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Food consumption patterns in rural Pakistan

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by

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In the sweet memory of my mother and to my father.

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CHAPTER 1. INTRODUCTION

Historically, the government of Pakistan has pursued a policy of import substituting industrialization. Prices of food, specially wheat which is the staple food for most Pakistanis, were kept low. This was done, partly, to ensure cheap supply of labor for the industrial sector and, partly, because of political pressures from urban consumers. The government also tried to maximize export earnings, conserve foreign exchange and contain the budget deficit. These objectives were contradictory and no single policy instrument was sufficient to achieve them. Consequently, a variety of instruments were employed ranging from macro economic measures like exchange rate overvaluation to specific commodity market interventions such as monopolizing the procurement, marketing and distribution of particular agricultural commodities. As a result of these policy induced distortions, domestic consumer prices often differed significantly from international prices and, for some commodities, even from domestic producer prices.

Despite four decades of interventionist policies, the results were mixed. Some industrialization occurred but the industrial base did not expand enough to provide employment to fast growing labor force. The balance of payments and budget deficits were quite large in most years. It can be argued that consumers faced lower food prices compared to a free market regime. But even this was not true of all food

commodities. Whatever implicit price subsidies the consumers received for food were because of the unanticipated effects of macro economic policies. More often than not, the same macro economic policies also depressed household incomes, especially, in the rural areas. In the final analysis, the policy induced distortions only created inefficiencies and waste in an already impoverished economy.

More recently, the Government of Pakistan, prodded by international donor agencies, has started a process of gradual deregulation and liberalization. For instance, the Pakistani Rupee has been devalued several times in the past few years, although, it remains a managed float. The operations of the parastatal institutions have been narrowed in scope to allow private traders into the marketing and distribution system of agricultural commodities.

In the recent years, with the strengthening of democratic institutions in Pakistan, the government has become more responsive to demands of rural constituencies. Public investments in rural infrastructure have increased. Special priority is being given to construction of farm to market roads. Plans are under way to connect all Union Council headquarters with the provincial or national highway system. These infrastructure investments are likely to improve linkages between the previously isolated rural markets. This would bring about a realignment of rural relative prices and, therefore, have significant impact on household consumption patterns.

The reforms in trade and exchange rate policies, and public investments in infrastructure will have important consequences for all sectors of the economy. This study is concerned with the effects of these policies on food consumption of farm households. In low income countries like Pakistan, a large proportion of household's budget is allocated to food. Therefore, changes in policies affecting food prices have

significant welfare consequences.

Before proceeding to the technical aspects of analyzing household's consumption behavior, it is necessary to highlight important features of the policy changes taking place in Pakistan. This would help determine the type of information needed for analyzing the impact of these policies. With these objectives in mind, the first section of this chapter describes government interventions in markets for selected agricultural commodities. This is followed in the second section by a discussion of the relevant macro economic policies. These two sections draw heavily on Hamid [24] and Dorosh [18]. The third section discusses government efforts to improve rural infrastructure. The fourth section reviews the previous demand studies in Pakistan, compares their results, and tries to determine whether the existing literature provides the information needed for comprehensive policy analysis. The final section outlines the objectives of this study.

Commodity specific policies: Direct interventions

Wheat

Two factors were important in shaping the wheat pricing policies in Pakistan. First, the price of wheat, which is the staple food for most Pakistanis, has always been a sensitive political issue. Therefore, various governments tried to keep wheat cheap in the domestic market. Second, the government wanted to ensure a fair return to farmers, most of whom did not have adequate storage facilities, and were likely to be exploited by traders in the post harvest glut. However, in government's view, the latter consideration was less important than protection of consumers' interests and maintaining low industrial wages.

To achieve these objectives wheat was procured directly from farmers at fixed price and sold to consumers through a system of ration shops, usually, at a subsidy. In the mid sixties worldwide inflationary pressures and higher domestic wheat prices, made operating this system difficult. The government did not want to increase the ration shop price of *atta*(wheat flour). To buy cheap wheat, it tried to monopolize procurement in Punjab. This had to be abandoned soon because of strong opposition from farmers. Maintaining the ration shop price of *atta* meant increasing the subsidy. Table 1.1 presents the consumer prices, the producer prices, the transport adjusted border prices and budgetary subsidy for wheat in Pakistan. By 1973, the budgetary subsidy on wheat had reached Rs 2 billion or around 10 percent of government's current expenditure. It remained a little lower in the late seventies and early eighties but started increasing again after 1984, reaching the Rs. 4 billion mark in 1986-87.

In 1987, the rising cost of wheat subsidy, large stocks from a record wheat harvest and from previously ordered but late-arriving shipments of imports, led to *derationing* of *atta* and abandoning the ration shop system. The government announced that it would supply wheat to the private sector at a price that was initially set at Rs 2080 per ton. The consumers, however, continued to enjoy wheat subsidy even after 1987 because the government still absorbed the transportation, storage and handling costs.

Sugar

Pakistan does not have comparative advantage in producing sugarcane because no area is well suited for its cultivation. But the government, in line with its import substitution policy, encouraged setting up of sugar mills and cultivation of sugarcane

Table 1.1: Wheat Prices and Consumer Subsidies (Rupees) [a]

Year	Producer Price (Rs/ton)	Consumer Price (Rs/ton)	Transport Cost Adjusted Border Price (Rs/ton)	Direct consumpion Subsidy (million Rupees)
1965-66	364.86	383.97	358.81	0
1966-67	456.01	434.13	370.43	0
1967-68	441.62	472.44	407.53	0
1968-69	414.65	423.60	274.65	0
1969-70	440.66	458.43	287.68	80
1970-71	439.97	461.77	304.06	101
1971-72	439.14	475.92	406.71	95
1972-73	584.30	558.96	834.71	939
1973-74	660.15	662.89	1279.51	1905
1974-75	961.94	930.51	1860.84	2243
1975-76	958.62	968.03	1537.80	1553
1976-77	955.64	980.74	1167.30	1683
1977-78	953.28	1017.55	1306.24	1571
1978-79	1164.73	1169.55	1609.14	2384
1979-80	1204.83	1386.52	1531.71	2353
1980-81	1398.61	1428.74	1855.65	1229
1981-82	1392.44	1505.03	1980.84	1299
1982-83	1540.02	1619.73	1948.24	1221
1983-84	1534.93	1645.86	1673.01	1267
1984-85	1680.96	1829.88	2511.04	2878
1985-86	1927.84	1986.15	2161.78	3919
1986-87	1925.04	1997.59	2810.59	4064

[a]Source: Tables 4.3.1 and 7.1(b), [24]

by imposing tariffs on sugar imports. As a result area under sugarcane increased from 200,000 hectors in 1949/50 to 800,000 hectors in 1987. During the same period the number of sugar mills increased eight fold, from 5 to 40.

Until 1983, the government announced the price at which mills bought sugarcane from farmers. All farmers in the area where the mill was located (called the "mill zone") had to sell their sugarcane to that mill. They could not sell it to any other mill or convert it into coarse brown sugar, called *Gur*, for their own consumption. The mills, in their turn, had to buy all sugarcane offered to them at the government announced price. A proportion of sugar produced in the mills was purchased by the government and sold at the ration shops. The mills sold the rest in the open Market. The ration shop price of sugar was lower than the open market price. This created an illusion that government was protecting consumer interests. But in reality, both the ration shop and the open market prices were much higher than the international price of sugar because of tariffs on its import.

After 1983 the government dismantelled sugar ration shop system and permitted the the mills to sell their entire production on the open market. It continued to intervene, however, through occasional releases from stocks of imported sugar to stabilize prices. The zoning system to procure sugarcane also remained in effect.

In the meanwhile, farmers started to lobby for higher prices. In 1986 the "zoning" system was abolished and producer price of sugarcane increased substantially due to competition among mills. During this time consumers continued to pay a high price for sugar because of high tariff on its imports. Table 1.2 gives the producer, consumer and the border prices of sugar.

Table 1.2: Sugarcane Prices (Rupees/ton) [a]

Year	Producer Price (Rs/ton)	Consumer Price (Rs/ton)	Transport Cost Adjusted Border Price (Rs/ton)
1965-66	54.649	1696.07	24.311
1966-67	47.288	1466.75	14.415
1967-68	58.352	1911.21	11.227
1968-69	67.273	1859.60	5.627
1969-70	66.915	1853.44	14.117
1970-71	66.584	1745.60	19.509
1971-72	59.949	1888.01	86.821
1972-73	105.236	2463.81	129.177
1973-74	103.091	3222.78	179.182
1974-75	127.221	3919.85	386.241
1975-76	138.940	4343.55	170.073
1976-77	137.566	4353.55	161.861
1977-78	136.476	4343.55	171.396
1978-79	135.066	4423.55	170.261
1979-80	166.652	5990.98	379.300
1980-81	217.532	7381.33	517.109
1981-82	214.682	8270.46	414.787
1982-83	213.567	8105.13	272.938
1983-84	211.220	8120.00	258.020
1984-85	209.388	7820.00	177.181
1985-86	207.946	8920.00	198.379
1986-87	260.153	9570.00	192.974

[a]Source: Table 4.3.5, [24]

Rice

The government intervention in the rice markets started in early seventies. Several factors were responsible for this. First, separation of the former East Pakistan (Bangladesh) in 1971 allowed diversion of rice, previously shipped to that rice deficit region, to the international markets. Second, the oil price increases after 1973 raised incomes in the Gulf states, boosting exports of high quality *Basmati* rice from Pakistan. This also coincided with the international commodity price boom. The doubling of rice prices within a year alerted the government to possibilities for earning additional revenues in rice trade. It responded with setting up the Rice Export Corporation (R.E.C.) and declaring rice export trade a state monopoly. This included not only exports of Basmati rice but also of ordinary rice (mainly the IRRI variety).

The R.E.C. operations were conducted on the assumption that Pakistan had a monopoly in the international trade for Basmati rice. Therefore, Basmati exports were restricted. In addition, a monopoly procurement scheme was introduced that kept producer prices low. Strict quotas were imposed on private dealer's sales in the domestic market to prevent increases in producers prices.

In 1986, pressures from farmers and the Rice Dealers Association forced the government to change rice policies. The compulsory procurement scheme was abandoned. Rice dealers were given limited access to export trade. They could export basmati rice in packets of 20 kg or less. But the R.E.C. still retained exclusive rights to bulk quantity rice exports. However, it was no longer obligated to buy rice from the farmers. When the price of ordinary rice (IRRI) dropped in the international market, it stopped buying rice from areas that were far away from the port. This resulted in a sharp decline in ordinary rice prices in Punjab.

Table 1.3: Basmati Rice Prices (Rupees/ton) [a]

Year	Producer Price (Rs/ton)	Consumer Price (Rs/ton)	Transport Cost Adjusted Border Price (Rs/ton)
1965-66	658.29	924.61	729.09
1966-67	756.05	1186.10	710.14
1967-68	660.10	837.26	954.77
1968-69	808.30	744.03	954.16
1969-70	761.20	722.43	772.92
1970-71	672.42	951.50	677.73
1971-72	822.33	1174.25	1394.47
1972-73	1056.93	2065.25	2138.18
1973-74	1381.76	2797.25	4209.87
1974-75	2069.05	3250.50	4023.46
1975-76	2028.25	3587.00	4492.13
1976-77	2297.49	3690.75	2603.93
1977-78	2259.89	3871.75	3704.22
1978-79	2470.17	3312.50	6644.90
1979-80	2412.17	3887.50	6130.86
1980-81	2832.23	4811.50	5939.32
1981-82	3100.31	5197.75	6280.17
1982-83	3163.71	5180.50	6674.55
1983-84	3174.49	5941.25	6733.93
1984-85	3203.29	5819.75	8017.58
1985-86	3539.51	6755.00	9225.33
1986-87	4235.39	7055.56	10610.09

[a]Source: Tables 4.3.2 and 7.1(b), [24]

Table 1.4: IRRI (ordinary) Rice Prices [a]

Year	Producer Price (Rs/ton)	Consumer Price (Rs/ton)	Transport Cost Adjusted Border Price (Rs/ton)
1968-69	422.265	-	-
1969-70	417.826	-	-
1970-71	443.285	504.50	302.58
1971-72	436.626	536.75	354.13
1972-73	417.945	802.50	959.77
1973-74	547.391	871.75	2587.10
1974-75	855.707	1212.25	2782.51
1975-76	830.019	1250.25	1501.64
1976-77	1180.240	1493.25	1299.30
1977-78	942.597	1631.00	1577.64
1978-79	1011.491	1356.50	1925.52
1979-80	975.203	1508.25	1932.33
1980-81	1200.514	1701.00	2607.09
1981-82	1401.556	2010.50	2413.92
1982-83	1566.241	2141.50	1924.78
1983-84	1600.862	2328.50	1955.56
1984-85	1572.067	2517.50	2212.94
1985-86	1634.785	2556.25	1646.15
1986-87	1616.280	2595.50	1660.91

[a]Source: Table 4.3.3, [24]

The prices of Basmati and ordinary rice are presented in Table 1.3 and Table 1.4, respectively. In the absence of intervention, the domestic producer and consumer prices should be equal. But the government drove a wedge between the two by monopolizing marketing and distribution of rice to restrict its sales to the domestic market. Tables 1.3 and 1.4 show that for most years between 1961 and 1987, consumer prices of Basamti and IRRI varieties are higher than the corresponding producer prices.

To conclude, the government has intervened heavily in markets for food. Import substitution and budgetary considerations were among the stronger motives for these interventions. Even the attempt to maintain low prices of staple food (wheat) had as much to do with the provision of cheap labor for the protected industrial sector as with the political clout of consumers. Trade taxes and quantitative restrictions were the most important forms of direct interventions. The former raised revenue in addition to protecting domestic industry. Government also seized other opportunities to raise revenue. This included monopolizing procurement, marketing and distribution of agricultural commodities. The use of budgetary consumption subsidies was avoided as much as possible. Whenever these subsidies were provided, their cost was kept low (e.g. by periodic increases in ration shop prices of *atta*).

Macro economic policies: Indirect interventions

Commodity market interventions affect prices of specific food items directly. But consumption decisions depend on relative prices. Government interventions elsewhere in the economy, as well as its macro economic policies, can effect relative prices of foods and other agricultural commodities. Two important relative prices are (a) the

price of tradeables relative to non-tradeables, called the *real exchange rate* and (b) the price of agricultural commodities relative to the price of non-agricultural goods.

Several policies can influence the real exchange rate. These include maintaining overvalued nominal exchange rates in the face of unsustainable deficits in external accounts and trade taxes and subsidies. An appreciation in the real exchange rate reduces real incomes of agricultural households from sales of tradeable crops. This could effect rural consumption patterns.

The non-agricultural sector supplies manufactured inputs and consumer goods to agriculture. An increase in the relative price of non-agricultural goods, resulting from increased protection of industry for instance, has two types of effects. First, the manufactured farm inputs become relatively more expensive, thus cutting into the purchasing power of farm households. Second, manufactured consumer goods become more expensive relative to other goods resulting in substitution effect in farm household's consumption away from them. Because of the importance of indirect effects of trade and exchange rate policies on consumption in general and rural consumption in particular, a review of the key features of these policies in Pakistan is presented in the next section.

Trade and exchange rate policies

In the first few years after independence in 1947, Pakistan pursued a liberal trade policy[1]. During this period, high demand for Pakistan's cotton and jute exports because of the Korean war commodity boom, generated adequate foreign exchange earnings to finance imports. An *Open Generalized license(OGL)* system was

[1] This section draws heavily on Chapter 3, [18] and Chapter 3, [24]

introduced under which licenses could be obtained to import any product.

After the war, export demand leveled off and by 1952 the country faced foreign exchange shortages. Instead of devaluing the currency, the government imposed import controls. The OGL was abolished and industrialists were issued licenses for importing intermediate and capital goods. Traders who imported under OGL were also given licenses in proportion to their imports in 1950/51. These were mostly used to import consumer goods. In addition, ban was imposed on export of most agricultural goods, except, jute and cotton that were subject to heavy export taxes. As a result of these policies, exports measured in 1960 US dollars, declined from $336 in 1952/53 to $95 in 1958/59.

The military government that took over in 1958 attempted to compensate the manufactured goods exporters for exchange rate overvaluation, while, at the same time, pursuing an import substitution policy. It introduced what is called the *Bonus Voucher Scheme* under which exporters of manufactured goods were issued vouchers equivalent to a percentage of their export earnings. These vouchers could be used to import items on the *Bonus List* or sold at the stock exchange where they fetched 1.5 to 1.8 times the face value. The Bonus voucher Scheme thus created a system of multiple exchange rates. Liberalization continued until 1965 when a war with India led to foreign exchange shortages and the government resorted to import controls once again.

In 1972 Pakistani rupee was devalued 131 percent against the US dollar and Bonus Voucher Scheme was abolished. Import policy was also liberalized. In 1976/77 the number of broad item categories that could be freely imported reached 407. The imports of luxury consumer goods continued to be banned or faced high import

duties. In the early seventies, devaluation coupled with improvement in Pakistan's terms of trade because of the commodity price boom, increased export earnings. The government imposed export duties of several items including raw cotton and textile products. These taxes were withdrawn after the boom collapsed.

Later in the decade domestic inflation resulted in exchange rate overvaluation and balance of payment difficulties. Instead of devaluing the rupee, the government introduced compensatory rebates for exporters that ranged from 7.5% to 12.5% of the f.o.b. value and provided them access to imported raw materials under the raw Material Replenishment Scheme (RMR). The first significant reform came in January, 1982, when the rupee was delinked from the dollar and converted to a managed float. The value of the rupee, now determined by loose purchasing power parity to a basket of Pakistan's major trading partner's currencies, began to decline. As a consequence, the government no longer had to restrict imports to avoid balance of payment difficulties. Most import restrictions were lifted and by 1989 the only items whose imports remained banned were a) items banned for religious or security reasons, b) luxury consumer goods and c) items banned to protect selected industries.

The effects of commodity specific and macro economic policies on various commodities are presented in Table 1.5. Note that the total effects are the sum of the effects of commodity market interventions and those of the macro economic policies. Except for sugar, that received 69% protection, the direct market interventions heavily taxed agricultural products. Between 1983 and 1987, for instance, the direct interventions amounted to a tax of 57% on Basmati rice, 26% on vegetable oil and 19% on wheat. By comparison, the growers of ordinary rice received a modest 7% protection. It must be noted, however, that these direct taxes and subsidies do

Table 1.5: Direct and Total Nominal Proctection Rates 1961-1987 (average annual percentages) [a]

Year	Direct Effect	Total Effect	Direct Effect	Total Effect
	Wheat		Basmati Rice	
1961-1965	8	-49	-37	-76
1966-1971	28	-46	-14	-72
1972-1977	-38	-56	-50	-67
1978-1982	-34	-48	-48	-60
1983-1987	-19	-33	-57	-65
1961-1971	19	-48	-20	-73
1972-1987	-31	-46	-52	-65
	Vegitable Oil		Ordinary Rice	
1961-1965	4	-40	16	-53
1966-1971	42	-21	18	-60
1972-1977	-18	-37	-34	-61
1978-1982	-36	-46	-38	-53
1983-1987	-26	-35	7	-17
1961-1971	24	-30	17	-57
1972-1987	-26	-40	-23	-44
	Sugar(ex-mill)			
1961-1965	97	3		
1966-1971	154	26		
1972-1977	-21	-43		
1978-1982	9	-11		
1983-1987	69	43		
1961-1971	128	16		
1972-1987	17	-6		

[a]Source: Table 7.2, [18]

not capture the full effect of interventions on consumers because they are based on farmgate prices. Low farmgate prices translate into consumer subsidies only if there are no other distortions. Often excise duties and other domestic taxes drive a wedge between producer and consumer prices reducing consumer subsidies. Therefore, the figures in Table 1.5 should be seen as illustrative and not as precise measures of the effect of distortions on consumers.

