The P.I.D.E. Macro-econometric Model of Pakistan's Economy

(Vol. I)

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THE OVERVIEW

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yet another model when the 'dust' raised by the first model had not yet settled. There are several valid reasons for reconstructing our vision of Pakistan's economy.[1]

To begin with, the PIDE Model (1982) was an interim report on an on-going project. To 'see' things more clearly, further experimentation was required with the specifications used in the model. As usually happens, these experiments necessitated a re-specification of several equations of the model. Secondly, much has been learnt from the first attempt. The publication of the model evoked considerable response from many scholars, who generously offered extremely valuable comments and suggestions. Most of the suggestions made by them necessitated further revisions of that model. Thirdly, the PIDE Model (1982) was restricted only to a structural analysis of Pakistan's economy. No attempt was made at that time to 'validate' the estimated equations through historical 'simulations', partly because the PIDE model-builders had just begun their slalom on the learning curve. Also, no sensitivity analysis was done to test the 'stability' of the estimated equations of the model. It is well known that even if equations perform well individually, they may 'misbehave' when allowed to 'mix' freely with other equations in the model, since errors then begin to build up. With the passing of the 'age of innocence', our horizons are now wider: besides structural analysis, we have attempted policy simulations and forecasting to push ahead with our exploration into the inadequately known and altogether unknown facts about Pakistan's economy. Fourthly, there was an element of artificiality in restricting ourselves in the PIDE Model (1982) to only log-linear forms of equation and in expressing all the endogenous variables in 'real' terms. These restrictions have now been removed.

Table 1.1 compares the major characteristics of the present model with the PIDE Model (1982) bringing out the 'pay-off' of the new effort in the last nine columns. The comparison in terms of the values of the key statistics clearly shows that in the present model not only the explanatory power of the individual equations is much greater but the incidence of the auto-correlation problem has also become manageable.[2] Also, in terms of the level of significance of the estimated

[1]Appendix A gives a detailed comparison of the two models, showing the many ways in which the present model differs from the PIDE Model (1982).

[2]In the PIDE Model (1982), a large number of equations suffered from auto-correlation, which was removed by applying the Cochrane-Orcutt technique. In sharp contrast, in the present model such correction was applied sparingly. This is an improvement because as is well known the Cochrane-Orcutt correction is not always 'harmless' in the sense that there is no guarantee that the final estimate of 'ρ' in the first-order autoregressive scheme will be the optimal estimate. This is because the iterative technique to estimate ρ may yield a local rather than a global minimum. See, for instance, Pindyck and Rubinfeld [10, p. 157].

Table 1.1

A Comparative Study of PIDE Econometric Model (1982) and the PIDE Macro-Econometric Model (1983)

	No. of Equations		Functional Form	No. of Estimated Parameters		Percentage of Parameters		Percentage of Equations				
								With $\bar{R}^2$		with *DW* statistic showing		
	Behavioural	Definitional		Intercept	Slope	Significant	Insignificant	Above .55	Above .70	No Autocorrelation	Negative Autocorrelation	Positive Autocorrelation
Present PIDE Model (1983)	33	25	Log-Linear=8 Linear = 25	27	71*	79	21	90	79	89	11	–
PIDE Model (1982)	36	17	All Log-Linear	36	108**	76	24	72	67	48	23	29

* Include 9 dummy variables.

** Include 23 dummy variables.

Chapter 1

THE OVERVIEW

> "The age of chivalry has gone, that of sophisters, economists and calculators has succeeded..."
> **Edmund Burke:** *Reflections on the Revolution in France*

The ambitious effort to build a formal model of Pākistan's economy, which started in 1979 in an atmosphere charged with hopes and fears, has now borne fruit in the form of the *PIDE Macro-econometric Model of Pakistan's Economy.* We have finally taken our seat in the Tinbergen–Klein bandwagon, which started its fateful journey along the road of knowledge several decades ago. We are late-riders, but better late than never. If the message we have tried to convey in these pages does make an impression on those who matter, the attitudinal transformation that it calls for in the manner of looking at economic problems and solving them may have been attained. It is no longer permissible to settle difficult questions of economic analysis and policy-making by reference to over-simplified, and mostly vague, theoretical formulations. The only way to overcome such difficulties is through seeking out empirically verifiable hypotheses, mostly by conducting a large number of experiments with alternative specifications, to get a firm hold on 'reality'. Instead of battling quixotically with unproven hypotheses born of an untutored intuition, we must be innovative and adaptive all along the line to venture forth in directions where no one has gone before to establish *new* testable propositions whose validity can be tested through known scientific methods. This search for valid hypotheses is particularly difficult in developing countries like Pakistan where we must travel all manner of 'roads not taken' so far because the set of empirically-tested propositions is almost an empty one in these countries.

The results of this highly (skilled-) labour-intensive search for an 'adequate' simulation of economic reality in Pakistan encompass the entire spectrum of applied econometrics – structural analysis, forecasting and policy evaluation. The present volume undertakes a study of the *structure* of Pakistan's economy within the framework of a dynamic simultaneous-equation model of 58 equations – 33 behavioural and 25 definitional. The size of the model is large enough to determine the behaviour of 58 endogenous variables which explicitly connect 'real' and monetary sectors of the economy, the fiscal and monetary policies of the government and the working of the external-trade sector. To determine the reliability and stability of the model, historical simulation (validations) and sensitivity analysis have been performed. These experiments confirm that the model has indeed captured within its net many facts of the real life with a relatively small margin of error, and that the 'excluded' facts are of relatively minor significance in explaining the economic structure. The accomplishments of the structural analysis have laid a solid groundwork for forecasting and policy evaluation, which constitute the subject-matter of the second volume of this report.

Although in the absence of policy simulation (to be reported in Volume II) the model does not chart out alternative development strategies, the values of the estimated coefficients of the 58 equations should help the policy maker to measure quantitatively the 'response' of key economic variables to specific changes in government policy. Then there is the important *educative* purpose that this modelling exercise has performed: to conduct a nation-wide search, not a witch hunt, to cull and glean all the relevant information from the existing sources. With the initiation of this self-regenerative process, many information gaps, not yet apparent, reveal themselves to be filled. As new data are generated, these 'facts' are then fed into a systematic analytical framework that the model provides to create *new* information about the 'reality'. This is new information because, to borrow a Shakespearian aphorism, facts in the real world *speak* but *say* nothing. However, in the rarefied atmosphere of the model these very facts *say* a lot about the structure of Pakistan's economy and its slow movement over time.

The present Overview provides a fairly complete introduction to the findings of the first volume. To bring out clearly the characteristics of the PIDE Macroeconometric Model (1983), the discussion in this chapter is divided into six sections: (i) Old Wine in New Bottle? (ii) Model's Morphology; (iii) Network of 'Connected' Variables; (iv) Model and Reality; (v) Policy Implications; and (vi) The Unfinished Agenda.

OLD WINE IN NEW BOTTLE?

The present model is appearing within a year of the publication of its predecessor, *The PIDE Econometric Model of Pakistan's Economy,* referred to hereinafter as the PIDE Model (1982) [8]. Since the data base used for the two models is the same, a question naturally arises concerning the need and desirability of constructing coefficients, the new model does better than the old one. Apart from other formal differences between the two models that the table makes obvious there are two important points that need explanation.

(i) The number of behavioural equations is now smaller than before – 33 equations in the present version as against 36 equations in the PIDE Model (1982). However, this is not a defect of the new model. The reduction in the number of behavioural equations is the net outcome of a conscious process of dropping and adding several equations that appeared in the PIDE Model (1982). The major 'casualties' were the 7 input demand functions appearing in the Production Block, which have now been replaced by four marginal productivity conditions. This change-over has been effected to meet the (valid) criticism, made by Professor Tinbergen, that the juxtaposition of the production functions with input demand functions in the PIDE Model (1982) yielded inconsistent coefficients of the relevant variables.

(ii) As against the 23 dummy variables appearing in the PIDE Model (1982), there are only 9 such variables in the present model. We are no longer playing vint with too many dummies on our side! Instead, better ways of capturing the flavour of 'reality' have been employed in the present model.

It is obvious from this comparison that the learning process has paid off. We have not flinched from being our worst critics if that improved the level of significance of the 'knowledge coefficient'.[3] The present model carries the torch lighted by the PIDE Model (1982) farther along the road of knowledge. We are now better equipped than before to handle complex macro-economic problems satisfactorily and to use the model effectively as a tool of economic analysis. If only as an illustration of that rare exception which proves the rule, the new wine tastes better than the old; and, as always, the new bottle, in terms of its greater 'sex appeal', is also much more attractive.

MODEL'S MORPHOLOGY

Size of the Model

The final choice of the size of the model has been a compromise between the ideal and the 'expedient'. Within the binding constraint of data availability, the 58

[3]This last observation applies to the senior author, who has been partner in both the 'plots'.

simultaneous-equation dynamic model is large enough to simulate the structure of Pakistan's economy and its movement over time. It allows enough elbow room for displaying the working of the various (exogenous) policy variables. Since the basic intersectoral and intrasectoral relationships of Pakistan's economy had to be studied to gain an understanding of how it all hangs together, a much smaller model would not have filled the bill.[4] Perhaps a somewhat bigger model than the present one should have been attempted but the non-availability of the relevant data put a damper on our ambitions. At any rate, the learning process has just begun; and the doomsday is, hopefully, not around the corner!

Table 1.2 gives the relevant information about the size of the model. Of the 58 equations, 33 are behavioural equations.[5] The rest of the 25 equations are definitional relations. The model is subdivided into three sub-models, which focus on those relationships (equations) that highlight the sectoral 'peculiarities' of the economy. However, the entire model has been simultaneously estimated and not separately for each of the three sub-models.[6] For expositional clarity, these sub-models are then classified into 6 blocks. (Note that the PIDE Model is *not* block-recursive.) The table clearly displays the 'sectoral hierarchy' of Pakistan's economy. The largest collection of equations is in the Production and Expenditure Sub-model. This 'fact' shows that the production and consumption activities of economic agents take up most of the 'space' in Pakistan's economy. The import and export sectors are embedded in the Production-Expenditure nucleus but do not dominate it. On the other hand, the fiscal and monetary relations reflect the efforts of the government to regulate the behaviour of the economy.

Type of Equations

The model is best described in terms of the number and type of the equations it contains. Note in Table 1.3 that most of the estimated equations explain the behaviour of the domestic sectors of the economy. Also, the production behaviour

[4]The so-called "law of parsimony" would have dictated a model of about six equations to keep to a minimum the parameters for the given numbers of endogenous variables. However, this rule is hardly adequate for econometric analysis, particularly when the purpose is to understand the structure of the economy. See Klein [6].

[5]Of the behavioural equations in the model, one (equation (2.19′)) is treated as function of time.

[6]The 33 behavioural equations have been estimated by using the instrument variable variant of the Two-Stage Least-Squares (2SLS) procedure to display the simultaneous determination of as many endogenous variables in response to changes in the values of the exogenous variables. The 2SLS method also allows us to establish a one-way link between the endogenous variables included in the model. As is well known, this estimation procedure yields consistent estimates of coefficients.

Table 1.2

The Size of the PIDE Macro-econometric Model (1983)

Sub-models and Blocks	Number of Equations used		Total
	Behavioural	Definitional	
Production and Expenditure	*20*	*14*	*34*
(i) Production Block	14	5	19
(ii) Expenditure Block (Includes one definitional equation for Resource Gap)	6	9	15
Foreign Trade	*6*	*7*	*13*
(i) Import Block	3	2	5
(ii) Export Block	3	3	6
(iii) Trade Gap and Current Account Balance	–	2	2
Fiscal and Monetary	*7*	*4*	*11*
(i) Fiscal Block	5	2	7
(ii) Monetary Block	2	2	4
Total	**33**	**25**	**58**

of the major commodity-producing sectors is explained entirely in terms of the supply of key inputs, which is assumed to be equal to their demand. This is a reflection of the fact that in a developing economy like Pakistan the basic problem is how to develop the production potential by various means and not how to use the existing potential more effectively by increasing effective demand. This is not to deny that in this model effective demand does exercise an important influence on final output. Indeed, the value added in "Other Sectors" is exclusively determined in terms of the final demand components. Thus the model is of a hybrid variety, duly emphasizing both the demand and the supply factors. As if to keep everybody happy, the model is neither wholly Keynesian, nor entirely anti-Keynesian.[7] (See the Flow Diagram in the next section.)

[7]Klein [5] has briefly discussed the reasons why a Keynesian model – i.e. one which determines effective demand with a given set of prices – is not wholly suitable for developing countries. However, as Malinvaud has pointed out, many of the econometric models in the developed countries also reflect characteristics of "supply" which have been found at least as important as those relating to "demand" [7].

Table 1.3

Type and Number of Equations in the PIDE Macro-econometric Model (1983)

Endogenous Variables	Number of Equations used		Total
	Behavioural	Definitional	
Value Added			
(a) in Agriculture	1	1	2
(b) in Manufacturing	1	2	3
(c) in "Other Sectors"	8	1	9
Derived Demand			
(a) for Agricultural Inputs	2	–	2
(b) for Manufacturing Inputs	2	–	2
GNP, GDP, Disposable Income, Disposable income net of Remittances (Definitions)	–	4	4
Share of Commodity-producing Sectors in GDP	–	1	1
Resource Gap (= Trade Gap) and Budget Deficit	–	3	3
Consumption	2	1	3
Investment	3	4	7
Capital Stock	–	1	1
Public Subsidies	1	–	1
Current Account Deficit	–	1	1
Imports	3	2	5
Exports	3	2	5
Tax Revenue	5	1	6
Money Supply	1	1	2
Price Level	1	–	1
Total	**33**	**25**	**58**

Type of Variables

In accordance with the well-known rule, the number of endogenous variables (58) is equal to the number of the equations in the PIDE Macro-econometric Model. However, there is no such restriction on the number of exogenous variables, which are 35 in all (Table 1.4). At first glance, the exogeneity of so many variables may appear to be a defect of the model. To some extent, this indeed is the case—e.g. some, if not all, of the 11 price and 2 wage variables should have been endogenized. For instance, variables like prices of manufactured goods and investment goods, wages, imports of services, cropping pattern, etc., would look better as endogenous variables. However, the inadequacy of data was the main bottleneck in the way of playing the endogenizing game with satisfactory ease. Also, the need for keeping the size of the model (the number of equations), and the cost of estimating it, within manageable limits has prevented us from being drawn into this game at the present unsatisfactory stage of our statistical preparations. As more data, expertise and computational facilities become available, additional equations will be added to the model by permitting quite a few of the exogenous variables to cross over into the endogenous camp.

However, in the structural model of a developing economy the presence of a relatively large number of exogenous variables is also a reflection of the pervasive nature of government intervention, which, like the ghost of Hamlet's father, frequents the economy, assuming the form now of price controls and then of quantitative restrictions. For instance, in Pakistan, the agriculture sector is regulated through a complex amalgam of price support schemes and subsidies on inputs. Similarly, the behaviour of the foreign-trade sector is regulated by quota restrictions and tariffs (subsidies) on imports and (exports). All such variables must remain exogenous. The same is true of the fiscal and monetary sectors where the government uses such policies as changes in tax rates and interest rate to influence the economy.

Policy Variables

An interesting aspect of the model is the high ratio of policy variables to non-policy exogenous variables: of the 35 exogenous variables in the model, 26 are policy variables. Table 1.5 lists these variables to display the large number of policy instruments which the government has employed from time to time to influence the allocation of domestic resources within as well as between sectors of the economy. Note that the model includes in it a large number of *prices* which are regulated by the government. All the key prices of both inputs and output are regulated to increase agricultural production. Similarly, the size and composition of industrial output are controlled through a variety of policies, e.g. direct control of the prices of investment goods, fixation of minimum wages, adjustment in effective exchange rates

Table 1.4

List and Number of Variables used in the PIDE Macro-econometric Model (1983)

Endogenous Variables	Number	Exogenous/Predetermined Variables	Number
Value Added by Sectors	14	Cropping Pattern	1
Income	4		
Consumption	3	Wage Rate	2
		Prices	11
Investment Expenditure	7	Remittances and Foreign Capital Inflow	2
Public Subsidies	1		
Capital Stock	1		
Inputs in Agriculture and Large-scale Manufacturing	4	Effective Exchange Rate	3
Share of Commodity-producing Sector in GDP	1		
Resource Gap	1	Imports of Services	1
Imports	5		
Exports	5	Inventories	1
Trade Gap	1	Lagged GNP Price Index	1
Current Account Deficit	1		
Money Supply	2		
Budget Deficit	1	Time Trend	1
GNP Price Index	1	Dummy Variables	9
		Credit Availability	1
		Foreign Exchange Reserves	1
Taxes	6	Lagged Consumer Goods Imports	1
Total	**58**	**Total**	**35**

Table 1.5

Policy Variables in the PIDE Macro-Econometric Model (1983)

1. *Prices*	
(i) of agricultural commodities	1
(ii) of tractors	1
(iii) of manufactured goods	1
(iv) of investment goods	1
(v) of primary goods exports	1
(vi) of manufactured goods exports	1
2. *Wage Rates*	
(i) in agriculture	1
(ii) in large-scale manufacturing	1
3. *Effective Exchange Rates for Imports*	
(i) for consumer goods	1
(ii) for intermediate goods	1
(iii) for capital goods	1
4. *Monetary Policy Variables*	
(i) Credit Availability	1
(ii) Foreign Exchange Reserves	1
5. *Fiscal Policy Variables*	
(i) Tax rates	7
(ii) Tax base	4
6. *Other Policy Variables*	
(i) Government subsidies and transfer payments	1
(ii) Foreign Capital Inflows	1
	26

for imports and exports, etc. An important finding of the present study is that quite a few of these relative-price variables – e.g. prices of tractors and investment goods, two of the three effective exchange rates for imports, etc.—are statistically significant.[8] However, the relative prices for exports are *not* significant.

Note that quite a few key policy variables do not appear in the model at all. The most prominent absentees are the prices of fertilizer and tubewells, and interest rate. The reason for the absence of these variables from the set of policy variables is that they do not appear in any of the equations of the model.[9]

NETWORK OF 'CONNECTED' VARIABLES

Since the PIDE Macro-econometric Model is large and complex, its basic structure is not visible to the naked eye. The accompanying flow diagram should help the reader in 'seeing' the model in its 'true colours'. If read systematically, it reveals its inherent simplicity in a striking fashion. First, the flow diagram is broadly divided into an exogenous-variables camp, which is situated on the right-hand side, and an endogenous-variables camp, located on its left-hand side. The ten major sectors which contribute to the Gross Domestic Product provide, so to speak, a horizontal 'roof' over both the camps. Then there are the two definitional camp-followers stranded between the two opposing camps.

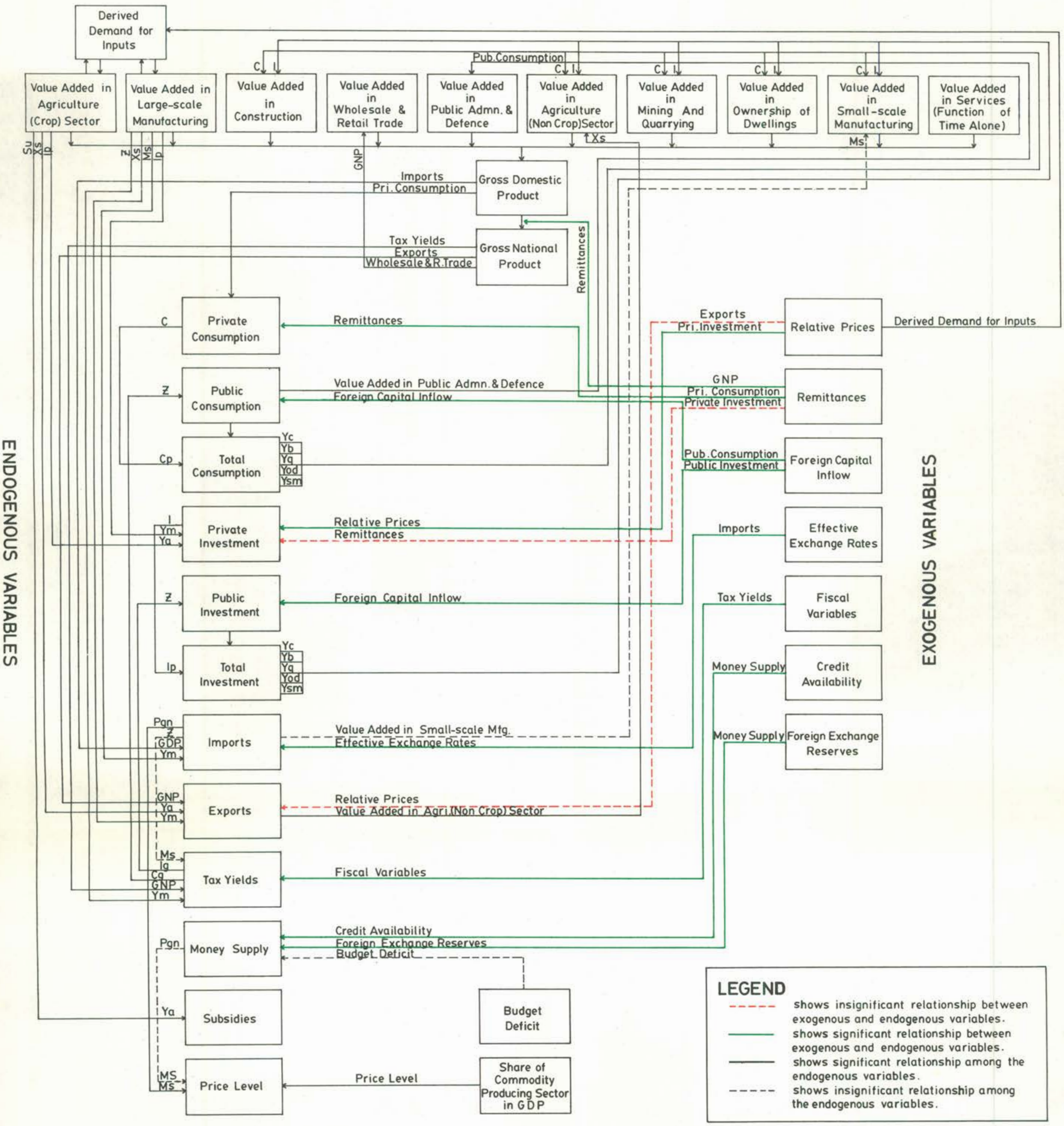
Secondly, what strikes the eye is the 'colourful' network of lines in the diagram. The lines painted with red and green colours issue forth from the exogenous-variables camp towards the endogenous-variables camp along the many *one-way* tracks that link the two.[10] The green solid lines show a healthy significant relationship between the two types of variables, while the red dotted lines, as usual, give a warning signal to the reader not to expect much from the indicated relationships. These are statistically insignificant (though not illegitimate) one-way relationships between specific 'pairs' of exogenous and endogenous variables. The black *solid* lines represent statistically significant relationships within the endogenous-variables camp, while the black dotted lines denote weak and insignificant relationships.

[8]The effective exchange rates for the imports of consumer goods and capital goods are significant while the effective exchange rate for intermediate goods is insignificant. See estimated equations (3.39′), (3.40′) and (3.41′) in Chapter 6.

[9]The fertilizer and tubewell variables were dropped from the equation for the value added in agriculture because they are highly collinear with each other and with the tractor variable. See equation (2.5′). The interest rate variable was dropped in favour of 'credit-availability' variable for the same reason. See equation (4.55′).

[10]The exogenous variables are the generous lot which give but take back nothing, while there is a lot of 'give-and-take' between the many endogenous variables displayed in the flow diagram.

FLOW DIAGRAM OF THE PIDE MACRO-ECONOMETRIC MODEL



NOTE This diagram includes interaction among all the Endogenous & Exogenous Variables included in the 33 behavioural equations of the model.

With this infomation in hand, let us start with the green and red lines to see how the exogenous variables get along with the endogenous variables. To begin from the top of the exogenous-variables camp, the green line coming from relative prices (e.g. price of Tractors/Price Index for Crops, price of Investment Goods/GDP Price Index, etc.) indicates a negative, though significant, relation between them and private investment and with the value added in agriculture through the courtesy of 'derived' demand for inputs. The red dotted line cautions that relative prices are only insignificantly related with exports.[11] Going down vertically, remittance income makes a significant impression on the GNP and, through it, on others in the endogenous-variables camp, i.e. on exports and taxes. The same holds for its relationship with private consumption and, through the good offices of the latter, with total consumption and the value added in construction. However, things do not go well between remittance income and private investment, the latter being declared out of court *because* of the infatuation of the former with private consumption. Foreign capital inflows favour both public consumption and public investment and, through the latter, total investment and the other 'takers'. The government enters the foray by announcing its connections with tax yields and, through the latter, with public consumption and public investment and all the rest. Effective exchange rates have a significant relation with total imports. The flow diagram also reveals the significant relationship of credit availability and foreign exchange reserves with money supply.

Two major highlights of the model are the insignificant connection between budgetary deficit and money supply, and the equally insignificant relation between the latter and the general price level. This 'fact' should disappoint anybody looking for Friedmanite sympathizers on the flow diagram. However, note the healthy and significant 'goings-on' between the 'share of commodity-producing sector in GDP' and the general price level, and, to a lesser extent, the negative, though significant, relation between import availability and the general price level. Both these relations should show that inflation is the progeny of 'real' parents at home; it has neither been imported from abroad nor fed by the 'money-bag'.

As for the inter-connections within the endogenous-variables camp, note that there are no one-sided affairs here, such as existed between the exogenous and endogenous variables. The values added in all the ten sectors make an impact on Gross Domestic Product, which relates with imports and private consumption, and, in the company of remittance income, faces up to Gross National Product, whose 'weight' is in turn felt by other variables like tax yields, exports of services and the

[11]This relationship is conspicuous by its insignificance: it shows that lower (higher) relative prices of exports do not provoke greater (lesser) exports.

value added in the wholesale and retail trade. The story of the more complex connections, both significant and insignificant, within the endogenous-variables camp can be read from the flow diagram. It need not be related too loudly.

However, note yet another important set of connections. Keep your gaze fixed on the 'roof' of the flow chart and note the essentially non-Keynesian connection between the value added in major commodity-producing sectors and the derived demand for inputs (which at all times is assumed to be equal to their supply). Now, move seven more steps on the 'roof' but stop short of courting the last entry and see for yourself the equally strong Keynesian sentiment that runs between the value added in seven sectors and the final demand components – viz. consumption, investment, imports and exports. These connections make the present model resemble a mermaid, which is about half non-Keynesian and the rest Keynesian. While these relations may be equivocal, the model exudes unequivocally non-Friedmanite sentiments!

By now the mysterious fog engulfing the network of variables must have been dispelled. What emerges on the flow diagram is a relatively 'noise-free' model representation of a turbulent dynamic economy, dutifully grinding on an even keel.

THE MODEL AND THE REALITY

Whether the model portrays 'reality' reasonably well is an important question that must be answered. For the very purpose of model-building is to capture within the four walls of the model the rather unruly 'real-life' phenomenon, and then to explain its inner logic in quantitative terms.[12] And yet, if the model gets too close to reality, it will get 'contaminated' by its turbulence and will die as a model. "To be" yet "not to be" is the perennial dilemma that the model builder must face up to in 'simulating' reality. He must be prepared to remain in a state of suspended animation within the vast space that lies between 'being' and 'nothingness'.

The PIDE Macro-econometric Model has been estimated for the 1959-60 to 1978-79 period, a span of time long enough to do a significant job of identifying the nature and strengths of the forces that have shaped Pakistan's economic structure. During this time span, the economy has been a witness to a large number of extraordinary events, even shocks: two brief wars with India in 1965 and 1971; a number of bad harvests followed by an equal number of good ones; a prolonged recession that engulfed the main commodity-producing sectors from 1970 to 1977;

[12]However, see Vernon [11] who questions the use of macro-economic model building for developing countries.

the secession of East Pakistan (now Bangladesh) that occurred in 1971; the wide-ranging process of nationalization which gripped the manufacturing sector in the mid-Seventies; the manifold increases in petroleum prices that started in 1973; and the inflow of workers' remittances in the Seventies that quickly graduated from a tiny trickle to an avalanche.

