960s from the low cost thermoplastic polypropylene (PP). In 1973, of total world jute exports, 14.11% went to the U.K., 12.72% to France, 3.05% to the U.S.A. and 3.04% to Italy. By 1975 PP had captured about 80% of the primary carpet backing market in the USA, 85-100% in Denmark, 48% in France, 20-35% in Italy/other EEC countries and 12% in the UK. Clearly, these cheaper synthetic substitutes represent a major threat to the jute exporters. Mujeri points out that, besides cheaper prices, the major advantage of PP over jute is its ready availability and constant levels of production. In fact, Peera (1979) points out that,

"the search for substitutes was a reaction to the observed behavior of the Asian suppliers, whose ability to guarantee stable as well as sufficient supplies of jute and jute products was increasingly questioned in the industrialized countries."

I hope to identify the effects of the prices of the substitutes on jute prices.

In summary, I will look at the factors that affect jute prices. This is important for several reasons. Since sudden changes in the price of jute are unanticipated by the individual farmer, they are adversely affected if they produce the same amount of jute each year but suddenly receive lower prices for it. Jute prices are also important factor in Bangladesh's development. If overall production remains stable, but prices suddenly drop, revenue fluctuates. In trying to aid the jute industry, there have been two arguments frequently repeated in Bangladesh. One is that, jute growers need to bring sudden supply shocks to a minimum. The other is that jute growers need to concentrate on developing new markets for jute, so that Polypropylene and other substitutes do not keep eroding the market. The analysis in this paper may help to isolate the more important factors effecting price variations and, therefore, point to which factors need to be concentrated on to reduce price fluctuations in the jute industry.

The Jute industry: background information

Jute Market Instability

Jute and jute product markets are effected by recurrent price instability. The Integrated Program for Commodities (IPC) had ten core commodities which it prioritized as requiring stabilization—jute was one of these ten commodities. Over 1976-86, average annual fluctuations were over 20% (in real prices)\(^3\). Price fluctuations were also large for jute manufactures such as hessian and carpet backing cloth. As a result, the export earnings of Bangladesh have suffered from costly discontinuities in the development process. Rahman (1986) argues that supply fluctuations have been the major source of market instability. The internal causes of supply instability that he identifies include lagged price expectations, resulting in a "cobweb" type behavior. In the absence of any guides, farmers base their acreage decisions on the previous season's price—resulting in a recurring imbalance between supply and demand. Weather, which is exogenous to the jute market, is one of the main causes of supply fluctuations in the region. In Bangladesh, agro-technology and physical infrastructure are low level, making the entire sector susceptible to weather variations. Farmers are constrained in their ability to respond to market signals by low income and infrastructural inefficiency. Much of the input distribution system is riddled with seed, fertilizer and pesticide delivery bottlenecks. Credit is not available in a timely fashion due to scheduling problems. Frequent power failure, labor unrest (although this is more endemic in the semi-urban areas) and managerial problems further compound supply vagaries.

On the demand side, jute is primarily used as a packing material for agricultural commodities. Trade in such agricultural commodities is influenced by economic activity and weather conditions. In developed countries, the agricultural sector is increasingly protected by technological developments. Thus the importance of weather induced shifts in demand for jute goods has gone down. The more important component is the demand-side reaction to chronic fluctuations in supply. This was initially manifested in international demand for a buffer stock scheme for jute. As this proved to be too costly, the emphasis shifted to developing

substitutes that could be produced in more stable producing regions. The development of synthetic substitutes, especially polypropylene, has been the most recent development in this area. Substitutes are described in more detail in the section below.

![Figure 1: Deviation of fiber production from trend](image)

Jute and the synthetics

Jute is used in manufacturing a variety of products used in industry, agriculture, transportation, construction, home furnishing and fashion accessories. The bulk of this usage is for jute bags and sacks for transportation of agricultural products, industrial application of jute fabrics and usage as the backing for carpets. During the century preceding the second world war, the aggregate consumption of jute was traditionally insensitive to variations in the demand in any single end-use application—this was obviously assisted by the great variety that existed in end-uses. In the early 1900s, processing technology helped the case of jute because of its coarseness and strength—applications where flex and hemp fibers were previously used made particular use of jute.

After 1945, world consumption of jute increased rapidly. From 1949/51-64/66, per annum growth rate was a healthy 3.9%. Even at this stage, one constraint to the jute industry’s rapid progress was the irregular supply problem. Though world supply of jute kept up with demand on the whole, yearly fluctuations in output constrained the orderly expansion of the world jute economy. Until the early fifties, world supply of raw jute remained uncertain, but after the shortfall of 1953, production of raw jute rapidly recovered and continued to expand throughout the decade, fostered by the Indian self-sufficiency drive and the emergence of Thailand as an important supplier of raw jute. Raw jute prices, apart from the Korean war period, remained fairly stable until the late fifties and world consumption was stimulated by the overall stability of the market.

World consumption of jute continued to expand in the early sixties. Technological development in handling transportation of agricultural products in developed countries began to effect jute utilization in bags

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and sacks, but these losses were more than offset by the booming carpet industry. Moreover, expansion of worldwide agricultural production boosted jute demand. However, after reaching a peak of 3.5 million tons in the mid-sixties, jute consumption stabilized and remained static. Two major factors have been identified as contributing to the end of expansion in jute demand:

i) Unstable and fluctuating supply of jute created an environment of high and fluctuating world prices. This was further aggravated by the extended period of civil unrest culminating in the nine month long independence war of Bangladesh in 1971. This resulted in a concerted effort by many of the primary, especially developed nation, consumers to move to jute substitutes.

ii) Competition from newly developed synthetic substitutes.

Particularly in the case of developed nations, synthetics began to infiltrate all the major end-markets for jute in the late sixties, introducing a dynamic component into the stable competition between jute and its traditional substitutes (mainly hard fibers, cotton and paper). Rising labor costs in handling and transportation of commodities stimulated an abrupt shift from bags to bulk handling and usage of containers. This cut significantly into jute demand. In addition, proliferation of supermarkets led to the widespread pre-packaging of groceries, reducing the need for bags and sacks in transportation of groceries from the wholesale to the retail market.