Table 1.5 suggests that indirect policies resulted in additional taxation. For most commodities, these policies reinforced the negative protection through direct interventions, raising the total taxes on Basmati rice, vegetable oil and wheat to 65%, 35% and 33% respectively, during the period from 1983 to 1987. Even the 7% protection of ordinary rice through direct interventions during this period was more than offset by the effects of macro economic policies, resulting in a tax of 17%. Only for sugar, the indirect effects reinforced positive protection through direct interventions.

The review of commodity market and macro economic policies shows that government has intervened heavily in markets for food. A policy reform that removes these distortions may have significant effects on consumption patterns. To assess the consequences of these reforms accurately, it is necessary to estimate a good set of demand elasticities. But the demand elasticity estimates are not robust to the assumptions made to obtain them. Many studies have used varying assumptions to estimate elasticities of demand for Pakistan. These issues will be taken up in the section reviewing previous demand studies in Pakistan.

The commodity market and macro economic interventions do not exhaust the set of policies that can influence consumption decisions. Infrastructure also plays an

important role. Rural households make most of their purchases in village markets. If these markets are isolated due to infrastructure bottlenecks, their prices vary considerably as do the regional consumption patterns. A government policy aimed at improving rural infrastructure will alter prices and, therefore, have significant consumption effects. The next section reviews past infrastructure policies and future plans.

Rural infrastructure policies

In Pakistan, the process of economic liberalization that started in the mid 1980's was also accompanied by government investments in rural infrastructure. The rural development program focused on construction of new roads, village electrification, and extending water supply and public health facilities to rural areas. The Sixth Five Year Plan(1983-88) pursued road construction with vigor, specially in its last two years [2]. Against the plan target of 10,000 kilometers, the new roads constructed totaled 14,957 kilometers. Road construction seemed to have been given a higher priority than other components of the development program. This is evident from the fact that none of the other rural development targets were met, during the plan period.

The Seventh Five Year Plan(1988-93) continued to accord priority to rural road construction. The rural roads program envisaged connecting all Union Council headquarters to the provincial and national highways. To meet this objective, 11,712 kilometers of new roads were needed. Later the program was extended to include

[2]This period coincided with the ending of marshal law and a new elected government assuming power.

"more and better farm-to-market roads village roads and canal bank roads(see [22] pp:124). Against the backdrop of these objectives, the Seventh Plan set a target of 8,500 kilometers of new rural roads. Given this target, majority of Union Council headquarters can be connected to the national highway system by the end of the plan period. This assessment is based on the assumption that priority will be given to connecting new Union Councils to the highway system rather than linking villages within jurisdictions that are already connected.

Rural markets in Pakistan are fragmented due to infrastructure bottlenecks. As a result, regional markets operate in near autarky. Depending on the local cropping patterns, some foods are cheap in these markets while others, that are not produced in the region, are expensive. Investments in infrastructure reduce transportation costs and eliminate price differentials. Because of the irreversible nature of these investments, changes in price structure are permanent. Therefore, they have long term effects in addition to causing short run adjustment in allocation decisions. Modeling these effects carefully, can provide new insights into long run consequences of government policies. The previous demand studies in Pakistan concentrated only on measuring household responses to short run changes in prices and incomes. No efforts were made to *explain* the long term behavior that was, often, accounted for by using ad hoc statistical techniques such as the fixed effects estimation procedure. This not only made the conventional studies less useful for policy analysis but it also undermined the quality of their estimates.

Previous demand studies in Pakistan

The analysis of consumer behavior in Pakistan has relied mostly on micro data. The time series long enough for reasonably dissaggregated analysis were, simply, not available. In addition, the need to take into account variations in regional demand patterns and in household characteristics, also contributed to this tendency. Over the years, there have been several household in Pakistan by the Central Statistical Office and other government organizations. These surveys provided the data used in most studies reviewed here.

The surveys, because they cover thousands of households all over the country, are expensive and their costs vary directly with the number of field visits. Most surveys, therefore, are at a point in time. It is customary to not record price information because prices are assumed to be same for all households in a given year and, therefore, of little use in econometric estimation. But this assumption is not entirely correct. Whenever prices are collected, they show pronounced regional patterns even within the same year, specially, in rural areas where regional markets are usually fragmented (e.g. see Deaton and Grimard [17] pp. 6) . Early surveys in Pakistan collected price information. This data limitation greatly influenced the course of research for many years.

Studies using single equation methods

Most early studies employed single equation estimation techniques that consisted in fitting Engel's Functions to estimate expenditure elasticities e.g. Rehman(1963), Siddiqui (1982) and Ali (1982). Some used Frisch technique to estimate price elasticities as well, for example, see Bussink (1970) and Ali (1982). MacEwan(1971) used

time series methods to estimate income elasticities.

More recently, the Engel Function studies became more specialized with tendency to focus on specific issues such as (a) rural-urban differences in consumption patterns (b) regional differences and (c) stability of Engel's relationship over time. Burney and Khan [13] examined rural-urban differences in consumption patterns. Malik *et al* [35] used data from Household Income and Expenditure Surveys for different years to test for intertemporal differences in consumption behavior, in addition to testing for rural urban differences. Malik *et al.* [34] tested for presence of regional and intertemporal differences. In most of this literature, the fixed effects model, because of its simplicity, was the technique of choice for modeling these differences.Other issues studied include the effect of socio-economic characteristics on household savings (Burney and Khan [12]) and the effects of alternative income distributions(Cheema and Malik [15]).

Demand systems approach

The knowledge of income elastities can help asses how the policies that change incomes affect consumption. Most government interventions, however, take the form of price distortions – even when the objective is to redistribute income. To evaluate the consequences of these distortions it is necessary to develop good estimates of own and cross price elasticities of demand in addition to income elasticities. Recognizing this need, several studies attempted to estimate full demand systems for Pakistan with data from the various household surveys, the absence of price variation notwithstanding.

If the data lack sufficient variation in prices to identify all parameters of the

demand system, the only other alternative is to rely on strong assumptions. An example of this approach is the Linear Expenditure System (LES). The LES does not require price information to calculate demand elasticities, instead, it derives them from knowledge of marginal budget shares and "committed expenditure" for a single commodity. The problem, however, is that the LES is based on the assumption of additive preferences, and implies linear Engel's curves. Economist regard additive preferences too restrictive and linear Engel curves have been rejected empirically. From a policy perspective, the most disturbing aspect of the LES is that the price elasticities are roughly proportional to income elasticities implying that the optimal tax structure be, more or less, uniform. The bias towards uniformity arises because the "goods that are attractive to tax on efficiency grounds, those with low price elasticities, are those heavily consumed by the poor, and thus the least attractive on distributional grounds"(Deaton and Grimard [17] pp. 18).

Despite its limitations, the non-availability of price data forced the earliest demand system studies to use the LES framework. Ali(1985) estimated a variant of the LES called the Extended Linear Expenditure system (ELES). He considered 12 items and found that housing, furniture and fixtures, education, recreation, and travel and transportation had some degree of price responsiveness, although, all had own price elasticities less than one. The strongest cross price effects were from changes in food prices. The income elasticities were greater than one for housing, furniture, personal care, and education. This study aggregated all types of food into a single category, therefore, it did not provide elasticities within the food group.

Ahmad *et al.* [2] used the 1979 Household Income and expenditure Survey (HIES) to estimate a Modified Linear Expenditure System for 17 items, includ-

ing 10 food groups. They found that marginal budget shares for foods, specially, wheat, rice and pulses were generally higher in rural areas compared to urban areas. More interestingly, the "minimum consumption requirements" that are estimated parametrically in the LES, varied considerably across regions(provinces). For example, minimum consumption requirement for wheat were higher in NWFP than other provinces, whereas, the minimum consumption requirements for rice were higher in Sind but negligible in NWFP. This is consistent with the observation that rice is the staple food in most of Sind. These results suggest that inter-regional variations in preferences may be important in explaining consumption behavior and should be explored further.

Ahmad and Ludlow [1] estimated a modified LES for 13 items using data from the 1976 Micro Nutrient Survey (MNS) conducted by the Planning Commission. They confirm the finding of Ahmad *et al* [2] that marginal budget shares for wheat, rice and pulses are higher in rural areas than urban areas. Burney and Akmal [11] estimated an Extended LES using household data from the 1984-85 HIES. They estimated income and price elasticities for large number of food items and a non-food category. The estimates were obtained separately for rural and urban areas and for six income groups within each area.

Alderman [3] was the first to investigate consumer demand behavior in Pakistan without relying on strong assumptions. The approach taken was to use spatial variation in prices for identifying parameters of the demand system. Independent price information from other sources was added to the 1979 HIES data, that did not have prices for all items, to estimate an Almost Ideal Demand System (AIDS).

The prices used were obtained from the *Monthly Statistical Bulletin* [3] which reported retail market prices for 12 urban centers. Because similar prices were not available for rural areas, the 39 rural district codes were linked to the nearest urban center and prices prevailing there used in place of rural prices. It was recognized that the definitions of commodity groups were not consistent between the two data sources and that the published prices were different from the actual prices at which rural households made purchases. Stated somewhat differently, the latter problem meant that rural prices were measured with error. In authors view, the solution to this problem was to use the fixed effects approach and transform the data by subtracting the respective district means from all variables.

The idea of using spatial variation in prices was a significant improvement over previous studies. The use of fixed effects model when rural prices were measured with error was, however, not entirely justified. If all right hand side variables are measured *without* error then the fixed effects model can sweep out the part of variation in expenditures that is attributable to differences in regional preferences (e.g. due to long term habits). But it cannot correct for measurement errors. Indeed, if measurement errors are present in the right hand side variables, the fixed effects transformation cannot even sweep away the long term structure of the model. The reason is that district means calculated from variables measured with error are biased and deviations from them cannot remove the regional effects completely [4]. Therefore,

[3] A Publication of the Federal Bureau of Statistics, Government of Pakistan

[4] The means would not be biased if the difference between the true value of a variable and its observed value is randomly distributed. But the variables under consideration are the unobserved rural prices and only the prices in the nearest urban centers are observed. The differences between the two are due to infrastructural and agro-climatic factors and there is no reason to believe that they are randomly

this approach is likely to give misleading results. In a study reviewed below Deaton and Grimard [17] replicated Alderman's method with the 1984-85 HIES data and found that two items had positive own price elasticities.

Deaton and Grimard [17] also relied on spatial variation in prices to identify demand system parameters but used data from the 1984-85 HIES that recorded unit values for household purchases. As such, the reported unit values can not be treated as exogenously given prices because quality choices reflected in them are endogenous to the household. The authors specified the following two equation model where unit values were determined by household quality choices and, therefore, depended on household-specific variables in addition to prices.

$$w_{Gic} = \alpha^0_G + \beta^0_G \, lnx_{ic} + \gamma^0_G \, z_{ic} + \sum_{H=1}^{N} \theta_{GH} \, lnp_{Hc} + (f_{Gc} + u^0_{Gic}) \qquad (1.1)$$

$$ln \, v_{Gic} = \alpha^1_G + \beta^1_G \, lnx_{ic} + \gamma^1_G \, z_{ic} + \sum_{H=1}^{N} \psi_{GH} \, lnp_{Hc} + u^1_{Gic}. \qquad (1.2)$$

The first equation postulates that w_{Gic}, the share of good G in the expenditure of household i, living in cluster c, is a functions of his expenditure (x_{ic}), demographic characteristics (z_{ic}), the N unobservable cluster prices (p_{Hc}) and f_{Gc}, the cluster fixed effect for good G that is orthogonal to the idiosyncratic disturbance, u^0_{Gic}. Because only unit values can be observed and not prices, a second equation was specified relating household unit values (v_{Gic}) to expenditure, demographic characteristics and commodity prices.

This model was estimated using a two step strategy. First, a fixed effects transformation of the data swept away all the cluster fixed effects from both equations,

distributed

leaving only the variation due to expenditure and demographic variables. The cluster fixed effects included village prices that, although unobservable, were assumed to be same for all households in the village (cluster). The estimate of β^1_G, obtained in this stage, is the *elasticity of quality* w.r.t expenditure. Next, *between* cluster information was used to estimate price responses. This involved calculating the cluster means of shares and unit values "purged" of expenditure and demographic effects:

$$\tilde{y}^0_{Gc} = \frac{1}{n_c} \sum_{i \in c} (w_{Gic} - \tilde{\beta}^0_G \; lnx_{ic} - \tilde{\gamma}^0_G \; z_{ic}) \tag{1.3}$$

$$\tilde{y}^1_{Gc} = \frac{1}{n^+_{Gc}} \sum_{i \in c} (ln \; v_{Gic} - \tilde{\beta}^1_G \; lnx_{ic} - \tilde{\gamma}^1_G \; z_{ic}). \tag{1.4}$$

where n_c is the number of households in cluster c and n^+_{Gc} is the number of households who purchase good G. The elements of y^1_{Gc} can be interpreted as "corrected prices". If cluster sizes are large, $\tilde{y}^0_{Gc}$ and $\tilde{y}^1_{Gc}$ tend to their true cluster means:

$$y^0_{Gc} = \alpha^0_G + \sum \theta_{GH} \; lnp_{Hc} + (f_{Gc} + u^0_{Gic}) \tag{1.5}$$

$$y^1_{Gc} = \alpha^1_G + \sum \psi_{GH} \; lnp_{Hc} + u^1_{Gic}) \tag{1.6}$$

Because there can be regional variations in tastes, y^0_{Gc} and y^1_{Gc} were regressed on regional and seasonal dummies and residual used in equations 1.5 and 1.6. This was done to isolate the part of spatial and temporal variation that was not to be attributed to prices.

If there are no measurement errors then, under mild restrictions on the matrix Ψ and standard assumptions about error terms , an estimate of the matrix of price effects, Θ is given by the OLS estimator, $S^{-1}R$, where $s_{GH} = cov(y^1_{Gc}, y^1_{Hc})$ and $r_{GH} = cov(y^0_{Gc}, y^1_{Hc})$. Ofcourse, measurement errors cannot be ruled out because

cluster sizes are small, therefore, Deaton and Grimard modified the estimation procedure accordingly.

Comparison of empirical findings

Having discussed the methodologies of previous demand studies in Pakistan, the next step is to compare results. The own price elasticities from estimated demand systems are presented in Table 1.6. The table shows that there is a wide variation in elasticity estimates from different studies. For example, the rice own price elasticity ranges from -0.28 to -1.53; wheat from -0.18 to -0.96; dairy products from -0.47 to -1.26 and oils and fats from -0.23 to -1.26. Clearly, some of this variation is because of the very different assumptions underlying the LES [columns (1) and (2)] and the AIDS [columns (3) and (4)] models and, to a lesser extent, because of differences is product definitions between studies. But the presence of substantial differences between elasticity estimates from the two AIDS formulations suggests that there are, also, other reasons.

One such reason is the way the regional taste variation is handled. Nearly all studies recognized that tastes were not same across regions, so that, it was necessary to isolate the variability in shares associated with taste differences from that which could be attributed to prices and total expenditures. Although, most studies chose a fixed effects transformation to sweep out these regional effects, the transformation itself was not carried out in a consistent manner. The studies differed in their definitions of "region" and the extent to which their fixed effect transformations were actually able to remove regional effects. Consider the issue of definition first. Alderman considered region to be the district, whereas, Deaton and Grimard defined it to

Table 1.6: Rural Uncompensated Own price Elasticities: Previous Studies [a]

Group	Ahmad et.al.	Ahmad and Stern	Alderman	Deaton and Grimard
	LES	LES	AIDS	AIDS
	(1)	(2)	(3)	(4)
Wheat	-0.38	-0.18	-0.96	-0.51
Rice	-0.92	-0.28	-1.93	-1.53
Meats	-1.18	-0.68	-0.35	-0.61
Dairy	-0.95	-0.47	-1.26	-0.89
Oils, fats	-0.82	-0.23	-	-1.59
Sugar	-0.83	-0.53	-	+0.03
Vegitables	-1.11	-0.42	-	-
Othr foods	-0.69	-0.64	-1.19	-0.40

[a] Alderman's elasticities have been converted from Compensated to uncompensated. Elasticities in Col (4) are from Deaton and Grimard, Table VI [17].

be the province. In Pakistan, where intra-province taste differences can be significant, Deaton-Grimard definition is too broad and could result in implausible estimates. For instance, rice is the staple food in most irrigated districts of Sind but is replaced by corn or other grains in rainfed districts of the province. Therefore, a provincial fixed effects model, such as the one used by Deaton and Grimard, would not, completely, sweep out the taste differences. As a result, some of the between regions variation in consumption expenditures, which is really because of habits formed over long periods of time, would be attributed to prices. This, perhaps, is the reason why Deaton and Grimard obtained a large own price elasticity of rice when their corresponding elasticity for wheat, which is also a staple food, is of reasonable magnitude(see Table 1.6).

Alderman's choice of district as the "region" was more realistic in the Pakistani context. Therefore, atleast in principle, he should have been more successful in isolating the long term structure of the model and obtaining a lower own price elasticity for rice. But Table 1.6 shows his estimated rice elasticity was even larger than the one obtained by Deaton and Grimard. In fact, most of Alderman's estimated own price elasticities were quite high compared to the corresponding elasticities of Deaton and Grimard. As argued earlier, the presence of measurement errors in the rural prices used by Alderman meant that the fixed effects transformation was not completely successful in removing all district effects. So the estimated elasticities contained some long run components (associated with regional taste differences that evolved over time), causing them to be larger in magnitude. Hence, both Deaton and Grimard, and Alderman failed to, properly, remove effects of regional taste differences and this resulted in imprecise elasticity estimates.

The need to pay more attention to modeling regional preference differences goes beyond greater precision in elasticity estimates. The next section argues that regional taste differences may be induced by long term economic factors. Using dummy variables to account for these differences does not help in doing policy analysis because these variables have no meaningful economic interpretation. Therefore, effort must be made to explicitly model tastes changes and, if possible, to link them to economic variables that could be influenced by policy.

Objectives of the study

A logical starting point in modeling regional preference variation is where the previous studies left off, that is, the dummy variable model. Nearly all the studies reviewed so far used dummy variables to account for regional tastes differences. In other words, most of these applied researchers believed that *preference differences among regions can be attributed to some region-specific variable.* The problem is that dummy variables, while being specific to the region, have little economic meaning. The standard model of consumer behavior can be greatly enriched if some other region-specific factors, having meaningful economic interpretations, can be shown to influence preferences. Establishing, scientifically, the existence of such a link requires two things. First, a hypothesis must be presented regarding what economic variables induce preference changes and how. Second, the behavioral implications of this hypothesis must be tested empirically. This study aims at accomplishing both these objectives. The remainder of this section is concerned with the hypothesis itself, leaving formal modeling and empirical testing to the later chapters.

This study proposes the hypothesis: *Taste differences among regions are induced*

by differences in long term relative prices. To understand how long-term patterns of relative prices cause regional taste differences, one has to look at certain features of rural commodity markets in developing countries. In most of these countries, infrastructure is inadequately developed and unevenly spread. There is usually a skeletal road network linking main urban centers. A peripheral network may also exist around these centers but it does not go deep into the country side. Farm to market roads are almost non-existent, especially, in the early stages of development. This makes transporting goods to, and from, rural areas costly. As a result, the regional markets tend to be fragmented and, more or less, autarkic.