Given these cataclysmic events that rocked the economy's boat so violently and so often, it has been a challenge to model-builders to specify a structural model that could hold within its chalice, sparkling and concentrated, the turbulence of real life and yet remain free from it. Within the binding data constraints, the 58-simultaneous-equations model presented here has succeeded reasonably well in simulating the 'workings' of Pakistan's economy. The model encompasses all the basic intrasectoral and intersectoral relationships between the 'real' and the monetary sectors, and those between the domestic and the foreign-trade sectors. The model also articulates explicitly the interconnections between the fiscal activities of the government and the rest of the economy. Then the inclusion in the model of almost all the important policy variables used in Pakistan for stabilization and development purposes has increased further the realism coefficient of the model. The success of the 'mission impossible' has been 'validated' by historical simulations, which replicate, with a relatively small margin of error, the real-life happenings, even the extraordinary ones that produce "turning points" in the historical time-series. The sensitivity analysis conducted to check on the stability of the model further confirms its explanatory faculties. These tests also make it safe to let the model make a 'second' contact with reality – this time to change it through corrective government policies. (Wait till the publication of Volume II of the present report to see the modalities of this second contact.)

It will be useful to highlight here some of the 'exploits' of the model:

(i) We try to determine the role of technological progress, defined as an outward shift of the production-possibility frontier with unchanged factor inputs, as a contributory factor in the growth of various sectors of the economy. Equation (2.8′) clearly shows that disembodied technological progress has been prominent in influencing the value added in large-scale manufacturing: it proceeded at an annual rate of 4.8 percent.

(ii) To determine the effect of the many extraordinary events alluded to above, 9 dummy variables (D_1 to D_9) are introduced in the appropriate equations.[13] Of these dummy variables, 8 were statistically significant,

[13]These equations are: (2.8′), (2.29′), (2.31′), (2.33′), (2.34′), (4.51′) and (4.53′). See Part III of this report for an explanation of the meaning and significance of these dummies.

verifying the depressing effect, on value added, of a long economic recession that compromised the growth possibilities of the commodity-producing sectors of the economy; the sharp increase in public consumption caused by Indo-Pak war in 1965; the steep reduction in private investment caused by nationalization during the 1972–74 period; the large changes in subsidies to agriculture given during the 1972–75 period; etc.

(iii) An attempt is made to determine the effect of migrant workers' remittances on various sectors of the economy. To analyse this phenomenon, its effects on private consumption and private investment in agriculture and manufacturing are investigated. The model shows that while remittances have had a magnified and significant effect on consumption, they exercise only an insignificant effect on investment. (See the Flow Diagram.)

(iv) As pointed out above, the success of the model hunt of real life events has been most strikingly proved by the extensive 'validation' exercises reported in Chapter 8. They confirm that the model replicated the time-paths of 90 percent of the endogenous variables with a relatively small margin of error. For half of the endogenous variables the margin of error is within the 5-percent range, while for most of the remaining variables the margin of error is within the 10-percent range. This is a satisfactory 'track' record, considering the serious data problems in Pakistan. Furthermore, as the many simulation graphs reproduced in Chapter 8 show, the model captures most of the significant "turning points" in the historical time-series data, caused by the many extraordinary events listed above. For instance, the historical simulation has captured the turning points caused by the Indo-Pak war of 1965 and the secession of the East Wing in 1971.

(v) A sensitivity analysis has been performed by increasing foreign-capital inflow and the marginal propensity to consume by 10 percent and changing the base of the time-series used in the model. It shows that the model does not 'explode' under the stress of exogenous events. In other words, it is stable. Needless to say that if the model had been unstable, a re-estimation of some of the parameters would have been called for. The success of the sensitivity analysis indirectly further confirms that the 'extra-model' forces exercised only a relatively minor effect on the structure of the economy.

These and other 'exploits' of the model are a forceful confirmation of the adequacy of the explanatory power of the estimated equations of the model.

POLICY IMPLICATIONS

The policy implications flowing from the estimated equations of the model are discussed at length in Chapter 10, in terms of the values of their coefficients.[14] However, to get a foretaste of the things to come, it is useful to recapitulate the highlights of that discussion at this stage. The model throws light on a number of structural aspects of Pakistan's economy, whose implications must be clearly understood to help in formulating 'proper' economic policies.

(i) The estimated equations in the Production Block confirm that agriculture is still a labour-intensive activity, where both the marginal and average productivities of labour are positive and greater than unity. On the other hand, the role of capital, which is exemplified by the contribution of tractors to the value added, is minimal. In sharp contrast, the manufacturing sector is highly capital-intensive. The marginal and average productivities of capital are much lower than those of labour, signifying a dis-equilibrium situation with respect to the relative use of capital and labour in this sector. These 'facts' clearly imply that measures should be taken to encourage the use of labour in *both* the agriculture and manufacturing sectors to maximize the flow of the value added. At the same time the inefficiencies in the use, indeed misuse, of capital must be minimized. There is also a need for studying the phenomenon of the very low productivity and output elasticity of tractors.

The equations in the Production Block also show that to maximize value added in the major commodity-producing sectors the Government should primarily aim at increasing the availability of key 'inputs'. However, there is also a place for the Keynesian remedy of regulating the value added in "Other Sectors" – particularly in construction, the 'ownership of dwellings' and small-scale manufacturing – where the output elasticity with respect to incremental consumption is very high.

(ii) The estimated equations in the Expenditure Block reveal interesting characteristics of consumption and investment, both public and private. While, as expected, the marginal and average propensities to consume out of disposable income are less than unity, they are much greater than unity.

[14]These coefficients are elasticities when the estimated equations are log-linear, but are 'marginal contributions' – e.g. marginal propensity to consume, marginal efficiency of capital, etc. – when the equations are linear. A fuller treatment of the difficult subject of policy evaluation will, however, be given in Vol. II of the present study.

for the remittance income.[15] There is, therefore, the need for regulating high consumption levels that the remittance income has tended to promote. The Government policy should aim at providing alternative productive outlets to the recipients of the remittance income.

(iii) Public consumption exhibits characteristics that are similar to those of private consumption: the marginal propensity to consume by the Government is less than unity and lower than the average propensity to consume. Also, the model does *not* provide any evidence of extravagant public consumption behaviour, which has been 'normal' by international standards. There is no evidence of any sizeable deflection of foreign assistance into public consumption. These are encouraging signs.

(iv) The model shows that private investment in agriculture and manufacturing is sensitive to changes in relative prices and the level of output. However, while the output elasticity in agriculture is greater than unity and higher than the price elasticity, the reverse holds for the manufacturing sector, where price elasticity completely dwarfs the output elasticity. The policy implications are too obvious to be explicitly stated.

(v) The estimated equations in the Import Block and Export Block reveal that while the price elasticities for imports are high, those for exports are very low or insignificant. By contrast, the output elasticities are high for *both* imports and exports. These findings are important for policy making. First, devaluation, or a combination of tax on imports and subsidy on export at equal rates, may not necessarily lead to an improvement in the balance of trade. Secondly, a vigorous export-expansion programme must rest primarily on increasing domestic production of exportable goods rather than on manipulating export prices (effective exchange rates for export). Thirdly, in devising a viable balance-of-payments policy account must be taken of the fact that the import bill, willy-nilly, rises with an increase in the GNP. This is particularly true of imports of intermediate goods which are highly responsive to changes in manufacturing output. Thus any precipitate measures taken to reduce the import bill below the secular level will compromise economic growth.

(vi) The equations in the Fiscal Block establish that, with the exception of income and corporation taxes, all major (indirect) taxes *are* elastic with respect to their bases. There is, therefore, a need for expanding the tax base, which will 'pay off' even more than the marginal increments in tax rates.

[15]Note that the *elasticities* computed from marginal propensities of private consumption out of *both* disposable income and remittance income add up to unity.

Indeed, many additional taxation efforts have been either insignificant or counterproductive. It follows that there is also the need for bringing the direct and indirect taxes into a better balance by broadening the base of income and corporate taxation. To achieve this, the many wasteful tax concessions, like tax holidays, should be withdrawn. Also, agricultural income must be brought into the income-tax net.

(vii) The most unexpected results of the model relate to the identification of the factors that cause monetary expansion and lead to an increase in the general price level. The estimated equations show that (i) deficit financing has *not* directly contributed to monetary expansion; (ii) monetary expansion does *not* explain changes in the general price level; (iii) credit expansion and foreign-exchange reserves are the two most important factors that explain monetary expansion; and (iv) the general price level is highly correlated with changes in the *share* of commodity-producing sectors.

These results pinpoint the need for regulating monetary expansion by controlling the creation of credit and by offsetting the expansionary effects of any increase in foreign-exchange reserves. It also follows that anti-inflationary policies must emphasize the need for raising the share of commodity-producing sectors in the GDP and, to a lesser extent, for *increasing* imports.

THE UNFINISHED AGENDA

The Macro-econometric Model of Pakistan's Economy marks the culmination of PIDE's efforts to build economy-wide models to provide a solid basis for consistent macro-economic policy-making in Pakistan. The model has been estimated and validated successfully, and has stood up well to sensitivity analysis. With the completion of the structural analysis, the foundation has been laid for conducting forecasting and policy-simulations exercises, the results of which will soon be published in Vol. II of the present report. With that done, the model will be ready for use as an effective tool for policy evaluation by relating specific economic policies to their effects throughout the economy.

Where do we go from here? Needless to state that efforts will continue for making further refinements of the specification of the model. We have just embarked on a train of thought that is bound to take its passengers everywhere and anywhere. However, note that the present set of equations has been arrived at after a large number of experimentations with all economically meaningful alternative formulations. Since the publication of the PIDE Model (1982), many of the crucial variables – e.g. the value added in various sectors – have been endogenized, while the equations suffering from a variety of econometric ailments have been re-specified and re-estimated. Winnowed with severe econometric tests, a fairly reliable system of equations has been created, given the imperfections of the data and a lack of reliable knowledge, *a priori* and empirical, about those parts of the economy – e.g. agriculture, small-scale manufacturing, and construction sectors – whose behaviour remains shrouded in mystery.[16]

Until such time as many more observations are added to the existing time-series data and new ones are generated, it will be more fruitful to shift the focus of enquiry from an economy-wide aggregate study to disaggregated studies of different aspects of the present model. Once these studies are completed, a more disaggregated macro-econometric model will become possible, which may be two or three times as large as the present model. The production side would have an input-output table embedded in it. Factor demands, factor supplies, and factor payments would be explained within the model which, in turn, would determine consumption, saving, and investment behaviours. Foreign trade, monetary, and fiscal blocks would be further disaggregated and more explicit links established between the domestic economy and the world economy. Prices, interest rate, and the exchange rates would be explained within the model and their resource-allocation role more fully analysed.

One promising line is to conduct a comprehensive study of labour market in Pakistan at a disaggregated level. A knowledge of the complexities of labour market needs to be combined with information on the use and availability of labour. Migration of labour from the rural to the urban areas and abroad needs to be explained explicitly and its repercussions on the economy – i.e. on employment, wages, etc. – should be analysed. The exact mechanism of determining wage levels in various sectors of the economy and the intersectoral wage differentials must also be spelled out. All this will require generation of data on the relevant aggregates at the micro level, which would be a project by itself. The statistical and economic facts revealed through such a study should permit an obvious extension of the present model involving an endogenization of the labour market.

Another fruitful extension would be to 'add on' to the present model an explicit mechanism that explains the distribution of income between the principal economic agents. The saving propensities out of wages, rents, interest and profit

[16]Apart from policy making and research, the PIDE model can be fruitfully used for the teaching of macroeconomics at various universities in Pakistan by clearly displaying the structure of Pakistan's economy. A model such as this, when made operational on a computer system, provides to the economists the equivalent of the physicist's laboratory facilities for conducting fruitful experiments.

incomes would have to be estimated and their implications for capital formation explicitly brought out. Such a study, requiring both cross-section and time-series data, will provide a rare insight into the possibilities of implementing a 'feasible' programme of income distribution, such as is not possible with the help of such simple statistics as Atkinson's index and Gini coefficient. These distributional cosiderations can be built into the model by specifying relationships (equations) to study the employment-generating potential of various commodity-producing sectors, the consumption behaviour of various income groups in terms of their calorie-intake, the relative distribution of industrial income between wage-earners and the capitalists and of agricultural income between the cultivators and the landlords, the relative share in government expenditure of social sectors like education, health, etc. Roping the socio-political reality into the simulation 'chamber' will take considerable amount of data on the relevant variables. There are difficulties but in view of the rich dividends that it will yield the effort is worth the candle.[17]

The monetary sector of Pakistan's economy deserves a more detailed treatment. The demand for money has to be brought into a general framework of demand by asset-holders for various assets, with money as one of the possible assets. Similarly, the behaviour of banks in determining the supply of money needs to be explicitly modelled. The effect of both money demand and money supply on interest rate needs to be specified and estimated; and the influence of expectations on the general price level and other variables should be clearly reflected in the model. However, for many such studies, *quarterly* time-series data will be needed, especially for the GDP, to permit fruitful experimentation with 'lags' of various lengths.

Both the Input-Output Table and National Income and Expenditure Accounts reveal different aspects of the economy. Whereas the former focuses on production, intermediate production, and intersectoral deliveries, the latter's focus is on final expenditures. Traditionally, models built around input-output tables have been planning models of a linear-programming vintage.[18] National income and expenditure accounts have generally provided a basis for macro-econometric models of a behavioural nature. For a 'complete' picture of the economy, these models need to be explicitly linked. The final demand categories would be supplemented with intersectoral deliveries and vice versa. It would then be possible to handle policy questions pertaining to the determination of sectoral growth priorities and the effect

[17]Some work has been done to study the distributional implications in terms of formal models. For instance, see S.I. Cohen [3] who has applied his model to India, Korea and Chile.

[18]Many such models are given in Adelman [1] and Chenery [2].

of such decisions on the existing economic structure. Since a 118 X 118 input-output table for 1975-76 has been completed recently at PIDE, it is worthwhile pursuing this project.[19]

The PIDE Macro-econometric Model could also become the focal point for exploring questions relating to the structural interdependence that exists between Pakistan's economy and its main trading partners. Indeed, through the PIDE Model, Pakistan is already participating in the laudable efforts made by Project Link and ESCAP's Asian Sub-link Project to understand better the many connections that tie national economies together into the framework of a world economy and to explore possibilities of greater regional economic collaboration.[20] Such 'links' also provide an effective mechanism through which improvements, both substantive and technical, can be made in the estimation procedures employed in the construction of national models.

An important aspect of the process of model-building is the development of new testable hypotheses about specific aspects of Pakistan's economy. Many of the standard hypotheses, used routinely by policy-makers and economists, have been designed to explain economic behaviour in advanced industrialized economies. These hypotheses may not be the best vehicles of thought for unravelling the mysteries of economic processes in a developing country like Pakistan. The present study offers quite a few such hypotheses about the determination of the value added in major commodity-producing sectors, the factors that explain consumption and investment behaviour and the temporal movement of the general price level. While no attempt has been made to generalize these formulations, it is hoped that similar experiments will be replicated in other developing countries as well. However, the 'net worth' of the hypotheses developed in the present study cannot be judged entirely by the possibilities of such cross-country generalizations because developing countries are not a homogeneous group. Even though they display similarities in some respects, they also have unique characteristics of their own, which need to be understood by econometric exercises such as the one undertaken for Pakistan's economy in this study.

In so far as the marginal utility of a scientific contribution is measured by the element of 'surprise' in it, the present model does contribute to our knowledge about

[19]A study of Pakistan by Khilji [4] successfully incorporates the 1963 input-output table into the econometric model.

[20]An initial effort, on a small scale, by Naqvi and Khan [9] explores the possibilities of trade expansion among Pakistan, India, Sri Lanka and Bangladesh.

Pakistan's economy. However, this is too restrictive a view. The numerous findings of the present study, which confirm what we already know only vaguely, make an equally important contribution to knowledge. Taking both these aspects into consideration, the policy makers will be greatly helped – even when they are shocked – by the many 'discoveries' of the present study which illustrate the very important point that intuition, or even pure induction, is no substitute for empirically-tested hypotheses when it comes to unravelling the mysteries of the 'structure' of a *non*-Robinson-Crusoe economy.

The demise of the 'age of chivalry', if it ever comes to pass in Pakistan, may be bad news for the economists and the policy-makers who routinely proffer standard cure-alls that range from a revolutionary reconstruction of man's unaltruistic behaviour, of course without revolution, to a sharp increase in the supply of clean water, which according to the protagonists of the idea will wash away all economic ills. However the publication of the present study, a truly revolutionary 'event' in Pakistan, will gladden the heart of those who are blessed – or cursed, shall we say – with the determination to travel along the thorny road of knowledge that begins with uncertainties and ends, if ever, with certainties. Whatever the outcome of this intellectual journey, one thing is absolutely clear: having come thus far, there is now no looking back. That being the case, "now let it work; mischief, thou art afoot, take thou what course thou wilt".

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PART II

SPECIFICATION OF THE MODEL

INTRODUCTION

The purpose of the chapters in this part is to develop a simultaneous-equation model for a better understanding of the multi-dimensional complexities of Pakistan's economy as it evolved during the 1959-60–1978-79 period.[1] The model would also enable us to discern more clearly than is otherwise possible the structure of the Pakistani economy and to assess quantitatively the relative 'weights' of the many components of this structure. Within such a quantitative framework, even inadequate explanations point out the many gaps in our knowledge that have to be closed before we may proceed further.

The model specified in the chapters of this part assumes that in a developing country like Pakistan the availability of inputs is at least as important as demand factors in determining aggregate output. There are in all 58 equations, of which 33 are behavioural and 25 definitional. To highlight within-the-model relationships, the model has been subdivided into 3 sub-models, each of which is in turn divided into two blocks.[2] The three sub-models are: (i) Production-Expenditure Sub-model, which contains 20 behavioural and 14 definitional equations; (ii) Foreign Trade Sub-model, which carries 6 behavioural and 7 definitional equations; and (iii) Fiscal and Monetary Sub-model, consisting of 7 behavioural and 4 definitional equations. However, the model is fully simultaneous in nature: there is interaction among economic variables both within each sub-model and across the sub-models. It is also dynamic.

[1] Almost all data on Pakistan are on a fiscal-year basis, i.e. July–June. Except where specified otherwise, whenever a year is mentioned in this study, it refers to the year ending on June 30.

[2] It may be noted that here the block classification is merely an expository device. This model, unlike the Brookings model, is not block-recursive.

There have been relatively few economy-wide models of Pakistan's economy based on time-series data.[3] The 53-equation model by Naqvi *et al.* [5], referred to hereinafter as PIDE Model (1982), was the first comprehensive attempt at macro-econometric model building. The model was cast in real terms and the functional form used was log-linear throughout. In the present model, we have allowed ourselves greater flexibility in choosing functional forms which have been selected on the basis of their superior explanatory power. Most of the equations are now in linear form and in constant values *while the tax equations are in nominal terms.* Some variables that were exogenous before have now been endogenised. Most of the specifications used in the PIDE Model (1982) have been revised in the light of extensive experimentation with alternative specifications. Also, the many inconsistencies in the data base that could only be tolerable in a first attempt have been removed in the present version. The differences between the PIDE Model (1982) and the present model will be highlighted in the discussion of individual functional relationships in the ensuing discussion.

There are four main considerations calling for a revised version of the PIDE Model (1982) so soon after its publication. Firstly, the PIDE Model (1982) was restricted to structural analysis only, without doing any validation of the model to check within-the-sample predictive power of the estimated coefficients. On the other hand, the equations finally chosen in the present model have been subjected to the standard validation and stability tests. The results of these exercises are given in Part IV of this report. Such exercises necessitated re-specification and re-estimation of many of the equations reported in the PIDE Model (1982). Secondly, the scope of the present study has been expanded to encompass all the three components of econometric analysis, viz. structural analysis, forecasting, and policy evaluation. The requirement of making reliable forecasts has also necessitated some revision of the PIDE Model (1982), which was restricted to structural analysis alone. Thirdly, the practice, adopted in the PIDE Model (1982), of superimposing explicit input demand functions on production functions in the agricultural and manufacturing sectors was open to question, mainly because it could give rise to inconsistent predictions about the levels of inputs and output in various sectors. There are many ways of resolving the problem.[4] The method used in this study has been to eliminate all the explicit input demand functions from the model and to replace them by input demand equations derived from marginal productivity conditions.

[3] Islam's short-run model of Pakistan's economy [3] consisted of 50 equations, of which 23 were behavioural. It used the OLS estimation technique and was confined to structural analysis, without engaging in any 'validation' exercise. Bhuiyan's model [1] concentrated on the financial side of the economy with a small real sector. Tims's model [6], though not an econometric model, was also a macro model, using two input-output tables for 1960-61 and 1964-65, to study the consistency of the Third Five Year Plan (1965–70). Khilji [4] incorporated an input-output table for 1963 with a disaggregated macro-econometric model of Pakistan (excluding Bangladesh).

[4] For instance, see Intrilligator [2].

Finally, the search for a better and more adequate explanation is a continuing process, requiring extensive experimentation with specifications and estimation techniques. This applies particularly to developing countries like Pakistan regarding which there exist few reliable hypotheses which could help to specify meaningful functional relationships. Because of the many inter-country structural differences, it is not possible, in constructing a model for a developing country like Pakistan, to accept *in toto* the many hypotheses about the behaviour of the endogenous variables which are suitable for developed economies. To evolve testable hypotheses which may adequately explain the working of a developing economy, there is no other way than that of making experiments, indeed a large number of them, which could then become the point of departure for more experimentation. The PIDE Model (1982) was the first such effort. We have undertaken the present work, relying mainly on extensive experimentation to remove the many deficiencies that any pioneering work suffers from, in the hope that we may have 'belled the cat' this time – if only to repeat, like Sisyphus, the feat shortly thereafter. To highlight the distinguishing characteristics of Pakistan's economy, the basic results of this study are compared with the many standard hypotheses that are reported in the vast literature on applied econometrics.

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Chapter 2

PRODUCTION-EXPENDITURE SUB-MODEL

For the sake of expositional clarity, the Production-Expenditure Sub-model is broadly divided into a Production Block and an Expenditure Block. Within the Production Block, 10 major sectors are identified. These are: agriculture (crop) sector; agriculture (non-crop) sector; large-scale manufacturing; small-scale manufacturing; construction; mining and quarrying; wholesale and retail trade; public administration and defence; ownership of dwellings; and services. Within the Expenditure Block, two major sectors are identified: consumption and investment.

Production Block

In the Production Block there are in all 19 equations, of which 14 are behavioural and 5 definitional. The definitional equations, given below, simply state that the value added at various levels of aggregation is a sum of the relevant elements of the production sector.

$$Y_g = Y_a + Y_b + Y_q + Y_{lm} + Y_{sm} + Y_c + Y_r + Y_{od} + Y_p + Y_s \quad (2.1)$$

$$Y = Y_g + R \quad \ldots \quad \ldots \quad \ldots \quad (2.2)$$

$$Y_A = Y_a + Y_b \quad \ldots \quad \ldots \quad \ldots \quad (2.3)$$

$$Y_n = Y - Y_A \quad \ldots \quad \ldots \quad \ldots \quad (2.4)$$

where

Y_g = Gross Domestic Product at factor cost;

Y_a = Value added in the agriculture (crop) sector;

Y_b = Value added in the agriculture (non-crop) sector;

Y_q = Value added in mining and quarrying;

Y_{lm} = Value added in large-scale manufacturing;

Y_n = Non-agricultural income;

Y_A = Value added in the agriculture sector;

Y_{sm} = Value added in small-scale manufacturing;

Y_c = Value added in construction;

Y_r = Value added in the wholesale and retail trade;

Y_{od} = Value added in ownership of dwellings;

Y_p = Value added in public administration and defence;

Y_s = Value added in services;

Y = Gross National Product at factor cost; and

R = Net factor income from abroad (i.e. remittances adjusted for net factor income outflow).

(i) Production Function for Agriculture (Crop) Sector

The first behavioural equation in the model relates to the agriculture (crop) sector. Following the PIDE Model (1982), a Cobb-Douglas production function with constant returns to scale is specified. It simply states that the value added in the agriculture (crop) sector, (Y_a), is a function of major agricultural inputs, cropping pattern and a time trend.

Agricultural Production Function

$$Y_a = f(L_a, T_r, Q, t) \qquad (2.5)$$

where

L_a = Agricultural labour;

T_r = Number of tractors;

Q = Share of wheat in the total cropped area (Q is a proxy for cropping pattern); and

t = Time trend.

It may be noted that this specification is much less 'ambitious' than the one used in the PIDE Model (1982), which also included as arguments area under crop, tubewell and fertilizer. This is because the estimation of the earlier specification yielded a negative sign for the tractor variable, suggesting that, on the margin, tractors made a negative contribution to the value added in agriculture! While there is some reason to believe that this may well have been the case, such a production function yielded meaningless results in validation and forecasting. (For details, see Chapter 5.)[1]

[1] Prof. Asad Zamán, in his correspondence with Naqvi (February 22, 1982), pointed out the possibility of high correlation among various inputs in agriculture sector. Furthermore, he suggested various improvements by changing the dependent variable to value added per unit of labour, instead of per acre. We experimented with all the suggested formulations and finally chose the one given in the text. (For more details, see Chapter 5.)

The specification and estimation of an aggregate agricultural production function have proved to be some of the most difficult problems in applied econometric work. In the UNCTAD model for India [19], output per acre is specified to depend simply on rainfall and a time trend. Similarly, in the Brazilian case DeVries [7] uses an equally simple form, specifying output in agriculture as depending on the total harvested land. Behrman and Klein [2] specify population as the relevant variable explaining output in the primary sector. In the model for Thailand by Chaipravat *et al.* [4], an agricultural production function is estimated in log-linear form with labour, land and capital stock as the arguments of the function. Marzouk [14], Khilji [11], and several others approach the determination of output in the agriculture sector through a fixed-proportion production function based on an input-output framework.

The specification used in the present model, though relatively simple, has evolved after extensive experimentation with alternative functional relationships. Admittedly, specifying an aggregate production function for the agriculture (crop) sector, as we have done, is an over-simplification. Capital-intensive large farms using modern inputs (fertilizers, tractors, improved seeds, etc.) co-exist with labour-intensive farms which employ traditional farming methods. It would, therefore, have been ideal to specify separate production functions, taking into account their input structures. However, improvements like these will become possible only with the availability of more and better data. Extensive experiments with a large number of functions have convinced us that in view of the high degree of complementarity among agricultural inputs like fertilizers, tractors, tubewells, etc., not much can be gained by merely adding more inputs as arguments of the agricultural production function. Perhaps, things may improve if a rainfall index were devised and included as an explanatory variable. (See Chapter 5 for further discussion of this point.)

Input Demand Functions for Agriculture (Crop) Sector

Given the Cobb-Douglas production function with constant return to scale, the well-known first-order conditions for the profit-maximization problem have been used to derive the input demand function for Labour (L_a) and tractors (T_r).[2]

$$L_a = \alpha_1 \frac{Y_a \cdot P_a}{W_a} \qquad \ldots \qquad \ldots \qquad \ldots \qquad (2.6)$$

[2] Prof. Tinbergen, in his correspondence with Naqvi (Nov. 25, 1982), objected to the practice, adopted in the PIDE Model (1982), of specifying separate input demand functions along with a production function. It may be noted that the practice of estimating input demand function like the one adopted in the text, with the help of marginal productivity condition, was also adopted in the Brookings Model and Wharton Model. See, for example, Kmenta and Ramsey [12] and Fromm and Klein [9].

$$T_r = (1-\alpha_1) \frac{Y_a \cdot P_a}{P_r} \quad \ldots \quad \ldots \quad \ldots \quad (2.7)$$

where

α_1 = The exponent for agricultural labour in the Cobb-Douglas production function;

W_a = Shadow wage in agriculture;

P_a = Price index of agriculture output; and

P_r = Price index of tractor.