Polypropylene: catalytic substitute

Jute had survived competition from various hard fiber substitutes in the past. Vegetable fibers, such as hemp and flax, had also been used as substitutes. Cotton and hard fibers were competition primarily to make bags and sacks. Hemp and flax were used in packaging and industrial applications. Cotton and hard fibers competed with jute in cordage use. Of these, only paper became a serious threat in the post-war era, primarily because of ready availability and stable prices—helped by low variable costs of paper plants at the time. Demand for substitutes was boosted by sudden uncertainty in Bangladeshi supply of jute in three periods: the Korean war, the crop failure of 1961 and the India-Pakistan war of 1965.

During the sixties, a new and far more potent substitute for raw jute was introduced: polyolefin plastics, primarily polypropylene and polyethylene—products of the rapidly expanding petrochemical industry. These new substitutes had high tensility, stiffness, impact resistance, light weight and low production costs. Polypropylene resin was first produced in the mid-fifties. But its commercial exploitation started in the early sixties. Throughout the sixties, its production and consumption increased at a phenomenal rate in the developed nations. This was due to both its ready availability and its stable prices. Economies of scale, technological improvements and producer competition has reduced PP prices by more than one half since its commercial inception. Prices fell most rapidly in the US and Japan, followed by Western Europe.

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5Polypropylene has a specific gravity of 0.90 and is the lightest thermoplastic. This makes it a low cost rigid material. Source: Jute and the Synthetics, World Bank Staff Working Paper, 1974.

Polypropylene is primarily a product of the petrochemical industry, obtained through propylene polymerization. In Western Europe and Japan, PP is a co-product of ethylene production. On the other hand, in the US, it is supplied primarily by refineries as a derivative of natural gas liquids and liquefied petroleum gases. As a result of this process, the US PP industry enjoys the advantages of a low cost, basic feedstock (gas) whose domestic prices are protected by the government from international price trends. The US, therefore, remains the cheapest cost producer of PP. Production of PP is highly capital intensive, with low variable costs (because PP is a low-cost feedstock). In 1972, PP resin costs in the US broke down as follows:

- Fixed cost=$154/ton (56%)
- Capital=62%
- Variable cost=$121/ton (44%)
- PP=59%
- Utilities=27%

In summary, PP was extremely competitive against jute because of its advantage in four areas: low prices, advanced market structures and delivery systems, superior product performance and development, and better marketing techniques. The following table shows traditional end uses for jute that PP has made inroads into (highlighted items are now competing with PP substitutes).

[Table 1: Comparative Price Trends of Jute and PP (US)]

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Jute Hessian</td>
<td>100</td>
<td>110.5</td>
<td>112.9</td>
<td>131.5</td>
<td>160.5</td>
<td>140.3</td>
<td>193.5</td>
</tr>
<tr>
<td>Jute Carpet Backing</td>
<td>100</td>
<td>111.2</td>
<td>93.8</td>
<td>97.5</td>
<td>116.3</td>
<td>103.5</td>
<td>118.5</td>
</tr>
<tr>
<td>PP resin</td>
<td>100</td>
<td>95.2</td>
<td>90.5</td>
<td>81</td>
<td>76.2</td>
<td>78.6</td>
<td>107.1</td>
</tr>
<tr>
<td>PP cloth</td>
<td>100</td>
<td>87.5</td>
<td>68.8</td>
<td>68.8</td>
<td>75</td>
<td>78.1</td>
<td>82.2</td>
</tr>
<tr>
<td>PP Carpet Backing</td>
<td>100</td>
<td>100</td>
<td>94.4</td>
<td>91.7</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

In Mujeri, Mustafa K. “The Elasticity of Substitution between Jute and Synthetic Substitutes” The Bangladesh Development Studies
Table 2: Major End-Uses of Jute in Developed Countries

<table>
<thead>
<tr>
<th></th>
<th>1968 (000 MT)</th>
<th>1971 (000 MT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bags and sacks</td>
<td>566</td>
<td>360</td>
</tr>
<tr>
<td>Other packaging, Industrial and Household use</td>
<td>297</td>
<td>221</td>
</tr>
<tr>
<td>Carpet-Backing Cloth</td>
<td>246</td>
<td>275</td>
</tr>
<tr>
<td>Carpet Yarn</td>
<td>118</td>
<td>104</td>
</tr>
<tr>
<td>Cordage, cable and other use</td>
<td>84</td>
<td>78</td>
</tr>
<tr>
<td>Felt and Padding</td>
<td>109</td>
<td>70</td>
</tr>
</tbody>
</table>

Bangladesh jute policy

Economic policy in the Bangladesh jute sector is of primary concern since it is consistently the largest exporter. In the Pakistan period (1947-71), jute policy was controlled by the Pakistan Jute Board. After the independence of Bangladesh in 1971, the Jute Board continued to carry out previous duties as the Bangladesh Jute Board. In addition, Bangladesh Jute Price Stabilization Board (BJPSB) was established to coordinate a stocks program. The first attempts to regulate the jute market came after the publication of a report by a commission created by the British colonial government in 1939. The following year, acreage controls began under a licensing scheme. Following this, prices rose from 8.80 Rupees/maund (1942/43) to 25.90 Rupees/maund (1946/47). However, it is worth noting that the price peak came in the war period and, therefore, may have had other factors influencing it. Hafeez (1984) concludes that the scheme was never really tested in this period. In 1949, the acreage policy was restarted by the post-independence Pakistan government. But India, now a separate entity, began producing its own jute without any acreage controls. As a result, India’s production skyrocketed from 23% (1947) to 50% (1953) of world production. At the same time, Pakistan’s production fell from 67% (1946-49) to 46% (1950s). As it turned out, the acreage policy was unable to actually control production. In nine out of the thirteen years of this scheme, actual acreage exceeded the license. The acreage control system was finally abandoned as a failure in 1960. Only a ban on jute cultivation within five mile radius of the India-Bangladesh border was in effect until 1971 (to prevent smuggling jute across the border to get higher prices). For this period, price fluctuations were significantly higher compared to the post-1960 period.