Agro-ecological conditions vary considerably between regions making their cropping patterns different. In a particular region, some crops are more profitable to grow than others. The near autarkic conditions prevailing in the region's markets make foods grown within the region much cheaper than those brought in from outside.

The optimizing behavior of farm households, who are rational economic agents, leads them to substitute away from more expensive out-of-region foods towards the cheaper locally grown ones. Persistent bias in consumption pattern in favor of local foods leads to habit formation. Households who have been consuming particular type of foods year after year (or perhaps, even, generation after generation) develop a taste for it. In addition, recipes change to take account of relative prices. Households within a region discover new, more tasty, dishes based on cheap local foods and master ways of cooking them. In other words, region specific knowledge and human capital come into existence, making locally produced foods even more cost effective to consume. All these changes are caused by long-term and persistent differences in relative prices. Therefore, between region variation in food expenditures, which most

studies ignore by using fixed effects approach, can be explained by long-term relative prices.

The hypothesis that habits may depend on long term prices is not new. Faden [19] illustrated the same idea with an interesting parable. He wrote,

> Two countries, Eastland and Westland, have populations whose tastes are at first identical. Rice is relatively cheap in Eastland, wheat relatively cheap in Westland. As a result, the rice/wheat consumption ratio is higher in Eastland than in Westland. Habituation[5] and extinction[6] lead to taste changes in these countries such that the taste for rice relative to wheat becomes stronger in Eastland than in Westland. Thus even if prices become equal in the two countries at some future date, the Eastlanders would still consume rice relative to wheat than Westlanders(pp. 554-555).

Faden did not operationalize the concept any further or conduct empirical test of the hypothesis. This study is concerned with using the *Habit Hypothesis* presented earlier, to construct a theoretical model whose implications can be empirically tested.

Establishing a connection between preference change and long-term relative prices has a lot of relevance for policy formulation, as the following examples show. Consider the implications of a policy aimed at improving rural infrastructure. The easing of infrastructural bottle-necks affects long-term relative prices in the region. The short run response to this change is measured by the elasticity of demand with respect to market prices. But in the long run, consumption is also affected by the

[5] *Habituation* is defined as " the process whereby the use of a facility increases the desire to use that facility."

[6] *Extinction* is a "process whereby prolonged absentation from the use of a facility eventually reduces the strength of desire for its use."

preference change that the movements in long-term relative prices induce. Measuring this response is as important for policy purposes as calculating market price elasticities. If these effects are not taken into consideration, policies will have significant unanticipated consequences in the long run. Another example is the permanent changes in prices resulting from policy reform. Economic policies reflect the relative strengths of the groups that stand to gain or lose from policy changes. The balance of political power between these groups is quite stable in the short run which makes it so difficult to implement policy reform. When reform does occur, it is usually a result of change in the underlying configuration of political forces. The new political economic equilibrium is likely to be maintained for a considerable time. If the reform involves realingnment of relative prices, as most reforms do, then in the long run, preferences change in the manner describe above. This generates a long run consumption response, over and above the transitory effects of market price changes.

The rest of this study is organized as follows. The next chapter reviews literature on habit persistence and discusses some philosophical issues related to modeling taste changes. The main feature of the chapter is the derivation of price conditional demand system using a notion of price dependent preferences. This demand system uses long term prices to explain persistence in regional consumption patterns. The third chapter describes the IFPRI survey, highlights the characteristics of surveyed populations and explains the construction of analytical data sets. The issues concerning econometric estimation are addressed in Chapter 4. The next chapter presents estimation results. The estimated parameters are used in Chapter 6 to simulate the effects of hypothetical infrastructure improvements and liberalization. The final chapter presents the conclusions.

CHAPTER 2. A DEMAND SYSTEM WITH PRICE DEPENDENT PREFERENCES

The *Habit Hypothesis*, presented in the previous chapter, states that long term relative prices induce persistence in consumption. It is natural, therefore, to examine ways persistence has been modeled in the literature. The next section reviews some models of persistence or habit formation in consumption. Because habit formation implies taste changes, many economist object to using these models. Some of them believe that, in the interest of division of intellectual labor, the study of taste formation should be left to other social scientists (e.g. psychologist, sociologists e.t.c). There are still others who argue that tastes should not be studied at all because they do not provide useful insights. In the opinion of this latter group, explaining a phenomenon by taste differences and leaving it at that, is a way of disguising analytical failures as considered judgments. Their preferred approach is to try to explain *all* behavior in terms of changes in prices and incomes.

This controversy is discussed in the third section that concludes, the objections noted above are not so much to postulating changing tastes *per se* as they are to terminating the argument once it is reduced to a difference in tastes. Therefore, much of the criticism levelled against the traditional habit persistence models can be avoided if habits themselves could be explained in terms of changes in prices and

incomes. The last section presents a model where differing preferences of regional populations are explained by, longstanding, spatial differences in prices.

Persistence in consumption

Three general approaches have been used in the literature to model persistence in consumption. They are the *ad hoc* specifications, the dynamic utility functions and the control theoretic models. A good discussion of these models is found in Johnson *et al*[27] and Pollak and Wales [40]. This brief review draws heavily on these sources.

Ad hoc models

Structural specifications: Many studies that modeled that persistence in consumption used *ad hoc* specifications. To some extent this was because such specifications were simple but also because improving upon them was difficult [Source ? Stan]. The simplest and the most frequently method for incorporating persistence was to include time trend in demand functions. Another common approach was to use the varying parameter model where parameters of the demand system depended on time trend or past consumption. Pollak and Wales [40] discusses several ways to incorporate persistence into a LES model. Consider the following demand equation from a standard LES model:

$$X_i = b_i - \frac{a_i}{p_i}\sum p_k b_k + \frac{a_i}{p_i}\mu$$

where X_i is the demand for good i, p a vector of prices and μ the expenditure on all X_i. One way to incorporate persistence is to make b_i a linear function of consumption

in the previous period (X_{it-1}). Thus,

$$b_{it} = b_i^* + \beta_i X_{it-1}.$$

Alternatively, b_{it} could depend on consumption in several of the previous periods:

$$b_{it} = b_i^* + \beta_i Z_{it-1} \qquad \textit{and}$$

$$Z_{it-1} = (1-\delta_i) \sum_{\tau=0}^{\infty} \delta^\tau X_{it-1-\tau} \quad .$$

In this specification, consumption in all previous periods matters, but. with a declining influence. In another specification habits depend on the peak consumption occurring within the last t^* periods so that:

$$b_{it} = b_i^* + \beta_i \max_{\tau - t^* < \tau < t} X_{i\tau} \quad .$$

If the influence of the previous peak diminishes with the passage of time then the following model is appropriate:

$$b_{it} = b_i^* + \beta_i (\delta_i)^{t-\tau} \max_{\tau < t} X_{i\tau} \quad .$$

It is also possible that the habit function depends on perceived, rather than actual, consumption with memory decaying geometrically:

$$b_{it} = b_i^* + \beta_i \max_{\tau < t} (\delta_i)^{t-\tau} X_{i\tau} \quad .$$

The habit function considered above is linear but it can be generalized to non-linear functions e.g $b_{it} = H^i(X_{it-1})$ and it can also depend on quantities of other goods, $b_{it} = H^i(X_{it-1}, ..., X_{nt-1})$.

In the above examples, one particular parameter of the Linear Expenditure System was chosen in an *ad hoc* fashion to depend on past consumption. Theory offers

no guidance on which parameters should depend on past consumption but it does place two restrictions. First, the parameters in the habit function must satisfy the theoretical restrictions on the parameters of the original demand system. Second, the signs of the coefficients of the habit function should be such that there is positive relation between current and past consumption. The last restriction, obviously, comes from the assumption of habit formation i.e. higher current consumption leads to higher future consumption, given prices and incomes.

Another type of *ad hoc* model is the *State Adjustment Model* of Houthakker and Taylor [25]. In this model quantities consumed depend on physical stocks of goods or psychological stocks of habits. For example, the quantity demanded at any moment in time (q_i) is given by

$$q_i = \theta_i + \alpha_i S_i + \kappa_i m + \nu_i p \tag{2.1}$$

where p and m are relative prices and income, respectively, at time t and S is some (physical or psychological) stock. The rate of change in stock, $\dot{S}$, is given by:

$$\dot{S} = q_i - \delta_i S_i \quad . \tag{2.2}$$

Equations 2.1 and 2.2, after some manipulations, yield:

$$q_i = \theta_i S_i + (\alpha_i - \delta_i) q_i + \kappa_i \dot{m} + \kappa_i \delta_i m + \nu_i \dot{p}_i + \nu_i \delta_i p_i \quad . \tag{2.3}$$

Note that 2.3 contains only the observable variables. This model is, still, *ad hoc* because it is not derived by maximizing utility.

Stochastic specification: The *ad hoc* models considered so far are *Structural* in the sense that habit variables have been included among the right side variables of the model. An alternative, but equally *ad hoc*, approach is to model persistence

through a *stochastic specification.* For example, a first order auto-regressive process can be appended to the otherwise static model to allow for persistence in consumption. Several studies have used this approach, e.g. Mackinnon [33], Luch and Williams [31] Green *et al.* [23] and Howe *et al.* [26]. Johnson *et al.* [27] reviewed these studies. They also conducted nested tests of the various *structural* and *stochastic* specifications of persistence against the static model, using Canadian data and the framework of the LES. The results indicated that taking persistence into account, either structurally or through auto-correlated error terms, improved performance compared to the static formulation.

Dynamic utility functions

The second major approach to modeling persistence involves dynamic utility functions. The examples include the dynamic LES Phlips [37], [38] and the Quadratic model of Houthakker and Taylor [25]. Consider the dynamic version of the LES presented in [27]. The static utility function is

$$U = \mu' log(q - \gamma) \tag{2.4}$$

where q is a vector of quantities and μ andγ are vectors of parameters. Persistence is modeled by making γ a function of a stock (physical or psychological) variable S:

$$\gamma = \theta + \bar{\alpha} S \quad . \tag{2.5}$$

The stock evolves according to the equation

$$\dot{S} = q - \bar{\delta} S \quad .$$

Maximizing the dynamic utility function defined by equations 2.4 and 2.5 gives the short run demand function:

$$q = \theta + \bar{\alpha}S + \frac{\mu}{(\lambda \bar{p})} \tag{2.6}$$

where $\lambda = (l'\mu)[m - p(\theta + \bar{\alpha}S)]^{-1}$ and $l'\mu = 1$. In the long run $\dot{S} = q_i - \delta_i S_i = 0$ which implies that $S = \frac{q_i}{\delta_i}$. Substituting the value of S in to 2.6 gives the long run demand functions. Note the equation for $\dot{S}$ does not play any role in the optimization process. The formulations such as this are called *myopic*, because, the consumer is assumed not to take into account the effects of current decisions on future consumption.

Control-theoretic models

To relax the assumption of myopic behavior, a third approach was proposed that involves the *Theory of optimal control.* For example, see Luch [32] and Klijn's ([29]) modification to Luch's formulation. The consumer, whose rate of time preference is l, is assumed to solve an inter-temporal utility maximization problem where he maximizes the discounted stream of utilities:

$$\int_0^\infty e^{-lt} U[q(t), s(t)]dt \ , \tag{2.7}$$

which depends on consumption in period t, i.e. [q(t)] and stock (S), subject to lifetime wealth constraint:

$$w + \int_0^\infty e^{-\rho t} m(t)dt = P' \int_0^\infty e^{-\rho t} q(t)d(t) \tag{2.8}$$

where w is the wealth; $m(t)$ the consumer's income at time t; ρ the discount rate and P, a vector of commodity prices. The stock evolves over time according to the equation of motion:

$$\dot{S}(t) = q(t) - \bar{\delta}S(t), \qquad S(o) = S. \tag{2.9}$$

In the terminology of *control theory* the utility maximization problem (2.7)-(2.9) is called an *isoperimetric problem.* Assuming that consumer considers first period real time and the remaining period planning time, Luch solved the first order conditions associated with (2.7)-(2.9) to derive differential demand equations. Luch's assumptions make his formulation a special case of a more general control problem. For a discussion of alternative assumptions about the forward-looking behavior of consumer, see Johnson *et al.* [27](pp. 87-88). Having reviewed the literature on habit persistence, lets now return to the question, briefly touched, in the introduction to this chapter – the desirability of explaining behavior by postulating variable preferences. These issues are taken up in the next section.

Should economists study taste formation?

Most economic analysis takes, as given, what people want and focuses on achieving those objectives most efficiently. If habit formation is allowed into the analysis, this neatness is lost because evolution of habits implies changing tastes. The study of habits, therefore, threatens to undo the division of labor that has long existed between the economists and other social scientists, whereby, the latter studied preference formation and the economists concerned themselves only with the implications of given preferences. Many economists defend this division of labor. For example, Milton Friedman writes,

> Despite these qualifications, economic theory proceeds largely to take wants as fixed. This is primarily a case of division of labor. The economist has little to say about the formation of wants; this is the province of the psychologist. The economists task is to trace the consequences of a given

> set of wants. The legitimacy of and justification for this abstraction must rest ultimately, in this case as with any other abstraction, on the light that is shed and the power to predict that is yielded by the abstraction.[1]

Despite Friedman's views, not all economists agree that tastes are none of their business. For example, Pollak and Wales [40][2] pointed out that Friedmans's remark applies to taste formation, not taste differences. Households may have different preferences depending, for instance, on their demographic profile. Including demographic characteristics into the analysis does not violate Friedman's dictum. Pollak also noted that even Friedman recognized tastes did not remain fixed – they were endogenous to the socio-economic system – he only argued that the study of taste formation should be left to the psychologists.

Stigler and Becker [43] adopted a much stronger position than Friedman and argued that economists should not even include taste differences in the analysis because doing so does not yield much insight "...no significant behavior has been illuminated by assumptions of differences in tastes" (p. 89). They rightly point out that " an explanation of economic phenomena that reaches a difference in tastes between people or times is the terminus of the argument: the problem is abandoned *at this point* to whoever studies and explains tastes (psychologist ? anthropologists ? phrenologists ? sociobiologist ?)" [emphasis original; p.76]. In other words, the real problem with assuming taste differences is that it prevents one from seeking further explanation of the phenomena that economic analysis may be capable of providing. Economic theory, Stigler and Becker emphasize, has wider applicability and prices and incomes

[1] Quoted in Pollak and Wales[40] pp 124, from Friedman [20]

[2] See pp 124.

can explain a much broader range of behaviors, including those that seemingly result from capricious tastes (e.g. addictions, habits, fashions e.t.c.). The theoretical framework used to study these behaviors is the *household production theory.* According to this theory, households combine their own time, skills (human capital) and other resources with market purchased *goods* to produce *commodities.* Household preferences are defined over *commodities* that have *shadow prices* although they may not have market prices because they are not, necessarily, purchased. Using this theory, Stigler and Becker show, consumption of commodities that cause "beneficial" addictions (e.g. music) may increase with exposure, not because consumers tastes change, but because their relative shadow price declines as skills in their appreciation are acquired through exposure.

The real significance of household production theory is that it takes away from the analyst the "unlimited degrees of freedom" that the assumption of unstable tastes allows and focuses attention on incomes and prices – whether market determined or shadow – as the fundamental determinants of behavior. Although the *Habit Hypothesis*, presented in the previous chapter, relies on habit formation (which may be interpreted as taste change) to explain differences in consumption behavior, it does not stop there. Habits acquired by regional populations are, in turn, explained by persistent differences in regional prices. Therefore, the hypothesis is, really, in the spirit of Stigler and Becker. The next section presents a model of price dependent preferences. This model is later used to derive an estimatable form of a demand system where, the expenditure shares, in addition to being functions of market prices, also depend on long term regional prices. The latter will be used to explain the part of variation in consumption expenditures of rural Pakistani households that is

attributable to habits evolved over long periods of time.

Price dependent preferences

The idea that preferences may depend on prices has a long history. Veblen ([44]) is often cited for using the notion of price dependent preferences in discussion of the "snob hypothesis". According to him, consumption of goods and services yields a mixture of direct and indirect utilities. The indirect utility is related to snob appeal and depends on price of the good. As price increases, snob appeal also increases, providing incentive for conspicuous consumption.

Despite its early emergence, the idea of price dependent preferences, did not gain wide currency among economist who had two reservatiors about it. First was the generally held view, mentioned above, that preferences were none of their business and should be left to other social scientists. Second, many economists believed that allowing preferences to vary would render theory of choice incapable of empirical verification, because, it could be made to rationalize any empirical data.

Pollak ([39]) attempted to allay some of these apprehensions. The crux of his approach was to distinguish between the market prices that enter the budget constraint and prices that alter preferences. He called the latter type of prices, *normal prices*. If Normal prices were independent of *current* market prices, then there was no danger of juxtaposition of the two roles of prices as constraining variables (through budget constraint) and as preference conditioning variables. In this situation normal prices acted as any other conditioning variable in the utility function such as age, household size or composition.

Analogous to the two formulations of prices, Pollak developed two corresponding

formulations of demand functions, namely, market price and normal price demand functions. The market price demand functions were obtained by maximizing price dependent preferences subject to budget constraint. The normal price demand functions were defined as the value taken by market price demand functions when market prices approach normal prices. Under certain conditions, it is possible to view market price demand functions as short run demand functions and the normal price demand functions as the steady state demand functions.

Pollak ([39]) did not cite some early work by Basmann on variable consumer preferences [see [5]; and [6]]. After the publication of Pollak's paper ([39]), Basmann and his associates extended his work (see [7] and [8]. However, most of their work on price dependent preferences was in the framework of *Generalized Futchner-Thurstone* utility function and dealt with conspicuous consumption . This study is concerned with habit persistence and neo-classical utility functions, therefore, that branch of literature is not reviewed in any greater detail.[3] In the context of production theory, Fulginiti has analyzed firm behavior when the technology set is conditional on expected prices (see [21]).

Pollak's model

In this section, some of Pollak's ideas are used to develop an empirical model that can capture regional variation in preferences. This model is based on the idea that long term patterns in regional relative prices induce preference changes. Unlike Pollak, [39], the *Veblen Effect* that causes a good to be more strongly preferred by the consumer if its price increases, is not assumed. On the contrary, it is hypothesize

[3]See [9] for a good survey of this literature.

that, over the long run, rational households develop preference for foods that are relatively cheap in their region. With this difference in mind, some of Pollak's key ideas and his notation are introduced below. This will be followed by a specification of price conditional AIDS model.

In Pollak's model, the utility $V(Q;\ P^N)$ depends on *normal prices*, where Q represents a consumption bundle. The normal price vector P^N may be a function of past and present prices, i.e. $P^N = N(P_t, P_{t-1}...)$. Market price(MP) demand functions $Q = h(P^M, \mu;\ P^N)$ can be obtained by maximizing $V(Q;\ P^N)$ s.t the budget constraint $\sum p_k^M\ q_k = \mu$, where P^M is a vector of market prices. The normal price (NP) demand functions $Q = H(P, \mu)$ is the vector of steady state values of market price demands. In other words $H(P, \mu) = h(P, \mu, P)$.

If P^N is independent of current market prices, MP demand functions are also the short run demand functions. Changes in market prices, P^M, do not affect P^N, therefore, they also leave preferences unaltered. The resulting demand functions have all the usual properties of traditional demand functions because they have been derived by maximizing a fixed utility function subject to budget constraint.The role of normal prices, in this exercise, is no different from that of the frequently used taste shifters, such as, race and age.