(ii) Production Function for the Large-scale Manufacturing Sector

A Cobb-Douglas production function has been specified for the large-scale manufacturing sector.

$$Y_{lm} = f(K_{lm}, L_{lm}, D_i, t) \quad \ldots \quad \ldots \quad (2.8)$$

In addition, the following definitional equation is specified.

$$K_{lm} = I_{lm} + (1-\delta) K_{lm-1} \quad \ldots \quad \ldots \quad (2.9)$$

where

Y_{lm} = Value added in large-scale manufacturing;

K_{lm} = Capital stock in large-scale manufacturing;

L_{lm} = Labour force in large-scale manufacturing;

D_i = Dummy variable for recession during the 1969-70–1976-77 period;

I_{lm} = Total investment in large-scale manufacturing; and

δ = Rate of depreciation.

The identity (2.9) relates capital stock to current investment and to lagged capital stock adjusted for depreciation.

Even though the large-scale manufacturing sector lends itself to a more straight-forward specification than agriculture, there are difficulties here as well for which there are no easy solutions. Firstly, in Pakistan, as in many other developing countries, availability of funds is a more decisive determinant of the value added in manufacturing than interest rates. Besides bank loans, retained earnings in the corporate sector have been important sources of investible funds. Secondly, fiscal policies–e.g. tax holidays, accelerated depreciation allowances, etc. – have been highly influential in determining the value added in large-scale manufacturing. Thirdly, quantitative restrictions, taking the form of investment sanctions and import licensing, have influenced the volume of the value added in large-scale manufacturing by changing not only the composition of investment but also its rate. Finally, economic changes, such as large-scale nationalization, have also been important in the determination of output in large-scale manufacturing. In varying degrees, one or more of these factors have been particularly important in the last 20 years; and yet time-series data are not available on most of these variables. An attempt should be made to explicitly incorporate the effect of these forces in future models.

Input Demand Functions for Large-scale Manufacturing

As in the case of agriculture, first-order conditions of profit maximization have been used to derive input demand function for labour (L_{lm}) and capital (K_{lm}), which are expressed in terms of output and their own prices. Thus

$$L_{lm} = \alpha \cdot \frac{Y_{lm} \cdot P_{lm}}{W_{lm}} \qquad \text{(2.10)}$$

$$K_{lm} = \beta \cdot \frac{Y_{lm} \cdot P_{lm}}{r_i} \qquad \text{(2.11)}$$

where

α = Exponent for labour in large-scale manufacturing;

β = Exponent for capital in large-scale manufacturing;

P_{lm} = Price index of manufactured goods in large-scale manufacturing;

W_{lm} = Wages in large-scale manufacturing; and

r_i = Shadow price of capital.

(iii) "Other Sectors"

The equations for the remaining eight production sectors are specified as follows:

Construction	$Y_c = f(C,I)$	(2.12)
Wholesale and Retail Trade	$Y_r = f(Y)$	(2.13)
Public Administration and Defence	$Y_p = f(C_g, t)$	(2.14)
Agriculture (non-crop)	$Y_b = f(C, I, X_T, M_T)$	(2.15)
Mining and Quarrying	$Y_q = f(C, I, X_T)$	(2.16)
Ownership of Dwellings	$Y_{od} = f(C, I)$	(2.17)
Small-scale Manufacturing	$Y_{sm} = f(C, I, X_T, M_T)$	(2.18)
Services	$Y_s = f(C, t)$	(2.19)

where

I = Total investment;

C_g = Public consumption;

C = Total consumption;

X_T = Total exports; and

M_T = Total imports.

Equations (2.12) to (2.19) express the value added in various sectors in terms of final demand.[3] This procedure can also be interpreted as "transformation of an input-output production process" [14]. The value added in construction, (Y_c), depends on total consumption (C) and investment activity, (I). Similarly, the value added in wholesale and retail trade, (Y_r), is determined by GNP alone. The value added in public administration and defence, consisting primarily of wages and salaries of government employees (civil and defence personnel), is hypothesised to depend on total public consumption expenditures and time trend.

Expenditure Block

In the Expenditure Block, there are 15 equations in all. Of these, 6 are behavioural equations while the rest are definitional equations. The first identity specifies an overall resource gap, (G_r), in the economy.

$$G_r = C + I - Y \quad \text{.. .. ..} \quad (2.20)$$

The following identity gives the breakdown of total consumption into private consumption, (C_p), and public consumption, (C_g).

Total Consumption

$$C = C_p + C_g \quad \text{.. .. ..} \quad (2.21)$$

Similarly, total investment expenditure is disaggregated into private investment, (I_p), public investment, (I_g), and changes in inventories, (S_t).

Total Investment

$$I = I_p + I_g + S_t \quad \text{.. .. ..} \quad (2.22)$$

The two components of investment, viz. private investment and public investment, are further disaggregated and defined as follows:

Private Investment

$$I_p = I_{pm} + I_{pa} + I_{po} \quad \text{.. .. ..} \quad (2.23)$$

[3] It may be noted that in the PIDE Model (1982) these sectors were either taken as exogenously determined or were specified to grow over time at an exogenously given exponential rate.

Public Investment[4]

$$I_g = I_{gm} + I_{go} \qquad (2.24)$$

$$I_{gm} = \bar{I}_{gm}$$

where

I_{pm} = Private investment in large-scale manufacturing;

I_{pa} = Private investment in agriculture;

I_{po} = Private investment in "Other Sectors";

I_{gm} = Public investment in large-scale manufacturing ; and

I_{go} = Public investment in "Other Sectors".

The total investment in the large-scale manufacturing sector, (I_{lm}), is expressed as the sum of private investment, (I_{pm}), and public investment, (I_{gm}), in this sector:

$$I_{lm} = I_{pm} + I_{gm} \qquad (2.25)$$

The following six behavioural equations are specified for individual components of the various definitions given above.

Consumption Behaviour

(i) *Private Consumption Function*

The equation explaining private consumption and the relevant identities are specified as follows:

$$C_p = f(Y_d, R, M/P_{gn}, \dot{P}) \qquad (2.26)$$

where

C_p = Private consumption;

Y_d = Disposable income, *not* adjusted for remittances;

M = Nominal money stock, (M_2 definition);

P_{gn} = GNP price index (1959-60 = 100); and

$\dot{P}$ = Time rate of inflation.

Disposable Income is defined as

$$Y_d = Y - Z_i \qquad (2.27)$$

and

$$Y^D = Y_d - R \qquad (2.28)$$

[4] Public investment in the large-scale manufacturing sector is exogeniously given in the model because it constitutes a relatively minor proportion of total public investment and also because the time-series on public investment behaves rather erratically.

where

Y^D = Disposable income, adjusted for remittances; and

Z_i = Income and corporation taxes.

The specification of the consumption function as adopted here is different from that specified in the PIDE Model (1982), which explains private consumption in terms of disposable income, inflation (forced-saving hypothesis), rate of interest, remittances from abroad, real balances, and foreign aid. In the present specification, the rate of interest and foreign aid have been dropped for the following reasons. Firstly, extensive experiments with alternative specifications revealed that interest rate and real balances are highly collinear, thus necessitating an alternative specification involving the inclusion of only one of these argument in the function. Secondly, although foreign aid may influence private consumption indirectly, there is very little theoretical basis for hypothesising a direct causal relationship, positive or negative, between the two variables.

It is interesting to note why we specified the Keynesian hypothesis instead of other theoretically more satisfactory hypotheses.[5] The Permanent Income Hypothesis has not been specified in view of Khan's study [10], which contradicts it. On the other hand, the Absolute Income Hypothesis has found some support from Pakistani data.[6] Ali [1] shows absolute income to be significant in explaining savings. The marginal propensity to save in his study comes out to be 0.11, implying an MPC of 0.89 for Pakistan (Bangladesh excluded). Perhaps more research is required on the consumption behaviour in a developing country like Pakistan because the accuracy with which it can be predicted has an important bearing on the forecasting ability of the model as whole.

(ii) *Public Consumption*

The behavioural equation for public consumption is specified to depend on public revenue, gross foreign assistance, and lagged government consumption. (The

[5]The main contending hypotheses in the field are: Keynesian Absolute Income hypothesis: Friedman's Permanent Income Hypothesis, Duesenberry's Relative Income Hypothesis and the Ando-Blumberg-Modigliani Life Cycle Hypothesis. For a fairly good overview of these contending hypotheses, see Dornbusch and Fischer [8]. These hypotheses, formulated initially for developed countries, have been tested in the context of many developing countries. Chenery and Eckstein [5], Singh [18], Williamson [20], Landsberger [13], and Mikesell and Zinser [15] have reviewed the existing empirical evidence for private consumption-savings behaviour in Latin American and other developing countries. One major finding is to support a medium-term version of Friedman's Permanent Income Hypothesis whereas efforts to find support for the Ando-Blumberg-Modigliani Life Cycle hypothesis have been much less successful.

[6]An earlier study by Bhuiyan [3] also attempted to explain consumption behaviour in Pakistan (including Bangladesh) in terms of the Permanent Income Hypothesis. He found that the marginal propensity to consume out of transitory income was not significantly different from unity, thereby contradicting the hypothesis.

last term reflects the inability of the government to alter its expenditure significantly in the short run.) This specification is similar to the one adopted in the PIDE Model (1982), with the exception of an additional term for the lagged consumption included here.

Public Consumption Function

$$C_g = f(Z, F_k, C_{g-1}, D_i) \qquad \ldots \qquad \ldots \qquad (2.29)$$

where

Z = Total public revenue;[7]

F_k = Foreign capital inflow; and

D_i = Dummy variable taking the value of 1 in 1965-66 and of 0 otherwise.

A priori, it is difficult to predict public consumption expenditure, particularly because a considerable part of public expenditure is dictated by the vagaries of politics, national and international. Nonetheless, equation (2.29) does appear reasonable. The postulated relationship may be explained by the fact that even though in the short run the government can use foreign assistance and deficit financing to cover the deficit on current account, in the final analysis it is tax revenues that constrain public consumption. In so far as public revenue influences government consumption, it is more relevant than the GDP variable. See UNCTAD [19], Marzouk [14], Rio and Klein [17], Khilji [11], Dar [6], and the PIDE Model (1982) for similar formulation.

Investment Behaviour

(i) *Private Investment*

In specifying private investment, account has been taken of sectoral peculiarities, especially those relating to value added and relative prices. All attempts to estimate a 'global' investment function for the entire private sector proved to be infructuous. In line with the approach adopted in the PIDE Model (1982), three equations for private investment in agriculture, manufacturing, and other sectors have been separately specified.[8] However, unlike the PIDE Model (1982), this

[7] The identity describing Z is given by equation (4.49) in the Fiscal Block.

[8] Investment function has received less rigorous treatment in other macro-econometric models of developing countries than that given in the present model. For example, in the UNCTAD Model [19], only one investment function, i.e. that of investment in fixed assets, has been estimated for the Indian economy, while a very simple function of inventory investment and depreciation has also been specified. Similarly, for the Nigerian economy only two equations – those for private investment in petroleum and non-petroleum sectors – are estimated, thus completely ignoring the public investment expenditure function.

model has treated private investment in "Other Sectors" as exogenously determined. This is because "Other Sectors" constitute an amorphous bag in which different elements, each of which requires a distinct specification, are inextricably mixed up. All attempts to disentangle this web failed.

(a) *Private Investment Function in Agriculture*

$$I_{pa} = f(Y_a, C_r, P_r/P_a, R) \qquad (2.30)$$

(b) *Private Investment Function in Large-scale Manufacturing*

$$I_{pm} = f(\triangle Y_{lm}, P_i/P_{gd}, C_r, R, D_i) \qquad (2.31)$$

and

$$\triangle Y_{lm} = Y_{lm} - Y_{lm-1} \qquad (2.32)$$

(c) *Private Investment Function in "Other Sectors"*

$$I_{po} = \bar{I}_{po}, \text{ exogenously given;}$$

where

$\triangle Y_{lm}$ = Changes in the value added in large-scale manufacturing;

P_r = Price index of tractor (1959-60 = 100);

P_{lm} = Price index of large-scale manufacturing output (1959-60 = 100);

P_i = Price index of investment goods (1959-60 = 100);

P_a = Price index of agricultural output (1959-60 = 100);

C_r = Real credit made available to the private sector;

I_{po} = Private investment in "Other Sectors"; and

D_i = Dummy variable for the 1971-72–1973-74 period.

In specifying equations for gross private investment for the three sectors mentioned above, a distinction must be drawn between planned (*ex ante*) and realized (*ex post*) investment. In countries with well-organized capital markets, the cost of capital can be clearly identified. Planned investment decisions are based on a comparison of the present value of the expected stream of income to be generated by marginal investment with the marginal cost of investment. Therefore, the variables which enter into investment decisions include the capitalization rate (applicable to real assets) and income. Pakistan does not have a well-functioning capital market so that a large part of domestically financed investment passes through extra-capital-market channels. In the rural sector, borrowing is done from friends and relatives. In the modern sector, legal limits on nominal interest rates are not always effective in clearing the market for loanable funds so that credit rationing must be introduced to enforce government priorities for sectors and enterprises as set out in the annual Investment Schedule. These considerations explain the non-inclusion of rate of interest as an argument in any of the investment equations above. On the other hand, factors like credit availability by sectors and the flow of foreign funds coming from remittances by Pakistani workers abroad, should be more important in influencing private investment behaviour. The findings in Khilji's study [11] and the PIDE Model (1982) confirm these statements.

In specifying the equation for private investment in agriculture, the value added in agriculture, availability of credit, relative price and remittances from abroad are used as arguments. However, in the equations for private investment in large-scale manufacturing, the value added in large-scale manufacturing appears in the first-difference form to simulate the working of the accelerator principle.[9] Besides the accelerator, the availability of credits, relative price, remittances, and a dummy variable (to capture the effect of large-scale nationalization in 1972) are also used as arguments in the equation.

(ii) *Public Investment in "Other Sectors"*

Public investment in "Other Sectors" is specified to depend upon total revenue, availability of foreign capital, and lagged public investment. The last-mentioned variable denotes the influence of on-going projects for which commitments have already been made. It may be noted that this equation does not include public investment in large-scale manufacturing.[10]

$$I_{og} = f(Z, F_k, D_i, I_{og-1}) \quad \ldots \quad \ldots \quad \ldots \quad (2.33)$$

where

Z = Total Public Revenue;

F_k = Foreign Capital inflow; and

D_i = Dummy variable for the 1963–65 period.

Public Subsidies[11]

The last equation in the Expenditure Block pertains to public subsidies, which consist of the expenses incurred by the government in distributing

[9] The inclusion of the accelerator in private investment in large-scale manufacturing was suggested by Professor Tinbergen in his correspondence, of 25, Nov. 1982, with Naqvi.

[10] In the PIDE Model (1982) an aggregate equation was specified including public investment in the large-scale manufacturing sector. However, the presence in the model also of an aggregate equation (2.8) for investment in the large-scale manufacturing sector (private and public) implied an inconsistency, leading to over-identification. This point was raised by (Late) Prof. Leif Johansen in his correspondence, dated November 26, 1982, with Naqvi.

[11] The PIDE Model (1982) treated subsidies as exogenously given.

improved seeds and fertilizers to farmers for free or at reduced rates. The government also incurs losses by procuring major crops (primarily wheat and rice) at a price higher than the market price and then rationing them at subsidized rates. Public subsidies (S_u) are, therefore, specified as depending upon the value added in major crops and a time trend, which has been added to denote the fact that subsidies have tended to increase over time. A negative relationship is postulated between subsidies and the value added by major crops because in years of increasing farm income subsidies have tended to go down.

$$S_u = f(Y_a, D_i, t) \quad \quad (2.34)$$

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Chapter 3

INTERNATIONAL TRADE SUB-MODEL

The International Trade Sub-model specifies 13 equations in all, of which 6 are behavioural equations and the rest are definitional relations. There are two blocks in the sub-model: the Export Block and the Import Block. For expositional simplicity, capital account is treated as exogenously determined. This is because capital inflows in Pakistan are largely determined by political and economic considerations – e.g. the confidence that aid-giving agencies repose in Pakistan's economy. Furthermore, the flow of foreign funds in response to changes in the interest rate is precluded by the regime of exchange controls.

To ensure a consistent closure of the foreign trade account, the trade deficit, (G_t), which by definition is equal to the resource gap, (G_r), is defined as follows:

$$G_t = M_T - X_T = G_r = C + I - Y \qquad (3.35)$$

where

M_T = Total imports; and

X_T = Total exports.

The current account deficit, (B), is derived from the trade deficit after making adjustment for net factor income from abroad, (R).

$$B = G_t - R \qquad (3.36)$$

(Four more identities are noted below, two each in the Import Block and the Export Block.)

Import Block

The Import Block contains 5 equations, 3 of which are behavioural equations while 2 are definitional identities. The latter are:

$$M_T = M_g + M_{sr} \qquad (3.37)$$

$$M_g = M_c + M_i + M_k \quad \ldots \quad \ldots \quad \ldots \qquad (3.38)$$

where

M_g = Imports of goods;

M_{sr} = Imports of services;

M_c = Imports of consumer goods;

M_i = Imports of intermediate goods; and

M_k = Imports of capital goods.

The 3 behavioural equations, given below, relate to the demand for imports of consumer goods, (M_c), intermediate goods, (M_i), and capital goods, (M_k). The imports of services are treated as exogenously given.

Consumer Goods Imports

$$M_c = f(Y_d, [E(1+t_c+b_c) . P_{cm}/P_c], M_{c-1}). \quad \ldots \qquad (3.39)$$

Intermediate Goods Imports

$$M_i = f\ (Y_m, [E(1+t_i + b_i).P_{im}/P_{iw}], M_{i-1}) \quad \ldots \qquad (3.40)$$

Capital Goods Imports

$$M_k = f\,(I, [E(1+t_k + b_k) . P_{km}/P_{mw}], M_{k-1}) \quad \ldots \qquad (3.41)$$

Services Imports

$$M_{sr} = \overline{M}_{sr}$$

where

Y_d = Disposable income;

E = Nominal exchange rate;

t_c = Weighted average tariff rate on consumer goods imports;

b_c = Bonus expenditure rate on consumer goods imports;

P_{cm} = Unit value index of consumer goods imports (1959-60 = 100);

P_c = Consumer price index (1959-60 = 100);

Y_m = Value added in manufacturing;

t_i = Weighted average tariff rate on intermediate goods imports;

b_i = Bonus expenditure rate on intermediate goods imports;

P_{im} = Unit value index of intermediate goods imports (1959-60 = 100);

P_{iw} = Wholesale price index of intermediate goods (1959-60 = 100);

t_k = Weighted average tariff rate on capital goods imports;

b_k = Bonus expenditure rate on capital goods imports;

P_{km} = Unit value index of capital goods imports (1959-60 = 100); and

P_{mw} = Wholesale price index of manufactured goods (1959-60 = 100);

In view of the widespread use of import restrictions and exchange controls in Pakistan, adjustments have to be made for both price and non-price restrictions. Hence, real *effective* exchange rates are used as the appropriate variable to capture the effect of changes in relative prices on the level of imports.[1] Lagged imports have been introduced to reflect the influence of established trade patterns.

The PIDE Model (1982) contained two additional equations for imports of foodgrains and energy. These equations have now been dropped from the specification for the following reasons. First, as Pakistan has ceased to be a net importer of foodgrains, the inclusion of such an equation in the model would have impaired the model's forecasting ability. Secondly, although the imports of energy now loom large in total imports, this is a relatively recent phenomenon which is not reflected in historical data, thereby creating problems for the historical simulation (validation) of the model.[2]

Export Block

In all, there are 6 equations in the Export Block. Of these, 3 are behavioural equations and 3 are definitional relations.

$$X_T = X_g + X_s \quad \ldots \quad \ldots \quad \ldots \quad (3.42)$$

[1]Many models for developing countries include relative prices as the relevant variable. See, for instance, the models by Khan [3] and UNCTAD [5] which use output and relative prices as arguments of the import functions.

[2]Also, these equations, estimated in the PIDE Model (1982), were rather poor: while the foodgrain equation had a very low explanatory power ($\bar{R}^2 = 0.128$), the energy equation suffered from auto-correlation (DW = 0.48). Subsequent experimentations also did not improve these equations.

$$X_g = X_p + X_m \qquad (3.43)$$

where

X_g = Exports of goods;

X_p = Exports of primary goods;

X_m = Exports of manufactured goods; and

X_s = Exports of services.

The behavioural equations relating to primary goods exports, manufactured goods exports, and services exports are mainly supply-oriented.

Primary Goods Exports

$$X_p = f\ (Y_a, P_{xp}/P_{gn}) \qquad (3.44)$$

Manufactured Goods Exports

$$X_m = f\ (Y_m, P_{xm}/P_{gn}) \qquad (3.45)$$

and

$$Y_m = Y_{lm} + Y_{sm} \qquad (3.46)$$

Services Exports[3]

$$X_s = f\ (Y, t) \qquad (3.47)$$

where

P_{xp} = Price of primary goods exports;

P_{xm} = Price of manufactured goods exports;

Y_m = Value added in manufacturing;

P_{gn} = GNP price index; and

t = Time trend.

Pakistan's share in the world export-market being relatively small, the country is a price-taker. As such, the three export equations specified above include domestic

[3]The exports of services were treated as exogenously given in the PIDE Model (1982).

production of exportable products as one of the arguments. The domestic relative prices of primary and manufactured goods are included to simulate Pakistan's predicament as a price-taker.[4] Higher domestic prices of exports would affect exports adversely, denoting a lower exportable surplus (higher domestic consumption). Although there has been a long-established practice in Pakistan of subsidizing some exports while taxing others, the relative price of exports should have been modified to take account of subsidies and taxes on exports. Such an attempt did not prove fruitful. We have, therefore, followed the practice of the PIDE Model (1982) in which domestic relative prices of exports are used.

The exports of services are specified to depend on the level of income and a time trend. It may be noted that no separate equation has been estimated for rice exports which now constitute 23 percent of Pakistan's total exports. This is because substantial rice exports are only a recent phenomenon, which the model will not explain adequately in the validation exercises.[5]

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[4]Model-builders have differed about the choice of the kind of relative price. Behrman and Klein [1] and Chaipravat *et al.* [2] use world prices relative to domestic prices of the export goods as the argument. On the other hand, UNCTAD [5] uses domestic price as the relevant variable. However, the specification used in this model is more relevant to Pakistan.

[5]For forecasting purposes, a separate equation is technically possible but is not specified here.

Chapter 4

FISCAL AND MONETARY SUB-MODEL

The Fiscal and Monetary Sub-model contains 11 equations, of which 7 are behavioural and the remaining 4 are definitional. The sub-model includes specifications for public revenue, money supply, and the price level. For expositional purposes, this sub-model is divided into two blocks: the Fiscal Block and the Monetary Block.

Fiscal Block

The Fiscal Block contains 7 equations, of which 5 are behavioural and 2 are definitional. Following the standard practice in applied econometric work, separate equations are specified for each of the major taxes.[1] In the PIDE Model (1982), all the tax equations were estimated in real terms. However, the estimated coefficients in real terms are not very useful for analysing changes in tax policy. Hence, in this study all tax equations are specified in *nominal* terms.

The first definitional relation measures the excess of nominal government expenditure over government revenue.

$$D = P_{gn}(C_g + I_g + S_u) - Z \quad \ldots \qquad (4.48)$$

The second identity simply describes the components of tax revenue.

$$Z = Z_c + Z_i + Z_e + Z_s + Z_l + Z_o \quad \ldots \qquad (4.49)$$

[1] Moriguchi [10], Chaipravat *et al.* [3] and UNCTAD [14] disaggregated government revenue, collected through direct taxes (income and corporation) and indirect taxes (customs duties and excise and sales taxes). In these separate functions, each source of revenue is estimated, using the tax base and, in some cases, the tax rate and the tax base as arguments. However, Behrman and Klein's model for Brazil [2] uses highly aggregated tax equation for estimating direct and indirect tax collections.

where

D = Government budget deficit;

Z_c = Customs duties;

Z_i = Income and corporation taxes;

Z_e = Excise taxes;

Z_s = Sales taxes;

Z_l = Land revenue; and

Z_o = "Other revenues".

The behavioural equations for different taxes are:

Customs Duties

$$Z_c = f(M_c \cdot P_{mc}, M_i \cdot P_{mi}, M_k \cdot P_{mk}, D_i) \quad .. \quad (4.50)$$

Excise Taxes

$$Z_e = f(Y_m \cdot P_{gn}, D_i) \quad .. \quad .. \quad .. \quad (4.51)$$

Sales Taxes

$$Z_s = f(M_g \cdot P_m, Y_m \cdot P_{gn}, D_i) \quad .. \quad .. \quad (4.52)$$

Income and Corporation Taxes

$$Z_i = f(Y_n \cdot P_{gn}, D_i) \quad .. \quad .. \quad .. \quad (4.53)$$

"Other Revenues"[2]

$$Z_o = f(Y_g \cdot P_{gn}, D_i) \quad .. \quad .. \quad .. \quad (4.54)$$

Land Revenue[3]

$$Z_l = \bar{Z}_l$$

where

D_i = The discretionary changes in various taxes.

The explanations of all other symbols remain as stated above.

Monetary Block

This block is composed of 2 behavioural equations and 2 definitional relations. The behavioural equations describe the determination of money supply and price level in the model.

[2] "Other Revenues" consist of net receipts of government organizations (post and telegraph, railways and all public departments).

[3] Land tax is treated as exogenously determined. This is mainly because land revenue, constituting only a relatively minor proportion of total tax revenue, has remained stagnant over time.

Money Supply

In the PIDE Model (1982), nominal money supply was treated as exogenously given and a money-demand function with a one-year lag adjustment was estimated. However, this procedure is open to question. Firstly, a one-year adjustment lag in the demand for money appears to be long, and yet data on lags of less than one year are simply not available in Pakistan.[4] Secondly, even though money markets in Pakistan are not altogether insensitive to changes in the interest rates, not much use has been made of this policy instrument for regulating money supply in Pakistan.[5] Thirdly, while the government does not exert any significant influence on the demand for money, it does play an active role in determining the nominal money supply to finance government deficits and to make appropriate adjustments for changes in foreign-exchange reserves. In view of these considerations, we will estimate a money-supply equation. This specification has the added attraction that it explicitly highlights the causal role of government in determining the level of money supply.

$$M_s = f(D, C_r, F_{er}) \quad \ldots \quad \ldots \quad \ldots \quad (4.55)$$

where

D = Government budget deficit, as defined by equation (4.48);

C_r = Bank credit to private and public sectors;

F_{er} = Foreign-exchange reserves held by the State Bank of Pakistan; and

M_s = Nominal money supply.

Thus money supply is assumed to depend functionally upon government budget deficits, the credit extended to private and public sectors and the level of foreign-exchange reserves.[6] It is expected that the sign of each of these variables would be positive. It is assumed here that money market is in equilibrium, i.e. money supply equals money demand.

$$M^d = M_s \quad \ldots \quad \ldots \quad \ldots \quad (4.56)$$

Price Level

Inflation has been analysed in different countries within the framework of 'monetarist' and 'structuralist' formulations. While the 'monetarists' blame an excessive growth of money supply for inflation, the 'structuralists' trace it to structural imbalances in the economy.[7] Pakistan's encounter with two-digit inflation took

[4] Prof. Tinbergen made this point in his letter addressed to Naqvi, dated November 25, 1982.

[5] Some studies on the demand for money show that money market in Pakistan *is* sensitive to changes in the interest rate on time deposits. See Khan [7; 8].

[6] This type of specification was earlier used by Khilji [9] for Pakistan and by Kabir [6] for Bangladesh.