Jute Board of Pakistan also instituted a policy of fixation of minimum prices at each tier of the domestic market, starting from grower’s level. This policy was also quickly announced a failure in the early

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8 Mujeri, Mustafa K. “The Elasticity of Substitution between Jute and Synthetic Substitutes” The Bangladesh Development Studies
10 In order to clarify the following discussion, the following chronology is useful:
   The primary jute producing area under British rule is the sector of India that later became Bangladesh. Following independence from British colonial rule (1947), India split into India and Pakistan. The primary jute producing area then became East Pakistan, later to become Bangladesh. But in the same period, alternative jute production centers began to rise in India. Therefore, both India and Pakistan show up as jute exporters in International Trade Statistics (ITS) Yearbook.
   In 1971, Bangladesh became independent from Pakistan. The primary jute producing region then becomes Bangladesh. Pakistan has no entries in the export tables of ITS from 1971.
11 1 maund = 82 lbs
1950s
d. Credit limitations constrained the authorities‘ intervention capability. Lack of organizational
efficiency meant that supervision of prices paid was also not possible. Jute traders took refuge of many
different, highly effective schemes to circumvent these regulations. The government‘s stocks operation was
similarly sabotaged by a lack of regularly available credit. Lack of proper guidelines, rigorous economic
analysis and the existence of escape clauses meant that the intervention occurred haphazardly and often after
the fact. To sum up, Ahmed clearly stated:
"...in practice whenever market conditions made it possible, raw jute prices to the growers fell below
the statutory minimum."13

Review of Empirical Work

Rabbani Rice-Jute Tradeoff Model14

This model looked at the grower‘s change in growing decision based on shifts in the relative prices of
rice and jute. Other research that has identified rice prices as a major supply shifter include Clark (1957)15
who focused on cash crops vs. subsistence farming and Ahmad et al (1979)16. The price of rice has been
included in my supply equation.

\[ x_t^* = a + bP_{t-1} + cY_{t-1} + U_t \]

\( x_t^* \) = Jute acreage farmers would plant in year t if there are no difficulties of adjustment

\( P_t \) = Harvest price of jute deflated by retail price of rice. Retail prices are used here, other literature has
looked at wholesale prices.

\( Y_t \) = Yield of jute fiber/acre deflated by yield rate of rice

\[ x_t - x_{t-1} = \lambda(x_t^* - x_{t-1}) \]

\( x_t \) = Actual acreage planted in year t

Solving the two equations yields:

\[ x_t = a + b_2P_{t-1} + b_3Y_{t-1} + b_4x_{t-1} + V_t \]

This equation links actual acreage this year with prices received, yield of jute fiber and acreage planted-- all
of the previous year.

14Rabbani, A K M Ghulam. “Economic Determinants of Jute Production in India and Pakistan” The Pakistan
Development Review 5(2), Summer 1965
15Clark, R. "The Economic Determinants of Jute Production" FAO Monthly Bulletin of Agricultural Economics and
Statistics 6(9), September 1957
16Ahmad, Q.K. et al. World Trade in a Primary Commodity: The case of jute. Third World Forum Occasional
Paper No. 7: 1979
In his paper, Rabbani states that "Cultural operations of jute and rice and particularly their timing reveal a close competitive relationship between the two crops."

The two main varieties of jute are grown in Bangladesh: *corchorus capsularis* (white jute) which grows equally well on high land (normal, no flooding) and low land (normally flooded) and *corchorus olitorius* (tossa jute) which only grows on high lands with drainage. Similarly, two main varieties of rice, *aus* and *aman*, are grown in the "jute districts". As Rabbani points out, *aus* is autumn harvested rice with its season coinciding with the jute season. Therefore, there is no opportunity for double cropping with jute—that is, production of *aus* rice has to be foregone in order to grow jute. *Aman*, on the other hand is winter harvested and four-fifths of annual rice production. Its season is later than jute season, but sowing or transplanting of *aman* rice overlaps maturing and harvesting periods of jute. Some double cropping is possible, but sacrifices in both crops are necessary, and sudden weather changes will throw the entire timetable off. Rabbani quotes a 1958-59 Jute Committee survey that showed that such double cropping covered about 3.5% of jute grower land. Clearly, farmers have to make a choice between growing rice and jute, usually not being able to do both—the prices that these two goods may obtain relative to each other would therefore be a deciding factor.

Rabbani predicted that relative price of jute and rice and their relative yields would influence a farmer's growing decision. He found that production of jute closely followed the rice-jute price ratio trend. On the basis of his strong results, I have incorporated the price of rice in grower regions as a factor influencing grower decisions regarding jute.

**Mujeri Substitution Model**

This model analyzed the rate of substitution between jute and its synthetic substitutes. I have incorporated the price of substitutes in my demand equation.

\[
\ln \frac{J_1}{J_2} = \sigma \ln \alpha_0 - \sigma \ln \frac{PJM}{PSS} + \ln u_0
\]

*J1*=Annual demand for jute  
*J2*=Annual demand for synthetic substitutes  
*PJM*=Price of jute manufactures  
*PSS*=Price of synthetic substitutes [This variable is incorporated into my model]

Mujeri used synthetic fibers as a substitute for jute manufactures only. In my model, I assume that these synthetic fibers are a substitute for raw jute. As the demand for jute manufactures drop, so will the demand for raw jute.

**Mujeri model of World Jute Market**

This model was influential in identifying variables that would effect jute prices. [See Appendix]

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Chu & Morrison's model of world non-oil primary commodity markets

This model is the primary framework for my modified model. Therefore, I will describe this model in detail below:

Total flow demand for non-oil primary commodity:

\[
Q_t^D = A_0(P_tED_t)^{-\alpha_1}PD_t^{\alpha_2}Y_t^{\alpha_3}e^{-\alpha_4\Delta r_t + \alpha_5\Delta q_tD_t}
\]

\[
\Rightarrow \ln Q_t^D = \ln A_0 - \alpha_1(\ln P_t + \ln ED_t) + \alpha_2 PD_t + \alpha_3 LnY_t - \alpha_4 \Delta r_t + \alpha_5 \Delta q_tD_t
\]

\[Q_t^D = \text{Total flow demand; } P_t = \text{Price of commodity (in dollars)}\]

\[PD_t = \text{Average of prices of substitutes in consuming countries (in domestic currency)}\]

\[ED_t = \text{Average of exchange rates between the dollar and currencies of consuming countries (national currencies/dollar)}\]

\[Y_t = \text{Level of economic activity in consuming countries}\]

\[A_0 = \text{Parameter; } r_t = \text{Real rate of interest; } q_t = \ln Q_t\]