Some restrictions are needed on the Normal price functions $N(.)$ to obtain meaningful demand functions. Pollak imposed the following three restrictions:

1. *Non-negativity*:

   The normal price of a good is nonegatively related to its price in every period:

$$\frac{\partial N^i}{\partial p_{it}}(P_t, P_{t-1}...)\ \geq 0 \qquad\qquad \tau\ \leq\ 1$$

2. *Homogeneity*:

   The normal price function is homogeneous of degree 1 in past and current prices:

$$N(\lambda P_t, \lambda P_{t-1} ...) = \lambda N(P_t, P_{t-1} ...)$$

   for all $\lambda > 0$.

3. *Convergence*:

   If actual prices converge to $\hat{P}$ then normal prices also converge to $\hat{P}$. In other words:

$$\lim_{t \to \infty} N(P_t, P_{t-1} ...) = \hat{P}$$

An important assumption relating normal prices to preferences is that individual's evaluation of a good is nonegatively related to normal price. This will be called the *Veblen Assumption*, henceforth. Pollak used it because he was interested in modeling behavior when product's quality was judged by its price. But this served to, unnecessarily, limit his model. If the Veblen assumption is dropped, the basic ideas of his paper have much wider applicability, as will be demonstrated below.

A final piece of Pollak's model is the *Relative Price Hypothesis*. He assumed that preferences were affected by relative, rather than absolute prices. Under this hypothesis, MP demand functions are unaffected by a proportional increase in all *normal* prices.

Adapting Pollak's Model As mentioned earlier, this study is not concerned with the Veblen effect. Its objective is to develop a model that can capture regional taste variation so that the *Habit hypothesis* can be, empirically, tested. Therefore,

several significant departures have to be made from Pollak's model. The two most important ones are the reformulation of the normal price function and dropping the Veblen assumption.

In Pollak's model, the normal prices depended on current and past market prices. In this model, the price in a particular region and time period, is thought to have *permanent* and *transitory* components. It is assumed that the normal prices depend only on permanent components. The permanent component is the time invariant part of price. For a given region, it remains constant through all time periods. The transitory component varies from year to year but it is the same for all regions in any given year.

Modeled in this fashion, the permanent component represents long term infrastructural factors, whereas, the transitory component represents current market conditions. If, for example, a crop is destroyed by drought in a particular year, its effect will be reflected only in the transitory component. Similarly, a short lived government subsidy resulting in lower price of a commodity will also be included in the transitory component. The permanent component changes slowly, if at all. It is immune, so to speak, to one time government interventions in commodity markets. But there are policies that, given enough time, can change even the permanent component. Examples of such policies include public investments in rural infrastructure that make transportation more efficient and cost effective, and introduction of new crops in the region. These policy interventions change prices permanently and, hence, their permanent components. The households respond to the changed relative normal prices by, slowly, adopting habits that result in increased consumption of foods whose prices have declined as a result of policy intervention.

The second modification involves replacing the *Veblen Assumption* with the *Habit Hypothesis.* Following Veblen's ideas on conspicuous consumption, Pollak also assumed that consumers were snobbish, so that, their preferences for a good were stronger, the higher its (normal) price. In contrast to Veblen and Pollak, the analysis in this study does not focus on conspicuous consumption. The objective of the study is to explain persistent differences in regional food consumption patterns that are not accounted for by current market prices and household incomes. Therefore, Pollak's model is modified in a way that retains it basic insight – the idea that prices condition preferences – but drops the *Veblen assumption.* This assumption is replaced by the *Habit Hypothesis* stating that rural households acquire tastes for goods that have been relatively cheap in the region, over the long run. In other words, household's valuation of the good is hypothesized to be non-positively related to its normal price.

The intuition behind the *Habit Hypothesis* is as follows. Regions have different cropping patterns depending on their agro-ecological conditions. Infrastructure bottlenecks make foods grown in the region cheap relative to those brought in from the outside. If better infrastructure does not become available, this relative price pattern persists overtime. Households, who are rational economic agents, respond to lower relative prices of local foods by substituting them for out-of-region foods. Persistence in relative prices ensures repetition of this consumption pattern year after year, leading to formation of strong habits favoring local foods. In addition to this, "learning by doing" takes place in the sense that households discover new, more tasty, recipes based on cheap local foods and master ways of cooking them. Therefore, long term prices not only induce habits, they also encourage creation of region specific culinary knowledge and human capital that make local foods even more cost effective

to consume.

It should be noted that the habit hypothesis is just that – a *hypothesis* to be tested. It is not an assumption. In the model, the effects of normal prices are in no way constrained to support the habit hypothesis. Given the structure of the model, the habit hypothesis is a completely falsifiable. Indeed, testing the hypothesis, empirically, is an important objective of this study.

The modifications to Pollak's original model may look drastic at first. But its essential feature, that prices that condition preferences can be different from those that enter the budget constraint, is still intact. This allows deriving short run demand functions by specifying a price dependent utility function and maximizing it subject to budget constraint. Alternatively, one could specify its dual that depends on normal prices in addition to other relevant variables. A cost function is specified that depends on normal price, utility and market prices. This cost function, has a functional from similar to that underlying the Almost Ideal Demand System (AIDS) [Deaton and Muellbaur ([16])].

Price Conditional Demand System

The Price Conditional Demand System (PCDS) presented below is based on a modification of the AIDS cost function. The price conditional form of the AIDS cost function can be written as:

$$log\ C(u, P;\ P^N) = (1-u)\ log\ a(P;\ P^N) + u\ log\ b(P;\ P^N) \qquad (2.10)$$

where $C(.)$ is the cost function, P the vector of market prices, P^N the vector of Normal Prices and u the utility level.

Following Deaton and Muellbaur, a translog flexible functional form is chosen for $log\ a(P;\ P^N)$. But unlike Deaton and Meullbaur, the $log\ a(.)$ function depends on normal prices, P^N, in addition to market prices.

$$\begin{aligned} log\ a(P;\ P^N) \;=\; & \alpha_0 + \sum_j \alpha_j\ log\ p_j + \sum_j \alpha_{N_j}\ log\ p_j^N \\ & + \frac{1}{2}\ [\ \sum_i \sum_j \gamma^*_{ij}\ log\ p_i\ log\ p_j \\ & + \sum_i \sum_j \gamma^*_{N_i N_j}\ log\ p_i^N\ log\ p_j^N \\ & + \sum_i \sum_j \gamma^*_{i N_j}\ log\ p_i\ log\ p_j^N \\ & + \sum_i \sum_j \gamma^*_{N_i j}\ log\ p_i^N\ log\ p_j\ ] \end{aligned} \tag{2.11}$$

The first three terms in (2.11) are the linear component of the Translog and the remaining terms are the quadratic component. Notice that compared to the linear component of the $a(p)$ function from the standard AIDS model, the linear component in this model contains an extra term, $\sum_j \alpha_{N_j}\ log\ p_j^N$, involving normal prices. The quadratic function is also modified. The first term in the quadratic component is the familiar cross-products term in *market prices* from the standard AIDS model. The next term is, analogously defined, cross-products term in *Normal Prices*. The last two terms are cross-products terms in market *and* normal prices.

The function $b(P)$ is defined as:

$$log\ b(P;\ P^N) = log\ a(P;\ P^N) + \beta_0\ \Pi p_j^{\beta_j} \tag{2.12}$$

Put expressions for $b(P;\ P^N)$ and $log\ a(P;\ P^N)$ in the cost function (2.10). Budget shares can be obtained by using Shephard's lemma. Note that these share

equations are derived from a price conditional cost function. Therefore,they are themselves conditional on the vector of normal prices P^N, in addition to being functions of market prices and utility. Next, derive an expression for u from the cost function and substitute it into the share equation. The resulting PCDS has share equations of the following form:

$$w_i\Big|_{P^N} = \alpha_i + \sum_j \gamma_{ij} \log p_j + \sum_j \gamma_{iN_j} \log p_j^N + \beta_i[\log x - \log a(P;\ P^N)] \quad (2.13)$$

where X is the total expenditure, and $\gamma_{ij} = \frac{\gamma^*_{ij}+\gamma^*_{ji}}{2}$ and $\gamma^N_{ij} = \frac{\gamma^*_{NiNj}+\gamma^*_{NjNi}}{2}$

If the price index $\log a(P;\ P^N)$ is replaced by the Stone's index, $\sum_i w_i \log p_i$, then the share equation becomes linear:

$$w_i\Big|_{P^N} = \alpha_i + \sum_j \gamma_{ij} \log p_j + \sum_j \gamma_{iN_j} \log p_j^N + \beta_i \log [X/\mathbf{P}] \quad (2.14)$$

where $\mathbf{P}$ is the Stone's index.

Theoretical restrictions: Economic theory imposes the following restrictions on the coefficients of the demand system:

Homogeneity:

$$\sum_j \gamma_{ij} = 0$$

Symmetry:

$$\gamma_{ij} = \gamma_{ji}$$

Adding-up:

$$\sum_i \alpha_i = 1, \quad \sum_i \gamma_{ij} = 0, \sum_i \beta_i = 0 \ \textit{and}$$

$$\sum_i \gamma_i N_j = 0.$$

An additional restriction is implied by *Relative price hypothesis* which states that preferences depend on relative, rather than absolute, normal prices. The parametric from of this restriction is:

$$\sum_j \gamma_i N_j = 0$$

In addition, symmetry in normal prices has been imposed. This restriction implies:

$$\gamma_i N_j = \gamma_j N_i$$

Constructing normal prices To end this section, method for constructing normal prices is described. Suppose market price in village v in year t is given by:

$$P_{vt} = \bar{P} + P_{v\cdot} + P_{\cdot t}.$$

where $P_{v\cdot}$ is the permanent component for village v and $P_{\cdot t}$ is the transitory component. Let $\bar{P}$ be the overall mean of price in all villages and years,

$$\bar{P} = \frac{\sum_v \sum_t P_{vt}}{NT} \qquad v = 1, 2, \ldots N; \quad t = 1, 2, \ldots T.$$

The permanent component $P_{v\cdot}$ is given by

$$P_{v\cdot} = \frac{\sum_t (P_{vt} - \bar{P})}{T}.$$

Let the permanent village price be defined as:

$$P_v^P = \bar{P} + P_{v\cdot}.$$

Normal price function is given by

$$P^N = P_v^P.$$

Note the normal price function has permanent village prices, P_v^P, as its arguments rather than past and present market prices.

The share equation has both the market and the normal prices as explanatory variables. The normal prices are not affected by transitory market conditions and change only in the long run. Given Normal prices, the elasticities with respect to *market prices* measure the short run response of the household's consumption to changes in these prices. For some purposes this may be the appropriate elasticity to look at. For instance, if the policy being considered involves a one time commodity market intervention, or if the intervention is likely to be abandoned after only a few years, then market price elasticities are appropriate measures of consumption response. These elasticities give the degree of household's responsiveness to changes in commodity prices, conditional on the assumption that it has not had enough time to change habits.

There are other policy changes that either last long or are not reversible once in place. Examples of the former are governments determination to keep a particular food staple cheap through continued subsidy, and imposition of an import tariff on a food product to protect the inefficient domestic processing industry (e.g. sugar in Pakistan). These policies reflect, a more or less stable, balance of political power or influence among the country's various interest groups. Therefore, they tend to last long. The examples of irreversible policies include investments in rural infrastructure that makes transportation and marketing cheaper, and introduction of improved crop varieties that bring down the cost of production. All these policies change relative

prices, permanently. Their effects work through changing habits and are picked up by normal prices. Therefore, the elasticities with respect to normal prices measure the long run response of the household's consumption to permanent changes in policies.

Most demand system studies measure only the market price elasticities. Although, many of them recognize that habits are important determinants of consumption behavior, the habit effects are usually purged by using a fixed effects transformation. The result is that such studies often fail to predict the long term consequences of pricing policies. They offer absolutely no predictions about the long term consequences of non-price policies e.g. improvements in rural infrastructure e.t.c. This is a serious limitation that could lead to erroneous policy analysis. For example, if the government is considering subsidizing a particular food, the immediate increase in the budgetary cost of the subsidy can be calculated using market price elasticities.

With the passage of time, however, household preferences shift in favor of the subsidized commodity, making the cost of continued subsidy larger than initially estimated. Such cost over runs can be, easily, anticipated through normal price elasticities. Therefore, the price conditional AIDS model presented above is a more comprehensive tool for tracing out the consequences of policy changes than its traditional counter part, the standard AIDS model. Apart from its policy relevance, the Price dependent preferences model also enriches the traditional habit persistence models by postulating a testable hypothesis regarding a link between habits and prices. Issues concerning the empirical testing of this hypothesis are discussed below.

Testing the Habit Hypothesis: In Pollak's original formulation, normal prices were non-negatively related to preferences. An increase in the relative price

of a commodity caused the consumer to value it more than before (the Veblen Assumption). But the *Habit Hypothesis*, presented in the previous chapter, is quite the opposite. It states, households tend to value more the foods that have been relatively cheap in the region over the long run. A test of this hypothesis is to see whether the quantity demanded of a particular food falls with an increase in normal price, other things remaining constant. The test is better carried out in the elasticity form. Define the own Price Related Preference Shift (PRPS) elasticity for a food to be the percentage change in quantity demanded for a one percent change in its normal price. If the *Habit Hypothesis* is correct, the own PRPS elasticities should be non-positive.

It is tempting to use the name, "elasticity with respect to normal prices," instead of PERPS elasticity. But this may mislead some readers who are accustomed to associating price elasticities with changes in quantity demanded resulting from rotation of budget constraint. Normal prices do not enter the budget constraint, therefore, changes in them leave the budget constraint unaffected. Their role in the model is to condition preferences. In other words, PRPS elasticities represent changes in quantity demanded due to preference shifts associated with formation of new habits, whereas, the ordinary price elasticities represent movements within the same preference map.

The Habit Hypothesis can be tested by estimating the demand system presented above, derived from price dependent preferences. The data requirements for this exercise are extensive. Micro data are needed on prices and household expenditures. Also the data must have enough spatial variation in, both, prices and expenditures to identify all parameters . This is really important because our ability to discriminate between the short run optimizing behavior of the household and its response to long term prices depends, crucially, on the overall regional variation in prices and

consumption expenditures. The most stringent of all requirements, however, is that the data set must enable calculation of normal prices. Because normal prices are defined as long term average prices in a region, the data set must cover more than one time periods so that averages can be computed. Moreover, there must be a good deal of temporal variation in prices otherwise the correlation between the market and the normal prices can cause severe multicolliniarity. In addition to price and expenditures data, information is also needed on household size and composition to control for demographic effects. The data set used in this study and the construction of the required variables is discussed in the next chapter.

CHAPTER 3. DATA

The data for the present study comes from a survey of rural Pakistani households conducted by the International Food Policy Research Institute (IFPRI) during 1986-1991. This study is based on, only, the sub-period 1986-1988 because when it was started, the data for the remaining periods were not available.

The objective of the IFPRI Survey was to assist the Federal Ministery of Food and Agriculture of the Government of Pakistan in formulating policies for poverty alleviation and improved household food security. Information was collected on a variety of farm household's consumption and production decisions, as well as their socio-demographic characteristics.

This section describes the survey methodology and presents some key features of the surveyed populations. Before going into these issues, a brief description of Pakistan's physical features and administrative units is provided. This would facilitate understanding of the sampling frame.

Survey design

Geography

Pakistan is geographically diverse. Stretching from the Himalayan mountains to the Arabian Sea, it contains an unusually large variety of physical features. From an

economic standpoint, however, it is useful to think in terms of two main regions – the Indus river plains and the mountainous region in the North and the West. The plains contain most of the country's agricultural land and its population. They are fed by an extensive system of interlinked canals and rivers whose cumulative length is approximately 40,000 miles. Farming is also done in the mountainous region wherever irrigation is possible or rainfall is adequate. Typically, mountain valleys hold some cultivable land.

The country is divided into four main administrative units. They are the provinces of Baluchistan, "North-Western Forntier Province" (NWFP henceforth), Punjab and Sind. Each province is further subdivided into districts. The provinces of Punjab and Sind make up the Indus plains while, Baluchistan and NWFP constitute the mountainous region.

Sample selection

The objective of the survey was to focus on the poorest districts of Pakistan. For this purpose a variety of production and infrastructure indices were used to draw up a list of poorest districts. Five districts were selected. They were Attock in Punjab province, Badin in the province of Sind, Dir in NWFP and Kalat in Baluchistan province. In additional, Faisalabad in Punjab was chosen as a control district because it was believed to be more prosperous and having better infrastructure and off-farm employment opportunities. District Kalat was, later, dropped because of logistic difficulties in conducting survey in Baluchistan. The remaining four districts still captured the broad geographical divisions of Pakistan.

Given the focus of the survey on rural poverty, random choice of districts within

each province was not possible. However, after this first stage of sampling, all subsequent stages were based on random sampling. Accordingly, villages and households within each district were chosen by stratified random sampling. In Sind, where villages may consist of spatially separated settlements called "Deh", an additional round of random sampling was conducted within villages.

Even within the districts, cropping pattern, employment opportunities and infrastructure varied considerably. To control for these factors, following procedure was adopted for drawing random samples of villages within each district. First, two markets called "Mandi" were chosen from each district. Next, corresponding to each market or Mandi, three lists of villages were prepared. The first list had villages within 5 kilometers of the Mandi; the second, between 5 to 10 kilometers; and the third, within 10 to 20 kilometers. Villages were randomly chosen from each list. Within each village, households were also chosen randomly. For each district, interviews were conducted by a team of three males and three females. Separate male and female questionnaires were designed and administered to each household.

Characteristics of surveyed population

Physical

Physical characteristics of regions such as climate, soil types and availability of irrigation, affect regional cropping patterns. If infrastructure is inadequately developed, prices in the fragmented regional markets are, largely, determined by the local cropping patterns. Although the IFPRI's household survey did not collect information on climate and soil types, it did record the proportion of irrigated land in the total acres of village land. Table 3.1 presents district averages of total village land,

irrigated land and percentage of uncultivated land.

Most irrigated land was found in Faisalabad where an average village had 1996 acres of land out of which 1363 were irrigated. This district also had the lowest proportion of uncultivated land (9%). On the other extreme, district Attock had no irrigated land and, on an average, 45% of village land in this district was uncultivated.

Table 3.1: Physical Characteristics of Surveyed Villages: Total and Irrigated Area, and Proportion of Uncultivated Waste [a]

	FAISAL-ABAD	ATTOK	BADIN	DIR
All land (Acers)	1996	5111	3071	1423
Canal irrigated(Acers)	1363	0	1026	238
Rainfed(Acers)	4	511	0	1141
Uncultivated area (percentage)	9	45	66	13

[a]Source: Tables 4.1, IFPRI document.

Access to infrastructure

Differing cropping patterns are not a sufficient condition for persistent differences in prices. If adequate infrastructure is available and regions are well connected with each other, price differentials tend to be small even when cropping patterns are

different. Long term price differentials are more likely to be observed when regions are separated by long distances and infrastructure is poorly developed. Therefore, access to infrastructure is an important determinant of differences in long term prices.

Table 3.2 presents average distance from surveyed villages to important locations in the district. These distances can be taken to be crude measures of access to infrastructure in the district. According to Table 3.2, average distance of surveyed villages from main market/Mandi is smallest in Faisalabad (6.65 km) and largest in Badin (9.75 km). The other important market is the weekly market which is an unorganized meeting place where commercial activity usually takes place in an open area. The smallest distance from weekly market was observed in Dir district. However, in this district the main markets are 9.48 km away on average, suggesting that weekly markets may be more important there .

Demographic characteristics

Population In terms of population, Faisalabad was the most densely populated district with an average 4417 persons per village(See Table 3.3). District Badin had Lowest population density of 1219 persons per village. Similarly, the average number of households per village was the highest at 541 in Faisalabad, whereas, it was the lowest in Dir which had 105 households per village.