[7] For details of the alternative hypotheses regarding inflation, see Holzmen and Bronfenbrenner [4].

place in the first half of 1970. During the same period, the main commodity-producing sectors suffered a severe stagnation.[8] This was also a period of rising import prices. It is, therefore, essential to know the relative 'weights' of various factors in producing high rates of inflation to frame a fruitful anti-inflationary policy.

As such, the following behavioural equation has been used to describe changes in the general price level:

$$P_{gn} = f(M_s, C_s, M_T, P_{gn-1}) \quad \ldots \quad \ldots \quad \ldots \quad (4.57)$$

where

M_s = Nominal money stock;

C_s = Share of commodity-producing sectors in GDP; and

M_T = Total imports;

In addition, a definitional relation is used to express C_s in terms of its components.

$$C_s = \frac{Y_A + Y_m}{Y_g} \quad \ldots \quad \ldots \quad \ldots \quad (4.58)$$

where

Y_A = Value added in agriculture;

Y_m = Value added in manufacturing; and

Y_g = GDP.

The specification used in this study differs in several respects from that given in the PIDE Model (1982), even though the motivation is the same. Firstly, in place of the trend value of the GDP, which featured in the PIDE Model (1982), the present version uses the share of commodity-producing sector in the GDP. This specification determines more effectively the role of supply-side factors as opposed to the inadequacy of effective demand as the causative factor.[9] Secondly, the present specification has used P_{gn} as the endogenous variable instead of the inflation rate in the PIDE Model (1982). This avoids unnecessary non-linearity if the latter is used as the endogenous variable. Finally, the present version has discarded the imported-inflation variable used in the PIDE Model (1982), which contained a specification

[8] The concept of stagflation with reference to Pakistan is discussed in detail in Naqvi [11] and Naqvi *et al.* [12].

[9] The factors operating on the demand side include monetary expansion, rising private and public expenditures, wage increases, etc. On the supply side, more important are factors like availability of goods, as reflected by the GDP and imports, increase in production cost and indirect taxes, the prices of imports, etc. The hypothesis that the slower growth of the commodity-producing sectors relative to the GDP is inflationary was advanced by Naqvi *et al.* [12].

error.[10] We now use import availability (M_T), as the relevant variable to test the imported-inflation hypothesis.[11] The money stock variable in equation (4.57) is included to test the monetarist hypothesis that inflation is a monetary phenomenon. A negative sign would mean that money supply was accommodating in nature. Also, a negative sign of C_s should indicate that a rise in the share of commodity-producing sector in the GDP lowers inflation. A negative sign for M_T, indicating that higher imports lead to lower inflation, would refute the imported-inflation hypothesis. To examine the role of expectations, a lagged endogenous variable, P_{gn-1}, is used as an explanatory variable.

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[11] The imported-inflation hypothesis has also been examined by Akhtar [1] for India and the Philippines. He uses growth rate of import price index along with the import-to-GNP ratio as a measure of imported inflation. In another cross-country study, Iyoha [5] used import-to-GNP ratio as a measure of imported inflation.

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PART III

ESTIMATION OF THE MODEL

INTRODUCTION

The preceding chapters dwell upon the specification of the model for Pakistan's economy. Also discussed in them are problems relating to the determination of the most appropriate functional form for various equations (linear or log-linear); the choice of the variables to be included (excluded) as arguments of specific functions; the decision to cast the chosen variables (dependent and independent) in real or nominal terms; the ascertainment of the expected size and sign of the coefficient of the included variable, etc. The choice on such vital matters has been made in the light of theoretical considerations as well as published and unpublished econometric studies on various aspects of the economies of Pakistan and other developing countries. However, the most proximate 'cause' of the 'final' choice has been the PIDE Model (1982) and the subsequent (unpublished) experimentation that it induced.[1] Even though in many cases its basic 'message' has been kept intact, we have made important departures from that model, thus becoming our own worst critics.[2]

Yet, there have been many slips between the cup and the lip – i.e. in going from specification to the estimation stage. Corresponding to each specification, several equations were estimated. Indeed, in the case of the agriculture production function over one hundred equations were tried to simulate in the model the mysterious and elusive 'facts' of the agricultural sector. (Some of the alternative equations are reproduced in the Appendix.) The choice set being so large, both economic and econometric considerations were accorded due 'weight' in making the final selection; and then the 'finalists', i.e. the chosen equations and the individual variables included in them, had to pass stringent econometric tests.

[1] Khilji [1] has also been helpful in making us depart from the PIDE Model (1982).

[2] This observation applies to the senior author only, who has been the chief accomplice in both the 'plots'.

First, each structural equation has been selected on the basis of its theoretical plausibility (in the context of Pakistan's economy), the goodness of fit, significant t-values and F-statistics. Also, satisfactory solutions have been sought of the various econometric problems which are common in time-series analysis, such as severe multicollinearity amongst the independent variables, serial correlation, etc. The former problem was solved in most cases by dropping highly correlated variables, while the Cochrane-Orcutt iterative technique was used to 'treat' cases of serial correlation.[3]

Secondly, the 'finalists' were subjected to a detailed 'validation' exercise (historical simulations) to make sure that the estimated equations 'track' well the actual course of the economy during the sample period, and also its many 'turning points'. (The results of the validation exercise are discussed in Part IV of this report.)

Thirdly, an extensive experimentation with functions and functional forms has also allowed us to drop those variables which exhibited an unstable behaviour, especially in cases where the coefficient changed 'signs' with relatively minor changes in specification.

The main motivation for this exercise has been the search for 'viable' hypotheses that can capture adequately the flavour of the 'reality on the ground' in Pakistan. This is essential because with only a few testable hypotheses available for explaining the behaviour of key economic variables in Pakistan, theoretical research and practical policy making usually fall back upon hypotheses developed in the more advanced economies of the West. While a knowledge of such 'alien' hypotheses provides an excellent starting point for econometric enquiry, it is not sufficient to understand fully the working of developing economies, for the simple reason that economic structures of the developed and developing economies are so different, and there are differences among the economic structures of developing countries as well. The behaviour of economic agents is to some extent, though not entirely, 'location-specific' and 'time-specific'. Accordingly, we have not restricted ourselves to a somewhat 'mechanical' testing of known hypotheses but have ventured to play the more exciting game of discovering new hypotheses which better describe the economic reality in Pakistan. This 'heretical' attitude towards the accepted litany is much more evident in this study than it was in the PIDE Model (1982).

The 58-simultaneous-equations model presented in Chapters 5–7 has been estimated by employing the instrument variant of 2SLS, since the OLS estimates of

[3]In all the equations reported here, the numbers in parentheses that appear below the coefficients are their respective t-statistics. $\bar{R}^2$ is the coefficient of determination adjusted for degrees of freedom and D.W. is the Durbin-Watson statistic.

simultaneous-equation parameters are known to be 'biased'.[4] Chapters 5 to 7 take up each estimated equation individually and analyse the results briefly. Since the rationale for employing various specifications was given in the previous chapter, the focus here will be on the goodness of fit, reliability, and plausibility of the estimates.

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[4] However, in the course of estimation it was found that the OLS procedure in most cases yielded estimates of key statistics almost identical with those produced by the 2SLS, confirming the well-known result that 2SLS has large sample properties.

Chapter 5

PRODUCTION-EXPENDITURE SUB-MODEL

For expositional clarity, the Production-Expenditure Sub-model has been subdivided into two blocks, the Production Block and the Expenditure Block.

Production Block

From among the ten major production sectors identified in the model, we have estimated production functions for only two of them, viz. Agriculture (crop) Sector and the Large-scale Manufacturing Sector.

(i) Agriculture (crop) Sector

The estimated production function for value added in this sector is as follows:

Agricultural Production Function[1]

$$Ln\,(Y_a/L_a) = 0.448 + \underset{(4.38)}{0.089}\,Ln\,(T_r/L_a) + \underset{(1.89)}{0.41}\,Ln\,Q \quad \ldots \quad (2.5')$$

$$\bar{R}^2 = 0.57;\ D.W. = 2.26;\ F = 13.05$$

where

Y_a/L_a = Value added in agriculture per agricultural labourer;

T_r/L_a = Tractor use per agricultural labourer; and

Q = The share of wheat in total cropped area.

In the equation given above, tractor is taken as a proxy for capital and all other auxiliary inputs. It is interesting to note that the size of the tractor coefficient

[1] It may be noted that there are problems in estimating the production function in this fashion because the dependent variable is heavily dependent on the error term, which is largely determined by the highly uncertain and mercurial weather variable. See Griliches [4].

is very low, implying that a one-percent increase in tractor per labourer (and other complementary inputs) increases the value added in agriculture by only 0.09 percent. The equation also implies that the elasticity of labour has the value of 0.91.[2;3] The relatively large coefficient of labour confirms that in Pakistan agriculture was still a highly labour-intensive operation during the sample period despite the many efforts made to mechanize it. The share of wheat in total cropped area (Q) is taken as a proxy for land on the assumption that increased production of wheat implies an increase in land use. Land itself is not included as a separate factor of production because it is highly correlated with the other variables. The values of key statistics show that the equation explains reasonably well the changes in the dependent variable and does not suffer from serial correlation. Also, all the variables are significant at the five-percent level of significance.

A number of factors have dictated the selection of the above equation. In the PIDE Model (1982), the agricultural output equation was estimated by the inclusion, as arguments, of all key inputs, viz. irrigated area, unirrigated area, fertilizers, tubewells, and tractors. The sign of the tractor coefficient came out to be negative – an unsavoury result in a production function. The main reason for such an implausible result may have been the high degree of multi-collinearity that exists among the key agricultural inputs, viz. fertilizers, tubewells and tractors, which have partial correlation coefficients of the order of 0.99. *This suggests that these inputs are complementary in nature so that their independent contribution to value added cannot be disentangled.*

Several attempts were made to find the 'best' equation. (Some of these equations are reproduced in Appendix B.) These attempts included use of moving averages, combining of irrigated and unirrigated land, dropping of certain variables, etc. The tractor term frequently switched signs depending upon which variables were included in the specification. The same was the case with other inputs. Equation (2.5′) was finally chosen on the basis of the policy relevance of the included variables. The equation also possesses high predictive ability. (See Part IV for a discussion of the validation results.)

[2] The value of the coefficient (i.e. elasticity) of labour is obtained by subtracting from unity the value of the coefficient (elasticity) of the tractor variable. This procedure is permissible because the production function is assumed to be of the Cobb-Douglas variety, with constant returns to scale.

[3] It may be noted that tractorization gained momentum only towards the fag end of the Seventies. Its coming so late in the sample period may have contributed to the low tractor coefficient. However, even now, in 1983, the evidence on the contribution of tractors to the value added in agriculture remains fragmentary and far from conclusive. A part of the problem of the low observed marginal productivity of tractors may be the fact that the highly lucrative off-the-farm uses of tractors have been at least as much important to the farmers as their on-the-farm uses. The PIDE is planning an extensive study of the phenomenon of agriculture mechanization.

Input Demand Functions for Agriculture (Crop) Sector: Given the coefficients (elasticity estimates) of the production function, the demand for the two inputs is derived by applying the familiar marginal productivity criterion. Assuming profit maximisation, the derived demand functions for labour and tractor are given below:

$$L_a = 0.911 \frac{P_a \cdot Y_a}{W_a} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (2.6')$$

$$T_r = 0.089 \frac{P_a \cdot Y_a}{P_r} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (2.7')$$

where

P_a = Price index of agriculture output;

W_a = Shadow wage in agriculture; and

P_r = Price index of tractor.

The coefficients in equation (2.6′) and (2.7′) are taken from the estimated production function, i.e. equation (2.5′). These equations suggest that the demand for labour (tractor) varies directly with the value added in agriculture and inversely with the shadow price of labour and capital (tractor) in agriculture. Furthermore, given the shadow prices of labour and tractors, an increase in the value added in agriculture, on the margin, draws very heavily on labour.

(ii) Large-scale Manufacturing Sector

Production Function for Large-scale Manufacturing

The production function for the second major component of the Production Block is as follows:

$$Ln\, Y_{lm} = \underset{}{-1.214} + \underset{(1.64)}{0.154}\, Ln\,(L_{lm}) + \underset{(13.49)}{0.889}\, Ln\,(K_{lm})$$

$$\underset{(4.98)}{-0.0957}\, D_3 + \underset{(13.26)}{0.048}\, t \quad \ldots \quad \ldots \quad (2.8')$$

$$\bar{R}^2 = 0.943; \quad D.W. = 2.17; \quad F = 58.44$$

where

Y_{lm} = Value added in large-scale manufacturing;

L_{lm} = Labour force in large-scale manufacturing;

K_{lm} = Capital in large-scale manufacturing;

D_3 = Dummy variable for observed recession taking the value of 1 for the period from 1969-70 to 1976-77, and of 0 elsewhere; and

t = Time trend.

In sharp contrast with agricultural production, equation (2.8′) shows that manufacturing activity in Pakistan is characterized by a very high degree of capital intensity. The equation also shows that large-scale manufacturing has also been favourably influenced by (disembodied) technological change at a rate of 4.8 percent per annum. The coefficient is highly significant. The equation also captures the negative and significant effect, on value added, of the recession that Pakistan's economy was plagued with during the 1969-70 to 1976-77 period. However, the size of the coefficient is very small.[4] The equation explains the observed phenomenon extremely well and is also free from auto-correlation. The coefficients of labour and capital add up to 1.04, suggesting constant returns to scale for labour and capital.

Input Demand Functions for Large-scale Manufacturing: The demand for inputs is derived from the production function itself by applying the marginal productivity conditions for labour and capital:

$$L_{lm} = 0.154 \frac{P_{lm} \cdot Y_{lm}}{W_{lm}} \quad \ldots \quad (2.10')$$

$$K_{lm} = 0.889 \frac{P_{lm} \cdot Y_{lm}}{r} \quad \ldots \quad (2.11')$$

where

P_{lm} = Price index of manufactured goods in large-scale manufacturing;

W_{lm} = Wages in large-scale manufacturing; and

r = Shadow price of capital.

The coefficients of labour and capital are identical with those obtained in the production function, showing that large-scale manufacturing is a highly capital-intensive operation. The interpretation of this equation is similar to that given for equations (2.6′) and (2.7′).

(iii) "Other Sectors"

The value added in "Other Sectors" is postulated to depend on demand factors since there is a relationship connecting the value added by sectors with the final demand components.[5]

[4] It would seem that the presence of a dummy variable, in a production function which assumes maximum output from the existing inputs, is not theoretically justifiable. However, the introduction of dummy variables is justified for taking into account unutilized capacity because the inputs used for estimation of the production function also include unemployed resources.

[5] See Khilji [6] and Marzouk [8] for a derivation of this relationship.

Value Added in Construction Sector

The estimated equation for the construction sector is:

$$Y_c = -469.26 + \underset{(9.78)}{0.05\,C} + \underset{(1.89)}{0.08\,I} \qquad \ldots \quad (2.12')$$

$$\bar{R}^2 = 0.96;\ D.W. = 1.36;\ F = 247.56$$

where

Y_c = Value added in construction;

C = Total consumption; and

I = Total investment.

The equation shows that the value added in construction is significantly and positively affected by total consumption and total investment, but more by the latter than by the former. The coefficients of both the variables are significant at the 5-percent significance level. The equation has high explanatory power but the Durbin-Watson statistic is low and lies in the indeterminate range.

Value Added in Wholesale and Retail Trade

$$Y_r = 89.99 + \underset{(20.64)}{0.131\,Y} \qquad \ldots \quad (2.13')$$

$$\bar{R}^2 = 0.92;\ D.W. = 1.44;\ F = 216.77$$

where

Y_r = Value added in wholesale and retail trade; and

Y = Gross National Product.

The estimated equation shows that the value added in wholesale and retail trade is positively and significantly affected by GNP. The explanatory power of the equation is quite high. The D.W. statistic is somewhat unsatisfactory.

Value Added in Public Administration and Defence

$$Y_p = -360.28 + \underset{(2.51)}{0.43\,C_g} + \underset{(2.85)}{132.37\,t} \qquad \ldots \quad (2.14')$$

$$\bar{R}^2 = 0.56;\ D.W. = 1.46;\ F = 12.69$$

where

Y_p = Value added in public administration and defence;

C_g = Public consumption; and

t = Time trend.

As expected, the equation shows that the value added in public administration is governed positively by public consumption and tends to increase with the passage of time. The proportion of public consumption, a large part of which goes to meet government expenditure on wages and salaries of public administration and defence personnel, is 0.43. In the light of the historical composition of public expenditure, the size of the coefficient is reasonable. There seems to be a trend towards an increase in the value added in this sector by about Rs. 132 million annually.

Value Added in Agriculture (Non-crop) Sector[6]

$$Y_b = 2162.18 + \underset{(16.11)}{0.035\,C} + \underset{(1.26)}{0.034\,I} + \underset{(2.97)}{0.125\,X_T} \quad \ldots \quad \ldots (2.15')$$

$$\bar{R}^2 = 0.99; \; D.W. = 1.60; \; F = 528$$

where

Y_b = Value added in agriculture (non-crop) sector;

C = Total consumption;

I = Total investment; and

X_T = Total exports.

This equation shows a positive relationship between the value added in the agriculture (non-crop) sector and final demand components. The coefficients of aggregate consumption and investment demand, which are approximately equal, are much smaller than the coefficient of exports. This implies that the non-crop agriculture sector is export-oriented. The equation represents a good 'fit' and indicates absence of serial correlation.

Value Added in Mining and Quarrying[7]

$$Y_q = -9.57 + \underset{(10.65)}{0.003\,C} + \underset{(7.29)}{0.016\,I} \quad \ldots \quad \ldots \quad \ldots (2.16')$$

$$\bar{R}^2 = 0.98; \; D.W. = 2.54; \; F = 416.5$$

where

Y_q = Value added in mining and quarrying;

C = Total consumption; and

I = Total investment.

The equation shows that output in this sector is determined by demand factors.

[6] Agriculture (non-crop) consists of livestock, fishing, forestry, and hides and skins.

[7] It may be recalled that in the PIDE Model (1982) the values added in Mining and Quarrying, and Ownership of Dwellings were specified to depend on time while the value added in Small-scale Manufacturing was assumed to be exogenously given.

Value Added in Ownership of Dwellings[8]

$$Y_{od} = 495.18 + 0.017C + 0.036I \quad \text{(2.17')}$$
$$\qquad (11.57) \quad (3.32)$$

$$\bar{R}^2 = 0.95;\ D.W. = 1.52;\ F = 181.5$$

where

Y_{od} = Value added in ownership of dwellings;

C = Total consumption; and

I = Total investment.

The value added in this sector is also explained significantly by the two domestic demand components – consumption and investment.

Value Added in Small-scale Manufacturing[9]

$$Y_{sm} = 0.036\ C + 0.059\ I - 0.003\ M_T \quad \text{(2.18')}$$
$$(8.73) \quad (2.08) \quad (0.12)$$

$$\bar{R}^2 = 0.70;\ D.W. = 1.29;\ F = 23.14$$

where

Y_{sm} = Value added in small-scale manufacturing;

C = Total consumption;

I = Total investment; and

M_T = Total imports.

The value added in this sector is satisfactorily explained in terms of domestic investment. Imports do not influence the value added in this sector. This is reasonable because by and large the import component of the small-scale manufacturing sector is very small.

Value added in Services[10]

$$Ln\ (Y_s) = 7.789 + 0.069\ t \quad \text{(2.19')}$$
$$(49.5)$$

$$\bar{R}^2 = 0.996;\ F = 2450$$

where

Y_s = Value added in services; and

t = Time trend.

[8] See Footnote 7.
[9] See Footnote 7.
[10] The Services Sector includes the value added in electricity and gas distribution, transport, storage and communication, and banking and insurance.

The value added in this sector is assumed to be time-trended, and has grown at an annual rate of 6.9 percent. This result accords with the known growth behaviour of the sector. More work needs to be done to explain its behaviour in terms of the basic economic factors.

Expenditure Block

This section presents estimates of the components of domestic demand consisting of private and public consumption expenditures and private and public investment expenditures.

Consumption

(i) *Private Consumption*

The equation for private consumption is:

$$C_p = 750.39 + 0.73 \underset{(28.77)}{Y^D} + 2.32 \underset{(9.05)}{R} \quad \ldots \quad (2.26')$$

$$\bar{R}^2 = 0.993; \; D.W. = 1.74; \; F = 1368.31$$

where

C_p = Private consumption;

Y^D = Disposable income adjusted for remittances; and

R = Remittances.

This equation shows that private consumption is significantly and positively affected by *net* disposable income and remittances. The marginal propensity to consume is 0.73, which is reasonable but lower than expected.[11] This may be explained by a much higher propensity to consume out of the remittance income due to some kind of 'remittance illusion' – i.e. the acquisition of the remittance income by individuals may have tended to change their consumption behaviour in a manner not warranted by an equivalent change in real disposable income. Such consumption behaviour is reasonable in the short run. However, with the passage of time the propensity to consume out of this kind of income may decline as such remittance inflows become more regular.[12] The equation fits the data well in that it explains 99.3 percent of the variation in private consumption and no auto-correlation is indicated.

[11] In the UNCTAD study [11], the MPCs estimated for Argentina and Nigeria are 0.738 and 0.665 respectively. Similarly, Liu [7] estimated MPC for Taiwan as 0.73. The MPCs estimated by Naqvi and Khan [10] for India, Bangladesh, and Sri Lanka are 0.77, 0.88 and 0.72 respectively. However, all these studies use disposable income, *not* adjusted for remittances.

[12] It may be noted that the estimated consumption function (2.26') is of a hybrid variety, lying somewhere between the Keynesian Absolute Income Hypothesis and Friedman's Permanent Income Hypothesis.

The estimated equation (2.26′) is much different from that reported in the PIDE Model (1982) both in conception and in the sign and size of the various coefficients of the included variables. For instance, in the latter the sign of the remittance variable was negative, which was unexpected. Furthermore, as opposed to the PIDE Model (1982) which used six explanatory variables – disposable income, rate of interest, change in GNP price index, remittances, foreign capital and real balances – the present version is much 'simpler' in scope. The main reason for adopting the present version is that most of the variables included in the earlier version are highly correlated, which also explains the unexpected negative sign of the remittance and the real balance variables in that version.[13]

(ii) *Public Consumption*

The equation for public consumption is estimated as follows:

$$C_g = 937.5 + \underset{(11.49)}{0.42}\ Z + \underset{(2.89)}{0.14}\ F_k + \underset{(3.67)}{1063.0}\ D_1 \qquad \ldots \ldots (2.29')$$

$$\bar{R}^2 = 0.93; \quad D.W. = 1.42; \quad F = 89.01$$

where

C_g = Public consumption;

Z = Total public revenue;

F_k = Foreign gross capital inflows; and

D_1 = Dummy variable taking the value of 1 for 1965-66 and of zero otherwise, to capture the effects of the Indo-Pak war.

The equation relates public consumption expenditure to the ability of the government to raise resources through tax and non-tax revenues and foreign capital inflows. The estimated equation (2.29′) is similar to the one contained in the PIDE Model (1982) but with one addition: a dummy variable has been introduced here to capture the extraordinary increase in expenditures that occurred due to the Indo-Pak war in 1965. The coefficient is significant and shows that public consumption in that year did go up by a little over Rs. 1 billion.[14] The equation yields the value of 0.42 for the marginal propensity to consume out of tax and non-tax revenue, and of 0.14 for the marginal propensity to consume out of gross capital inflows.[15] The estimates

[13] *A priori,* we expect a positive sign for real balances in the private consumption equation. See Ackley [1] and Khan [5] for further discussion of this issue.

[14] Another dummy variable was introduced for the 1971 war but it proved to be insignificant.

[15] Khilji [6] found a negative relationship between public consumption expenditure and foreign aid which is an implausible result. But, then, while Khilji used net foreign aid, we have used gross foreign aid.

seem plausible since approximately 45–50 percent of the government revenue goes to meet consumption expenditures and interest payment on foreign debt.[16]

Investment

(i) *Private Investment*

No attempt has been made to estimate an aggregate investment function for the private sector. Instead, two investment functions for the private sector are estimated. The first relates to investment in the agricultural sector and the second to investment in the large-scale manufacturing sector. However, as opposed to the PIDE Model (1982), this version treats private investment in "Other Sectors" as exogenously determined because of the non-availability of disaggregated data and the very poor 'fits' that repeated experiments yielded.

Private Investment in Agriculture

$$Ln\, I_{pa} = -7.84 + \underset{(1.99)}{1.45}\, Ln\, Y_a \underset{(1.80)}{-0.70}\, Ln\left(\frac{P_r}{P_a}\right) + \underset{(0.76)}{0.10}\, Ln\, R \qquad \text{.. (2.30')}$$

$$\bar{R}^2 = 0.71; \; D.W. = 1.74; \; F = 16.89$$

where

I_{pa} = Private investment in agriculture;

Y_a = Value added in the agriculture (crop) sector;

P_r/P_a = Relative price of tractor; and

R = Remittances.

This equation shows that private investment in agriculture is positively related to the value added in agriculture and negatively associated with changes in the price of tractors. The coefficients of both the variables are significant. The sign and size of these coefficients are consistent with those appearing in the equation relating to the agriculture production function. It is interesting to note that, contrary to the popular view, remittances have had little effect on investment in agriculture – or elsewhere. This finding is consistent with equation (2.26′) in which the remittance coefficient is over 2 and highly significant, suggesting that private consumption has absorbed most of the income from this source.[17]

[16] The UNCTAD study [11] shows that the marginal propensity to consume out of total tax revenue is only 0.273 in Nigeria. Marzouk [8] found it to be 0.462 for Sudan.

[17] This finding is also consistent with the PIDE study on labour migration where it is found that only 3.8 percent of the remittances go to investment in agricultural machinery in the private sector.

The equation represents a good fit and indicates a lack of serial correlation. It is also a vast improvement over the corresponding equation in the PIDE Model (1982) in terms of the explanatory power of the included variables. (The earlier equation suffered from auto-correlation as well.) Equation (2.30′) was chosen from a large number of estimated equations. In particular, to determine the effect of remittances, slope dummies and intercept dummies were introduced but the coefficients were insignificant in all these formulations.

Private Investment in Large-scale Manufacturing

$$I_{pm} = 2076.38 + \underset{(1.73)}{0.25} (\triangle Y_{lm}) - \underset{(7.56)}{1321.14} (P_i/P_{gd}) - \underset{(5.48)}{496.46} D_2 \qquad (2.31')$$

$$\bar{R}^2 = 0.81; \; D.W. = 1.33; \; F = 27.08$$

where

I_{pm} = Private investment in large-scale manufacturing;

$\triangle Y_{lm}$ = Changes in value added in large-scale manufacturing;

P_i/P_{gd} = Price of investment goods/GDP price index; and

D_2 = Dummy variable taking value of 1 for the 1971-72 to 1973-74 period and of zero otherwise to capture the effect of large-scale nationalization and the consequent fall in investment.

The highlight of this equation is the introduction of an 'accelerator', the value of which is 0.25 and statistically significant. The value of the accelerator coefficient appears to be on the high side when compared with those noted in certain developed countries.[18] However, with virtually no capital markets in Pakistan, a marginal increment in the value added may have induced a greater-than-normal increase in investment. The coefficient of the relative price variable is significant and bears the correct negative sign. This shows that an increase in the price of investment goods induces a decline in private investment in the large-scale manufacturing sector – a result which accords with intuition. The equation yields a good 'fit', with all the included variables being highly significant.

Alternative equations, in both linear and log-linear forms, were tried to ascertain in particular the influence of credit availability and imports of capital goods. However, the coefficient of credit availability was found to be insignificant. Various

[18] Arestis and Hadjimatheou [2] estimate investment function using the accelerator principle for the United Kingdom. They report the coefficient of accelerator as low as 0.085. However, they do mention that the size of the coefficient was "unusually low".

lag distributions were also imposed upon the equation without getting any improvement in the results. (Some of these alternative estimates are reported in Appendix B.) Compared with the equation reported in the PIDE Model (1982), the present equation is much more satisfactory statistically as well as in terms of its economic content.