Supply of the commodity:

\[
Q_t^S = B_0(P_tES_t)^{\beta_1}PS_t^{-\beta_2}S_t^{\beta_3}
\]

\[
\Rightarrow \ln Q_t^S = \ln B_0 + \beta_1(\ln P_t + \ln ES_t) - \beta_2 LnPS_t + \beta_3 LnS_t
\]

\[Q_t^S = \text{Supply (production) of commodity}\]

\[PS_t = \text{Average of production costs in exporting countries}\]

\[ES_t = \text{Average of exchange rates between the dollar and currencies of exporting countries (national currencies/dollar)}\]

\[S_t = \text{Exogenous supply shocks; } B_0 = \text{Parameters}\]

Assuming that short-run price elasticity of supply of primary commodities is very low, Chu and Morrison postulate that:

\[\beta_1 = 0\]

\[\beta_2 = 0\]

Rewriting the second equation, they get:

\[Q_t^S = B_0 S_t^{\beta_3}\]

\[\Rightarrow \ln Q_t^S = \ln B_0 + \beta_3 LnS_t\]

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18Chu, Ke-Young and Morrison, Thomas K. "1981-82 recession and commodity prices" IMF Staff Papers, 31 (March-June 1984)
Equilibrium Condition:
\[ Q^S = Q^D \]

The equilibrium condition is solved for price to get following:
\[
[\alpha_1 - \alpha_4 (1 - L)^2] p_t = \alpha_0 - \beta_0 + \alpha_3 y_t + \alpha_2 PD_t - \alpha_1 ed_t - \alpha_4 (1 - L) i_t - \beta_3 (1 - \alpha_5 (1 - L)) s_t
\]
\[ p_t = \ln P_t; y_t = \ln Y_t; PD_t = \ln PD_t; ed_t = \ln ED_t; s_t = \ln S_t; i_t = \text{Nominal rate of interest} \]
\[ L = \text{Lag operator (LP}_t = P_{t-1}) \]
\[ r_t = i_t - \Delta P_t \]

Chu and Morrison simplify the price equation to get the following:
\[
\begin{bmatrix}
\theta_1 \Delta P_t \\
\theta_2 \Delta Y_t \\
\theta_3 \Delta PD_t \\
\theta_4 \Delta ed_t \\
\theta_5 \Delta^2 i_t \\
\theta_6 \sigma_t
\end{bmatrix} = \begin{bmatrix}
\theta_0 \\
\theta_1 \\
\theta_2 \\
\theta_3 \\
\theta_4 \\
\theta_5 \\
\theta_6
\end{bmatrix}
\]
\[ \theta_i = \text{Lag polynomials of finite order} \]

[Note: Price equation has change in interest rate as an explanatory variable. Therefore the equation for the rate of change in price (\( \Delta P_t \)) has the second differential of interest (\( \Delta^2 i_t \)) as an explanatory variable]

Modified Chu & Morrison model for jute market

Chu & Morrison's model focuses on the demand side of price variability. In my modified model, I expand on the supply-side variables that they omitted, with particular reference to the jute market. The modified equations are as follows:

Quantity Demanded:

**Assuming ad valorem tariff**
\[
Q_t^D = \gamma_0 + \gamma_1 P_t (1 + T_t) + \gamma_2 PS_t + \gamma_3 Y_t + \gamma_4 r_t + \gamma_5 \text{INNOV}_t
\]

**Assuming additive tariff**
\[
Q_t^D = \gamma_0 + \gamma_1 (P_t + T_t) + \gamma_2 PS_t + \gamma_3 Y_t + \gamma_4 r_t + \gamma_5 \text{INNOV}_t
\]

\[ P_t = \text{Price of Bangladesh jute on world market (in Dollars).} \]

\[ PS_t = \text{Price of primary jute substitute (Polypropylene/Synthetic fibers). If this goes down, demand for jute falls.} \]

\[ Y_t = \text{Economic activity in primary jute consuming countries. If economic activity goes up in these countries, demand is stimulated. These countries include U.K., USA, Italy, France, Germany, etc. Although Pakistan shows up as major importer in post 1971 period, it has no jute imports in pre-1971 period—during that period, Bangladesh was part of Pakistan and Pakistani manufacturers of finished jute goods transferred the raw jute from Bangladesh to Pakistan (which would not show up as a trade transaction).} \]
\( r_t \)= Interest rates-- used to measure the opportunity cost of holding stocks of jute. If the world interest rate goes up, it becomes more expensive to hold stocks of jute in the US, UK, etc. since the money could be invested profitably at the interest rate. Therefore, importers who buy excess amounts and store it in their home country will now buy it less. On the other hand, if the storage happens in Bangladesh, and Bangladeshi interest rates go up, suppliers may cut back production. In sum, the sign on the coefficient is not clear.

\[ \text{INNOV}_t = \text{Dummy variable for new innovation in producing synthetic substitute for jute. This will dampen demand for jute. Mujeri (1980) states that PolyPropylene was introduced in the 1960s, but he does not state a specific date of entry into the market. The PPI given by the US Bureau of Labor Statistics only begins publishing figures for PP resin as used for fibers (differentiated from its use as molding injection, etc.) in December of 1975.} \]

\( T_t = \text{Ad valorem or additive tariff as applicable. Buyers will not see this separately, they will perceive it as part of the price-- as tariff goes up, demand for goods on which there is an import tariff will go down. However, in the case of jute this tariff is likely to be zero. Protectionism has largely been leveled at Bangladeshi finished goods, especially garments, that compete with domestic industries more important than Polypropylene (which is a byproduct). In addition, buyers of primary commodities are usually more informed about how tariffs raise their costs and therefore, there is probably significant opposition to tariffs on jute. Mujeri (1979) regressed domestic price of raw jute on the difference between the world price of raw jute and the export duty levied by importers and the freight from exporting country to U.K. [apparently the U.K. is a major transition point for jute exports.]. Mujeri's model did not have significant results for this coefficient for Bangladesh, India or Thailand. One reason for this may be because he used the export duty of raw jute and jute manufactures (EXDT).} \]

\[ Q_i^S = \varphi_0 + \varphi_1 P_i + \varphi_2 RICE_i + \varphi_3 WAR_i + \varphi_4 WEATH_i + \varphi_5 WAGE_i \]

\( RICE_i = \text{Price of rice. The jute/rice price ratio has long been accepted as a key factor to measure area under jute}^{19}. \text{As this ratio goes up, supply of jute should go up as it becomes more profitable. In Bangladesh, farmers often face a tradeoff between growing a cash crop like jute and growing a food crop such as rice}^{20}. \text{This is especially true of farmers who have a plot of land so small that rice grown on it would be used up in family consumption. But rice can also be a cash crop: the excess after personal consumption, if any, can be sold by farmers.} \]

Mujeri (1979) regressed the area under raw jute cultivation on a ratio of the domestic price of raw jute and rice: \( \text{RPR} = \text{Price of raw jute/Price of rice. For India and Thailand, acre under cultivation was positively} \]

\[ ^{19}\text{Clark, R. "The Economic Determinants of Jute Production" FAO Monthly Bulletin of Agricultural Economics and Statistics 6(9), September 1957} \]

\[ ^{20}\text{Ibid., p 7} \]
correlated to the ratio by a factor of 1483.13 and 231.44 respectively. As expected, as jute becomes a more valuable crop relative to rice, its cultivation increases. For Bangladesh though, the results were insignificant.