Household size Rural Pakistani households are quite large in size. Table 3.4 presents average household size by district and expenditure quintiles. The average size of households surveyed was 8.91 in 1988. Similar percentages were observed in other years. In 1988, the highest average number of households members was 11.43

Table 3.2: Average Distance from Surveyed Villages to Important Locations in the District [a]

	FAISAL-ABAD	ATTOK	BADIN	DIR
Mandi/main bazaar	6.50	9.25	7.95	9.48
Weekly market	6.65	9.25	8.00	4.48
Tehsil capital	11.88	17.13	12.45	9.82
District capital	38.23	71.76	27.75	24.08
Bank	4.43	6.38	9.20	6.14
Med. clinic/dispensary	3.18	4.38	7.15	3.58
Tractor rental	.	9.63	1.23	1.53
Flour mill	.	4.50	5.45	1.52
Procurement center	16.48	16.71	9.20	1.68
Sugar mill	11.52	.	25.55	86.51
Fertilizer depot	3.62	11.13	9.25	10.29
Elementary school:boys	.	.	1.38	0.38
Elementary school:girls	.	.	5.25	0.56
Secondary school:boys	4.26	7.43	9.25	1.64
Secondary schools:girls	6.76	11.14	9.40	2.69
Cannal/Karez head	1.90	.	2.05	1.58

[a]Source: Table 4.2, IFPRI document. Distances provided are to the nearest location. A dot(.) denotes a missing value.

Table 3.3: Population, Number of Households and Land-Owning Households in Surveyed Villages [a]

	FAISAL-ABAD	ATTOK	BADIN	DIR
Village population	4417	1775	1219	1502
No. of households	541	279	370	105
No of land-owning households	315	241	178	74
No. of artisans	34	38	233	23

[a]Source: Tables 4.1, IFPRI document.

in district Dir; Attock had the lowest household size of 7.03. Again, this pattern of highest observed household sizes in Dir and the lowest in Attock was stable over time.

An interstering pattern in average household sizes was the significant decline in going from the lowest to the highest expenditure quintiles. In 1988, for example, the average size declined from 12.18 in the lowest quintile to 6.09 in the highest quintile– a drop of nearly 50 percent. This pattern persisted in all years and in all districts(see Table 3.4).

Household composition A similar pattern was found for the percentage of children under the age six in the household. The percentage of children, of both sexes, declined with expenditure quintile. This pattern remained unchanged across districts

Table 3.4: Average Household Size by District and Expenditure Quintile. [a]

	Expenditure quintiles					
	I	II	III	IV	V	All
YEAR 1986-87						
FAISALABAD	10.83	8.76	7.72	7.60	6.00	7.76
ATTOK	9.08	8.36	7.33	7.34	5.52	6.79
BADIN	10.22	8.08	7.54	6.02	3.96	8.32
DIR	16.68	12.87	10.48	8.64	7.12	11.06
ALL	11.50	9.60	8.54	7.54	5.78	8.59
YEAR 1987-88						
FAISALABAD	11.97	9.26	8.46	7.93	6.26	8.24
ATTOK	9.33	8.67	7.42	7.40	5.95	7.03
BADIN	10.62	8.15	7.52	5.83	4.21	8.49
DIR	17.50	13.08	10.62	8.38	7.31	11.24
ALL	12.05	9.83	8.70	7.55	6.09	8.84
YEAR 1988-89						
FAISALABAD	12.08	9.37	8.26	7.90	6.14	8.21
ATTOK	8.56	8.97	7.57	7.40	5.85	7.02
BADIN	10.79	8.31	7.86	5.52	4.58	8.65
DIR	17.73	12.90	10.75	8.65	7.40	11.34
ALL	12.18	9.90	8.85	7.56	6.09	8.91

[a]Source: Table 4.5, IFPRI document.

and over years. In 1988, for instance, the percentage of female children under age six was 11.41 in the lowest quintile and 9.20 in the highest quintile. The corresponding figures for males were 12.23 percent and 9.99 percent, respectively.

Household incomes and expenditures

The data regarding real and per capita incomes are presented in Table 3.5. District Dir had the highest average household real income and district Attock the lowest. For example, in 1988-89 a typical household in Dir earned Rs. 32686, on average, whereas, it earned only Rs. 16281 in Attock. Similar figures for 1986-87 were Rs. 36168 and Rs. 21044 for Dir and Attock, respectively.

Interestingly, Table 3.5 shows that household real incomes were lower in Faisalabad – the control district – as compared to Dir. This is somewhat surprising considering that Faisalabad was chosen as control district because it was thought to be more prosperous and offering relatively better employment opportunities.

The bottom part of Table 3.5 reports real per capita incomes by district and expenditure quintile. These figures show, the lead Dir had over Faisalabad in terms of real household incomes did not extend to real per capita incomes. In the first year of the survey for instance, the average per capita income in Faisalabad was Rs. 4464 while that in Dir was Rs. 3381. A similar pattern was found in other years. This result can be explained in terms of larger household sizes in Dir compared to Faisalabad (see Table 3.4 above). Note that district Attock had the lowest per capita incomes of all districts in all years.

Table 3.5: Real and Per Capita Income by Year, District and Expenditure Quintile [a]

	Expenditure Quintiles					
	I	II	III	IV	V	All
REAL INCOME						
YEAR 1986-87						
FAISALABAD	30088	27368	22718	27470	48470	32742
ATTOK	7844	16191	16255	20266	26546	21044
BADIN	21407	21978	36384	27294	22764	25105
DIR	42656	34459	34319	30160	43471	36168
ALL	25830	26225	297345	26036	35499	28669
YEAR 1988-89						
FAISALABAD	26577	24711	26445	24652	50942	32184
ATTOK	7863	12820	14693	14595	19997	16281
BADIN	26006	26804	49112	30053	27724	31159
DIR	41460	29815	28319	28400	41490	32686
ALL	28281	25876	31866	23583	33737	28669
PER CAPITA INCOME						
YEAR 1986-87						
FAISALABAD	2603	3234	3084	3731	7585	4464
ATTOK	845	1943	2137	2772	5359	3504
BADIN	2067	2703	4332	4329	6035	3170
DIR	2509	2641	2980	3403	5986	3381
ALL	2152	2745	3250	3463	6182	3560
YEAR 1986-89						
FAISALABAD	2022	2635	2839	3103	7553	4058
ATTOK	893	1406	1943	1964	4005	2663
BADIN	2373	3205	5320	5365	6124	3710
DIR	2266	2154	2433	3158	5102	2905
ALL	2250	2613	3300	3158	5461	3358

[a]Source: Table 4.13, IFPRI document.

Sources of income

Non-farm incomes were the largest component in incomes of rural households. This was true for all expenditure quintiles and years. For example, the households in the lowest quartile earned 38.16% of their 1988 income in non-farm activities. The corresponding figure for the highest quintile was 32.65%. In Faisalabad district, which has more textile related units, 75% of income in the lowest quintile came from non-farm sources. Crop sector is the second largest contributor to rural incomes. This is followed by livestock sector. In some districts, such as Attock and Dir, transfer incomes were also significant component of rural incomes. Surprisingly, income from farm wages remained small as a percentage of total income in all years and all districts. Farm wages accounted for around 3% of rural household incomes for the lowest quintile and less than one percent for the highest quintile.

Food expenditures

Table 3.6 presents average per capita real food expenditures. The level of these expenditures is around Rupees 1800 for both the first and the last years. Attock had the highest per capita real expenditures in both years followed by Faisalabad. Per Capita food expenditures rose with expenditure quintile. In 1988, the lowest quintile households spent Rupees 1266, in real per capita terms, on food while the households in the highest quintile spent Rupees 2554. Other years exhibited similar increase in food expenditure per head with expenditure quintile.

Table 3.6: Real Per Capita Household Food Expenditures, by Expenditure Quintile and District [a]

	Expenditure quintiles					
	I	II	III	IV	V	All
YEAR 1986-87						
FAISALABAD	1256	1616	1841	2215	2857	2108
ATTOK	1605	1717	2094	2302	3581	2681
BADIN	1073	1347	1406	1611	2128	1333
DIR	1246	1405	1646	1890	2368	1692
ALL	1149	1461	1686	2055	2968	1865
YEAR 1988-89						
FAISALABAD	1204	1464	1641	1852	2719	1906
ATTOK	1177	1333	1695	1880	1499	2008
BADIN	1318	1630	1803	2187	2460	1656
DIR	1146	1467	1714	2017	2489	1754
ALL	1266	1518	1728	1959	2554	1806

[a]Source: Table 4.15, IFPRI document.

Construction of analytical data sets

In this section I will describe the construction of variables needed for estimating the demand model in chapter 2. These variables are expenditures on items consumed, their prices and variables representing household characteristics, e.g. household size, and age of the household head.

Aggregation over commodities

Every applied demand study must deal with the issue of aggregation across commodities. The household surveys, generally, collect information on a large number of items. Econometric considerations do not permit analysis at that level of dissaggregation. It is common practice to combine items into broad groups and conduct analysis in terms of these aggregates. In this study the 40 items that were covered in the survey were aggregated into 8 broad groups: wheat, rice, meats, dairy products, oils and fats, sugar, vegetables, and other foods. The last category contained all food items not included in any of the other food categories.

Non-food items and leisure were excluded from the demand system. Theoretically speaking, such exclusions are justifiable only if foods are weakly separable from non-foods and leisure (See Deaton and Muellbauer [16] pp: 119-126). If weak separability of foods holds then it can be shown that a subutility function exists whose arguments are only the quantities of foods consumed. Given prices of food items, the subutility function can be maximized subject to expenditure on foods. The resulting demand functions have all the properties of the Marshallian demand functions.

The assumption of weak separability needs to be empirically tested before it can be used to limit the demand system to, just, the food items. Such testing, however,

was not possible with the available data. One difficulty was that prices for some non-food items (e.g. certain kinds of fuels) were not available. Similar difficulties also lay in the way of determining the opportunity cost of leisure for self employed farm workers. Therefore, week separability was imposed without empirical testing. This is a limitation of the present study. The rest of this section is concerned with the construction of appropriate prices indices for food groups and estimating household annual expenditures from information contained in the survey questionnaires.

Prices

During the three year period(1986-88) covered in this study, households were interviewed eleven times. In the first year, five interviews were conducted. In each of the subsequent years households were interviewed three times. Each interview is referred to as a 'round'. The survey records the amount payed per unit by the household for each item purchased in each of the rounds. These unit values, however, cannot be considered as prices because they reflect quality choices and, therefore, are endogenous to the household (see Deaton and Grimard [17]). Demand systems are derived from dual formulations of the consumer's utility maximization problem in which prices are exogenous. Therefore, the use of unit values in place of prices in demand systems estimation is, strictly speaking, not justified.

One way to overcome this problem is to use average of the unit values as price. This is quite appropriate because individual household's behavior has relatively small influence on the average price. The next question is, whether averages should be computed at the level of village, the district or the whole country. A related question is whether prices used in the analysis should pertain to the round or they should be

average item prices in the year. The latter question cannot be satisfactorily answered without deciding what is the most appropriate time span for analyzing consumption expenditures. I will defer issues related to expenditures to the next section and only note that prices used were average annual prices. This rest of this section will focus on spatial aspects of prices.

If exogeniety of prices were to be, relentlessly, pursued then the obvious choice is to take averages at the national level. But the survey covered only three years. Three price data points for each item which would not permit any kind of econometric estimation. Even district level averages do not allow more than 12 data points per item (there are 4 districts). This suggests going down to the village level. There are 45 villages which give 135 ($= 45 \times 3$) data points.

Sufficient degrees of freedom are not the sole justification for averaging unit values at the village level — there is an even more compelling economic rationale. In developing countries like Pakistan, road infrastructure is not well developed. Some remote areas — for example, district *Dir* in the *North-West Frontier* province — may be difficult to reach. Even within the same district, infrastructure is unevenly developed. Not all villages in all districts have farm to market roads. Depending on the distance from the districts major market and whether or not there are farm to market roads, transportation costs can vary a lot. This may lead to fragmentation of markets and considerable price variation among villages within the district and across districts. This spatial variation in prices, along with their variation across years can be used to identify parameters of the demand system. Not doing so would be a waste of information.

Lastly, there is the definitional rationale. The prices that the households faces

are the prices prevailing in the market where they operate. Inasmuch as the rural households make a large proportion of their purchases in the village markets, using prices from any other market would be logically inconsistent.

The mechanics of constructing price indices Constructing price indices involved two steps. First, prices of individual items were constructed from reported unit values and then the prices of items within a group were aggregated into a single group price index. These computations are described below.

To construct prices of individual food items, the unit values were, first, cleansed of recording and data entry errors. For every item, annual average unit values and their standard deviation were computed. All unit values more than 2 standard deviations away from their respective means were replaced with missing values. The household records assigned a missing price were excluded from all subsequent price calculations. However, other information from these records, such as household expenditures, continued to be used.

The next step was to compute average annual unit values, for each item and for each household. These annual unit values were then averaged over all households in the village to get average village price. This was free of the effects of individual choices and could be regarded as exogenous to the household.

Inspection of this price series revealed that prices for some items were missing for some villages. The missing values could have been generated by the earlier screening to eliminate outliers, or, they could represent a genuine corner solution. The latter situation would arise if no household in the village consumed the item in question. The following rule was adopted to deal with missing prices. If an item had a missing

price in a village, its price was taken to be the average district price for that item in the year in question. If the item was not reported consumed in any of the villages in the district, then its average provincial price was taken as the village price. Finally, if the item as not consumed in the entire province, then its national average price was considered its village price. This last step was rarely needed; for most items average prices were defined at the district level.

After assigning various items to appropriate food group, and constructing village prices for each item, the next step was to aggregate item prices into a single group price index for the village. The village price for the group was defined as the Stone's price index of individual item prices. The the logrithim of Stone's price index for any group G is:

$$log\ P_G = \sum_i w_{iG}\ log\ p_{iG}$$

where p_{iG} is the price of i^{th} item in the group G, and w_{iG} is its share in the aggregate village expenditure on the group.

If annual household expenditures on each food item are known, construction of Stone's index is straight forward. However, the way most surveys collect information, estimating the annual expenditures incurred by the household on each item consumed is not a trivial matter. It, inevitably, involves some degree of approximation. The remainder of this section is devoted to these and other issues related to estimating household's annual expenditures on various items.

Household expenditures

The household survey was based on weekly recall of item expenditures. This was done to ensure reliability of recall. In each interview(round) the household reported

expenditure on market purchase of each item and the quantity of that item used from own stocks, during the previous week. In addition, the household also reported the frequency of market purchases for each item purchased.

Weekly expenditure on an item can be defined as the sum of the market expenditure on it and the value of consumption of that item from own stocks, both, during the span of a week. The weekly expenditure could then be multiplied by the number of weeks in the year to get an estimate of yearly item expenditure. This approach, however, suffers from what is commonly known as the *infrequency of purchase problem.* The household purchases of a certain item may be infrequent so that no amount of it is purchased during the week prior to interview. In this situation the reported purchase of that item would be zero although positive quantities of it were consumed during the week. To overcome the infrequency of purchase problem, information regarding the frequency of purchases was used. The method employed for calculating yearly expenditure using the frequency of purchase information is explained below.

As noted earlier, market purchases can be made with varying frequencies. These frequencies were recorded along with the amount spent on market purchase of each item. The frequencies varied from daily, weekly, biweekly, monthly through annually. The amount purchased of an item can be thought of as having been consumed during the period indicated by the frequency code. This assumption was used to arrive at weekly consumption of purchased items. For example, if the reported expenditure on an item was Rupees 100, and the frequency of purchase was 4 (ie monthly) then the household was assumed to have spent Rupees 100 on that item during the month. In other words, the weekly expenditure on market purchase of that item was Rupees 25. This procedure was used to convert all expenditures on purchased items into weekly

basis. These were added to the value of weekly consumption from own stocks to get item expenditure in the interview week. Because consumption from own stocks was already reported on a weekly basis, additional manipulation was not needed.

The next step was to extrapolate the weekly item expenditure figures, for the various weeks in the year in which interviews were conducted, to the whole year. This was done using additional information regarding interview dates. The survey reported dates when each household was interviewed. Using these dates, all three years was divided into sub-periods corresponding to interval between adjacent interviews. Because the number of interviews conducted in a year differed across years, so did the number of sub-periods. The first year had four sub-periods while each of the remaining years had three. For each household, the length of each sub-period (measured in weeks) was recorded in a variable called WEEKSGAP. The item expenditures during the interview week were multiplied by WEEKSGAP (length of sub-period) to get expenditure on that item during the sub-period. Next the estimated expenditures during all sub-periods in the year were added-up by item. Similarly, using the WEEKSGAP variable, the lengths of all sub-periods within the year were also added-up to estimate the time elapsed between the first and the last interview of the household in question, during that year. For each item, the sum of sub-period expenditures during the year were divided by the length of time elapsed between the first and the last interview in the year to get "average weekly consumption rate" for the item. This rate was multiplied by 52.14 – the number of weeks in a year – to get annual household expenditure for that item.

CHAPTER 4. ESTIMATION

This chapter is concerned with estimating the price conditional demand system (2.14) developed in chapter 2. To highlight the issues involved in the estimation of this system, it is convenient to start with the single equation model. Consider the general linear regression model corresponding to the i^{th} equation of the demand system

$$y_i = X_i\beta_i + e_i \tag{4.1}$$

where y_i is a $N \times 1$ vector of dependent variables, X_i a $N \times K_i$ matrix of explanatory variables, β_i a $K \times 1$ vector of parameters and e_i is a vector of disturbance terms. Assume the errors are distributed with $E(e_i) = 0$ and the variance-covariance matrix $E(e_i e_i') = \Phi$. The strategy for estimating this model depends on the structure of error processes, as reflected in the variance-covariance matrix Φ. If the errors are independently and identically distributed with a constant variance then

$$E(e_{ih}e_{is}) = 0 \qquad\qquad h \neq s, \tag{4.2}$$

which implies $\Phi = \sigma^2 I$. Under these assumptions the ordinary least squares(OLS) estimator is unbiased and has minimum variance in the class of estimators that are linear functions of y_i. However, if $E(u_{ih}u_{is}) \neq 0$, the off-diagonal elements in Φ are non-zero and efficiency is gained by generalizes least squares (GLS) procedure that

involves transforming the model using information on the structure of the variance-covariance matrix Φ(or an estimate thereof in a two step procedure if the true Φ is unknown).

Now consider a system of M equations of the same structure as equation(4.1). Even when error terms in every equation satisfy the conditions required for single equation estimation by OLS, efficiency may be gained by using GLS on the whole system, if there is an across equation association of the errors. To see this rewrite the system of M equations as

$$\begin{bmatrix} y_1 \\ y_2 \\ \vdots \\ y_M \end{bmatrix} = \begin{bmatrix} X_1 & & & \\ & X_2 & & \\ & & \ddots & \\ & & & X_M \end{bmatrix} \begin{bmatrix} \beta_1 \\ \beta_2 \\ \vdots \\ \beta_M \end{bmatrix} + \begin{bmatrix} e_1 \\ e_2 \\ \vdots \\ e_M \end{bmatrix} \tag{4.3}$$

where each of the y_i, X_i, β_i and e_i corresponds to the i^{th} equation of the demand system. Alternatively,

$$y = X\beta + e. \tag{4.4}$$

The dimensions of Y, X, β and e are $(MN \times 1)$, $(MN \times K)$ $(K \times 1)$,and $(MN \times 1)$, respectively, with $K = MK_i$. Written in this form (4.3) can be viewed as a general linear model just like (4.1). The errors in this model are distributed with $E(e) = 0$ and variance-covariance matrix $\tilde{\Omega}$. If the elements of the disturbances are contemporaneously correlated with variance $\sigma_{ij}, i, j = 1, 2, ...m$, then the matrix $\tilde{\Omega}$ has the following the following structure

$$\tilde{\Omega} = \tilde{\Sigma} \otimes I_N. \tag{4.5}$$

where

$$\tilde{\Sigma} = \begin{bmatrix} \sigma_{11} & \sigma_{12} & \cdots & \sigma_{1M} \\ \sigma_{12} & \sigma_{2} & \cdots & \sigma_{2M} \\ \vdots & & \ddots & \\ \sigma_{M1} & & & \sigma_{MM} \end{bmatrix}. \tag{4.6}$$

The off-diagonal elements in $\tilde{\Sigma}$ are *contemporaneous correlations* between errors across equations. Note that contemporaneous correlation can be quite strong even when (4.2) holds, making σ_{ij} nonzero. This is specially true for sets of equations such as a demand systems, assumed to be derived from optimizing behavior of a single household. These equations are more likely to be related through their disturbance terms.