Public Investment

Public Investment in "Other Sectors"

No equation has been estimated for the public sector's investment in large-scale manufacturing, which is taken as exogenously given in this model. This is because it is a relatively minor proportion of the total public investment and the time-series of this variable also behaves very erratically. However, public investment in "Other Sectors" is significantly related to the total public revenue and foreign capital inflow..

$$I_{og} = 59.725 + \underset{(9.53)}{0.423\, Z} + \underset{(2.11)}{0.113\, F_k} + \underset{(5.04)}{968.68\, D_4} \quad \ldots \quad (2.33')$$

$$\bar{R}^2 = 0.78; \; D.W. = 1.60; \; F = 23.35$$

where

I_{og} = Public investment in "Other Sectors";

Z = Total public revenue;

F_k = Foreign capital inflows; and

D_4 = Dummy variable taking the value of 1 for the 1962-63 to 1964-65 period and of zero otherwise.

The equation shows that the marginal contribution of public revenue to investment in "Other Sectors" is higher than that of foreign capital.[19] The equation also features a dummy variable to capture the sudden jump in investment expenditure (i.e. higher than the past trend) in the last three years of the Second Five Year Plan; viz. 1962-63, 1963-64 and 1964-65. This dummy variable is highly significant. As the key statistics show, the equation is reasonably good and is free from serial correlation. This equation is a considerable improvement over the equation reported in the PIDE Model (1982), which suffered from serial correlation. It may also be noted that the present equation differs from the earlier version only by the dummy variable additionally included in it.

[19] For Brazil, Behrman and Klein [3] found a very low coefficient (0.14) of the total public revenue in the public investment equation.

Public Subsidies[20]

$$S_u = 451.26 - 0.14\, Y_a + 93.69\, t - 245.23\, D_5 - 234.58\, D_6$$
$$\quad\quad (1.83) \quad\quad (3.75) \quad\quad (1.85) \quad\quad (2.35)$$

$$+869.94\, D_7 \quad \ldots \quad \ldots \quad \ldots \quad (2.34')$$
$$(8.76)$$

$$\bar{R}^2 = 0.93; \quad D.W. = 2.43; \quad F = 51.18$$

where

S_u = Public subsidies;

Y_a = Value added in the agriculture (crop) sector;

t = Time trend;

D_5 = Dummy variable taking the value of 1 for (1970-71), and of zero otherwise;

D_6 = Dummy variable taking the value of 1 for 1971-72 and 1972-73 and of zero otherwise.

D_7 = Dummy variable taking the value of 1 for 1973-74 and 1974-75 and of zero otherwise.

The equation shows that the public subsidies are negatively related to increments in agricultural output. However, there has also been an increase in subsidies over the years. The dummy variables represent the years in which major changes in subsidies were instituted. All the coefficients are significant. The negative sign of the coefficient for agricultural income is correct, since it indicates that subsidies decrease when income rises in the agricultural sector.

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Chapter 6

INTERNATIONAL TRADE SUB-MODEL

This chapter takes up the estimation of the two major components of international trade, viz. exports and imports. These two components have been further disaggregated according to their economic use. The first block deals with imports and the second block with exports. Both the functional forms and the estimated equations differ considerably from those reported in the PIDE Model (1982). Firstly, extensive experimentation with different equations shows that the log-linear forms used in the PIDE Model (1982) are econometrically inferior to the linear forms used in the present model. Secondly, the equations for foodgrains and energy estimated in the PIDE Model (1982) have been omitted here. Instead, imports of these items are treated as exogenously determined. Thirdly, exports of services, treated as exogenously determined in the PIDE Model (1982), are endogenized here. However, the attempt to estimate an equation for imports of services did not prove fruitful. Fourthly, the dummy variable used in the PIDE Model (1982) to assess the effect of East Pakistan's separation on the foreign trade sector has been omitted from the estimated equations presented below. This is mainly because of the unstable behaviour of this variable through repeated experiments. Finally, and most importantly, the equation reported below passed the 'validation' test with flying colours. (See Part IV.)

Import Block

In this block three equations have been estimated for the various categories of imports. They include consumer goods imports, imports of raw materials and intermediate goods and capital goods imports. For want of the relevant data, imports of services are taken as exogenously determined.

Consumer Goods Imports

The equation for consumer goods imports is estimated as a demand equation depending upon disposable income and relative prices. Also, a one-period lag for consumer goods imports is included to reflect the effect of past import behaviour on the present level of imports.

$$M_c = 176.456 + 0.024\,Y_d - 48.455\,E_c + 0.50\,M_{c-1} \qquad (3.39')$$
$$\qquad (3.52) \qquad (2.09) \qquad (2.11)$$
$$\bar{R}^2 = 0.52; \quad D.W. = 1.86; \quad F = 7.54$$

where

M_c = Imports of consumer goods;

Y_d = Disposable income; and

E_c = Effective exchange rate for consumer goods.

All the coefficients are significant at the one-percent significance level. The equation shows consumer goods imports to be positively related to disposable income and previous year's import levels, and negatively to changes in *effective* exchange rate for imports. The signs of the coefficients are as expected. The coefficient for disposable income implies an income elasticity of a little over unity for imports in the short run; while it is greater than 2 in the long run.The long-run marginal propensity to import (MPM) is found to be 0.05.[1] The overall fit of the equation is quite satisfactory. The relevant results are comparable with those obtained in the PIDE Model (1982), but the economics of the present equation appears to be more satisfactory – e.g. it makes more sense to use disposable income than total domestic consumption. The findings of the present study, however, differ in many respects from those made for developing countries by a number of other studies. For example, Chaipravat *et al.* [1] found a consumption elasticity of consumer goods imports to be 0.77, while Yu's estimates [4] are closer to the ones reported in the present study. Yu found the MPM of consumer goods for Taiwan to be 0.045, which is close to the long-run MPM reported here. Furthermore, consumer goods imports in the present model are more sensitive to changes in relative prices than those of other developing countries. For example, the study on Thailand by Chaipravat *et al.* [1] shows that price elasticity for imports in Thailand is close to 0.86 as compared with the long-run price elasticity of 1.62 reported here.

Imports of Raw Materials and Intermediate Goods

The domestic demand for the imports of raw material and intermediate goods is a derived demand. Hence, value added in the manufacturing sector is expected to influence the demand for these goods. Also, relative prices should exert an influence on import demand.

$$M_i = -731.81 + 0.456\,Y_m - 1.048\,E_i \qquad .. (3.40')$$
$$\qquad (3.23) \qquad (0.052)$$
$$\bar{R}^2 = 0.87; \quad D.W. = 1.77; \quad F = 63.92$$

[1]Khilji's study [2] also shows MPM equal to 0.05 in the long run.

where

M_i = Imports of intermediate goods;

Y_m = Value added in the manufacturing sector; and

E_i = Effective exchange rate for intermediate goods.

The estimated equation shows a fairly high marginal propensity to import intermediate and raw material goods and implies an elasticity of 7.32! This seems plausible since most of the domestic manufactures, at the margin, do depend heavily on imported raw materials etc.[2] Although the sign of the effective exchange rate term is negative as expected *a priori,* it is not significant. This implies that demand for imports is insensitive to changes in their prices. Also, this variable is insignificant, showing that the (negative) effect of changes in the effective exchange rate is completely swamped by changes in the level of the output of final goods, which seem to exercise a predominant effect on intermediate goods imports. This result, which is more reasonable, contrasts sharply with that reported in the PIDE Model (1982) where this variable is significant, even though the size of the coefficient is quite small there as well. The present equation also marks a definite improvement over that reported in the PIDE Model (1982), which suffered from severe serial correlation and had much lower values for $\bar{R}^2$ and F-statistic.

Capital Goods Imports

This equation is demand-oriented, featuring as independent variables the value added in manufacturing and the effective exchange rate for capital goods imports.

$$M_k = 751.959 + \underset{(5.49)}{0.286\, Y_m} - \underset{(4.41)}{69.135\, E_k} \qquad \ldots (3.41')$$

$$\bar{R}^2 = 0.47; \quad D.\,W. = 1.94; \quad F = 9.43$$

where

M_k = Imports of capital goods;

Y_m = Value added in the manufacturing sector; and

E_k = Effective exchange rate for capital goods.

Both coefficients are significant and bear the correct signs. The imports of capital goods appear to be quite responsive to variations in relative prices as well as to

[2]In terms of income elasticity of intermediate goods imports, our findings differ widely from those of Chaipravat *et al.* for Thailand [1]. They show that the income elasticity for imports is close to 0.82.

changes in output in the manufacturing sector. It makes more sense to use value added in manufacturing as the explanatory variable than to use total investment, which was included in the PIDE Model (1982). The estimated coefficient seems to be plausible and the overall fit is satisfactory.[3]

Services Imports

The imports of services are assumed to be exogenously determined. All attempts to estimate a meaningful equation proved to be infructuous. More work needs to be done on this element of the import bill.

Export Block

The export block includes three types of exports: primary goods, manufactured goods, and services exports. The equations for the three categories of export goods represent the supply of these two items, given an infinite elasticity of foreign demand for Pakistan's exports.[4] The estimated equations reported in this block mark a definite improvement over those given in the PIDE Model (1982), where the size of the elasticity coefficients was implausibly large and the equations suffered from serial correlations.

Exports of Primary Goods

$$X_p = 313.84 + \underset{(2.79)}{0.065}\, Y_A - \underset{(0.32)}{1.209}\, (P_{xp}/P_{gn}) \quad .. \quad (3.44')$$

$$\bar{R}^2 = 0.60; \quad D.W. = 1.91; \quad F = 15.0$$

where

X_p = Primary goods exports;

Y_A = Value added in agriculture; and

P_{xp}/P_{gn} = Domestic price of primary goods exports relative to the price index of the GNP.

Agriculture output is the main determinant of the exports of primary goods, whereas relative prices though bearing the correct sign, are not significant. The overall fit is good and free from serial correlation. In sharp contrast with the size of the elasticity

[3]The coefficient of output in the manufacturing sector with respect to capital goods imports in our model is fairly close to that estimated by Yu for Taiwan [4]. He found a coefficient of 0.31.

[4]This is the small-country assumption, which matches the corresponding assumption for imports: the foreign supply of Pakistan's imports is infinitely elastic.

co-efficients reported in the PIDE Model (1982) – over 4 for the domestic consumption variable and 3 for the effective export rate variable – equation (3.44′) above yields a reasonable elasticity value of 0.78 for the agricultural income variable and of 0.11 for effective export rate.

Exports of Manufactured Goods

$$X_m = 695.26 + \underset{(3.41)}{0.302}\ Y_{lm} - \underset{(1.65)}{6.03}\left(\frac{P_{xm}}{P_{gn}}\right) \quad .. \quad (3.45')$$

$$\bar{R}^2 = 0.43; \quad D.W. = 1.91; \quad F = 7.69$$

where

X_m = Exports of manufactured goods;

Y_{lm} = Value added in large-scale manufacturing; and

P_{xm}/P_{gn} = Domestic price of manufactured goods exports relative to the price index of the GNP.

As in the case of the exports of primary goods, the output in large-scale manufacturing figures significantly in explaining the behaviour of exports in this category: the implied elasticity is 0.93, which contrasts with the implausible value of a little over 5 reported in the PIDE Model (1982). The same holds for the relative price variable: here the implied elasticity is 0.41 as compared with the value of 3 reported in the PIDE Model (1982). Again, the key statistics here make this a much superior equation.

Exports of Services

$$X_s = -222.0 + \underset{(2.15)}{0.02}\ Y - \underset{(0.32)}{5.10}\ t \quad .. \quad (3.47')$$

$$\bar{R}^2 = 0.92; \quad D.W. = 2.57; \quad F = 103.55$$

where

X_s = Exports of services;

Y = Gross National Product; and

t = Time trend.

Exports of services are estimated to depend upon changes in the GNP. Also, a trend term is included to get a feel of the evolution of the exports of services over time. In terms of the various econometric tests, the equation is good.

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Chapter 7

PUBLIC REVENUE AND MONETARY SUB-MODEL

The first section of this chapter analyses the behaviour of public revenue which is disaggregated into five sources. (The major components of public expenditures have already been analysed in the Expenditure Block of the Production-Expenditure Sub-Model.) The second section takes up the monetary sector of the economy, which shows the determination of money supply and the price level.

The estimated equations reported in this chapter differ sharply from those given in the PIDE Model (1982). Firstly, all the revenue equations in this model are given in *nominal* terms. It will be recalled that in the PIDE Model (1982) these tax variables were measured in real terms, which was not a very satisfactory procedure. Secondly, all equations in this chapter are in linear form instead of the log-linear form adopted in the PIDE Model (1982). Thirdly, the land revenue equation reported in the PIDE Model (1982) has been dropped. Land revenue is now assumed to be determined exogenously. Fourthly, the monetary block reports equation for money *supply* instead of money demand (see Chapter 4). Fifthly, the equation for price level replaces the 'inflation' equation in the PIDE Model (1982). All these changes have paid rich dividends in terms of the vastly improved explanatory power of the estimated equations reported below.

Public Revenue Block

The equations for public revenue are taken up individually.

Customs Duties

One of the major sources of public revenue in Pakistan is customs duties. The average tax rates on imports of intermediate goods, consumer goods and capital goods are estimated directly.

$$Z_c = \underset{(0.54)}{0.12} (M_c . P_{mc}) + \underset{(2.61)}{0.370} (M_i . P_{mi}) + \underset{(1.67)}{0.245} (M_k . P_{mh}) \tag{4.50'}$$

$$\bar{R}^2 = 0.96; \; D.W. = 2.00; \; F = 204.0$$

where

Z_c = Customs duties;

M_c = Imports of consumer goods;

P_{mc} = Import price index of consumer goods;

M_i = Imports of intermediate goods;

P_{mi} = Import price index of intermediate goods;

M_k = Imports of capital goods; and

P_{mk} = Import price index of capital goods.

The above-estimated equation indicates that taxes on intermediate goods contribute most to the revenue from customs duties, followed by the taxes on imports of capital goods and consumer goods. Note that the marginal contribution of consumer goods imports to customs duties is insignificant.[1]

No dummy variable has been used in this formulation to account for the changes in tax rates.[2] Also, the present equation gives a three-way breakdown of imports as against the aggregate imports variable used in the PIDE Model (1982). The estimated equation is excellent because of its very high explanatory power. It is also free from auto-correlation.

Excise Taxes

$$Z_e = -151.461 + \underset{(18.94)}{0.249} Y_m . P_{gn} + \underset{(0.268)}{43.385} D_8 \tag{4.51'}$$

$$\bar{R}^2 = 0.94; \; D.W. = 1.50; \; F = 150.17$$

where

Z_e = Excise taxes;

Y_m = Value added in manufacturing;

[1]Tims's study on Pakistan [6] reports a very low coefficient (0.137) of total merchandise imports in the equation for customs duties. Furthermore, the UNCTAD study for Nigeria [7] shows the relevant coefficient of the relevant imports as 0.32. However, the results given in the text are comparable with those yielded by Khilji's study [2].

[2]Dummy variables were introduced to capture the effects of various discretionary changes in tax rates, but they turned out to be statistically insignificant.

P_{gn} = GNP price index; and

D_8 = Dummy variable taking the value of 1 for 1966-67 and of zero otherwise.

Revenue receipts from excise taxes are related directly to the value added in the manufacturing sector. The size of the coefficient is reasonable.[3] Only one dummy variable has been used for the tax-rate change in 1966-67, which is insignificant. The overall 'fit' of the equation is very good.

Sales Taxes

The third important source of public revenue is the sales tax. It is levied on imports as well as on the manufacturing sector.

$$Z_s = 246.586 + \underset{(1.33)}{0.027}\ (Y_m \,.\, P_{gn}) + \underset{(1.65)}{0.024}\ (M_g \,.\, P_m) \quad .. \quad (4.52')$$

$$\bar{R}^2 = 0.84;\ D.W. = 1.59;\ F = 51.06$$

where

Z_s = Sales taxes;

Y_m = Value added in manufacturing;

P_{gn} = GNP price index;

M_g = Total imports of goods; and

P_m = Import price index.

The estimated equation shows that sales taxes are positively related to the value added in manufacturing and the value of imports. However, only the latter coefficient is significant, indicating that sales taxes are mostly raised from imports.[4] Once again, the present equation does not include any dummy variable. The outcome of these 'changes' in specification has been a vast improvement in the explanatory power of the estimated equation. (The $\bar{R}^2$ was only 0.363 for the relevant equation in the PIDE Model (1982)).

[3]It is surprising to note that the size of the coefficient of manufacturing output in the excise tax equation did not change in a period of 15 years. For example, Tims's study [6] reported the coefficient of manufacturing output to be 0.215.

[4]Like the coefficient of excise taxes, the coefficient of merchandise imports in the sales tax equation did not change much over time. Tims [6] reported a coefficient of 0.031.

Income and Corporation Taxes

These taxes are levied only on non-agricultural income, which is defined as total income less agricultural income.

$$Z_i = 132.4 + \underset{(22.51)}{0.025}\ Y_n \cdot P_{gn} \ \underset{(1.56)}{-279.73}\ D_9 \qquad (4.53')$$

$$\bar{R}^2 = 0.96; \quad D.W. = 1.70; \quad F = 204.0$$

where

Z_i = Income and corporation taxes;

Y_n = Non-agricultural income;

P_{gn} = GNP price index; and

D_9 = Dummy variable taking the value of 1 in 1973-74 and of zero otherwise.

The equation shows that the coefficient of the non-agricultural income variable is highly significant even though its marginal contribution to the revenue from income and corporation taxes is small.[5] The implied elasticity calculated at mean values is 0.85, which is close to the findings of the PIDE Model (1982) where the elasticity was reported to be 0.88. The changes in the tax rates introduced in 1973-74 are represented by a dummy variable which is significant at the 90-percent confidence level. The negative sign of the coefficient suggests that any marginal gains from discretionary changes in tax rates were more than offset by a concomitant contraction of the tax base induced by the various tax incentives given to encourage domestic investment.

Land Revenue

Land revenue is assumed to be exogenously determined, mainly because of the high volatility of the revenue from this source and its very small contribution to the total tax revenue. These revenues are derived from cultivated (or cropped) acreage and have tended to remain constant over the years.

"Other Revenues"

$$Z_o = -773.44 + \underset{(16.21)}{0.083}\ Y \qquad \ldots \qquad \ldots \qquad (4.54')$$

$$\bar{R}^2 = 0.93; \quad D.W. = 1.83; \quad F = 267.02$$

[5] Tims's study on Pakistan [6] reports a coefficient of non-agriculture income close to 0.04, and the implied elasticity of about 1.29.

where

Z_o = "Other Revenues"; and

Y = Gross National Product.

The estimated equation shows that "Other Revenues" are positively related to the GNP. The overall fit is good and the equation is free from auto-correlation.

Monetary Block

As explained in Chapter 4, the money demand function estimated in the PIDE Model (1982) has been discarded in the present model in favour of a money supply equation, which explains better the policy variables that affect the monetary magnitudes in the economy.

Money Supply

$$M_s = -220.56 + \underset{(30.28)}{1.799}\, C_r + \underset{(0.214)}{0.095}\, D + \underset{(11.58)}{2.105}\, F_{er} \quad \ldots \quad (4.55')$$

$$\bar{R}^2 = 0.997; \; D.W. = 1.90; \; F = 2098.0$$

where

M_s = Nominal money supply;

C_r = Bank credit to private and public sectors;

D = Government budget deficit; and

F_{er} = Foreign exchange reserves held by the State Bank of Pakistan.

The money supply equation is functionally related to total bank credit, government budget deficit, and foreign exchange reserves. It is interesting to note that the coefficient of budget deficit is statistically insignificant. This may be explained by the fact that deficit financing has been accommodating instead of exercising an autonomous influence on money supply – a result which is contrary to the general belief in Pakistan. The credit multiplier is approximately 1.80 and the foreign exchange reserve multiplier is 2.1. The overall fit is good with an acceptable D.W. statistic.

Various alternative versions including variables such as remittances, public consumption, etc. were tried as exogenous variables. However, these were discarded because the estimated equations suffered from serial correlation. (Some of the alternative estimated equations are reported in Appendix B.)

Price Level

In sharp contrast with the PIDE Model (1982), which featured the changes in the rate of inflation as the dependent variable, the present model replaces it by the GNP implicit deflator. The theoretical rationale for adopting this formulation has been given at length in Chapter 4.

$$P_{gn} = \underset{}{353.37} - \underset{(2.30)}{0.009\,M_T} - \underset{(3.80)}{572.25\ C_s} + \underset{(0.87)}{0.0004\,M_s} + \underset{(7.81)}{0.92\ P_{gn-1}} \qquad (4.57')$$

$$\bar{R}^2 = 0.99;\ D.W. = 1.76;\ F = 631.63$$

where

P_{gn} = GNP price index;

M_T = Total imports.

C_s = Share of commodity-producing sectors in GDP; and

M_s = Nominal money supply.

The results of this equation provide many interesting insights into the manner in which changes in the price level are generated and sustained in a developing economy like Pakistan. Firstly, money supply does *not* exert any significant effect on the changes in the price level. The very small size of the coefficient of the money supply variable and its statistical insignificance contradict the simplistic notion held by some people in Pakistan that inflation is a purely monetarist phenomenon.[6] It may be noted that this finding, along with equation (4.55′) where the coefficient of 'D' is insignificant, shows that budgetary deficits also do *not* exercise an autonomous expansionary effect on the price level. Secondly, the price level is negatively related with the level of imports. Note that the coefficient is very small, though statistically significant. This result shows that a greater *availability* of imported goods lowers the domestic price level. It contradicts the popularly-held notion that domestic inflation is largely an imported phenomenon. This follows because if inflation *were* imported there would have been a positive and significant relationship between the changes in the level of imports and the price level. Thirdly, the high and significant positive relationship between last year's price level and the changes in the current year's price level lends support to the view that inflationary expectations tend to push prices up in the manner of a self-fulfilling prophecy. Fourthly, the very large

[6]It is interesting to compare the result reported in the text with that reported by Naqvi and Khan [5] for Sri Lanka, where inflation appears to be largely a monetary phenomenon.

size of the coefficient of the 'commodity-share' variable and its statistical significance show that *the share of the value added in commodity-producing sectors in the GDP exercises by far the most important influence on the price level.*[7]

These results show quite convincingly that inflation in Pakistan is stagflationary in nature and is explained mostly by the 'real' factors rather than by the monetary variables. By the same token, it lays the blame for high rates of inflation on domestic policies. The first and second observations noted above also seem to suggest that *in a developing country like Pakistan both imports and money supply tend to 'accommodate' themselves to changes in the price level, instead of exercising an autonomous influence on that level.*

It may be noted that the equation explains almost all the variations in the price level, and it is also free from auto-correlation. This equation is a vast improvement over the corresponding equation in the PIDE Model (1982), which also suffered from specification error. (See Chapter 4.) We experimented with a large number of equations before choosing equation (4.57′). Some of the alternative estimated equations are reported in Appendix B.

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[7]This finding confirms the hypothesis advanced by Naqvi *et al.* [3] that the adverse movement in the ratio of value added in commodity-producing sector to that in the services sector tends to build an inflationary bias in the growth process itself. Furthermore, Khan [1] also found this variable highly significant in the inflation equation for Pakistan. An import price index was also used instead of the value of imports as an explanatory variable. However, the estimated equation deteriorated in the economic context and suffered from serial correlation.

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PART IV

VALIDATION AND SENSITIVITY ANALYSIS OF THE MODEL

Chapter 8

VALIDATION OF THE MODEL

Introduction

The preceding chapters present a fairly detailed treatment of the specification and estimation of the econometric model for Pakistan. Most equations have good fits as indicated by $\bar{R}^2$, and do not suffer from any of the standard econometric problems which usually arise when time-series data are used. Also, most of the estimated coefficients are statistically significant and plausible. Out of a total of 71 estimated slope coefficients, 56 are statistically significant of which 36 are significant at the one-percent level. However, these 'indicators' are still not sufficient to ensure the validity of the model. It is necessary that the reliability and the forecasting ability of the model as well as its stability are also firmly established. Historical simulation (validation) verifies the ability of a model to 'track' the (actual) historical behaviour of the endogenous variables during the sample period and, in particular, to capture their turning points. To check on the stability of the model, sensitivity analysis needs to be carried out.

To evaluate the predictive power of a model, the normal practice is to compare the actual series of an endogenous variable with the series predicted through the model. As mentioned earlier, an equation may have an extremely good fit, but when the model is taken as whole, the same equation may have a poor simulation track record. Once all the equations are combined into a simultaneous-equation system, and feedbacks are allowed across equations and over time, there is a possibility of the building up of errors, the probability of which is increased if the model is dynamic, like the present one. Taking into account all the factors mentioned above, an attempt has been made to validate the model outlined in the preceding chapters and check on the stability of the model by carrying out *ex post* sensitivity analysis.

The results of this complicated exercise show that the model presented in the earlier chapters tracks the historical data well, with a relatively small margin of error.

The actual and predicted series are reasonably close to each other: approximately one-half of the endogenous variables included in the model lie within the range of the 5-percent margin of error, which is remarkably low for a developing country like Pakistan. Out of the remaining one-half of the endogenous variables, about 90 percent lie within a 10-percent error margin. Furthermore, a study of simulation graphs shows that the variables simulated in the present model capture most of the 'turning points' in the historical data with a fair degree of accuracy.

Considering the rather poor quality of data, which plagues econometric work in a developing country like Pakistan, this is as good a track record as one would expect.[1] It may be interesting to compare these simulation results with those of other models for developing countries. For instance, Behrman and Klein's model for Brazil [3] has an error margin of more than 10 percent in the exports and imports functions. Also Marzouk's model for Sudan [7], Dar's [5] and Agarwala's [1] models for India, and Khilji's [6] and Bhuiyan's [4] models for Pakistan show an error of more than 10 percent in many variables.[2] It can therefore be safely stated that in both absolute and relative terms the present model can serve as an effective tool for forecasting and policy evaluation.

To test the stability of the model, we ran a series of standard stability tests, making changes in the base year, in an estimated coefficient, and in the values of exogenous variables. The results of this exercise, which are reported in Chapter 9, show that the model is also 'stable'.[3]

Solution Methods for Validation and Checking Stability of the Model

Only for computational reasons, the model has been simulated – i.e. solved – by first dividing it into three recursive blocks.[4]

[1]In developed economies of the West, where the data base is consistent and refined, the standard procedure to judge the predictive ability of a model requires an error margin of less than 5 percent. However, this standard is much too stiff for developing countries, where data suffer from gross deficiencies and crude approximations.

[2]No such exercise was performed for the PIDE Model (1982) [9], which in its intent and purpose was restricted to structural analysis alone.

[3]More on this point can be found in Pindyck and Rubinfeld [10] and Arestis and Hadjimatheou [2].

[4]It should be carefully noted that these 'blocks' are used merely as an expository device. As noted earlier, the present model, like its predecessor, is not block-recursive.

Block 1: The first block comprises 7 equations, connected predominantly with the agriculture sector. It is a self-contained block in that all endogenous variables appearing here do not depend upon endogenous variables in other blocks. Also, these variables have simultaneous relations within the block and their values are needed as inputs in other blocks.

Block 2: This block, which is the largest within the model, contains 28 equations. Like Block 1, it is also 'self-sufficient' in that the endogenous variables are simultaneously related with one another within the block, and at the same time also 'feed' the third block.

Block 3: This block consists mainly of definitions and identities which are drawn together from the model.