WARt=This is a dummy variable for war years: 1965=Indo-Pakistan war which caused Bangladesh to be cut off from Pakistan. 1971/72=Liberation war of Bangladesh against Pakistan which occurred from March 26th to December 16th 1971. The war disrupted all industrial activity and would have reduced the supply of jute in 1971 and its effect should have carried over to 1972 as reconstruction efforts went on.

WEATHRt=Dummy for particularly adverse weather shock.
  1970=Cyclone hits Bay of Bengal
  1974/75=Floods and great famine of Bangladesh. Although partially ascribed to tremendous mismanagement by the post-independence government, disruption of food grain supplies from the rural sector was also a major factor. Therefore it may be safe to assume that the supplies of raw jute were disrupted during this period.

However, it is very possible that there are qualitative differences between these natural disasters. For example, one of these may have occurred in a season when jute has already been harvested, in which case that year may have to be dropped.

Mujeri (1979) introduced a dummy called DUMBD for this one year in his simultaneous equation model for world jute market. ACRBD (Area under raw jute cultivation in 1000's of acres) had a correlation coefficient with DUMBD of -554.53 (s.e.=-2.19). SRJBD (End year stock of raw jute) had a correlation coefficient with DUMBD of 278.16(s.e.=1.97).

WAGEt=Wages in agricultural labor sector. An increase in the average wage will cause the profit margin to decrease for those jute traders who hire farmers to cultivate their land. This may result in a fall in supply. The fact that Mujeri (1979) does not include rural wages in his model may be an indicator that the variable may not be significant.

Equating the supply and demand equation and solving for price, I get the following:

With ad valorem tariff
\[
P_t = \theta_0 + \theta_1 PS_t + \theta_2 Y_t + \theta_3 R_t + \theta_4 INNOV_t + \theta_5 RICE_t + \theta_6 WAR_t \\
+ \theta_7 WEATHR_t + \theta_8 WAGE_t
\]

With additive tariff
\[
P_t = \theta_0 + \theta_1 PS_t + \theta_2 Y_t + \theta_3 R_t + \theta_4 INNOV_t + \theta_5 T_t + \theta_6 RICE_t + \theta_7 WAR_t \\
+ \theta_8 WEATHR_t + \theta_9 WAGE_t
\]

Predicted signs:

**Ad valorem tariff**

\[
Q_D^I = \gamma_0 + \gamma_1 P_t (1 + T_t) + \gamma_2 P_{S_t} + \gamma_3 Y_t + \gamma_4 r_t + \gamma_5 \text{INNOV}
\]

\[
[T_t \geq 0]
\]

\[
Q_D^I = \phi_0 + \phi_1 P_t + \phi_2 \text{RICE}_t + \phi_3 \text{WAR} + \phi_4 \text{WEATHR} + \phi_5 \text{WAGE}_t
\]

\[
\gamma_0 + \gamma_1 P_t (1 + T_t) + \gamma_2 P_{S_t} + \gamma_3 Y_t + \gamma_4 r_t + \gamma_5 \text{INNOV} = \phi_0 + \phi_1 P_t + \phi_2 \text{RICE}_t + \phi_3 \text{WAR}
\]

\[
+ \phi_4 \text{WEATHR} + \phi_5 \text{WAGE}_t
\]

\[
\Rightarrow \left( \gamma_1 (1 + T_t) - \phi_1 \right) P_t = (\phi_0 - \gamma_0) - \gamma_2 P_{S_t} - \gamma_3 Y_t - \gamma_4 r_t - \gamma_5 \text{INNOV} + \phi_2 \text{RICE}_t
\]

\[
+ \phi_3 \text{WAR} + \phi_4 \text{WEATHR} + \phi_5 \text{WAGE}_t
\]

\[
\Rightarrow \frac{A_0 P_t}{B_0} = \frac{B_0 + B_1 P_{S_t} + B_2 Y_t + B_3 r_t + B_4 \text{INNOV} + B_5 \text{RICE}_t + B_6 \text{WAR} + B_7 \text{WEATHR} + B_8 \text{WAGE}_t}{A_0}
\]

\[
\Rightarrow P_t = \frac{1}{A_0} \left( B_0 + B_1 P_{S_t} + B_2 Y_t + B_3 r_t + B_4 \text{INNOV} + B_5 \text{RICE}_t + B_6 \text{WAR} + B_7 \text{WEATHR} + B_8 \text{WAGE}_t \right)
\]

\[
\Rightarrow P_t = \theta_0 + \theta_1 P_{S_t} + \theta_2 Y_t + \theta_3 r_t + \theta_4 \text{INNOV} + \theta_5 \text{RICE}_t + \theta_6 \text{WAR} + \theta_7 \text{WEATHR} + \theta_8 \text{WAGE}_t
\]