The model (4.4) is called the *Seemingly Unrelated Regression* (SUR) model. The non-zero off-diagonal elements in $\tilde{\Sigma}$ means that the variance-covariance matrix $\tilde{\Omega}$ is not diagonal. Thus, even when OLS estimators are efficient on an equation by equation basis, GLS applied to the whole system provides better estimates by taking into account contemporaneous correlation between errors of different equations. In other words, the efficiency gain comes from considering a wider class of estimators – those that are linear function of y rather than y_i. Because the true $\tilde{\Omega}$ is not known, it is replaced by its consistent estimate constructed from OLS residuals, yielding asymptotically efficient estimators (see Zellner [45]). Numerical results suggest that asymptotic benefits over OLS are realized for relatively small samples ([28]).

Economic theory imposes certain restrictions on demand systems which require adaptation of the SUR estimation procedure. Because share equations must add-up to 1, $\sum e_i = 0$ implying that $\tilde{\Omega}$ is singular (see Pollak and Wales [40] p. 130). To

overcome this difficulty, one equation is dropped from the system. The coefficients of the dropped equation are recovered using the adding-up restriction. Theoretically, it makes no difference which equation is dropped to overcome the singularity problem. Zellner suggested iterating the estimation procedure until the estimates converge, if the covariance matrix must be estimated.

A special feature of the SUR procedure is that if there are no cross equation restrictions and the explanatory variables are the same for all equations, the procedure offers no efficiency gain over estimating the stacked model (4.3) by OLS. However, If the cross equation restrictions suggested by economic theory (e.g. Symmetry) are used as maintained hypothesis, SUR procedure is more efficient than OLS.

If the errors in (4.4) follow a normal distribution then the estimators in Zellner's iterative procedure approach Maximum Likelihood estimates. Barten [4] showed that the Maximum Likelihood estimators are invariant to the choice of deleted equation, when the cross equation restrictions are imposed.

In this analysis the system of share equations was estimated using the NL procedure in the econometric software package SHAZAM release 6.2. The NL procedure uses Maximum Likelihood to estimate parameters. The share equation for "other foods" was dropped to avoid singularity. The adding-up restriction was used to recover the parameters of this equation. Also, following Moschini and Vissa [36], the real incomes and prices were divided by their sample means, before taking their logs as per the used functional form.

In the price conditional demand system of Chapter 2, expenditure shares of particular foods are functions of the logrithims of market prices, incomes and normal prices. For most policy analysis, economists are concerned with how *quantity* de-

manded changes with changes in prices and incomes. The estimated coefficients can be used to compute demand elasticities that express these relationships in quantity terms. The Marshallian and Hicksian elasticities can be computed using the following formulas

$$\epsilon_{ii} = -1 + \frac{\gamma_{ii}}{\bar{w}_i} - \beta_i \tag{4.7}$$

$$\epsilon_{ij} = \frac{\gamma_{ij}}{\bar{w}_i} - \beta_i(\frac{\bar{w}_j}{\bar{w}_i}) \tag{4.8}$$

$$\delta_{ii} = -1 + \frac{\gamma_{ii}}{\bar{w}_i} + \bar{w}_i \tag{4.9}$$

$$\delta_{ij} = \frac{\gamma_{ii}}{\bar{w}_i} + \bar{w}_j. \tag{4.10}$$

where ϵ_{ij} is the Marshallian elasticity of commodity i with respect to the market price of commodity j and δ_{ij} is similarly defined Hicksian elasticity; $\bar{w}_j$ is the mean budget share of commodity j. The expenditure elasticity for commodity i is given by

$$\eta_i = 1 + \frac{\beta_i}{\bar{w}_i}. \tag{4.11}$$

An important objective of this analysis was to test the *Habit Hypothesis* (Chapter 2) relating consumption habits to long term prices. The share equations of the prices conditional demand system depend on normal prices in addition to market prices and incomes. The Price Related Preference Shift(PRPS) elasticities (preference shift elasticities, for short) give the percentage change in quantity demanded of a food item due to one percent change in normal price. Like their market price counterparts, preference shift elasticities can also be derived from the estimated coefficients as

$$\epsilon^N_{ii} = -1 + \frac{\gamma^N_{ii}}{\bar{w}_i} - \beta_i \tag{4.12}$$

where ϵ^N_{ii} is the own PRPS elasticity of commodity i.

Limitations of the estimation procedure

This analysis is limited in its stochastic specification because it considers, only, a relatively simple error structure, with errors from different equations of the demand system are contemporaneously correlated. This is not completely realistic because household specific effects related to the demographic profile, education and ethnic/religious etc., background also affect consumption. Given panel data such as the one used for this analysis, the time invariant, household specific effects can also be modeled. For example, the individual $h's$ expenditure share on any one commodity can be written as

$$y_h = X_h\beta + u_h \mathrm{j}_T + e_h \qquad h = 1, \cdots, N \qquad (4.13)$$

where y_h is a $T \times 1$ vector of dependent variables, X_h is a $T \times k$ matrix of explanatory variables, e_h is a $T \times 1$ disturbance vector , j_T is a $T \times 1$ vector of ones. The term $u_h \mathrm{j}_T$ represents the time invariant household specific random effect. The model such as 4.13 is also called the *error components model.* For a single individual, it can be shown that the variance-covariance matrix can be written as (see Judge *et al.* [28], pp 488-494):

$$\begin{aligned} V &= E[(u_h \mathrm{j}_T + \mathrm{e}_h)(u_h \mathrm{j}_T + \mathrm{e}_h)'] \\ &= \sigma_u^2 \mathrm{j}_T \mathrm{j}_{T'} + \sigma_e^2 I_T \end{aligned}$$

or

$$V = \begin{bmatrix} \sigma_u^2 + \sigma_e^2 & \sigma_u^2 & \cdots & \sigma_u^2 \\ \sigma_e^2 & \sigma_u^2 + \sigma_e^2 & \cdots & \sigma_u^2 \\ \vdots & & \ddots & \vdots \\ \sigma_u^2 & \sigma_u^2 & \cdots & \sigma_u^2 + \sigma_e^2 \end{bmatrix} .$$

Considering all N households the variance-covariance matrix can be written as:

$$\Phi = I_N \otimes V \ .$$

Another possible refinement is to recognize that, in addition to having two or more components, errors in different equations are related, as in the SUR model. These refinements make the model more difficult to estimate, but they are refinements of a statistical nature. Since the more simple specification produced good results, these refinements were left.

CHAPTER 5. RESULTS

Chapter 1 set out two objectives for this study. First, to obtain estimates of demand elasticities for important food items without imposing *ad hoc* restrictions on consumer preferences. Second, to test the *Habit Hypothesis*. This hypothesis states that rational households acquire tastes for foods that have been relatively cheap in the region over the long run. Many non-market government policies such as those aimed at improving rural infrastructure, bring about a realingnment in permanent prices. Therefore, an implication of the habit hypothesis is that these policies can have significant impact on food consumption patterns in the long run. Just how important this impact is in relation to the effect of short-lived changes in prices depends on the relative magnitudes of conventional elasticities of demand and PRPS elasticities. The theoretical framework capable of addressing these issues is the price conditional demand system developed in Chapter 2. This chapter presents the estimation results from the price conditional demand system.

The first section of this chapter presents market price and expenditure elasticities for eight food items for rural Pakistani households. In the next section, the PRPS elasticities are used for testing the *Habit Hypothesis*. This is followed in section three by a comparison of elasticity estimates from this study with those previously available for Pakistan and presumably in current use for policy analysis. The final section

discusses the sensitivity of the market price and expenditure elasticity estimates to changes in the definition of normal prices.

Market price and expenditure elasticities

In the price conditional demand system of Chapter 2, as in the Almost Ideal Demand System, the dependent variables are budget shares of items and independent variables are logs of prices and real expenditure. For ease of interpretation, parameter estimates from share equations are used to compute demand elasticities.[1]. Table 5.1 presents the the own price elasticities for the price conditional demand system applied to the Pakistani household data. All own price elasticities are negative and their standard errors are quite small, making all of them highly significant at conventional levels.[2] Most of the estimated own price elasticities are less than one. However, the own price elasticities for vegetables and "other foods" categories are greater than one.

The cross price elasticities (reported in Table 5.2) are generally small. But there are some prominent cross effects with reasonable magnitudes. For example, the largest cross effect in wheat equation is from the price of edible oils. The elasticity of wheat with respect to edible oil price is -0.32, indicating a complimentary relationship. This may, in part, be a reflection of the widely observed habit, in Pakistan,

[1]The parameter estimates and their associated t statistics are presented in Appendix Table A.1

[2]The standard errors reported in Table 5.1 are approximations obtained by assuming that the mean level of shares in equations (4.7) and (4.8) are non stochastic. If shares are assumed given, elasticities become simple linear combinations of parameters. The estimate of the variance of an elasticity can then be obtained, as a linear function of the variances and covariances of estimated parameters.

Table 5.1: Estimates of Own Price Elasticities: Rural Pakistan[a]

	PCDS (1)	Deaton and Grimard (2)	Alderman (3)
Wheat	-0.71 (0.16)	-0.51 (0.08)	-0.96
Rice	-0.56 (0.14)	-1.53 (0.12)	-1.93
Meats	-0.64 (0.14)	-0.61 (0.13)	-0.35
Dairy	-0.73 (0.08)	-0.89 (0.03)	-1.26
Oils and fats	-0.73 (0.09)	-1.59 (0.40)	-
Sugar	-0.74 (0.11)	+0.03 (0.40)	-
Vegitables	-1.07 (0.09)	-	-
Other foods	-1.43 (0.06)	-0.40 (0.08)	-1.19

[a]Alderman's elasticities have been converted from Compensated to uncompensated. Elasticities in Column (2) are from Deaton and Grimard [17], Table VI.

Table 5.2: Estimated Own and Cross Price Elasticities: PCDS for Rural Pakistan [a]

ITEM	Wheat	Rice	Meats	Dairy	Oils & fats	Sugar	Veg.	Other food
Wheat	-0.71	0.14	0.07	0.06	-0.32	0.16	0.17	-0.06
	(0.16)	(0.11)	(0.09)	(0.09)	(0.08)	(0.08)	(0.07)	(0.03)
Rice	0.15	-0.56	-0.29	-0.28	-0.07	-0.02	-0.17	0.46
	(0.14)	(0.14)	(0.01)	(0.09)	(0.09)	(0.08)	(0.08)	(0.03)
Meats	-0.05	-0.42	-0.64	-0.01	-0.25	-0.37	0.27	-0.15
	(0.14)	(0.11)	(0.14)	(0.10)	(0.10)	(0.07)	(0.09)	(0.04)
Dairy	-0.07	-0.22	0.02	-0.73	0.05	-0.14	-0.42	0.17
	(0.07)	(0.05)	(0.05)	(0.08)	(0.05)	(0.03)	(0.04)	(0.02)
Oils & fats	-0.46	-0.11	-0.16	-0.10	-0.73	-0.23	0.22	0.12
	(0.09)	(0.07)	(0.07)	(0.07)	(0.09)	(0.05)	(0.06)	(0.02)
Sugar	0.22	-0.02	-0.32	-0.19	-0.26	-0.74	0.49	0.04
	(0.12)	(0.09)	(0.08)	(0.07)	(0.07)	(0.11)	(0.07)	(0.02)
Vegitables	0.20	-0.19	0.37	-0.71	0.37	0.48	-1.07	-0.07
	(0.11)	(0.09)	(0.09)	(0.08)	(0.08)	(0.06)	(0.09)	(0.08)
Other foods	-0.11	0.29	-0.22	0.29	0.26	0.12	0.01	-1.43
	(0.02)	(0.02)	(0.02)	(0.03)	(0.02)	(0.01)	(0.05)	(0.06)

[a] Figures in the parenthesis are the estimated *standard errors* of elasticities

of consuming fried wheat bread for breakfast. Wheat also has a small positive cross elasticity with respect to the price of rice, the other main staple food in Pakistan, but it is not statistically significant. Hence, there is very little substitutability between the two main staples, indicating a stronger role of habits in the choice among staples. This point will be elaborated in more detail below when the estimated PRPS elasticities are discussed. Meats and rice are complements while meats and vegetables are substitutes. Similarly the price of other foods has a positive effect on rice demand, indicating substitutability; the price of dairy products has the opposite effect. Sugar and edible oils are compliments.

Although the signs and magnitudes of cross effects are generally consistent with the observed consumption patterns in Pakistan, there are a few anomalous cases. For example, the cross price elasticity of meat with respect to sugar price is negative and statistically significant, suggesting that meats and sugar are compliments — an unlikely relationship, atleast in the context of Pakistan. Similarly, the cross price elasticity of vegetables with respect to the price of dairy products is -0.71 which is almost as large as the own price elasticity of vegetables.

The expenditure elasticities are presented in Table 5.3. As expected, all expenditure elasticities are positive. For all food groups, the magnitudes of expenditure elasticities are in line with the *a priori* expectations. That is, the expenditure elasticities for both the staple foods, wheat and rice, are less than one. The expenditure elasticity of sugar is also less than one. It is commonly observed that budget shares of meats and dairy products rise as incomes increase. Accordingly, the expenditure elasticity for meats is 1.62 and that for dairy products is 1.34. Similarly, the expenditure elasticity for oils and fats is greater than one. The expenditure elasticity of

Table 5.3: Estimates of Expenditure Elasticities: PCDS for Rural Pakistan [a]

	PCDS	Deaton and Grimard	Alderman	Ahmad et al	Siddiqui
	(1)	(2)	(3)	(4)	(5)
Wheat	0.50	0.37	0.33	0.35	-
Rice	0.78	0.68	1.01	1.03	-
Meats	1.62	1.10	1.50	1.52	1.18
Dairy	1.34	1.05	1.32	1.08	0.49
Oils and fats	1.24	0.42	-	0.89	0.55
Sugar	0.77	0.86	-	1.00	-
Vegitables	0.70	-	-	1.32	0.36
Other foods	0.95	0.59	0.56	0.77	-

[a]Sources: Alderman [3]; Ahmad et al. [1]; Deaton and Grimard [17], Table A1, column (1); Siddiqui [42].

other foods is close to one, although, the plausibility of this result depends on the foods are included in this category [3] The expenditure elasticity for vegetables, which according to our estimate in 0.70, should also be interpreted keeping in mind the rather limited range of items included in this category.[4].

Having discussed the own price and the expenditure elasticities, separately, it is instructive to compare the two, pair-wise, for each food group. The expenditure elasticities for meats, dairy products, and edible oils are all greater than one. But their own price elasticities are less than one (-0.65, -0.73, and -0.73, respectively). In contrast, the expenditure elasticity for vegetables is less than one but the own price elasticity is greater than one (-1.43). Finally, for the two staple foods and sugar, both the expenditure and the corresponding own price elasticities are less than 1. Hence there is no consistent pattern of relationships between the expenditure and the own price elasticities.

This finding, on the relationship between expenditures and price elasticities, contrasts sharply with results from formulations based on the rather stronger assumption of additive preferences, such as the LES, that restrict the own price elasticities to be proportional to expenditure elasticities. It is well known, for example, that the proportionality between income and price elasticities drives the optimal tax structure towards uniformity (Deaton [17]) Therefore, an advantage of allowing for more flexible representation of consumer preferences is that it lets data, rather than *ad hoc* assumptions, guide the tax system reform.

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[3] All food items not included in the any of the seven specific food categories are included in "other foods" category.

[4] The survey collected price and expenditure information on only onions, potatoes and *Sag* (a green leafy vegetable, like spinach).

Testing the Habit Hypothesis

One objective of this study was to test the *Habit Hypothesis* presented in Chapter 1. According to this hypothesis, the taste differences observed among regions were induced by differences in long term relative prices. The implication of this hypothesis is that permanent changes in pricing policy or improvements in rural infrastructure will have long term effects on consumption, over and above the observed short run response to changes in market prices, and the two effects can be highly misleading to policy, if confounded.

In Chapter 2 a PCDS was developed that allowed empirical testing of the *Habit Hypothesis*. The important feature of this system was that the resulting share equations were functions of normal prices in addition to depending on market prices, income and demographic variables. The normal prices represented the long term regional price. The presence of these prices in the share equations reflected the parametric dependence of preferences on prices. During estimation the normal prices were supposed to pick up the part of variation in shares that was due to long term habits. If the habit hypothesis is correct then habits should be negatively related to normal prices. The testable from of this restriction is that all PRPS elasticities should be non-positive.

Table 5.4 presents the estimated own PRPS elasticities. All of these elasticities are negative. Therefore, we fail to reject the Habit Hypothesis. In other words, the available data support the idea that consumers prefer, more strongly, the foods that have been relatively cheap in the region over the long run. In short, habitual consumption patterns are responsible for the persistence in consumption observed in the data.

Table 5.4: Estimated Own PRPS Elasticities: PCDS for Rural Pakistan [a]

	PRPS Elasticity
Wheat	-1.37
Rice	-2.66
Meats	-1.77
Dairy	-1.00
Oils and fats	-0.52
Sugar	-1.57
Vegitables	-1.76
Other foods	-0.77

[a]Normal Prices are defined at the village level.

Note that all PRPS elasticities are large in absolute magnitudes, specially, when compared to own market price elasticities. For instance, wheat rice meats and vegetables all have own PRPS elasticities that are greater than one. The PRPS elasticity of rice, which is the largest in this group, is -2.66. Dairy products have own PRPS elasticity of 1. Only edible oils and "other food" out of the eight food groups considered have PRPS elasticities less than one. These estimates suggest that the long run effects on consumption are much stronger than the market price effects. Therefore, government policies, such as improvements in rural infrastructure, that change normal prices should have much larger long run effects than haphazard commodity market interventions.

Comparison of results with previous studies

In this section, the estimated elasticities from the PCDS are compared with estimates from previous studies. The comparison will be limited to only the two AIDS formulations (Deaton and Griamrd [17], and Alderman [3]). The estimates from the LES are not really comparable to the PCDS estimates because that system imposes more arbitrary and highly restrictive conditions on consumer preferences.

Table 5.1 presents the own price elasticities from the PCDS as well as from Deaton and Grimard, and Alderman's studies. The own price elasticities for meats, dairy products and wheat differ less than 30 percent from corresponding estimates of Deaton and Grimard. The own price elasticity of meats is very close to Deaton and Grimard's estimates and that for dairy products is differs only by around 20 percent. The own price elasticity for wheat lies between those estimated by Deaton and Grimard, and Alderman.