After decomposing the model in a block-recursive manner, we started the historical simulation (validation of the model) beginning with 1960-61. The observed lagged values of endogenous variables for the period prior to 1960-61 and the actual exogenous variables over the sample period were used as inputs into the system. The model then generated values for all contemporaneous and lagged endogenous variables. In doing so, we used Newton's method, which involves interaction as well as linearization and matrix inversion.[5]

Historical Simulations

There are various summary statistics available for evaluating the predictive accuracy of a model such as the Mean Absolute Error, the Mean Absolute Percentage Error (MAPE), the Root-Mean-Square Error (RMSE), the Root-Mean-Square Percentage Error (RMSPE), the Mean Percentage Error (MPE), Theil Inequality Coefficient (TIC), and so on. All these statistics evaluate the forecasting accuracy of the model.[6] These criteria basically compare the actual (historical) time series of a variable with the series 'predicted' by individual equations in the model. Since there is no unique preferred criterion and all the statistics mentioned above perform the same kind of duties, we have used RMSPE[7] and TIC to judge the forecasting accuracy of our model.

[5]For further discussion of Newton's method, see Saaty and Bram [11].

[6]See Pindyck and Rubinfeld [10] for the relevant computational formulas.

[7]However, the values of RMSPE in this study have been given in proportions, *not* in percentages. That is why in subsequent pages we have spelled out RMSPE as Root-Mean-Square Proportional Error.

The RMSPE is an absolute measure indicating the mean error of prediction. It can range from 0, indicating perfect prediction, to 1.0 which denotes zero predictive ability of the model. In the case of TIC (μ), its value lies between 0 and 1. If $\mu = 0$, then the predicted (P_t) and the actual (A_t) coincide, indicating a perfect fit. If $\mu = 1$, then the predictive ability of the model is zero. While estimates of both the TIC and RMSPE are shown in Tables 8.1–8.4, only the TIC estimates are used in the text to avoid unnecessary details. Besides these statistics, it is essential to ascertain by a study of simulation graphs whether the predicted series capture the various turning points in the historical data. However, to save space, simulation graphs of only 18 most important variables are reproduced in the text. For the sake of expositional clarity, the various summary statistics and simulation graphs are reported by sub-models and blocks.

PRODUCTION-EXPENDITURE SUB-MODEL

Production Block

The summary statistics, such as TIC and RMSPE, for all the endogenous variables of the Production Block are reported in Table 8.1. Three simulation graphs are also shown. The results for each endogenous variable are discussed separately.

Gross Domestic Product (GDP)

The actual and predicted series of GDP are very close to each other: the TIC shows an error margin of only one percent! A look at the simulation chart (Fig. 1) shows that the model predicts the actual series with a high degree of accuracy. The year 1970-71 was an abnormal year, marked by social upheaval that culminated in the separation of East Pakistan (now Bangladesh). This turning point is also captured and the GDP is overpredicted by only Rs. 101 million.

Value Added in Agriculture (Crop) Sector

The model predicts the historical behaviour of the value added in agriculture with a fair degree of accuracy. The actual and predicted series are exceedingly close to each other. The TIC statistic indicates an error margin of only 2.5 percent. However, a look at the simulation graph (Fig. 2) shows that the predicted series missed at least two turning points, those in 1969-70 and 1973-74, where the model underpredicts the value added in agriculture by Rs. 472 million and 560 million respectively. It may be noted that the years from 1969-70 to 1973-74, when the major turning points occurred, were characterized by extraordinary events, both favourable and unfavourable, e.g. the separation of the East Wing, two bumper crops and a bad season. The model has captured a few kinks but not the turning points.

Table 8.1

Results of Validation Exercise: Production Block

Endogenous Variables	Equation No.	TIC	RMSPE
Gross Domestic Product (Y_g)	(2.1)	0.01	0.0309
Value added in Agriculture (Crop) Sector (Y_a)	(2.5′)	0.025	0.0478
Value added in Large-scale Manufacturing (Y_{lm})	(2.8′)	0.078	0.1434
Value added in Construction (Y_c)	(2.12′)	0.05	0.1278
Value added in Wholesale and Retail Trade (Y_r)	(2.13′)	0.015	0.0370
Value added in Public Administration and Defence (Y_p)	(2.14′)	0.065	0.1896
Value added in Agriculture (Non-crop) Sector (Y_b)	(2.15′)	0.002	0.0155
Value added in Mining and Quarrying (Y_q)	(2.16′)	0.04	0.0878
Value added in Ownership of Dwellings (Y_{od})	(2.17′)	0.01	0.0343
Value added in Small-scale Manufacturing (Y_{sm})	(2.18′)	0.045	0.1029
Value added in Services (Y_s)	(2.19′)	0.015	0.0325

Note: TIC = Theil Inequality Coefficient.
RMSPE = Root-Mean-Square Proportional Error.
Equation numbers correspond to those given in Chapters 2 and 5.

Value Added in Large-scale Manufacturing

The actual and predicted series are close to each other, even though the TIC value shows an error of 7.8 percent, which is larger than in the preceding two cases. The simulation graph (Fig. 3) shows that the model tracks the actual series with a high degree of accuracy till 1965-66 and then follows divergent paths until 1968-69. Again, for the years 1969-70 and 1970-71, the model faithfully reproduces the behaviour of actual series, which is noteworthy because these were the abnormal years of Indo-Pak war. However, after 1970-71 the gap between the actual and predicted series is again large, and the model systematically overpredicts from 1971-72 onward. This was the period of large-scale nationalization and deep economic recession (1972-73 to 1976-77). However, the predicted series does capture the turning point in 1976-77 when the economy started on a definite recovery path. The long-term trend of output in the manufacturing sector is brought out clearly by the predicted series in the latter half of the Seventies. This shows that manufacturing capacity is much higher than is being currently utilized.

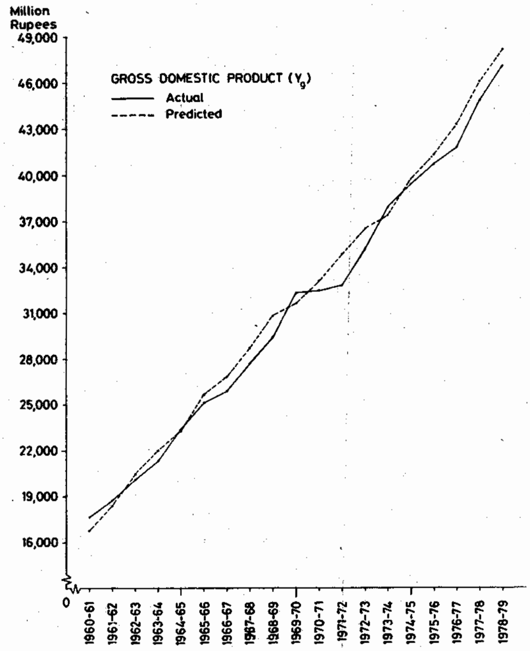

Fig.1

"Other Sectors"

The actual and predicted series for the value added in "Other Sectors" – construction, wholesale and retail trade, public administration and defence, agriculture (non-crop), mining and quarrying, ownership of dwellings, small-scale manufacturing, and services – are exceedingly close to each other; the TIC statistics lie between 1 percent and 6.5 percent of the error margin. Notable among these is the value added in public administration and defence. The simulation graphs (not reproduced here) show that the model successfully captured the turning points in 1965-66 (Indo-Pak war) and 1974-75, when government expenditures increased substantially.

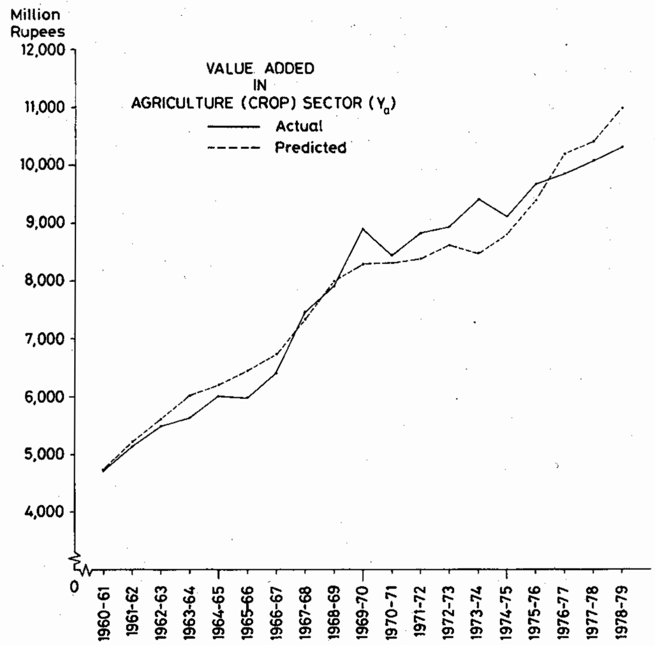
Million
Rupees
12,000
11,000
10,000
9,000
8,000
7,000
6,000
5,000
4,000
0
VALUE ADDED
IN
AGRICULTURE (CROP) SECTOR (Y_a)
Actual
Predicted
1960-61
1961-62
1962-63
1963-64
1964-65
1965-66
1966-67
1967-68
1968-69
1969-70
1970-71
1971-72
1972-73
1973-74
1974-75
1975-76
1976-77
1977-78
1978-79

Fig. 2

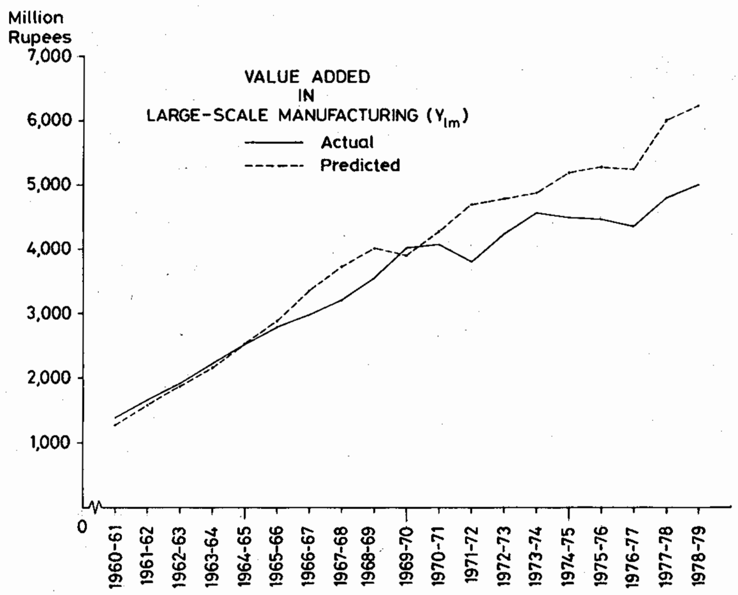
Million
Rupees
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
VALUE ADDED
IN
LARGE-SCALE MANUFACTURING (Y_{lm})
Actual
Predicted
1960-61
1961-62
1962-63
1963-64
1964-65
1965-66
1966-67
1967-68
1968-69
1969-70
1970-71
1971-72
1972-73
1973-74
1974-75
1975-76
1976-77
1977-78
1978-79

Fig. 3

Expenditure Block

The performance of each of the endogenous variable in this block is discussed below in terms of the summary statistics reproduced in Table 8.2. Also, four simulation graphs have been reproduced.

Table 8.2

Results of Validation Exercise: Expenditure Block

Endogenous Variables	Equation No.	TIC	RMSPE
Private Consumption (C_p)	(2.26′)	0.03	0.0732
Public Consumption (C_g)	(2.29′)	0.045	0.0952
Private Investment in Agriculture (I_{pa})	(2.30′)	0.07	0.1523
Private Investment in Large-scale Manufacturing (I_{pm})	(2.31′)	0.09	0.2753
Public Investment in "Other Sectors" (I_{og})	(2.33′)	0.06	0.1729
Public Subsidies (S_u)	(2.34′)	0.08	0.6369

Note: TIC = Theil Inequality Coefficient.
RMSPE = Root-Mean-Square Proportional Error.
Equation numbers correspond to those given in Chapter 5.

Private Consumption

The actual and predicted series are close to each other: the TIC shows an error margin of only 3 percent. The simulation graph (Fig. 4) shows that although the actual and predicted series are close to each other, the model underpredicts after 1972-73. It seems that consumption expenditure grew at a faster rate during the late Seventies than in the earlier periods. This has definite implications for savings and capital formation in the economy. The equation predicts the long-run average consumption behaviour reasonably well. However, the upturn in consumption in the latter half of the Seventies is not captured by the model. It remains to be seen whether this increase in private consumption is a cyclical or a secular trend.

Public Consumption

The TIC shows an error margin of only 4.5 percent. Also, as simulation graph (not reproduced here) shows, the model captures at least two turning points (1965-66 and 1966-67) in the historical series. These two years were abnormal, when the economy was subjected to the stresses of the Indo-Pak war and the post-war effects. The simulation graph also shows that after 1972-73 the predicted series overestimates the historical series. The deliberate effort by the government to curtail the consumption expenditure below its long-term trend explains why the predicted series diverges from the actual series.

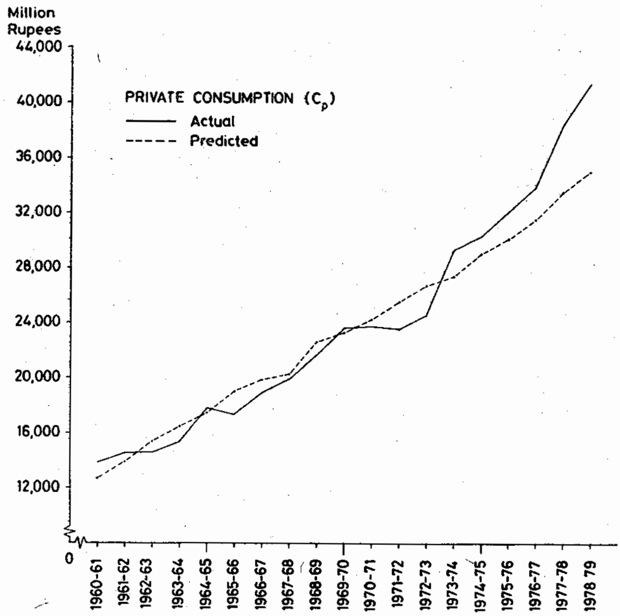

Fig. 4

Private Investment in Agriculture

As is obvious from Fig. 5, private investment in agriculture experienced sharp swings throughout the sample period. The sharp increase in investment in 1964-65 was due to the change in the government policy, promoting agricultural investment through increased subsidies on tractors and tubewells. This change in policy was brought about by recommendations in G. Mohammad's study [8]. The fall in investment in 1965-66 was due to the Indo-Pak war of 1965. After that, investment was stagnant till 1968-69 but was followed by another sharp increase in 1969-70. This coincides with the launching of the Fourth Five-Year Plan. Another sharp decline in the private investment in this sector occurred in 1974-75. This was the effect of the post-flood period. It is remarkable that the predicted series has captured most of these turning points (Fig. 5). The accuracy of prediction is confirmed by the TIC value of 7 percent.

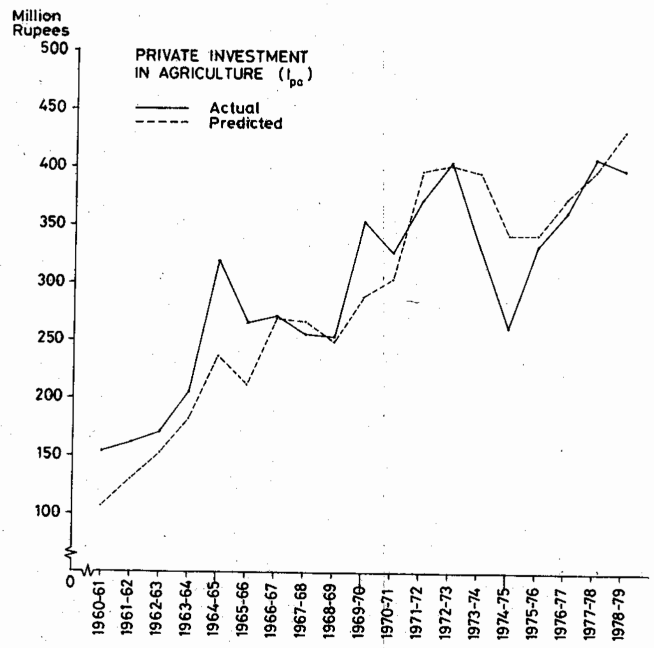

Fig. 5

Private Investment in Large-scale Manufacturing

As shown in Fig. 6, private investment in large-scale manufacturing has been subject to sharp swings throughout the sample period. It reached its peak in 1964-65. However, since then it has shown a declining trend. The sharpest decline occurred during the period from 1971-72 to 1974-75, when many large-scale manufacturing industrial units were nationalised. Since then private investment has hovered around the low point achieved in 1974-75. The predicted series captures the rising trend till 1964-65 and the subsequent downfall successfully. The TIC value of 9 percent is higher than its value for other variables in this block. It is still satisfactory, considering the problems associated with the modelling of the private investment behaviour.

Public Investment in "Other Sectors"

There are two distinct periods – 1960-61 to 1964-65 and again 1972-73 to 1977-78 – when historical data on public investment show an increasing trend. Between 1965-66 and 1971-72, public investment was virtually stagnant. This period was characterised by two Indo-Pak wars and political turmoil in East Pakistan (now Bangladesh). Considering these problems, it is remarkable that the predicted series captures these trends (graph not shown here) although after 1969-70 the estimated equation constantly overpredicts. The divergence between the two series is within reasonable limits. The TIC value is quite low: only 6 percent.

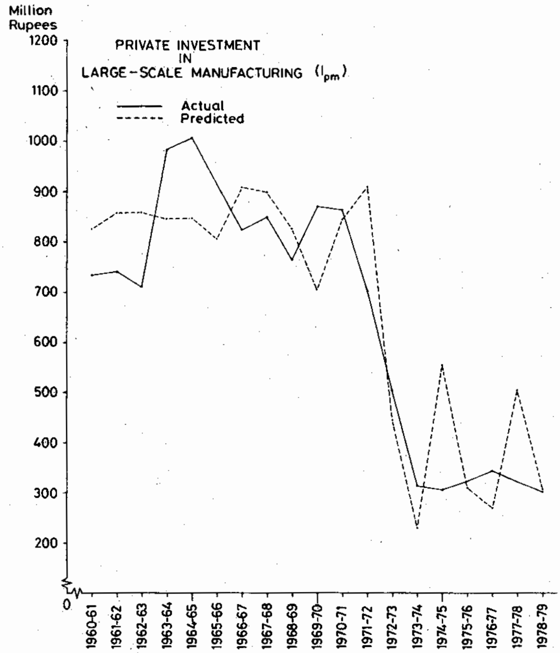

Fig. 6

Public Subsidies

The predicted series provides a satisfactory simulation fit: the TIC statistic is 8 percent. The simulation chart (Fig. 7) shows that the predicted series captures the most significant turning points in the actual series, viz. the years 1973-74 and 1974-75, when very large subsidies were provided to the agriculture sector. This was done to soften the blow of the devastating floods which in 1973 completely destroyed almost all the standing crops. The subsidies to the agriculture sector rose from Rs. 302 million in 1972-73 to Rs. 1448 million in 1973-74 and were Rs. 1481 million in 1974-75. The model predicts, for 1973-74 and 1974-75, subsidies of the order of Rs. 1476 million and Rs. 1523 million, respectively, which is quite a close prediction.

FOREIGN TRADE SUB-MODEL

Import Block

The key summary statistics, such as TIC and RMSPE, for all the endogenous variables in the foreign trade sub-model are reported in Table 8.3. Selected simulation graphs have also been reproduced to check on the accuracy with which the estimated equations predict the 'turning points' in the historical time-series data.

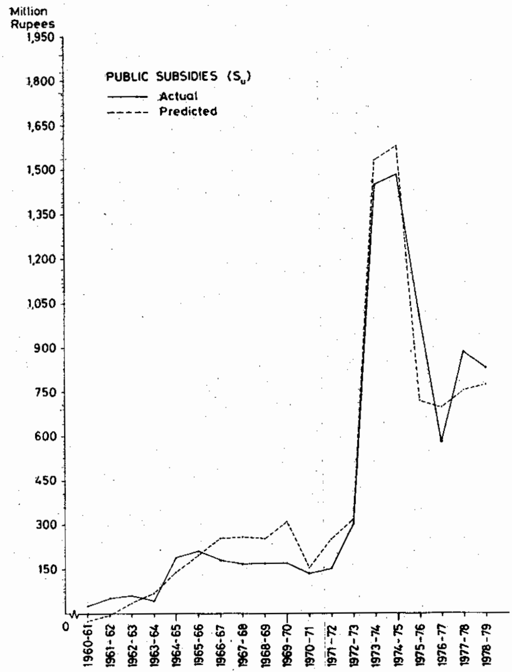

Fig.7

Table 8.3

Results of Validation Exercise: Foreign Trade Sub-model

Endogenous Variables	Equation No.	TIC	RMSPE
IMPORT BLOCK			
Imports of Consumer Goods (M_c)	(4.39′)	0.12	0.4003
Imports of Raw Materials (M_i)	(4.40′)	0.20	0.6585
Imports of Capital Goods (M_k)	(4.41′)	0.09	0.2543
EXPORT BLOCK			
Exports of Primary Goods (X_p)	(4.44′)	0.065	0.1369
Exports of Manufactured Goods (X_m)	(4.45′)	0.085	0.2463
Exports of Services (X_s)	(4.47′)	0.07	0.1787

Note: TIC = Theil Inequality Coefficient.
RMSPE = Root-Mean-Square Proportional Error.
Equation numbers correspond to those given in Chapter 6.

Imports of Consumer Goods

The TIC shows an error margin of 12 percent, which is relatively (and absolutely) high. However, as the simulation graph (Fig. 8) shows, the predicted series caputres most of the turning points in the historical data. Most prominent among these turning points are the years 1969-70 and 1971-72. The year 1969-70 witnessed a significant decline in imports in the wake of serious political disturbances in the country. In 1971-72, the Pakistani rupee was devalued by 137 percent, and large imports were allowed under the IMF loan facility to cushion the price-raising effects of the devaluation. Imports then showed a consistent decline in 1973-74 and 1974-75 and after an upsurge in 1975-76 fell again in 1976-77. Since then the trend has been upwards. These oscillations are explained by import restrictions and, subsequently, by the liberal import policies followed by the present government.

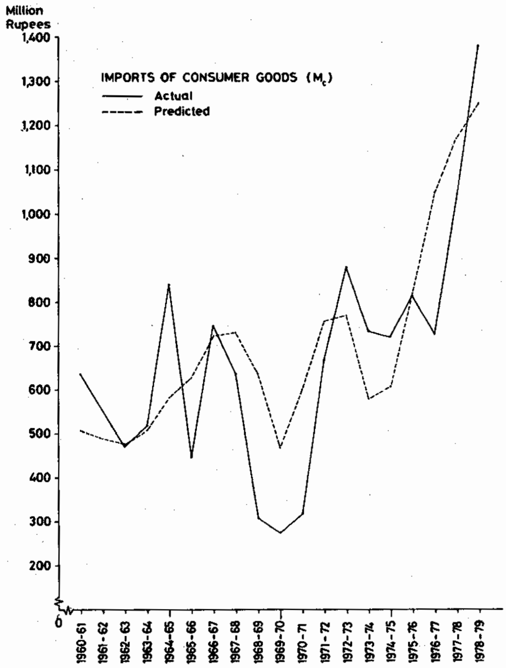

Fig. 8

Imports of Capital Goods

In sharp contrast, the estimated equation for capital goods imports is good: the TIC is only 9 percent. Also, the simulation chart (Fig. 9) shows that the actual and the predicted series are close to each other and remain together even when sharp changes occur in the historical data. The predicted series captures at least two significant turning points in the historical data, viz. the years 1971-72 and 1973-74 – the years of political strife, the war in Bangladesh, and nationalisation.

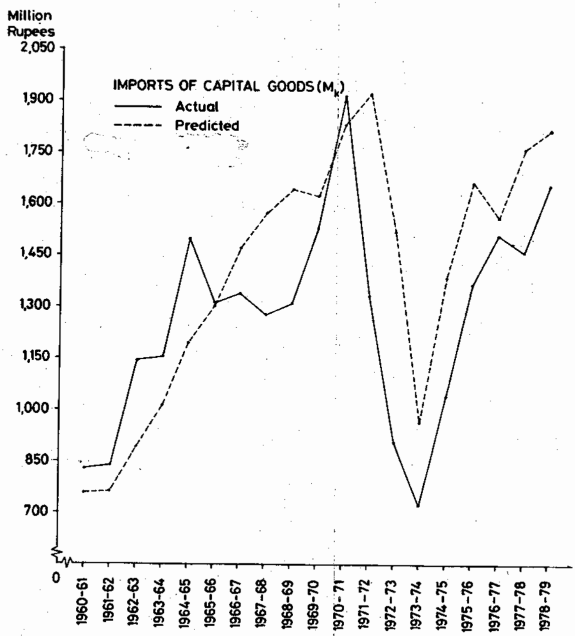

Fig. 9

Imports of Raw Materials

The TIC value is fairly high: 20 percent. The predicted series is generally above the actual series, as seen in Fig. 10. However, the trend of both the series is the same. Up to, 1967-68 both the predicted and the actual series are fairly close to each other, but diverge significantly thereafter. The model predicts fairly accurately the period of high industrial activity in the Sixties. However, the gap between the actual and the predicted series increases after 1968-69 and continues to do so until 1976-77. The model continuously overpredicts during this period of recession. This seems reasonable because, due to recession, the output in the manufacturing sector (which uses mostly imported raw materials) declined considerably.[8] However, during the latter part of the period the gap between the actual and the predicted series starts to close and in 1978-79 both series coincide.

[8]The significant negative impact of recession on the manufacturing sector (lage-scale) was also observed in estimated equation (2.8'), Chapter 5.

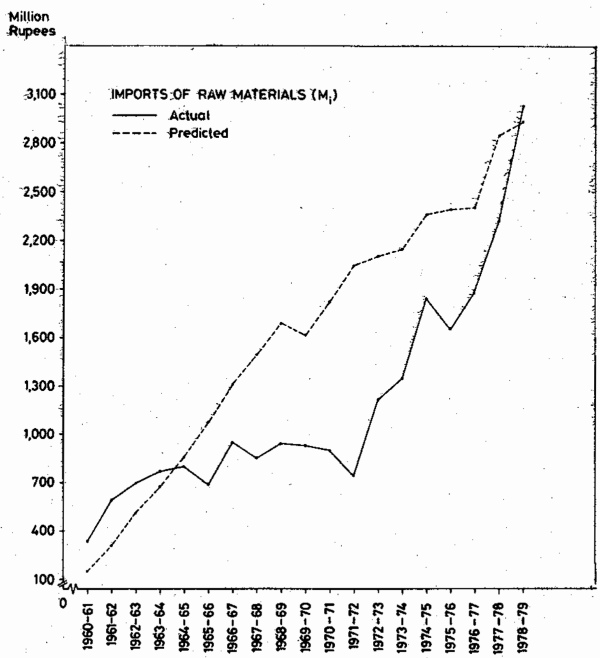

Fig.10

Export Block

Exports of Primary Goods

Historically, there have been wide fluctuations in the primary goods exports, especially of cotton exports which account for 28 percent of the primary goods exports. The inelasticity of foreign demand, sharp price changes, lags in production, and absence of buffer stocks have been some of the reasons for the sharp fluctuations. The estimated equation offers a very good simulation fit: the TIC is only 6.5 percent (Table 8.3). However, the simulation graph (Fig. 11) shows that the predicted series fails to capture the main turning points, particularly the two that occurred in the Seventies, when stockpiling boom sharply pushed upwards the international prices of cotton. The predicted line is more in the nature of a trend line that smooths out extreme fluctuations in the historical data.