**Additive Tariff**

\[
Q_D^I = \gamma_0 + \gamma_1 P_t (1 + T_t) + \gamma_2 P_{S_t} + \gamma_3 Y_t + \gamma_4 r_t + \gamma_5 \text{INNOV}
\]

\[
(-) (+) (+) (-) (-)
\]

\[
Q_D^I = \phi_0 + \phi_1 P_t + \phi_2 \text{RICE}_t + \phi_3 \text{WAR} + \phi_4 \text{WEATHR} + \phi_5 \text{WAGE}_t
\]

\[
(+) (-) (-) (-) (-)
\]

\[
\gamma_0 + \gamma_1 P_t (1 + T_t) + \gamma_2 P_{S_t} + \gamma_3 Y_t + \gamma_4 r_t + \gamma_5 \text{INNOV} = \phi_0 + \phi_1 P_t + \phi_2 \text{RICE}_t + \phi_3 \text{WAR}
\]

\[
+ \phi_4 \text{WEATHR} + \phi_5 \text{WAGE}_t
\]

\[
\Rightarrow (\gamma_1 - \phi_1) P_t = (\phi_0 - \gamma_0) - \gamma_2 P_{S_t} - \gamma_3 Y_t - \gamma_4 r_t - \gamma_5 \text{INNOV} - \gamma_1 T_t + \phi_2 \text{RICE}_t
\]

\[
(+) (+) (+) (-) (-)
\]

\[
+ \phi_3 \text{WAR} + \phi_4 \text{WEATHR} + \phi_5 \text{WAGE}_t
\]

\[
(-) (-)
\]
\[ P_t = \frac{1}{A_0} (B_0 + B_1 P_S + B_2 Y_t + B_3 r_t + B_4 \text{INNOV} + B_5 T_t + B_6 \text{RICE} + B_7 \text{WAR} + B_8 \text{WEATHR} + B_9 \text{WAGE}_t) \]

\[ (\rightarrow) \quad (\rightarrow) \quad (+) \quad (+) \quad (+) \quad (-) \quad (-) \quad (-) \quad (-) \]

Data sources

\( P_t \) = Price of Bangladesh jute exports. IPS has jute price (US$/MT) for Bangladesh from 1957-1990. The period 1948-1956 was filled with the prices from International Trade Statistics Yearbook. The International Trade Statistics Yearbook has export figures by country. The figures for Pakistan (1948-56) include Jute exports by value and amount (Pakistan Rupee). The value is divided by amount to get an approximate Price/Metric Ton for jute exports. This figure is then converted to US Dollars using the exchange rate for Pakistan provided in IPS. The figures are deflated by US CPI. This variable is called JUTE.

\( P_S \) = Price of synthetic substitutes. The US Producer Price Index (pub: US Bureau of Labor Statistics) has an aggregate index for Plastic materials and synthetic fibres. This index was used as a proxy for change in prices of synthetic substitutes. However, upon running the regression, the results for the coefficient of this variable were significant and the wrong sign. Going back to the PPI, I found that Polypropylene, marked by Mujeri (1980) as the primary competitor for jute starting from the 1960s, only appears in the disaggregated form of the PPI for synthetics after 1975. The PPI previous to this date measures changes in the prices of other synthetic fibers, which may or may not be substitutes for jute. Moreover, post 1975, when the index for Polypropylene is published, the overall synthetic fiber index increases much faster than the Polypropylene index. This index is obviously an imperfect proxy for price of substitutes. A better source may be the list price of PP polymer in the US, which Mujeri uses in his model of elasticity of substitution (1980)\(^{22}\). For these reasons, I dropped this variable from my preliminary regression and used the INNOV dummy variable, with 1967/68=1 for the entrance of Polypropylene\(^{23}\). This also produced unsatisfactory results. Finally, I used an aggregate index, which uses the index for cotton up to 1976, then switches to index for PP fiber and filament, this variable is labeled PPI2. In addition, I include a dummy called INNOV2 that is 1 for all the years that cotton is used (1948-1976).

Because of this new aggregate substitute index, there is a chunk of missing data from 1951-1959. I dropped nine years from the beginning of the sample-- the sample is now from 1957-1990, sample size is down to 34.

\( Y_t \) = Economic activity of primary importing countries. Majority of the importers are industrialized nations (Japan, U.K., USA, Italy, France, etc.). IPS' index for Industrial production for the industrialized countries is

\(^{22}\)Mujeri lists as his source for this FAO Commodity Bulletin and Modern Plastics monthly.

\(^{23}\)Approximate year given by Mujeri (1980)
used to measure this variable. The index is missing for 1948-49. The industrial production for USA is substituted in for those two years. This variable is called INDUS.

\( r_t \) = Interest rates. London three month rate was used. Variable is INTER.

\( \text{RICE}_t \) = The Bangladesh domestic price of rice was not available. The export price (in $) for Thailand rice was calculated from International Trade Statistics Yearbook by dividing amount exported by value earned. These figures were deflated by US CPI. There were several discrepancies in the rice prices:

- The export figures for Thailand between 1954-1967 were given in Thai baht in ITS. I used the Thai exchange rate to convert this to US$. However, the prices thus obtained seem far in excess of any possible prices for rice.
- There were no Thailand figures for 1948-1949. Rice export figures for India, converted from Indian rupee, were used here.

\( \text{WAR}_t \) = 1 for 1965, 1971, 1972. It was decided to have two war variables: \( \text{WAR1} \) for 1965, \( \text{WAR2} \) for 1971/72. \( \text{WEATHR}_t \) = 1 for 1970. 197

\( \text{WAGE}_t \) = Assuming that rural wages move with the Consumer Price Index, I use the CPI for Bangladesh from IFS. This figure goes back to 1957. The CPI for Pakistan is used for 1948-1956. Since the two countries had a common national account pre-1971, the unified Pakistan CPI should apply to both countries. This variable is BDCPI.

\( t_t \) = Still searching appropriate data.

**Predicted Signs**

\( \text{PPI2} \) = Positive. As price of substitutes goes up, demand for jute goes up.

\( \text{INNOV2} \) = Negative. Entry of new innovation drives down demand for jute, lowering price.

\( \text{INTER} \) = Negative. Interest rates going up raises cost of storage, pushing down demand abroad.

\( \text{INDUS} \) = Positive. Growth in industrial nation production would increase demand for jute which would raise the price.

\( \text{RICE} \) = Positive. Higher rice prices would induce switch from jute crop, reducing supply.

\( \text{WAR} \) = Positive. This would cause a major supply shortfall (the results for \( \text{WAR2} \) variable may indicate that by 1971 a buffer stock system was in place, but no evidence of this was found in the literature). Same for \( \text{WEATHR} \).