The really large difference in the magnitudes of own price elasticities is for rice. The estimate of this elasticity from the price conditional model was -0.56 compared to -1.53 from Deaton and Grimard's, and -1.93 from Alderman's studies. This large difference was mainly due to an apparently unfortunate choice on handling the fixed effects in both these studies. It was argued in Chapter 1 that the methodologies used in the cited studies were not able to completely remove the fixed effects that included regional habit components. As a result, the estimates were confounded, because some of the habit responses were picked up by market prices. That own price elasticity of rice was affected much more by this confounding than the elasticity for any other food has to do with rice being a staple food and habits playing a comparatively much stronger role in choice of staples than other foods. The observation made earlier that the cross price elasticity estimated from the price conditional model indicates virtually no substitution between rice and wheat, or between rice and any other commodity, supports this view.

An important contribution of these results is that they provide plausible estimates of price elasticities for sugar and edible oils, the two food commodities that had experienced the heaviest government intervention in the past. Until the mid-eighties, the extent of state control over the prices of sugar and edible oils was so great that there was virtually no price variation across regions. Therefore, Alderman, who used data from the 1979 Household Income and Expenditure Survey, dropped both of these items from the demand system. Deaton and Grimard tried to estimate price elasticities for sugar and edible oils using the 1984-85 Household Income and Expenditure Survey data. By this time, price controls had eased somewhat but sub-

stantial government intervention remained.[5] Therefore, econometric estimation from a single cross section of households was still a formidable task. It is not surprising, then, that Deaton and Grimard's estimate of own price elasticity for sugar was positive, although it was not statistically significant. Likewise, their estimated own price elasticity of edible oils was -1.53, which seems quite high. In contrast to these results, PCDS the elasticity estimates for both commodities were negative, well determined and of reasonable magnitudes. The own price elasticity for sugar was -0.74 and that for edible oils was -0.73. Note, the improvement in estimates comes both from the specification and from using a data set that combined increased spatial variation in prices that followed the 1986 liberalization with temporal variation.

Table 5.3 presents the expenditure elasticities from this and previous demand studies in Pakistan. For rice, sugar and vegetables, the PCDS estimates are within range of estimates from earlier literature. The expenditure elasticities for meats, dairy products and, oils and fats from our model are larger, especially, compared to Deaton and Grimard. But this may be the result of the selection criteria used in IFPRI's Pakistan Rural Household Survey that focused the sample on the poorest districts.

In comparing results with previous literature, it is not customary to compare cross price elasticities. This may be because cross price elasticity estimates are more volatile and often have signs that fail to confirm observed consumption relations (substitutability vs complementarity). But if a model explains data better than others, the improvement should also be reflected in cross price elasticities. Comparing

[5]For example, the *Zoning System* was still in effect that prohibited sales of sugarcane by farmers to mills outside the *Mill Zone*. This system remained in effect until 1986.

our cross price elasticities with Deaton and Grimard's (not reported) we find that, with one exception, all of their significant cross effects are concentrated in the rice equation, whereas in our model, they are well spread out over the entire elasticity matrix. Although there are no hard and fast rules to suggest what the configuration of cross effects should be, their concentration in one equation is rather peculiar. The skepticism is reinforced when it is recalled that rice is the one item most affected by inappropriate treatment of habit related fixed effects in the Deaton and Grimard study. Therefore, the improvement in estimates that results from better treatment of habits in the PCDS appears to extend to the cross effects as well.

Sensitivity of results to alternative definitions of normal prices

In the PCDS results discussed above, the normal prices were defined at the village level. This decision was based on the observed *within* district variation in prices. Except meats and "other foods", village mean prices for all the remaining items were significantly different from each other in at least one district. Given this pattern of spatial variation in prices, the normal prices are, ideally, defined at the village level. However, to see how an alternative definition of normal prices might affect elasticity estimates, the PCDS was re-estimated using normal prices defined at the district level. The results of this exercise are presented in Table 5.5. The own price elasticities from the alternative model (with normal prices defined at the district level) are presented in Column (1). To make comparison easier, corresponding estimates from the original model(with village level normal prices) are reproduced in Column (3). Similarly, columns (2) and (4) contain expenditure elasticity estimates from the alternative and original models, respectively.

Table 5.5: Sensitivity of Estimeted Market Price and Expenditure Elasticities to Alternative Definitions of Normal Price: PCDS for Rural Pakistan [a]

	Alternative Model		Original Model	
	Own Price (1)	Expenditure (2)	Own Price (3)	Expenditure (4)
Wheat	-0.58	0.50	-0.71	0.50
Rice	-0.16	0.76	-0.56	0.78
Meats	-0.63	1.62	-0.64	1.62
Dairy	-0.72	1.32	-0.73	1.34
Oils and fats	-0.60	1.27	-0.73	1.24
Sugar	-0.84	0.78	-0.74	0.77
Vegitables	-1.05	0.65	-1.07	0.70
Other foods	-1.40	0.95	-1.43	0.95

[a] In the *original Model*, normal prices were defined at the village level. In the *alternative Model* they were defined at the district level. Columns (4) and (5) that contain own price and expenditure elasticities, respectively, corrosponding to the original model are reproduced from Table 5.1.

Comparing estimates from the two models, an interesting pattern of similarities and differences emerges. For four out of the eight items, own price elasticity estimates from both models were close with virtually identical elasticities for animal products(meats and dairy products). The largest differences in estimated own price elasticities were observed for cereals. In particular, the own price elasticity for rice changed, dramatically, from -0.56 in the original model to -0.16 in the alternative model where the normal prices were defined at the district level.

These findings are hardly surprising. Livestock and poultry can be raised in almost any region without regard to soil type and availability of water. Thus, the availability of animal products is more or less the same, especially, within the same district, leading to greater homogeneity in habits of consuming these products. This view is also supported by results from the t tests reported earlier (see Table 5.6) that fail to reject the null hypothesis of no significant difference between mean village prices for meats within district, for all districts.[6] In other words, the the district level normal prices for animal products are reasonably good approximations of village level normal prices, therefore the estimates do not change dramatically.

In sharp contrast to animal products, the regional availability of a particular cereal is heavily dependent on local cropping patterns that are determined by such factors as availability of irrigation and type of soil etc. Because rice needs more specialized growing conditions (including a more abundant water supply) than other cereals, its prices exhibit greater variation even within districts. Consequently, change in definition of normal prices significantly alters the rice elasticity estimates. Finally,

[6]For dairy products, the mean village prices were significantly different within district Badin. But this may be a result of inclusion of powdered and formula milk in this category. These types of milk are mostly imported.

Table 5.6: Estimated t-ratios for the Null Hypothesis: No Difference Between Village Price Means Within District [a] (Rural Pakistan)

	Wheat	Rice	Meats	Dairy	Oils & fats	Sugar	Veg.	Other food
Faisalabad	0.63	2.54	1.91	1.61	4.42	2.08	0.47	0.23
Attock	0.92	1.84	1.49	1.34	3.94	0.43	0.55	0.26
Badin	2.41	1.78	1.00	2.09	3.31	2.20	3.24	0.98
Dir	1.12	1.92	0.62	1.58	3.33	2.57	0.86	0.21

[a]Under the Null Hypothesis the *test statistic* is $t = \frac{\bar{X}_H - \bar{X}_L}{\sqrt{2(S.E)^2}}$, where $\bar{X}_H$ and $\bar{X}_L$ are the highest and the lowest village means in the district, and $S.E$ denotes the standard error of village means.

note that expenditure elasticity estimates from both the models were very close for seven out of eight items.

To conclude, elasticity estimates are sensitive to definition of normal prices, especially, for cereals. In most developing countries, cereal markets are heavily regulated by the governments because their prices affect real wages and general welfare of low income households the most. Therefore, appropriate definitions of normal prices are absolutely crucial if the estimated elasticities are to be used for effective and precise policy analysis.

CHAPTER 6. POLICY ANALYSIS

The conventional demand systems are limited to providing estimates of market price and income elasticities. While these estimates are useful in assessing the short run effects of pricing policies, they do not shed much light on the long term consequences of these policies. Moreover, the conventional model provides no help in tracing out the impact on consumption of non-market policies such as infrastructure improvements. Many long term effects in consumption arise from habit formation. By linking habits to normal prices, the PCDS provides a way of analyzing long run consequences of policies that change these prices.

One determinant of normal prices is infrastructure. If infrastructure is inadequately developed, market prices vary considerably from region to region. In addition, these price differentials have a tendency to persist over time. The evidence presented in the previous chapter suggests that persistent relative price differences are the cause of observed spatial hetrogeniety of consumption patterns. Investments in infrastructure changes normal prices by permanently bringing down transportation costs. Given sufficient time, consumption habits also change. The PCDS, therefore, provides a way of assessing the long term consequences of investments in rural infrastructure.

Two infrastructure scenarios are considered in this chapter. The first scenario

examines the short run consequences of infrastructure improvements and assumes that only the market prices change while the normal prices remain fixed at their observed levels. The second scenario allows habits to adopt to price changes and examines the long term consequences of infrastructure improvements.

The normal prices can be influenced by several factors besides infrastructure. In fact, any permanent change in market prices is eventually reflected in normal prices. Trade liberalization is another example of policies that can influence normal prices. Most conventional demand system models can trace out the the short run consequences of liberalization. But most often, successful liberalization result in a permanent realingnment of relative prices. The PCDS is a useful tool for analyzing the long terms effect of such reforms on consumption patterns.

This paper considers three liberalization scenarios. The first scenario focuses on the period immediately following liberalization and simulates the short run effects. The assumption here is that normal prices do not change in the short run. So liberalization affects consumption only through changes in market prices.

The second scenario takes the long run view that liberalization changes normal prices and therefore habits. The estimates of total nominal protection rates are used to determine the the direction and magnitudes of changes in domestic prices. Note that total nominal protection rate includes effects of both the direct government intervention and macro economic distortions.

The third scenario deals with the combined effects of liberalization and infrastructure improvements. On the surface, the two policies seem to be unrelated and either one could be pursued without the other. But they do have something in common – the set of their beneficiaries. These policies generally benefit rural populations

and the probability of their adoption depends on the strength of farmers lobby.

It is a common observation that farm lobbies are weak in the early stages of development. However, after an initial phase, these lobbies begin to gain strength and demand elimination of macro economic distortions that discriminate against agriculture, and improvements in rural infrastructure. This is perhaps one reason why liberalization and infrastructure investments take place somewhat contemporaneously. In Pakistan the liberalization that started in the mid 1980's was accompanied by plans to invest in rural infrastructure. It is, therefore, important to look at the combined effects of liberalization and infrastructure improvement. This is taken up in the third section.

The final section of this chapter examines a link between age and habit formation. An indirect test is conducted to test the hypothesis that older people have stronger habits. Interest in this hypothesis stems from issues related to inter-generational distribution of tax burden. If older people were to have strong habits, they would bear greater burden of commodity taxes. The results of the test, however, fail to confirm the existence of such a link between age and habits. The section concludes by pointing out possible improvements in the testing procedure and argues that further testing should be done before drawing final conclusions.

Improvements in rural infrastructure

This section deals with the impact of improvements in rural infrastructure in both the short run and the long run. The short run scenario considered the immediate response of consumption to a realignment of market prices brought about by infrastructure improvements. It is assumed that the time horizon is so short that

price changes are unable to, significantly, alter habits. In other words, the infrastructure improvements cause market prices to change but the normal prices remain at the observed levels. The long run scenario, by contrast, assumes that the price changes caused by infrastructure improvement persist for so long that normal prices are altered, thereby, inducing new habits.

Short run effects of infrastructure improvement:

The immediate effect of improvements in infrastructure is to reduce transportation costs and move prices in regional markets closer to the national average price. The infrastructure improvement was simulated by letting the market prices in all regions equal the national average prices [1]. Table 6.1 presents the short run impact of infrastructure improvements. The most striking feature of the short run impacts of infrastructure shock is the remarkable constancy of simulated regional expenditure shares.

Historically, wheat has been the staple food in all districts except Badin where it is replaced by rice. This is reflected in a 4 percent expenditure share of wheat in Badin, whereas, households in other districts spent 17-19 percent of their total food budget on it. Similarly, the observed average share of rice in households' total expenditure on food was 27 percent in Badin but less than 5 percent in all other districts. These consumption patterns did not change very much in the short run following the simulated infrastructure improvement. Even after the infrastructure shock, Badin households spent 27 percent of their food expenditures on rice while

[1] Note that the dependent variables in the share equations were the logs of price levels that had already been normalized by sample means. The value of this variable, evaluated at the national average price is zero [because log(1)=0]

Table 6.1: Simulated Impacts of Infrastructure Improvement On Food Expenditure Shares: Various scenarios

		Observed	Simulated	
		District Average	Short Run	Long Run
		——— Shares ———		
Wheat				
	Faisalabad	0.17	0.19	0.14
	Attock	0.19	0.20	0.14
	Badin	0.04	0.04	0.15
	Dir	0.18	0.16	0.14
Rice				
	Faisalabad	0.03	0.03	0.11
	Attock	0.03	0.02	0.10
	Badin	0.27	0.27	0.11
	Dir	0.05	0.09	0.11
Meats				
	Faisalabad	0.05	0.08	0.09
	Attock	0.08	0.09	0.10
	Badin	0.11	0.08	0.09
	Dir	0.12	0.12	0.10
Dairy				
	Faisalabad	0.22	0.16	0.19
	Attock	0.18	0.19	0.19
	Badin	0.16	0.20	0.18
	Dir	0.20	0.20	0.19

Table 6.1 (Continued)

		Observed	Simulated	
		District Average	Short Run	Long Run
		——— Shares ———		
Oils & Fats				
	Faisalabad	0.17	0.15	0.13
	Attock	0.13	0.14	0.13
	Badin	0.14	0.14	0.13
	Dir	0.07	0.10	0.13
Sugar				
	Faisalabad	0.09	0.12	0.10
	Attock	0.09	0.10	0.10
	Badin	0.09	0.07	0.10
	Dir	0.09	0.10	0.09
Vegetables				
	Faisalabad	0.12	0.11	0.09
	Attock	0.11	0.11	0.09
	Badin	0.06	0.03	0.10
	Dir	0.10	0.11	0.09
Other Foods				
	Faisalabad	0.16	0.16	0.15
	Attock	0.21	0.15	0.15
	Badin	0.12	0.17	0.15
	Dir	0.19	0.11	0.15

their wheat expenditure were low, around 4 percent.

In other districts where the staple food was wheat, the assumed changes in market prices associated with the hypothetical infrastructure improvement did not lead to staple switching. In these districts, the shares of wheat in household expenditures remained within the range observed in the sample. The rice expenditure shares also remained low except in district Dir where it increased from its observed average level of 5 percent to almost 10 percent. But even in Dir wheat continued to enjoy the status of staple food commanding 18 percent of total household food expenditure.

The non-cereal foods showed more short-run responsiveness to infrastructure improvements. The general pattern was that simulated shares declined in districts where observed shares were high and increased in districts where the observed shares were low. Thus the meat share increased 3 percentage points in Faisalabad and declined 3 percentage points in Badin; Dairy products share fell from 22 percent to 16 percent in Faisalabad and rose from 16 percent to 20 percent in Badin; the share of Oils and fats declined from 17 percent in Faisalabad to 15 percent and increased in Dir from 7 percent to 10 percent; The share of "other foods" declined from 21 percent in Attock to 15 percent but rose in Badin from 12 percent to 17 percent. The behavior of sugar shares was different. There was virtually no dispersion in the observed sugar shares and households in all districts spent around 9 percent of total food expenditure on it. After the simulated infrastructure improvement, however, sugar shares ranged from 7 percent in Badin to 12 percent in Faisalabad.

The results of this simulation suggest that in the period immediately after infrastructure improvement, household's consumption continues to follow historical patterns observed in their region. This result is obtained, largely, because habits do not

change in the short run. Among the various food groups, cereals shares were least responsive to simulated infrastructure changes because their consumption is, relatively, more habit-determined. However, the Habit Hypothesis suggests that given sufficient time, the changed patterns of relative prices would start inducing new habits. The combined effects of market price changes and the newly acquired habits may be substantial, especially for cereals. The next scenario considers this long run effect on household consumption patterns.

Long run effects infrastructure improvements

In the PCDS, the coefficients of normal prices reflect consumption habits. Normal prices are long term prices specific to the region. Improvements in infrastructure cause systematic changes in market prices. Because of the irreversibility of such investments, the new patterns of relative prices persist. Table 6.1 presents the simulated long term effects of infrastructure improvements on household expenditure shares in various regions. In sharp contrast to the short run scenario where the cereals consumption followed historical patterns, the shares of wheat and rice change dramatically in the long run.

Recall that the observed average share of wheat in district Badin was 4 percent and it remained at that level in the short run after the infrastructure shock.In the long run scenario, however, the simulated wheat share jumped to 15 percent which is higher than the long run simulated share in any other district. For other regions where wheat was already being consumed as a staple food, the long run effects of infrastructure were not as large. The over all effect of this was to leave the average of simulated wheat shares close to its observed national average.

Although the arithmetic average of simulated wheat shares remained close to the observed average, it does not follow that infrastructure improvement would leave total wheat consumption in the country unchanged. The districts considered and the provinces they represent, have different population densities. The average simulated wheat share in all districts excluding Badin actually declined to 14 percent compared to its observed level of 18 percent [2]. Because the remaining three districts (and the provinces they represent) have a much greater demographic weight than Badin, the total consumption of wheat in the country may decline in the long run if infrastructural bottle-necks are removed.

For rice, the other major staple food, the simulated long run impacts of improvements in infrastructure are even more dramatic than wheat. There were substantial increases in food budgets allocated to rice in all regions except Badin. The simulated long run share of rice doubled in district Dir and more than tripled in Faisalabad and Attock districts. In Badin, the average budget share of rice dropped to 11 percent from the high observed level of 27 percent. However, decreased rice consumption in Badin (or in Sind, the province it represents) cannot out weigh increased consumption everywhere else in the country because the district has a smaller population weight than combined weight of the other three districts. Therefore, it seems safe to say that if the government invests heavily in infrastructure, Pakistan's rice consumption is likely to increase in the long run.

Although Pakistan currently exports rice, its domestic production is not very large. Rice exports are made possible because most Pakistanis consume wheat as their

[2]the decline in the simulated long run wheat shares occurred in each individual district, except, Badin.

staple food. Given the simulated increase in rice consumption following infrastructure improvements, the country may become a net importer of rice in the long run.

Besides staple foods, there are several other prominent long run effects of infrastructure improvements. But none of these effects match the magnitude of effects on the two main cereals. For example, the meats share doubled in Faisalabad compared to its observed level; The share of dairy products fell 3 percentage points in Faisalabad and increased by 2 percentage points in Badin; edible oils share dropped from the observed 17 percent level to 13 percent in Faisalabad but almost doubled in Dir.

An interesting pattern in the simulated shares from the long run infrastructure scenario is the large reduction in their dispersion. For sugar and rice, for example, the dispersion almost disappeared; it was greatly reduced for other food items. This is remarkable because regions are inhabited by different ethnic groups with differing consumption habits. The hetrogeniety of preferences is highlighted by the observed range of 24 percentage points for the share of rice in various regions. The almost complete convergence of the simulated budget shares in the long run suggests that most differences in regional consumption can be attributed to long term relative price differences and not to the ethnic backgrounds of households. Yet too often, economists declare ethnic differences as the final explanation of regional variation of habitual consumption patterns. The attention is then focused on using statistical artifacts, such as the fixed effects model, to purge the data of these *inexplainable* effects. Thus, ignoring the role of long term prices leads to premature "terminus" of the analysis, an unfortunate outcome that Stigler and Becker so convincingly argued against.