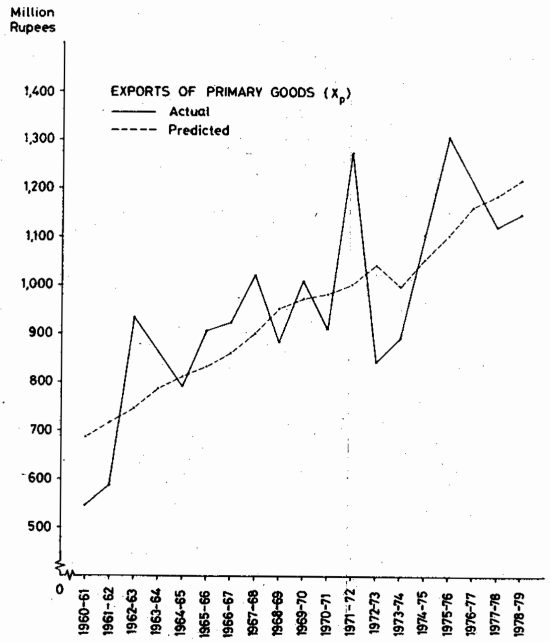

Fig.11

Exports of Manufactured Goods

The simulation graph (Fig. 12) shows that there have been three distinct periods when exports of manufactured goods coincide with the government's aggressive export-promotion policies and the opening up of the Middle East market. These periods are: 1960-61 to 1963-64, 1964-65 to 1968-69, and 1973-74 to 1975-76. The main downturn occurs in 1972-73, when the East Pakistan (now Bangladesh) market suddenly melted away. Then the period from 1975-76 to 1977-78 was plagued by worldwide recession, which reduced Pakistan's exports because many Western countries imposed quantitative restrictions on imports from developing countries, including those from Pakistan. The predicted series again trace the general trends in these exports while ignoring the sharp fluctuations in the historical time series. The error margin is only 8.5 percent, as shown by the TIC (Table 8.3).

Exports of Services

The predicted series tracks the historical data quite well: the TIC shows an error margin of only 7 percent. Although the simulation fit is good, it fails to capture any of the turning points. Most of these turning points reflect the state of the economy, especially foreign trade. The fluctuations in the exports of services are not as extreme as noticed in connection with other exports. (The simulation graph in not shown here.)

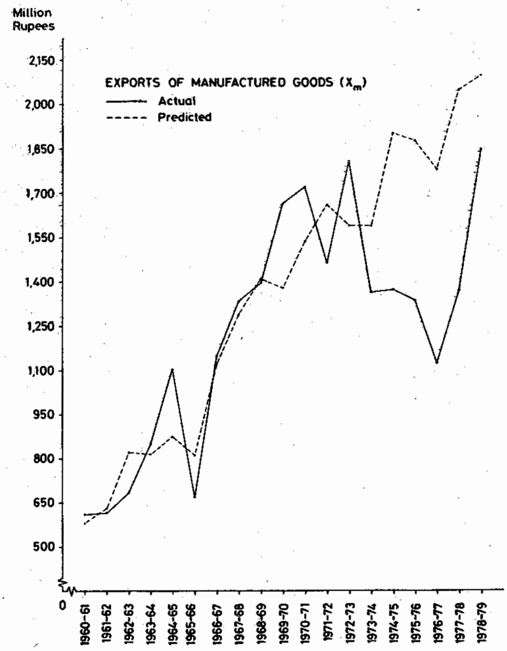

Fig. 12

FISCAL AND MONETARY SUB-MODEL

Fiscal Block

The summary statistics for all the endogenous variables in this sub-model are reported in Table 8.4.

Table 8.4

Results of Validation Exercise: Fiscal and Monetary Sub-model

Endogenous Variables	Equation No.	TIC	RMSPE
FISCAL BLOCK			
Customs Duties (Z_c)	(5.50′)	0.12	0.3082
Excise Taxes (Z_e)	(5.51′)	0.09	0.3681
Sales Taxes (Z_s)	(5.52′)	0.087	0.2886
Income and Corporation Taxes (Z_i)	(5.53′)	0.083	0.1862
"Other Revenues" (Z_o)	(5.54′)	0.065	0.1586
MONETARY BLOCK			
Money Supply (M_s)	(5.55′)	0.053	0.1202
Price Level (P_{gn})	(5.57′)	0.07	0.1416

Note: TIC = Theil Inequality Coefficient.
RMSPE = Root-Mean-Square Proportional Error.
Equation numbers correspond to those given in Chapter 7.

Customs Duties

This source of the government revenue has generally been stable and has shown an upward trend throughout the sample period as seen in Fig. 13. However, there occurred a marked decline in the customs revenue in 1963-64 and in 1971-72, caused by import liberalisation and the 1972 devaluation. The TIC value of 12 percent shows a relatively large margin of error. However, the simulation graph shows that the estimated equation also captures at least two turning points (1974-75 and 1976-77) in the historical data. In the year 1974-75, which was a period of high rate of inflation, the historical series shows a jump in customs duties, because the tax equations are estimated in nominal term; and then there is a kink in 1976-77, reflecting the fact that the growth of customs duties was slower in this period than in earlier periods. The predicted series also follows this trend closely and captures the turning point as well. However, on the whole, the predicted series is in the nature of a trend line.

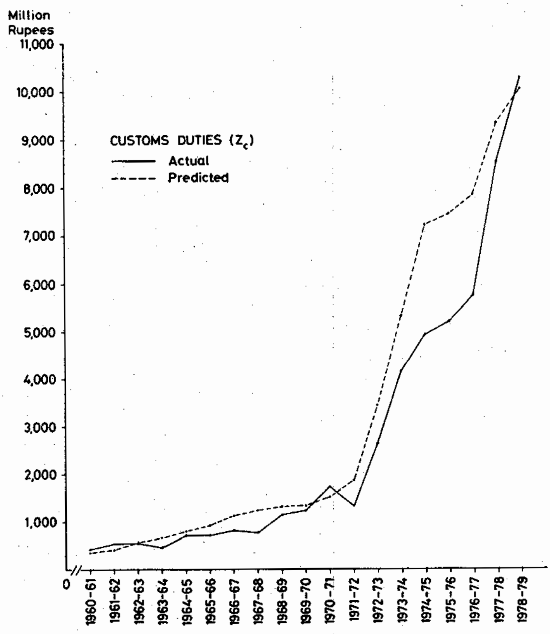

Fig.13

Excise Taxes

This source of the government revenue has been remarkably stable, given the volatile nature of Pakistan's economy. As Fig. 14 shows, the actual series passes through two distinct phases. From 1960-61 to 1970-71 the excise tax revenue tended to increase smoothly. It was stagnant in 1971-72 and then continued to increase thereafter. The predicted series follows the actual series closely, particularly in the Seventies, when the model predicts with a high degree of accuracy. However, the model overpredicts up to 1968-69 and then underpredicts in the years 1969-70 and 1970-71. But, surprisingly enough, the actual and the predicted series are almost identical in 1971-72 and remain close to each other thereafter. The simulation chart illustrates graphically the excellent track record of the estimated equation, even though during this period the economy experienced high rates of inflation, a deep recession in the first half of the decade, and an economic recovery in the second half (starting with 1976-77).

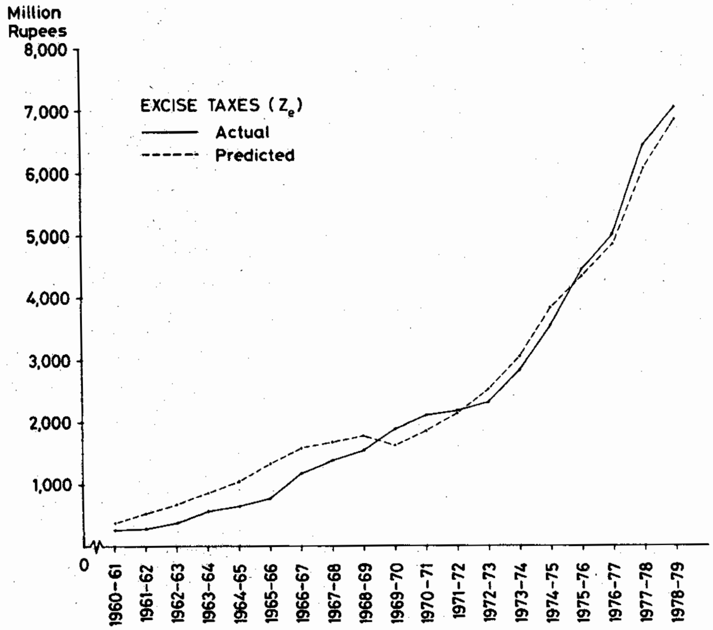

Fig.14

Sales Taxes

The revenue from sales tax was stable till 1963-64, increased continuously till 1966-67, and experienced sharp fluctuations during the 1967-68 – 1972-73 period. It has steadily increased since then (Fig. 15). Considering this erratic behaviour, the simulation fit is reasonable: the TIC value is only 8.7. The revenue from sales tax shows a decreasing trend during the 1970-71–1972-73 period, because output in the manufacturing sector declined and there was a downward trend in imports of raw materials and capital goods as well. As the simulation graph shows, the predicted series follows the actual series closely, but smooths the fluctuations experienced from 1966-67 to 1971-72 by ignoring the turning points.

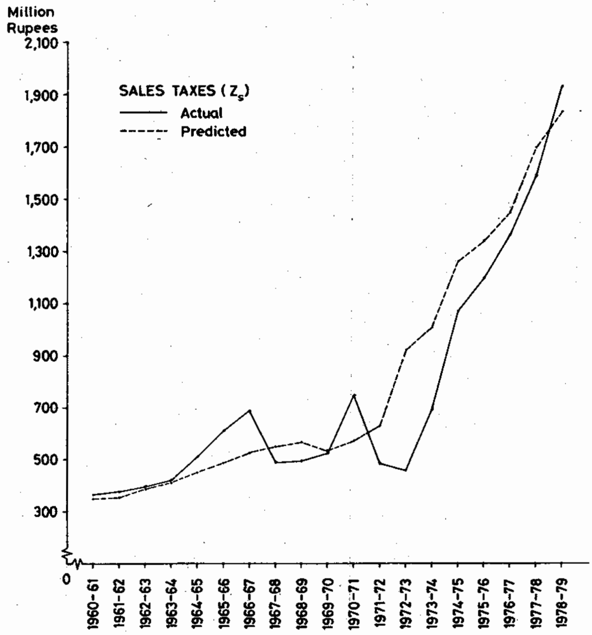

Fig.15

Income and Corporation Taxes

As Fig. 16 shows, the revenue from income and corporation taxes remained stagnant till 1968-69, increased sharply from 1969-70 to 1971-72 and then fell sharply in 1972-73. Since then it has continued to increase. The last increase in the revenue from this source in the Seventies can be attributed to the high rates of inflation experienced during the decade. Considering these changes, it is creditable that the estimated equation predicts the actual series throughout the sample period. In particular, the model predicts the actual series, from 1972-73 onwards, with a high degree of accuracy despite the several discretionary changes in the tax rates and high rates of inflation: the TIC statistic shows an error margin of only 8.3 percent.

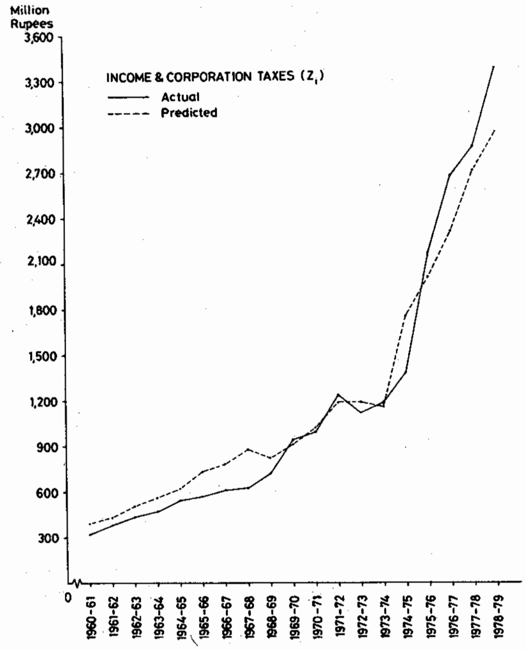

Fig.16

"Other Revenues"

This amorphous category of revenue shows wide fluctuations during the 1961–1973 period. Since then it has stabilized and increased gradually. The model predicts this series very well: the TIC value is only 6.5 percent.

Monetary Block

Money Supply

As indicated by Fig. 17, the actual series on money supply has been remarkably stable, growing only gradually over time. The estimated equation predicts this trend extremely well: the TIC is only 5.35 percent, indicating that the actual and the predicted series remained close to each other throughout the period, the only exceptions being the years 1973-74 and 1974-75 when the equation overpredicts by Rs. 7410 million and Rs. 4640 million respectively. This is probably due to the demonetisation that occurred in this period.

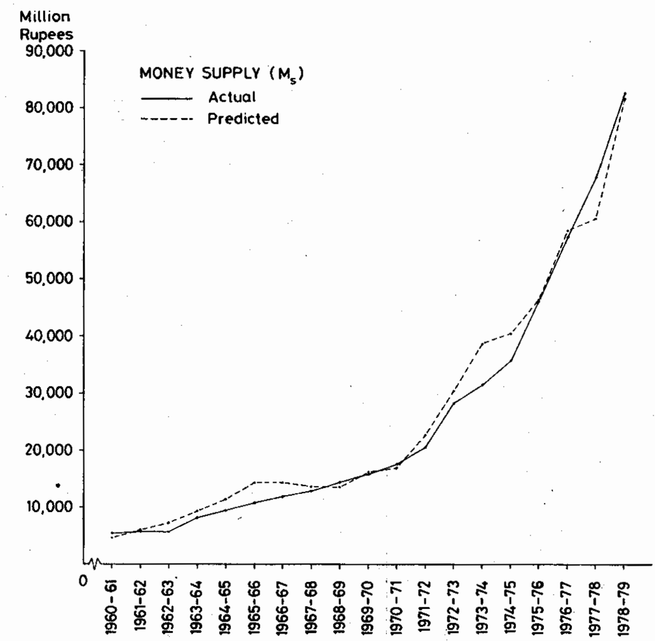
Million
Rupees
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
MONEY SUPPLY (M_s)
Actual
Predicted
1960-61
1961-62
1962-63
1963-64
1964-65
1965-66
1966-67
1967-68
1968-69
1969-70
1970-71
1971-72
1972-73
1973-74
1974-75
1975-76
1976-77
1977-78
1978-79

Fig.17

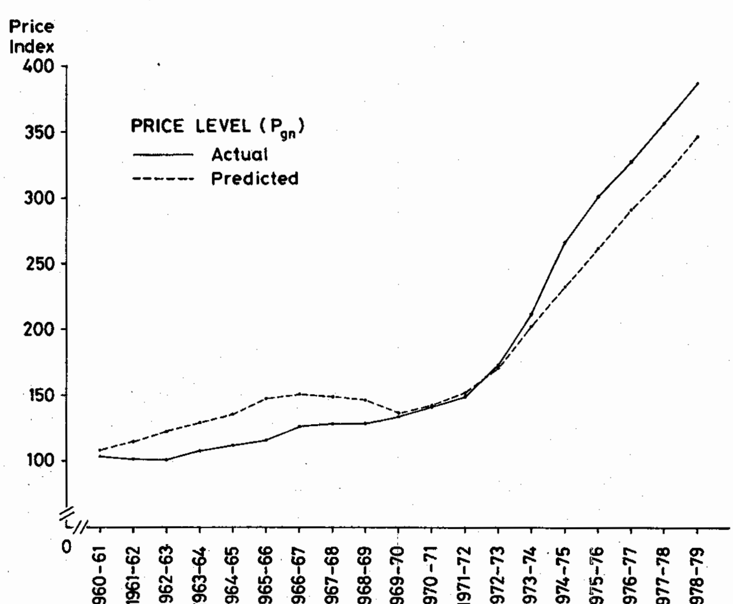
Price
Index
400
350
300
250
200
150
100
0
PRICE LEVEL (P_{gn})
Actual
Predicted
1960-61
1961-62
1962-63
1963-64
1964-65
1965-66
1966-67
1967-68
1968-69
1969-70
1970-71
1971-72
1972-73
1973-74
1974-75
1975-76
1976-77
1977-78
1978-79

Fig.18

Price Level

The Sixties were characterised by price stability in contrast with the high inflation rates experienced during the Seventies. This behaviour of the price level is portrayed in Fig. 18, which also shows that the price level has been predicted with a high degree of accuracy. The actual and the predicted series are close to each other: the TIC shows an error margin of 7 percent. Most of the error in prediction is attributable to the earlier years when there was price stability. However, from 1969-70 onwards the prediction approximates the actual series.

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Chapter 9

SENSITIVITY ANALYSIS OF THE MODEL

In Chapter 8, the results of the validation exercise were discussed at length. The predictive ability of the model was evaluated with the help of such key statistics as Root-Mean-Square Proportional Error (RMSPE) and Theil Inequality Coefficient (TIC). The simulation graphs were also used to check the accuracy with which the model tracks down the main 'turning points' in the historical time-series data. These tests show that the model has a high predictive power. However, the testing does not end with such an exercise. It is equally important to check on the dynamic stability of the estimated coefficients. Obviously the model is not stable if even small changes in parameters, values of exogenous variables, or the base years of the time-series data produce large cyclical changes in the model. Forecasting or policy simulations done with such a model will be highly suspect. As such, sensitivity analysis is undertaken to check on the stability of the model, i.e. to see how *insensitive* the model is to various 'shocks'. These shocks are of three types:

(a) Change in the value of exogenous variables;
(b) Change in the estimated coefficients; and
(c) Change in the initial conditions or the base year.

The results of this exercise can also be given plausible economic meaning. However, these results are largely of a mathematical nature. They show that the estimated equations are dynamically stable: they come out almost unsinged from the furnace of econometric testing, showing that the model portrays the reality faithfully. They also establish that the model can be used for forecasting and policy simulation and as a reliable tool of economic analysis and policy-making.

(i) Change in the Exogenous Variable

To test the dynamic response of a model to exogenous 'shocks', it is required that one of the exogenous variables of the system should change. In the present case the equilibrium solution is allowed to change in response to a 10-percent increase in 'foreign capital inflow' over the entire sample period. The results obtained after administering this 'shock' (reported in Table 1 in the Appendix to this chapter) show that the values of TICs are not significantly different from those reported earlier for thirty important endogenous variables. In other words, the simulated series generated in response to the shock do not diverge much from the control solution.[1] This 'proves' that the model is inherently stable – i.e. it does not 'explode' in response to the proposed shock. However, to save space, 5 simulation graphs (Figs. 19–23) are reproduced in the text. They compare the simulated values with the control solution values of five key endogenous variables, viz. GDP, total consumption, total investment, price level, and the trade gap. The simulation graphs confirm the obvious point that a 10-percent increase in foreign capital inflow will increase GDP, total consumption and total investment, and that by increasing the values of these three variables, this 'shock' will make a direct impact on all those sectors which are determined by final demand variables.

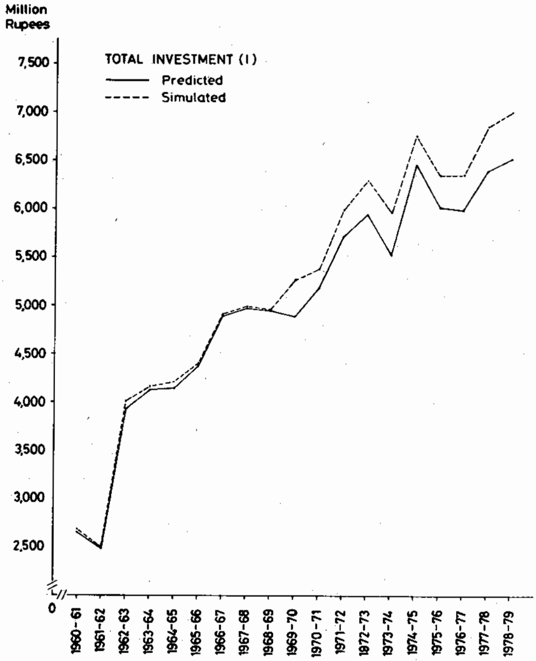
However, the effect of the shock on the price level and trade gap is not so obvious. To see clearly the effect of the shock on the trade gap, which in the model is defined as *always* equal to the resource gap, both the simulated and predicted series are plotted in Fig. 23. The graph shows that in the early Sixties the simulated series was marginally above the predicted series, whereas after 1968-69 the former series started to diverge at an increasing rate from the latter. This wayward behaviour of the simulated series faithfully reflects the actual increase – i.e. that shown by historical times-series data – in trade deficit which occurred in the latter half of the sample period due to a sharper increase in the country's imports than that in its exports. The simulated graph also illustrates the important point that foreign capital inflow, as a rule, *increases* the resource (trade) gap by immediately increasing the import bill whereas the induced increase in exports takes place with a time lag – and that too is not certain.

The simulated series of price level shows two turning points – those occurring in 1966-67 and 1969-70. After a rise until 1966-67, prices fell – reached the lowest level in 1969-70 – and then started to rise. This phenomenon is true for the predicted series as well. This behaviour of prices is intriguing and does not lend itself to any meaningful economic explanation.

(ii) Change in the Estimated Coefficient

To test the response of the model to a parameter change, the marginal propensity to consume (MPC) out of private consumption expenditure was increased by 10 percent from 0.73 to 0.80. Table 2 in the Appendix reports the results of this experiment. Simulation graphs (Figs. 24–28) compare the simulated values with the predicted values for the same five variables as in Section (i) above.

[1] This is standard terminology for the historical simulation series.


Million
Rupees
TOTAL INVESTMENT (I)
Predicted
Simulated
7,500
7,000
6,500
6,000
5,500
5,000
4,500
4,000
3,500
3,000
2,500
0
1960-61
1961-62
1962-63
1963-64
1964-65
1965-66
1966-67
1967-68
1968-69
1969-70
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1971-72
1972-73
1973-74
1974-75
1975-76
1976-77
1977-78
1978-79

Fig.19

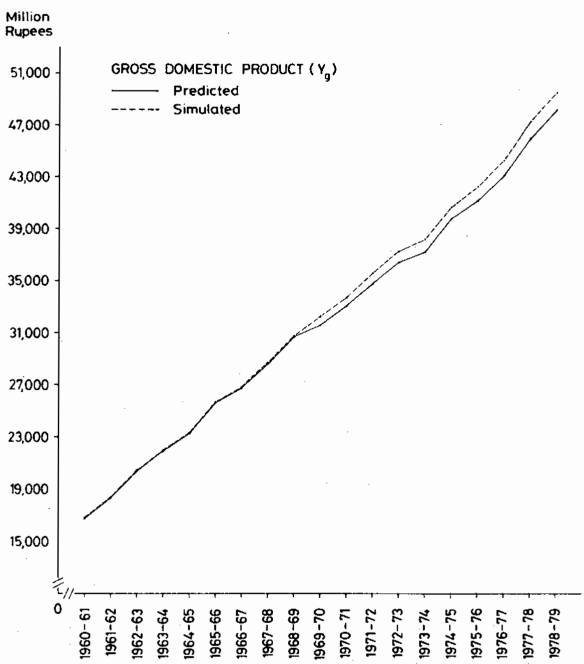
Million
Rupees
GROSS DOMESTIC PRODUCT (Y_g)
Predicted
Simulated
51,000
47,000
43,000
39,000
35,000
31,000
27,000
23,000
19,000
15,000
0
1960-61
1961-62
1962-63
1963-64
1964-65
1965-66
1966-67
1967-68
1968-69
1969-70
1970-71
1971-72
1972-73
1973-74
1974-75
1975-76
1976-77
1977-78
1978-79

Fig.20

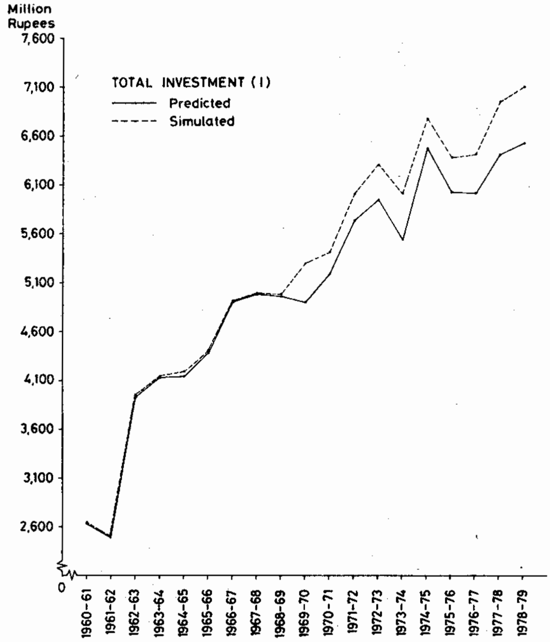
Million
Rupees
7,600
7,100
6,600
6,100
5,600
5,100
4,600
4,100
3,600
3,100
2,600
0
TOTAL INVESTMENT (I)
Predicted
Simulated
1960-61
1961-62
1962-63
1963-64
1964-65
1965-66
1966-67
1967-68
1968-69
1969-70
1970-71
1971-72
1972-73
1973-74
1974-75
1975-76
1976-77
1977-78
1978-79

Fig. 25

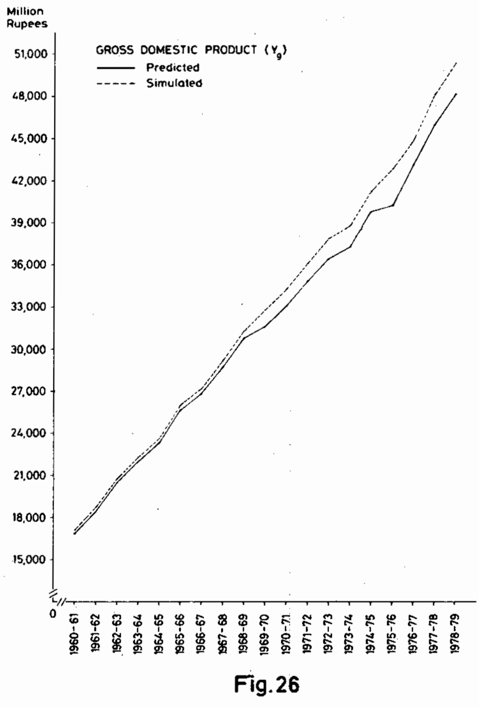
Million
Rupees
51,000
48,000
45,000
42,000
39,000
36,000
33,000
30,000
27,000
24,000
21,000
18,000
15,000
0
GROSS DOMESTIC PRODUCT (Y_g)
Predicted
Simulated
1960-61
1961-62
1962-63
1963-64
1964-65
1965-66
1966-67
1967-68
1968-69
1969-70
1970-71
1971-72
1972-73
1973-74
1974-75
1975-76
1976-77
1977-78
1978-79

Fig. 26

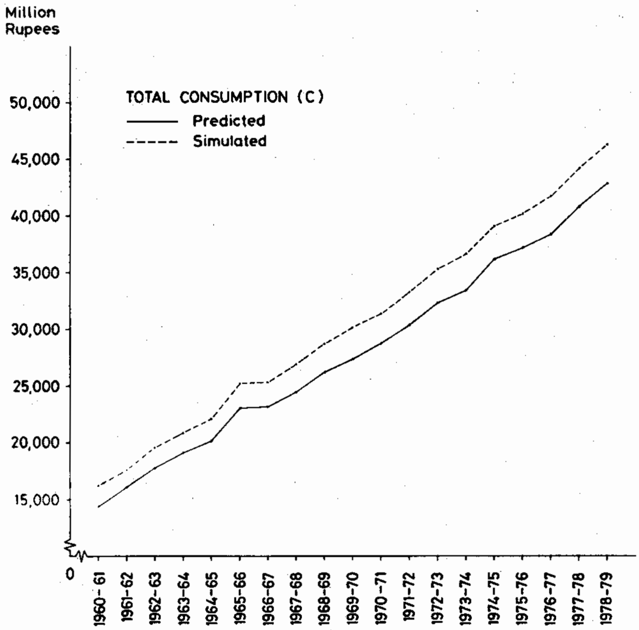
Million
Rupees
50,000
45,000
40,000
35,000
30,000
25,000
20,000
15,000
0
TOTAL CONSUMPTION (C)
Predicted
Simulated
1960-61
1961-62
1962-63
1963-64
1964-65
1965-66
1966-67
1967-68
1968-69
1969-70
1970-71
1971-72
1972-73
1973-74
1974-75
1975-76
1976-77
1977-78
1978-79

Fig. 27

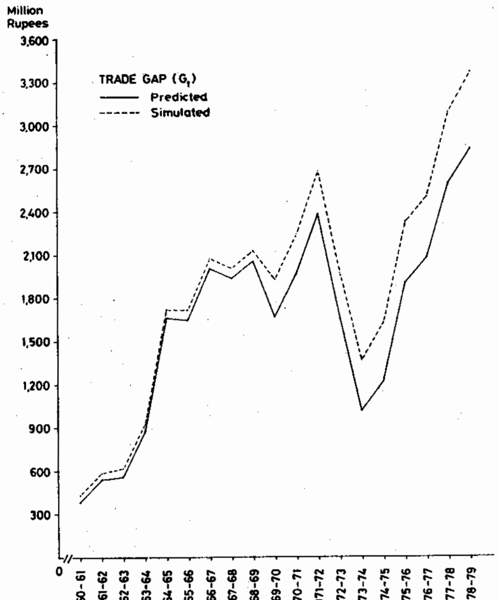
Million
Rupees
3,600
3,300
3,000
2,700
2,400
2,100
1,800
1,500
1,200
900
600
300
0
TRADE GAP (G_t)
Predicted
Simulated
1960-61
1961-62
1962-63
1963-64
1964-65
1965-66
1966-67
1967-68
1968-69
1969-70
1970-71
1971-72
1972-73
1973-74
1974-75
1975-76
1976-77
1977-78
1978-79

Fig. 28

The 'shock' has produced relatively mild changes in the endogenous variable. The incremental TICs for variables are very small. However, it is interesting to note that the model does not 'explode' (not literally, but only in mathematical sense) even though the shock is relatively large. The differences in TIC values remain within the acceptable range. As far as other variables are concerned, the induced changes are insignificant. Note that the direction of the response to this shock is almost identical with that of the earlier.