\( \text{BDCPI} \) = Positive. Increase in rural wages would push up jute production costs. Assuming fixed amount of capital for each land-owner, jute production would have to be reduced. Prices would go up.
Regressional Results

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>SE</th>
<th>t-statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>3.42285</td>
<td>2.75199</td>
<td>1.24377</td>
</tr>
<tr>
<td>INDUS</td>
<td>-0.017310</td>
<td>.501244</td>
<td>-0.034534</td>
</tr>
<tr>
<td>BDCPI</td>
<td>-0.110773</td>
<td>0.24597</td>
<td>-0.450376</td>
</tr>
<tr>
<td>RICE</td>
<td>0.137615</td>
<td>0.144484</td>
<td>0.952459</td>
</tr>
<tr>
<td>PPI2</td>
<td>-0.317277</td>
<td>0.322638</td>
<td>-0.983381</td>
</tr>
<tr>
<td>INNOV2</td>
<td>0.127150</td>
<td>0.212854</td>
<td>0.597358</td>
</tr>
<tr>
<td>WAR1</td>
<td>0.043300</td>
<td>0.232320</td>
<td>0.186379</td>
</tr>
<tr>
<td>WAR2</td>
<td>-0.127085</td>
<td>0.251518</td>
<td>-0.505272</td>
</tr>
</tbody>
</table>

Adjusted R-Squared = 0.399118  
F-statistic = 13.077

WAR1 and RICE have the expected positive sign, but low t-statistic—yet the results as a whole are significant (note: high adjusted R-squared). This seems to indicate there might be multicollinearity. In addition, there were large discrepancies in the data since most of the series were pieced together from various sources and proxies were frequently used. Mis-specification of data may have been a cause for these results.

Conclusion

The regression results seem to point to war (a supply shock) and rice prices as having an effect on prices. Both of these are supply-side variables. It is interesting that the war variable that has the desired sign is the earlier 1965 war. This war, between Pakistan and India, caused communication and transportation links between East and West Pakistan to be completely snapped. As a result, Bangladesh was completely isolated from central command in Pakistan and also the rest of the world during this period. This would have resulted in a complete cessation of supply of jute—an extreme supply shock. This may be considered analogous to the situation in later years where floods disrupted communications, resulting in fall of exports (although the WEATHR variable did not have the predicted signs). The question then is, why does the 1971 war not have a similar effect, given the much longer duration of the second war (nine months) and also given that Bangladesh’s production capacities were much more adversely effected in this war. The explanation may be that large stocks of jute were kept in Pakistan and elsewhere by that time (especially so in the light of the 1965 war). Since the Pakistan government was engaged in assuring the US donors that the war was a mere “internal disturbance”, there would be incentives to attempt to keep the normal flow of jute exports uninterrupted, and the stocks may have been used for this.

In addition, on the basis of other empirical work and literature on the subject, it is possible to identify several key variables that had an effect on jute prices. Firstly, supply fluctuations due to natural disasters, fertilizer distribution problems, internal instability, regional wars, etc. have been endemic over the last three decades. This has resulted, not only in price fluctuations on the international market, but also in importers taking the initiative to switch to other fiber products. This has eroded jute’s demand on the world market over time. Jute exporters have attempted to combat supply fluctuations by proposing international buffer stock schemes. These have proved unworkable because of the great cost involved in arranging for transportation to a storage site abroad.
Because of supply problems, there has been great emphasis placed in jute consuming countries on producing a workable jute substitute. The arrival of Polypropylene has ended jute's control over the export market. While PP does not approach jute in quality, it is a better substitute than other fibers used in the past. It also has several advantages over jute: It is produced in developed nations and therefore, importers are not held to the mercy of supply variations in developing nations, especially Bangladesh. In the US, PP is a byproduct and has relatively cheap and stable prices. It can be produced in the importing country itself and therefore, transportation, import duties, etc. are avoided. As a combination of all these factors, PP has caused the demand for jute to erode over time. However, variations from year to year in jute prices should not be caused by PP except in the first few years when it came on the market. Over the long term, the relative market position of jute and PP should stabilize. Mujeri comes to a similar conclusion in his study of the world jute market. In addition, jute prices have been seen to vary over periods when the prices of substitutes have been relatively steady. It has to be concluded that supply shortfalls and interruptions have the largest effect on jute prices. For jute exporters suffering from price fluctuations, the optimal strategy is to concentrate on correcting the infrastructural sources of supply variations.

Future research in this direction may progress on two tracks. Firstly, better data sources than the ones I used need to be identified. This would probably require obtaining the data from primary Bangladesh sources. Secondly, for some of my variables (weather, tariff), adequate data or appropriate proxies could not be identified. In addition, variables in Mujeri's model [see Appendix], such as Acreage, Yield Per Acre (which would take into account improvements in crop growing technology), etc. were not even included because of the impossibility of getting data that specific. The lack of data has made the analysis incomplete. Better data sources would help to properly identify the variables that are significant for jute prices.
Bibliography
Ahmad, Qazi Kholikuzzaman et al. World Trade in a Primary Commodity: The case of jute. Third World Forum Occasional Paper No. 7: 1979


Chu, Ke-Young and Morrison, Thomas K. "1981-82 recession and commodity prices" IMF Staff Papers, 31 (March-June 1984)


Rahman, Sultan Hafeez. Evolution of Jute Policies and a Jute Policy Model for Bangladesh (Research Monograph No. 3) BIDS, Dhaka: 1984

________. "Analysis of Flexible Market Stabilization Policy in the Jute sector and its sensitivity to a parametric change in demand" Bangladesh Development Studies 12(3), September 1984


________. "An analysis of seasonal jute price behavior" Bangladesh Development Studies 15(3), September 1987


Thomas, Vinod. "Price Elasticities of demand for Bangladesh's jute" Bangladesh Development Studies 7(2), Summer 1979

Appendix A

Mujeri's model of the world jute market24

[For each equation, regressions are done using data for Bangladesh, India and Thailand. For consumption equations, importing countries are used.]

BD=Bangladesh, IN=India, TH=Thailand, RW=Rest of the World, W=World

• Production of Raw Jute

\[ ACR_i = \alpha_0 + \alpha_1 ACR_{i-1} + \alpha_2 PRJ_{i-1} + \alpha_3 RPR_{i-1} + \alpha_4 SDRAV_i + \alpha_5 RYP_A_{i-1} + \alpha_6 T + \alpha_7 DUM \]  

ACR = Area under raw jute cultivation

PRJ = Price of jute

PRR=Domestic price of rice/other alternate crops

[have incorporated the variable PRR into my model]

RPR=PRJ/PRR

SDRAV = Standard deviation of relative acre value of previous 3 years

RYPAt-1 = Relative yield of previous season (RYPA=YPAJ/YPAR)

YPAJ=Yield of jute, YPAR=Yield of rice

DUM = Dummy for 1971 war (Bangladesh), and other major events for other countries [I have put a similar but multi-year dummy variable in my model]