Table 6.2: Simulated Impacts of Liberalization On Food Expenditure Shares: Various scenarios [a]

		Liberalization Without Infrastructure		Liberalization With Infrastructure
	(1)	(2)	(3)	(4)
	Shares			
Wheat				
Faisalabad	0.17	0.16	0.18	0.14
Attock	0.19	0.18	0.20	0.14
Badin	0.04	0.03	0.04	0.15
Dir	0.18	0.15	0.17	0.14
Rice				
Faisalabad	0.03	0.04	0.05	0.13
Attock	0.03	0.03	0.04	0.12
Badin	0.27	0.29	0.29	0.13
Dir	0.05	0.08	0.09	0.12
Meats				
Faisalabad	0.05	0.08	0.06	0.08
Attock	0.08	0.08	0.07	0.08
Badin	0.11	0.11	0.10	0.08
Dir	0.12	0.13	0.11	0.09

[a]Observed shares are in column (1); columns (2) &(3) present simulated short-run and long-run shares when liberalization is *not* accompanied by infrastructure improvement; column (4) presents the combined long run impact of liberalization and infrastructure improvement.

Table 6.2 (Continued)

		Liberalization Without Infrastructure		Liberalization With Infrastructure
	(1)	(2)	(3)	(4)
	——— Shares ———			
Dairy				
Faisalabad	0.22	0.18	0.13	0.15
Attock	0.18	0.19	0.15	0.16
Badin	0.16	0.20	0.15	0.14
Dir	0.20	0.23	0.18	0.16
Oils & Fats				
Faisalabad	0.17	0.16	0.17	0.14
Attock	0.13	0.14	0.15	0.14
Badin	0.14	0.16	0.16	0.14
Dir	0.07	0.09	0.10	0.14
Sugar				
Faisalabad	0.09	0.08	0.10	0.1
Attock	0.09	0.08	0.10	0.1
Badin	0.09	0.08	0.11	0.1
Dir	0.09	0.07	0.10	0.1
Vegetables				
Faisalabad	0.12	0.11	0.12	0.09
Attock	0.11	0.10	0.11	0.09
Badin	0.06	0.04	0.05	0.09
Dir	0.10	0.08	0.09	0.08

Table 6.2 (Continued)

		Liberalization Without Infrastructure		Liberalization With Infrastructure
	(1)	(2)	(3)	(4)
	——— Shares ———			
Other Foods				
Faisalabad	0.16	0.19	0.19	0.19
Attock	0.21	0.19	0.19	0.19
Badin	0.12	0.09	0.09	0.09
Dir	0.19	0.17	0.17	0.17

Liberalization

This section presents the results of removing all direct and indirect distortions. The distortions include not only commodity market interventions but also trade and exchange rate policies. Three scenarios were considered. The first two scenarios assumed that liberalization was not accompanied by improvements in infrastructure. The focus was on comparing the short run and the long run impacts of liberalization. Note that the long run impacts stem from formation of new habits in response to changes in normal price that liberalization eventually brings about. The third scenario considered the long term impacts when liberalization was also accompanied by investments in infrastructure.

To simulate the impacts of policy changes so diverse as ending state monopoly over procurement of particular agricultural commodities, and eliminating exchange rate over valuation, some measure of the magnitude of resulting distortion is needed. One such measure can be the total nominal protection rates that take into account both the direct and the indirect government interventions. The nominal effects calculated by Dorosh *et al.* and presented in Table 1.5 were used in this study. Although the Table 1.5 presents nominal protection rates for several years, only those corresponding to the sub-period 1983-1987 were used. This period corresponds most closely to period covered by IFPRI's household survey (1986-1988). It was assumed that after liberalization, the prices of all food items would change by a factor of 1 plus the negative of their respective total nominal protection rate. For instance, the total nominal rate of protection for wheat was -0.33, implying a tax of 33 percent. The post liberalization price of wheat was assumed to be $p_W(1 + 0.33)$, where p_W is the domestic price of wheat observed before liberalization. For ease of reference, the

relevant part of Table 1.5 is being reproduced below.

Short run effects of liberalization

The short run can be thought of as the period immediately following liberalization. In this period, market prices change but there is no appreciable effect on normal prices. Therefore, habits do not change very much.

The short run impacts of liberalization are presented in column (2) of Table 6.2. The results are similar to those obtained for the short run infrastructure simulation. For example, the simulated shares of rice remained close to its observed levels that were high for district Badin but quite low for the other three districts. The same pattern was found for wheat. Its simulated share was high in districts where its observed share was also high (Faisalabad, Attock and Dir) and low in Badin where its observed share was low.

Long run effects of liberalization

If liberalization persists long enough, it causes changes in normal prices and hence in consumption habits. Column (3) in Table 6.2 presents the long run effects of such a change. Unlike the long run impacts of improvements in infrastructure, liberalization did not produce significant changes in simulated regional shares, even in the long run. As mentioned earlier, the one long run effect of the infrastructure shock was the reduction in dispersion of regional shares of cereals. This pattern was not repeated even in the long run following liberalization. The long run simulated share continued to followed historical patterns whereby the staple food was rice in Badin and wheat in other districts.

Liberalization with infrastructure improvement

The previous simulations considered the effects of improvements in infrastructure and liberalization separately. This section considers the effects of these policies simultaneously. Column (4) in Table 6.2 presents the long run effects of liberalization that is accompanied by improvements in infrastructure.

For the main staple foods, wheat and rice, the long run effects of the considered policy changes were large. In the rice-staple Badin district where observed wheat share was only 4 percent, the simulated share jumped to 15 percent. Similarly, the simulated share of rice in the three wheat-staple districts(Faisalabad, Attock and Dir) increased from its observed level of under 5 percent to 12 percent.

There were also changes in shares of other food items. For instance, the observed shares of dairy products ranged from 16 to 22 percent in various districts. But the simulated shares varied only from 14 to 16 percent. The simulated share of vegetables in Badin rose from the observed 6 percent to 9 percent. Note that this share had remained close to its observed level even in the long run scenario where liberalization was *not* accompanied by improvements in infrastructure.

As in the earlier simulation that considered, only, the long run effects of infrastructure improvements, there is a large reduction in dispersion of simulated shares. This, again, supports the Stigler-Becker thesis that prices and incomes are the fundamental determinants of behavior. If all differences in incomes and prices – including those in normal prices – are eliminated, differences in consumption patterns among regions, nearly, disappear.

Habit formation and age

The previous section used the PCDS to simulate impacts of infrastructure improvements and trade liberalization. This section considers another natural extension – the relationship between habits and age. Abstracting from the possibility of migration, older households in any given region have had longer exposure to the normal prices prevailing in that region. Therefore, compared to the young, they should develop stronger preference for goods that are relatively cheap in the region. By contrast, the food demand of the young should be more responsive to *market prices* because habits play a lesser role determining their consumption patterns. This hypothesis will be tested below.

The relationship between habits and age has important policy implications. For example, if the old have stronger habits, the incidence of commodity taxes may fall more heavily on them. The reason is that they may be less able to substitute away from taxed commodities. The old may find it specially difficult to switch staples (from wheat to rice, for example).

This section attempts an indirect test of the hypothesis that consumption of older household is more habit determined, compared to the young. But before any such test can be conducted, the definitions of *old* and *young* households must be clarified. For this study, the households are categorized according to the age of the household head. It is acknowledged that this involves a strong assumption regarding intra-household distribution of power. If the age of the household head is 35 years or less, the household is classified as "young"; if the household head is 55 years or older, the household is classified as "old". Given these definitions, there were 411

observations in the "young" category and 789 observations in the "old" category [3]. The households that did not fit either category were excluded from the analysis.

A separate PCDS was estimated for each sub-sample of households and their estimated elasticities compared. The test of the hypothesis consisted in comparing the PRPS elasticities and the market price elasticities for the two sub-samples. If the degree of habit formation depended on age, then the old households would have own PRPS elasticities that are larger in absolute magnitude. The young households would have larger (in absolute terms) PRPS elasticities. Tables 6.3 and 6.4 present the estimated PRPS and *market price* elasticities.

Consider the results for own PRPS elasticities. Only three out of the eight reported PRPS elasticities for old households were greater than the corresponding elasticities for the young households. Even among these three, the estimates for dairy products and for "other foods" from the two sub-samples were not too far apart. These results do not provide any support to the the hypothesis that consumption of the old is more habit determined than that of the young. The results of market price elasticities are somewhat different(see Table 6.4). For five out of eight food items, the young households demand was more market price elastic than that of the old households.

These results are somewhat difficult to interpret. It is clear that the link between habits and age is not confirmed. Estimates of PRPS elasticities suggest that consumption of the old households is not, necessarily, more habit-determined than that of the young. This leaves the question of greater market price responsiveness of food demand by the young. The analysis does not provide an explanation. All that

[3]The total number of observations in the sample was 2403

Table 6.3: Normal Price Elasticities for Young and Old Households: PCDS for Rural Pakistan [a]

	Young	Old
Wheat	-2.21	-1.20
Rice	-2.39	-2.86
Meats	-2.60	-1.67
Dairy	-0.92	-0.95
Oils and Fats	-0.48	-0.43
Sugar	-1.89	-1.12
Vegitables	-1.74	-1.71
Other foods	-0.73	-0.77

[a]If age of the household head is 35 years or less, the household is classified as "young"; if the household head is 55 years or older, the household is classified as "old".

Table 6.4: Market Price Elasticities for Young and Old Households: PCDS for Rural Pakistan [a]

	Young	Old
Wheat	-0.61	-0.68
Rice	-0.61	-0.44
Meats	-0.47	-0.61
Dairy	-0.84	-0.67
Oils and Fats	-0.92	-0.69
Sugar	-0.41	-0.94
Vegitables	-1.14	-0.96
Other foods	-1.44	-1.38

[a] If the age of the household head is 35 years or less, the household is classified as "young"; if the household head is 55 years or older, the household is classified as "old".

can be said is that the absence of strong price induced biases in consumption habits of the young does not appear to be the cause of their greater flexibility.

Although the results presented above do not support the hypothesis regarding a link between habits and age, the issue should be explored further. Because there were no other studies on this topic, the model used in this study was kept simple. To have a greater degree of confidence in the results obtained, some of these assumptions should be relaxed and econometric estimation procedure improved. Several improvements can be made that could make the model more realistic. For example, instead of arbitrarily choosing the cut-off points for young and old groups, the households could be sorted in ascending order of their head's age. The the youngest one third could then be classified as "young"and the oldest one third as "old" while the middle third are dropped. Another improvement could be to relax the assumption that household head wields absolute decision-making power. When there are multiple income earners in the household, the power of the individual designated as its head may be diluted. Taking into account the ages of other income earners may provide a better way of classifying households. Also prolonged absence of the household head may lead to delegation of decision-making authority to women or younger male members. This could be quite important in districts like Attock where a significant number of males join the army. Finally, the estimation procedure should be modified to take into account arbitrary truncations of sample at ages 35 and 55. These improvements will be taken up in future research.

CHAPTER 7. CONCLUSIONS

Since the mid 1980's, the government of Pakistan has introduced a number of economic reforms and has adopted new policies aimed at accelerating the pace of economic development. These include elimination of trade and exchange rate distortions, ending of state monopolies over procurement, marketing, and export of agricultural commodities, and investments in rural infrastructure, especially, in farm to market roads. Assessing the effects of these policies on food consumption requires information on demand parameters. The consumption patterns of rural Pakistani households exhibit a good deal of persistence along regional lines because of longstanding habits. Sometimes these long run habit effects are confounded with the short run responses to price and income changes. This makes analyzing the consequences of economic reforms and new policies, very difficult. An accurate and complete policy analysis requires untangeling the two effects. Therefore, it is necessary to not only model persistence in consumption but to also make explicit the links between habitual behavior and any economic factors that could be influenced by government policies.

The previous literature on demand analysis in Pakistan, has ignored the issue of persistence in consumption. A common approach has been to attribute habit differences among regional populations to their ethnic backgrounds. Because ethnicity is exogenous to the economic system, many researchers saw this as a justification for

purging habit effects from data by using the fixed effects model.

Although some types of economic behaviors may be affected by ethnic, cultural and religious factors, there are several reasons why the approach taken by the previous studies is unsatisfactory. First, the link between habits and ethnicity is an assumption made for convenience; no evidence is presented to support the claim. Second, even if some part of habitual behavior can be justifiably attributed to ethnic background, the rest may, still, be explained by economic factors. The use of fixed effects technique purges *all* habit effects from the data, whether or not they are caused by ethnic factors. Third, one might ask if the habit effects are really fixed. There is no reason why they may not vary systematically with some economic variables [1]. Using a fixed, or even a random effects model, is no substitute for additional information on model specification.

The lack of conceptual clarity regarding the nature and causes of habitual behavior has taken its toll on the quality of estimates. Some of the demand elasticities, estimated by previous studies in Pakistan, have wrong signs or implausible magnitudes. Also, there is little consensus in the existing literature on the values of these elasticities. The erratic nature of results has diminished their usefulness to policy makers.

These problems were caused by inappropriate specification of the demand system that ignored the role of spatial patterns of long term prices in forming habits. This study presented a hypothesis that households develop stronger preferences for foods that have been relatively cheap in their region, on a long term basis. This idea was

[1] Ofcourse, an alternative to fixed habit effects is to assume that they are random. But this begs the question, which is, whether the habits can be *explained* rather than, merely, be accounted for.

implemented by using the notion of price dependent preferences to derive estimatable form of a demand system. The shares in the resulting price conditional demand system depended on long term prices, called normal prices, in addition to being functions of market prices and incomes.

The estimates from the PCDS gave plausible values for price and income elasticities of demand. In addition, the preference shift elasticities supported the hypothesis that household tastes shift in favor of commodities that have been relatively cheap in the region, over the long run.

The results have two broad areas of implications. First, they provide intuition on how liberalization and investments in infrastructure might affect food consumption in the long run. The PCDS can capture the long run effects because its share equations have normal prices as explanatory variables. The simulations based on the PCDS parameter estimates suggest that liberalization is not likely to change consumption patterns very much. This is likely to be true not only in the short run but also in the long run where post liberalization prices are assumed to induce new habits. In sharp contrast to this, infrastructure improvements that eliminate regional price differentials, are likely to cause major changes in regional consumption patterns in the long run.

The second broad implication is that relatively simple models based on neoclassical economic theory, can also explain the part of household consumption behavior that is often attributed to their ethnic backgrounds. The results support the Stigler-Becker argument that persistent differences in behavior are not caused by capricious tastes but by varying levels of accumulation of habit capital. The contribution of this study is to, empirically, show that differences in consumption habits

among regions can be explained by differences in long term prices. If the regional price differentials were eliminated permanently, the consumption patterns of regional populations would become almost identical in the long run. This is demonstrated, very convincingly, by the simulated improvements in infrastructure.

Some specific conclusions also emerge from the investigation. For example, cereals consumption was found to be, relatively, more habit-determined. Therefore, if government investments in infrastructure continue to narrow regional price differentials, the greatest impact is likely to be on demand for cereals. In particular, rice consumption will likely increase and wheat consumption will decrease. Although Pakistan currently exports rice, it is not a very big producer. Therefore, the long run impact of infrastructure improvement could, potentially, turn the country into a net rice importer.

This investigation has provided some insight into the likely impact of liberalization and infrastructure improvement. It has also provided plausible measures of demand elasticities that are necessary for an accurate and complete policy analysis. But the analysis has its limitations and can be improved in several ways. The results should be interpreted with these limitations in mind.

The reader is cautioned against treating simulation results as predictions. Their purpose is to illustrate the impact of infrastructure improvements and liberalization on consumption while keeping supply side factors fixed. It is hoped that this would aid strategic thinking on these issues. In reality, however, the supply side factors do not remain fixed; they are also affected by normal prices (e.g. see Fulginiti [21]). The exact magnitudes of changes in food consumption cannot be calculated without taking into account the effects of changes in supply on prices.

It must, also, be noted that the estimates in this study are based on a sample drawn from selected rural districts. The survey did not cover the urban areas or the province of Baluchistan. Even in the sampled provinces, not all agro-climatic zones were covered. Because agro-climatic conditions influence regional prices, this may be a serious limitation.

Finally, the theoretical model used in this study does not explain how habits are formed. Habit formation is a dynamic process that cannot be fully captured by a static model such as the one used in this analysis. A useful extension of the model would be to make it dynamic along the lines suggested by Becker and Murphy (see [10]).

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APPENDIX

The Price Conditional Demand System (2.14) was estimated in expenditure share form. The elasticity estimates, reported in various Tables in Chapter 5, were derived using estimated parameters and the formulas (4.7 - 4.12). This appendix reports all the estimated parameters of the original system (2.14).

Table A.1: Parameter estimates: PCDS

Parameter[a]	Estimate	t-ratio
A1	0.02580	0.5588
D1	0.00736	19.2420
G11	-0.06011	-2.0730
G12	0.00865	0.4598
G13	0.14006	8.0776
G14	-0.00074	-0.0432
G15	-0.01901	-1.4373
G16	-0.02828	-1.7982
G17	-0.00319	-0.2117
B11	0.03068	1.3498
B12	0.00321	0.2648
B13	0.01286	0.8489
B14	-0.00538	-0.4395
B15	-0.05301	-4.8772
B16	0.01641	1.5815
B17	0.01470	1.4496
C1	-0.06883	-16.4470
A2	0.14300	3.4742
D2	-0.00333	-9.9563
G22	-0.06719	-2.9658
G23	-0.00716	-0.5167
G24	0.02269	1.5359
G25	0.02338	1.8677
G26	0.04621	3.2647
G27	-0.00542	-0.3793

[a] G_{ij} and B_{ik} are, respectively, the coefficients of jth Normal price and kth market price, in ith share equation; C_i and D_i are the coeffcients of real food expenditure and household size, respectively, in the ith equation.

Table A.1 (Continued)

Parameter	Estimate	t-ratio
B22	0.03944	3.1061
B23	-0.03330	-3.2551
B24	0.01065	1.0922
B25	-0.01677	-1.8889
B26	-0.02972	-4.3276
B27	0.03076	3.6130
C2	0.05908	16.3670
A3	0.29244	8.0781
D3	0.00260	7.0739
G33	-0.18016	-11.2600
G34	-0.01384	-1.1354
G35	-0.00898	-0.8778
G36	0.00083	0.0736
G37	0.05434	5.2332
B33	0.04502	3.0089
B34	-0.03493	-3.4731
B35	-0.01070	-1.1627
B36	-0.00375	-0.4535
B37	-0.02123	-2.5526
C3	-0.02325	-5.8079
A4	0.33013	9.8078
D4	-0.00633	-13.3320
G44	0.01282	0.6753
G45	-0.07383	-6.4781
G46	0.03591	3.7480
G47	0.05208	5.0006
B44	0.06290	4.1264
B45	0.01770	2.0224
B46	-0.02086	-3.5411
B47	-0.07252	-10.2990
C4	0.06595	12.3420

Table A.1 (Continued)

Parameter	Estimate	t-ratio
A5	-0.016908	-0.5188
D5	-0.002421	-7.0040
G55	0.063228	4.3004
G56	0.014377	1.7088
G57	-0.024615	-2.7448
B55	0.037731	3.4182
B56	-0.025444	-4.2645
B57	0.030002	4.3541
C5	0.030511	8.0951
A6	-0.009334	-0.2649
D6	0.000894	4.5839
G66	-0.051437	-2.7519
G67	-0.016376	-1.4644
B66	0.021519	2.3407
B67	0.041369	6.8827
C6	-0.019923	-9.7443
A7	0.079647	2.4289
D7	0.001571	7.2200
G77	-0.073986	-5.2236
B77	-0.010158	-1.1686
C7	-0.036483	-14.9380