T = Time trend; T = 1 for first year

\[ YPAJ_i = \beta_0 + \beta_1 ACR_i + \beta_2 T + \beta_3 T^2 + \beta_4 DUM \]

\[ J_i = ACR_i \times YPAJ_i \]

J=Total production of raw jute

\[ JRW_i = \chi_0 + \chi_1 JRW_{i-1} + \chi_2 T \]

JRW=Total production of raw jute for the Rest of the world

\[ RJW_i = JBD_i + JIN_i + JTH_i + JRW_i \]

RJW=Total world production of raw jute

• Stocks of Raw Jute

\[ SRJ_i = \delta_0 + \delta_1 SRJ_{i-1} + \delta_2 PRJW_i + \delta_3 RJUJM_i + \delta_4 DEVNP_i + \delta_5 DUM \]

SRJ=Year end stocks of raw jute

PRJW=World price of raw jute

RJUJM=Total amount of raw jute used in production of jute manufactures

DEVNP=Deviation of actual production from normal production

\[ WSRJ_i = SRJBD_i + SRJIN_i + SRJTH_i \]

WSRJ=World stock of raw jute

• Stocks of Jute Manufactures

\[ SJM_i = \varepsilon_0 + \varepsilon_1 PRODJM_i + \varepsilon_2 SRJ_i + \varepsilon_3 ASRJ_i \]

SJM=Stock of jute manufactures

PRODJM=Production of jute manufactures

• Consumption of Jute Manufactures and Synthetic Substitutes

\[ LnCONJM_i = \phi_0 + \phi_1 LnCONJM_{i-1} + \phi_2 Ln N_{i-1} + \phi_3 Ln \frac{NI}{NI_{i-1}} + \phi_4 LnPJM_i \]

CONJM=Consumption of jute manufactures

NI=Index of national income (1960=100)

PJM=Domestic price of jute manufactures

\[ CONJS_t = \varphi_0 + \varphi_1\text{CONJS}_{t-1} + \varphi_2N_t + \varphi_3T + \varphi_4PJS_t \]

CONJS = Total consumption of jute manufactures and synthetic substitutes

\[ PJMW_t = \text{World price of jute manufactures} \]

PJS = Composite price of jute manufactures and synthetic substitutes

\[ \Pi CONJM_t = \gamma_0 + \gamma_1\text{PJM}_t \]

\[ \Pi CONSS_t = \gamma_2\text{PSS}_t \]

\[ Ln CONJ = \gamma_0 + \gamma_1\text{PJM}_t \]

\[ CONSS = \text{Total consumption of synthetic substitutes in jute-end uses} \]

\[ PJMW = \text{World price of jute manufactures} \]

\[ PSS = \text{World price of synthetics} \]

**Production of Jute Manufactures**

\[ PRODJM_t = \eta_0 + \eta_1\text{PRODJM}_{t-1} + \eta_2\left( \frac{\text{PJM}_t}{\text{PRJ}_t} \right) + \eta_3\Delta \left( \frac{\text{PJM}_t}{\text{PRJ}_t} \right) + \eta_4T + \eta_5\text{SJ}_{t-1} \]

\[ \text{PRJ} = \text{Domestic price of raw jute} \]

**Price of Raw Jute and Jute Manufactures**

\[ PRJW_t = t_0 + t_1\frac{\text{WSRJ}}{\text{WCRI}_t} + t_2T + t_3\text{KOREA} \]

\[ \text{WCRI} = \text{World consumption of raw jute} \]

\[ \text{KOREA} = \text{Dummy variable for Korean War} \]

\[ PJMW_t = \kappa_0 + \kappa_1\text{PRJW}_t + \kappa_2\text{KOREA} + \kappa_3\text{DUM} \]

**Production of Jute Manufactures**

\[ PRODJM_t = \eta_0 + \eta_1\text{PRODJM}_{t-1} + \eta_2\left( \frac{\text{PJM}_t}{\text{PRJ}_t} \right) + \eta_3\Delta \left( \frac{\text{PJM}_t}{\text{PRJ}_t} \right) + \eta_4T + \eta_5\text{SJ}_{t-1} \]

\[ \text{PRJ} = \text{Domestic price of raw jute} \]

**Price of Raw Jute and Jute Manufactures**

\[ PRJW_t = t_0 + t_1\frac{\text{WSRJ}}{\text{WCRI}_t} + t_2T + t_3\text{KOREA} \]

\[ \text{WCRI} = \text{World consumption of raw jute} \]

\[ \text{KOREA} = \text{Dummy variable for Korean War} \]

\[ PJMW_t = \kappa_0 + \kappa_1\text{PRJW}_t + \kappa_2\text{KOREA} + \kappa_3\text{DUM} \]

\[ LnPRJ_t = \lambda_0 + \lambda_1Ln(PRJW_t - EXDT_t - FR_t) + \lambda_2LnER_t + \lambda_3\text{KOREA} + \lambda_4\text{DUM} \]

\[ \text{EXDT} = \text{Export duty levied by major producers on raw jute/jute manufactures} \]

\[ \text{FR} = \text{Freight charges on transportation of raw jute} \]

\[ \text{ER} = \text{Exchange rate (nc/US$)} \]

\[ Ln\text{PJM}_t = \mu_0 + \mu_1Ln(PJM_t - EXDT_t - FR_t) + \mu_2LnER_t + \mu_3\text{KOREA} + \mu_4\text{DUM} \]

\[ \text{NEXRJ}_t = J_t - TDURJ_t + SRJ_{t-1} - SRJ_t \]

\[ \text{NEXRJ} = \text{Net exports of raw jute} \]

\[ \text{TDURJ} = \text{Total domestic uses of raw jute} \]

\[ TDURJ_t = RJUJM_t + \text{OTHURJ}_t \]

\[ \text{OTHUR} = \text{Other exogenous uses of raw jute} \]

\[ RJUJM_t = \nu_0\text{PRODJM}_t \]

\[ NEXJM_t = PRODJM_t - \text{CONJM}_t + SJM_{t-1} - SJM_t \]

\[ \text{NEXJM} = \text{Net exports of jute manufactures} \]

\[ WCJM = \sum \text{CONJM}_t \]

\[ WCJM = \text{World consumption of jute manufactures} \]

\[ WCRJ_t = \nu_0WCJM_t \]

\[ PRODJMW_t = \sum \text{PRODJM}_t \]

\[ \text{PRODJMW} = \text{World production of jute manufactures} \]

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