The effect of the shock is to increase private consumption, GDP and total investment. The price level and trade gap follow a cyclical pattern, which is comparable with that produced by the controlled solution. An inspection of Figs. 24–28 confirms that total consumption, total investment and GDP do increase as a result of the shock. However, note that the induced increase in the relevant endogenous variables is larger as compared with that resulting from the first experiment.

It is interesting that the induced increase in trade (resource) gap is wider in the second experiment than in the first one. This is due to the fact that a 10-percent increase in domestic consumption directly reduces domestic savings and the exportable surplus. It also increases the demand for imports. The differential effect of the two experiments on price level should also be noted. The second experiment produces much milder movement in the price level than the first one. This differential response of the price level may be due to a higher output -increasing effect of an increase in MPC than of an equivalent percentage increase in foreign aid.[2] The MPC is an integral part of the model determining simultaneously savings, gross capital formation, and output in various sectors of the economy. Any change in it is bound to change the character and nature of the economy. Thus, even more than the first experiment, the second one provides a stiff test of the stability of the model.

(iii) Change in the Initial Condition or Base Year

Finally, to test the dynamic stability of the model, the base year of the historical time-series is changed. In an intrinsically stable model, changing the base year should not affect its control solution values, the rationale being that the base-year values of endogenous variables are also needed to solve a simultaneous system of difference equations. Sometimes the solution algorithm may be highly sensitive to these values, especially when the parameter values are such that the model is (almost) unstable.

[2]However, note that a 10-percent increase in the coefficient is not equivalent to a 10-percent increase in foreign capital inflow.

The model was simulated first by changing the base year from 1959-60 to 1964-65. It made *no* difference in the simulated values of the endogenous variables corresponding to the control solution. (To save space, the results of this experiment are not reported.) The base year was then changed to 1969-70. The results reported in Table 3 in the Appendix show that the incremental values of TIC show no significant difference between after-the-shock solution (simulated predictions) and the control solution. In 13 out of 30 cases, the change in TIC is less than 0.008 in absolute terms. For the remaining cases, the changes in TIC are no greater than 0.058.

Figs. 29—33 compare simulated predictions with control solution values for the same set of variables, viz. GDP, total consumption, total investment, price level, and trade gap. The results of this experiment prove that predictions of the model are not sensitive to changes in the base year. This again confirms that the model is stable.

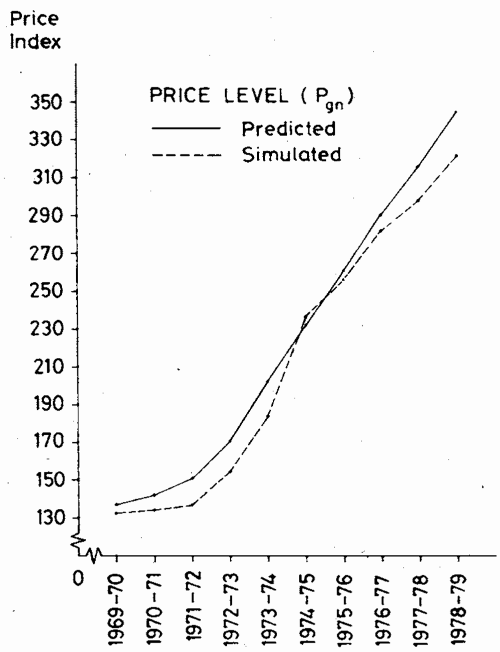

Fig. 29

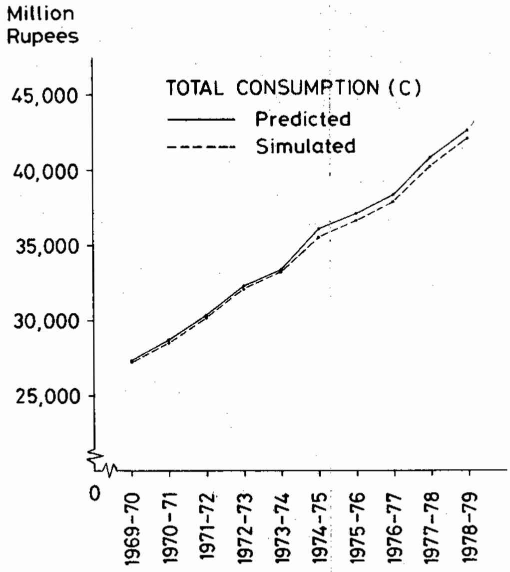
Million
Rupees
45,000
40,000
35,000
30,000
25,000
0
TOTAL CONSUMPTION (C)
Predicted
Simulated
1969-70
1970-71
1971-72
1972-73
1973-74
1974-75
1975-76
1976-77
1977-78
1978-79

Fig. 30

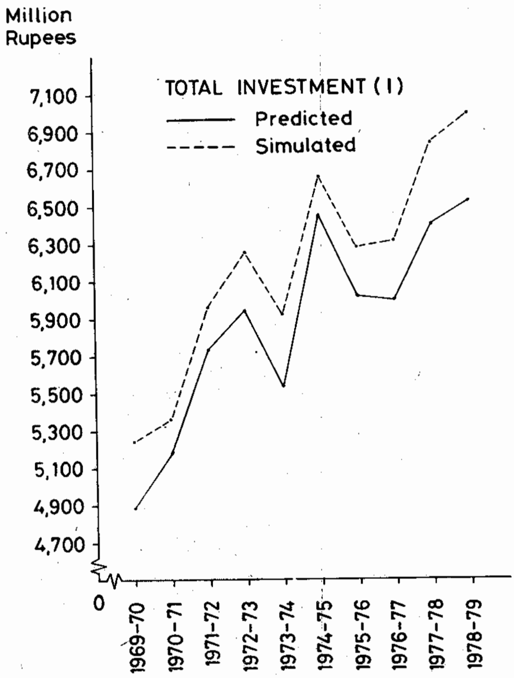
Million
Rupees
7,100
6,900
6,700
6,500
6,300
6,100
5,900
5,700
5,500
5,300
5,100
4,900
4,700
0
TOTAL INVESTMENT (I)
Predicted
Simulated
1969-70
1970-71
1971-72
1972-73
1973-74
1974-75
1975-76
1976-77
1977-78
1978-79

Fig. 31

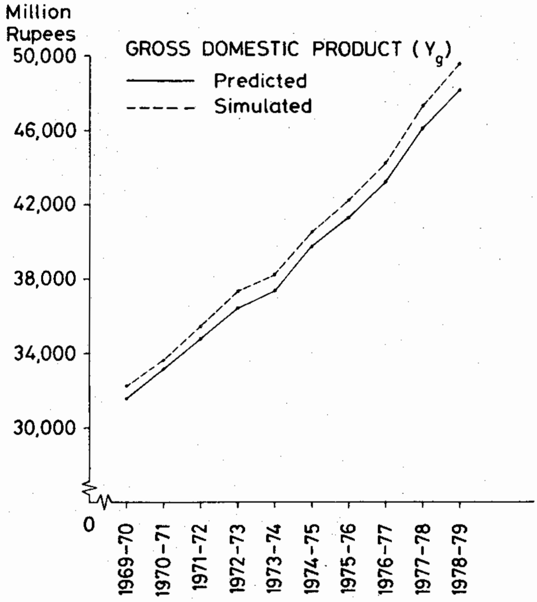
Million Rupees
GROSS DOMESTIC PRODUCT (Y_g)
Predicted
Simulated
50,000
46,000
42,000
38,000
34,000
30,000
0
1969-70
1970-71
1971-72
1972-73
1973-74
1974-75
1975-76
1976-77
1977-78
1978-79

Fig. 32

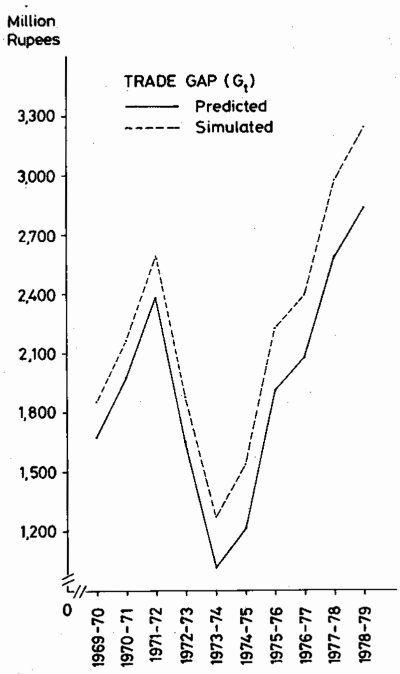
Million Rupees
TRADE GAP (G_t)
Predicted
Simulated
3,300
3,000
2,700
2,400
2,100
1,800
1,500
1,200
0
1969-70
1970-71
1971-72
1972-73
1973-74
1974-75
1975-76
1976-77
1977-78
1978-79

Fig. 33

Appendix

Table 1

Results of Sensitivity Analysis obtained after changing the Exogenous Variable (F_k) by 10 percent

Endogenous Variables	TIC_2	ΔTIC	$RMSPE_2$	ΔRMSPE
PRODUCTION BLOCK				
Gross Domestic Product (Y_g)	0.021	0.011	0.0432	0.0123
Value Added in Agriculture (Crop) Sector (Y_a)	0.023	–0.002	0.0479	0.0001
Value Added in Large-scale Manufacturing (Y_{lm})	0.091	0.013	0.2150	0.0716
Value Added in Construction (Y_c)	0.057	0.007	0.1333	0.0055
Value Added in Wholesale and Retail Trade (Y_r)	0.017	0.002	0.0398	0.0028
Value Added in Public Administration and Defence (Y_p)	0.079	0.014	0.2103	0.0207
Value Added in Agriculture (Non-crop) Sector (Y_b)	0.007	0.005	0.0179	0.0024
Value Added in Mining and Quarrying (Y_q)	0.050	0.010	0.1114	0.0238
Value Added in Ownership of Dwellings (Y_{od})	0.016	0.006	0.0330	–0.0013
Value Added in Small-scale Manufacturing (Y_{sm})	0.050	0.005	0.1042	0.0013
Value Added in Services (Y_s)	0.015	0.000	0.0325	0.0000
EXPENDITURE BLOCK				
Private Consumption (C_p)	0.034	0.004	0.0691	–0.0041
Public Consumption (C_g)	0.052	0.007	0.1366	0.0414

Continued –

Table 1 – *Continued*

Endogenous Variables	TIC_2	ΔTIC	$RMSPE_2$	$\Delta RMSPE$
Private Investment in Agriculture (I_{pa})	0.078	0.008	0.1626	0.0103
Private Investment in Large-scale Manufacturing (I_{pm})	0.094	0.004	0.2841	0.0088
Public Investment in "Other Sectors" (I_{og})	0.085	0.025	0.2322	0.0593
Public Subsidies (S_u)	0.132	0.052	0.6369	0.0000
IMPORTS AND EXPORTS BLOCKS				
Imports of Consumer Goods (M_c)	0.129	0.009	0.4199	0.0196
Imports of Raw Materials (M_i)	0.238	0.038	0.7589	0.1004
Imports of Capital Goods (M_k)	0.117	0.027	0.3294	0.0751
Exports of Primary Goods (X_p)	0.064	–0.001	0.1373	0.0004
Exports of Manufactured Goods (X_m)	0.095	0.01	0.3075	0.0612
Exports of Services (X_s)	0.085	0.015	0.1884	0.0097
FISCAL AND MONETARY BLOCKS				
Customs Duties (Z_c)	0.151	0.031	0.3726	0.0644
Excise Taxes (Z_e)	0.101	0.011	0.3110	0.0166
Sales Taxes (Z_s)	0.111	0.024	0.3150	0.0264
Income and Corporation Taxes (Z_i)	0.092	0.009	0.2049	0.0187
"Other Revenues" (Z_o)	0.07	0.005	0.1676	0.0009
Money Supply (M_s)	0.055	0.002	0.1202	0.0000
Price Level (P_{gn})	0.078	0.008	0.1632	0.0216

where TIC_2 = New equilibrium value of Theil Inequality Coefficient after the shock.
ΔTIC = Difference between simulated and predicted TICs.
$RMSPE_2$ = New equilibrium value of Root-Mean-Square Proportional Error after the shock.
$\Delta RMSPE$ = Difference between simulated and predicted RMSPEs.

Appendix

Table 2

Results of Sensitivity Analysis obtained after changing the Coefficient of MPC in Private Consumption Expenditure Equation

Endogenous Variables	TIC_3	△TIC	$RMSPE_3$	△RMSPE
PRODUCTION BLOCK				
Gross Domestic Product (Y_g)	0.026	0.005	0.0538	0.0229
Value Added in Agriculture (Crop) Sector (Y_a)	0.023	0.00	0.0478	0.0000
Value Added in Large-scale Manufacturing (Y_{lm})	0.068	–0.023	0.2150	0.0716
Value Added in Construction (Y_c)	0.067	0.01	0.1526	0.0248
Value Added in Wholesale and Retail Trade (Y_r)	0.021	0.004	0.0458	0.0088
Value Added in Public Administration and Defence (Y_p)	0.080	0.001	0.2097	0.0201
Value Added in Agriculture (Non-crop) Sector (Y_b)	0.019	0.012	0.0400	0.0245
Value Added in Mining and Quarrying (Y_q)	0.071	0.021	0.1578	0.0700
Value Added in Ownership of Dwellings (Y_{od})	0.029	0.013	0.0877	0.0534
Value Added in Small-scale Manufacturing (Y_{sm})	0.061	0.011	0.1375	0.0346
Value Added in Services (Y_s)	0.015	0.000	0.0325	0.0000
EXPENDITURE BLOCK				
Private Consumption (C_p)	0.063	0.029	0.1400	0.0668
Public Consumption (C_g)	0.052	0.000	0.1371	0.0419

Continued –

Table 2 – *Continued*

Endogenous Variables	TIC_3	△TIC	$RMSPE_3$	△RMSPE
Private Investment in Agriculture (I_{pa})	0.081	0.003	0.1665	0.0142
Private Investment in Large-scale Manufacturing (I_{pm})	0.037	–0.057	0.2839	0.0086
Public Investment in "Other Sectors" (I_{og})	0.086	0.001	0.2353	0.0624
Public Subsidies (S_u)	0.132	0.000	0.6369	0.0000
IMPORTS AND EXPORTS BLOCKS				
Imports of Consumer Goods (M_c)	0.132	0.003	0.4411	0.0408
Imports of Raw Materials (M_i)	0.246	0.008	0.7884	0.1299
Imports of Capital Goods (M_k)	0.122	0.005	0.3280	0.0737
Exports of Primary Goods (X_p)	0.064	0.000	0.1386	0.0017
Exports of Manufactured Goods (X_m)	0.095	0.000	0.3075	0.0612
Exports of Services (X_s)	0.91	0.006	0.2027	0.0240
FISCAL AND MONETARY BLOCKS				
Customs Duties (Z_c)	0.160	0.009	0.3972	0.0890
Excise Taxes (Z_e)	0.109	0.008	0.4214	0.0533
Sales Taxes (Z_s)	0.113	0.002	0.3245	0.0359
Income and Corporation Taxes (Z_i)	0.095	0.003	0.2191	0.0329
"Other Revenues" (Z_o)	0.074	0.004	0.1903	0.0317
Money Supply (M_s)	0.055	0.000	0.1204	0.0002
Price Level (P_{gn})	0.082	0.004	0.1726	0.0310

where TIC_3 = New equilibrium value of Theil Inequality Coefficient after the shock.
△TIC = Difference between simulated and predicted TICs.
$RMSPE_3$ = New equilibrium value of Root-Mean-Square Proportional Error after the shock.
△RMSPE = Difference between simulated and predicted RMSPEs.

Appendix

Table 3

Results of Sensitivity Analysis obtained after changing the Base Year

Endogenous Variables	TIC_4	△TIC	$RMSPE_4$	△RMSPE
PRODUCTION BLOCK				
Gross Domestic Product (Y_g)	0.024	0.014	0.0497	0.0188
Value Added in Agriculture (Crop) Sector (Y_a)	0.027	0.002	0.0527	0.0049
Value Added in Large-scale Manufacturing (Y_{lm})	0.128	0.050	0.2778	0.1344
Value Added in Construction (Y_c)	0.063	0.013	0.1455	0.0177
Value Added in Wholesale and Retail Trade (Y_r)	0.026	0.011	0.0518	0.0148
Value Added in Public Administration and Defence (Y_p)	0.088	0.023	0.2429	0.0533
Value Added in Agriculture (Non-crop) Sector (Y_b)	0.010	0.008	0.0213	0.0058
Value Added in Mining and Quarrying (Y_q)	0.057	0.017	0.1263	0.0385
Value Added in Ownership of Dwellings (Y_{od})	0.017	0.007	0.0339	–0.0004
Value Added in Small-scale Manufacturing (Y_{sm})	0.044	–0.001	0.0913	–0.0116
Value Added in Services (Y_s)	0.014	–0.001	0.0304	–0.0021
EXPENDITURE BLOCK				
Private Consumption (C_p)	0.040	0.010	0.0764	0.0032
Public Consumption (C_g)	0.075	0.030	0.1667	0.0715
Private Investment in Agriculture (I_{pa})	0.065	–0.005	0.1494	–0.0029

Continued –

Table 3 – *Continued*

Endogenous Variables	TIC_4	△TIC	$RMSPE_4$	△RMSPE
Private Investment in Large-scale Manufacturing (I_{pm})	0.116	0.026	0.3682	0.0929
Public Investment in "Other Sectors" (I_{og})	0.058	–0.002	0.2847	0.1118
Public Subsidies (S_u)	0.075	–0.005	0.3542	–0.2827
IMPORTS AND EXPORTS BLOCKS				
Imports of Consumer Goods (M_c)	0.122	0.002	0.4296	0.0293
Imports of Raw Materials (M_i)	0.254	0.054	0.9303	0.2718
Imports of Capital Goods (M_k)	0.148	0.058	0.4241	0.1698
Exports of Primary Goods (X_p)	0.063	–0.002	0.1275	–0.0094
Exports of Manufactured Goods (X_m)	0.137	0.052	0.4072	0.1609
Exports of Services (X_s)	0.064	–0.001	0.1513	–0.0274
FISCAL AND MONETARY BLOCKS				
Customs Duties (Z_c)	0.159	0.039	0.4155	0.1073
Excise Taxes (Z_e)	0.036	–0.054	0.0868	0.2813
Sales Taxes (Z_s)	0.140	0.053	0.4135	0.1249
Income and Corporation Taxes (Z_i)	0.067	–0.016	0.1513	–0.0349
"Other Revenues" (Z_o)	0.052	–0.013	0.1353	–0.0233
Money Supply (M_s)	0.051	–0.002	0.0980	–0.0222
Price Level (P_{gn})	0.065	–0.005	0.1188	–0.0228

where TIC_4 = New equilibrium value of Theil Inequality Coefficient after changing the base year.

△TIC = Difference between simulated and predicted TICs.

$RMSPE_4$ = New equilibrium value of Root-Mean-Square Proportional Error after changing the base year.

△RMSPE = Difference between simulated and predicted RMSPEs.

PART V

POLICY IMPLICATIONS

Chapter 10

POLICY IMPLICATIONS

In the preceding chapters, we specified and estimated a macro-econometric model to understand the structural relationship of Pakistan's economy and to provide a quantitative basis for intelligent policy-making. Furthermore, to check on the reliability of the estimated coefficients and the forecasting ability of the model a detailed historical simulation exercise was performed. An attempt was also made to ascertain the stability of the model by doing sensitivity analysis. All the key statistics obtained through these exercises verify that the model can 'safely' be used for making policy prescriptions.[1] For this purpose, we make use of the values of the coefficients – e.g. elasticities, marginal propensity/marginal productivity, etc. – which provide a convenient yardstick for measuring exactly the magnitude of effect of a marginal change in the independent variable on the dependent variable.[2]

It will be recalled that the equations estimated in Chapters 5 – 7 are in both linear and log-linear forms. In a linear equation, the value of the coefficient signifies the marginal contribution of the independent variable to the change in the dependent variable while in the case of log-linear equation it denotes elasticities. To get a deeper analytical insight into the working of the model, we have computed elasticities for the linear equations and marginal rate of change for the log-linear equations. Estimates of average rates of change, given mostly for the sake of completeness, are computed readily because elasticity is defined as the ratio of the marginal rate of change to the average rate of change.

[1]However, in order to prescribe a policy package to regulate the course of the economy and to change its direction, it is essential to conduct detailed policy simulation – i.e. how the equilibrium values of the key endogenous variables respond to discrete changes in the key exogenous variables. Work on this vital aspect of econometric analysis is under way. Its results will be presented in another volume which will be published by the end of this year (1983).

[2]The estimated coefficients are extremely useful in analysing the dynamic behaviour of the economy and for studying the implications of structural change due to various unseen factors. For details regarding the usefulness of macro-models, see Kmenta and Ramsey [3]. In this chapter each equation of the model has been analysed in a partial-equilibrium framework.

PRODUCTION-EXPENDITURE SUB-MODEL

Production Block

(i) Agriculture

The values of elasticities (η), average productivity (AP) and marginal productivity (MP) of labour and tractor are required to help in evaluating the policy options in agriculture.

Table 10.1 provides interesting insight into the working of the agricultural sector. Firstly, the elasticity of agricultural output is much higher with respect to labour than with respect to tractors. In other words, it is more productive, on the margin, to employ labour than a tractor. While the higher output elasticity for labour is understandable, the very low value for tractors needs some explanation. This somewhat counter-intuitive result may have been due to two factors: (i) non-farm uses of tractors outweigh their on-the-farm use; and (ii) the effective use of tractors, which according to equation (2.5′) has a positive and significant effect on value added, may have been impeded by the inadequate availability of complementary inputs – e.g. fertilizer and water.[3] Secondly, both the average and marginal productivities of labour are positive and greater than unity. This finding runs counter to the standard argument that the marginal productivity of agricultural labour is close to zero in developing countries.

Table 10.1

Output Elasticities (η), Average Productivity (AP) and Marginal Productivity (MP) of Value Added in Agriculture with respect to Selected Variables

Variables	$(\eta = \frac{MP}{AP})$	(AP)	(MP)
a. Labour	0.911	1.124	1.024
b. Tractor	0.089	0.270	0.024

Note: The information given here is based on equation (2.5′) in Chapter 5.

[3] It should be recognized that the time-series data on tractors are not very reliable at present. See Chapter 5, footnote 3.

Both these points have important policy implications. On the one hand, it is clear that agriculture is a predominantly labour-intensive sector and there is still 'room' in it for employing additional labour productively. This is an economic argument for slowing down rural-urban migration. On the other hand, the policy with respect to tractorization needs close scrutiny. To maximize the output-increasing effects of tractors, marginal increments in tractors should be linked to a corresponding increase in the availability of fertilizers and water. However, this observation needs to be qualified by recognizing the 'fact' that off-the-farm uses of tractors may have been promoted by the profit-maximizing behaviour of the owners whose income is considerably enhanced, and that some of these uses, e.g. transportation of crop from the farm to the market, do indirectly contribute to enhancing the (social) profitability of agricultural operations as well.

(ii) Large-scale Manufacturing

The information about large-scale manufacturing, presented in Table 10.2, shows that the level of capital intensity is much higher in this sector than in agriculture. A comparison of the values of elasticities of labour and capital suggests that to maximize the value added in large-scale manufacturing it is more profitable, from the private producers' point of view, to employ a unit of capital than a unit of labour. However, such a course of action is socially sub-optimal in a labour-surplus economy like Pakistan. Higher elasticities of capital in this sector are the result of the consistent use of capital-cheapening policies – e.g. import licensing at an overvalued rate of exchange, low rates of interest, etc. – and of an oligopolistic market structure that such policies have induced in this vital sector of the economy. Such policies have lowered social welfare by promoting both allocative inefficiency and X-inefficiency, which reflects the use of inferior technology in this sector by the domestic producers. However, it may be noted that both the average and the marginal productivities of capital are much lower than the corresponding productivities of labour, implying that capital has been very inefficiently used in the manufacturing sector.[4]

This analysis suggests that government policies should aim at (i) encouraging a more economical use of capital; (ii) lowering the capital/labour ratio through appropriate pricing policies to increase greater employment of labour; (iii) pricing capital at its opportunity cost, instead of subsidizing its use by capital-cheapening policies;

[4]This result follows by definition. It should be remembered that the production function for large-scale manufacturing estimated in Chapter 5 assumes constant returns to scale and only two factors of production, capital and labour. With these assumptions, the marginal productivities of labour and capital *must* be inversely related to the capital/labour ratio: the higher (lower) the capital/labour ratio, the lower (higher) the marginal productivity of capital.

and (iv) decreasing the level of capital intensity through technological change to expand the use of labour. The last-mentioned recommendation suggests that a direct subsidy to the process of learning and technological change would increase social welfare by making industries X-efficient.

Table 10.2

Output Elasticities (η), Average Productivity (AP) and Marginal Productivity (MP) of Value Added in Large-scale Manufacturing with respect to Selected Variables

Variables	$(\eta = \frac{MP}{AP})$	(AP)	(MP)
a. Capital	0.889	0.506	0.45
b. Labour	0.154	5.454	0.84

Note: The results reported here are based on equation (2.8′) in Chapter 5.

(iii) "Other Sectors"

Table 10.3 shows that the value added in public administration and defence (Panel C) is highly elastic (2.32) with respect to public consumption and also that a one-unit marginal increment in public consumption increases the value added in this sector by 0.43. Similarly, the value added in wholesale and retail trade (Panel B) is also highly elastic with respect to GNP (the relevant elasticity is 2.50). Also, each marginal increment in the GNP leads to an increase of 0.13 in the value added in this sector. The output elasticity of construction (Panel A) with respect to total consumption is greater than unity. This testifies to the consumption-oriented nature of the construction activity in Pakistan, which is probably dominated by luxury housing units, plazas, etc. This impression is confirmed by the result that the output elasticity of ownership of dwellings with respect to total consumption (Panel F) is also greater than unity. Also, note that the output elasticity of small-scale manufacturing with respect to total consumption is 5.02 and with respect to total investment it is 1.51. These results have Keynesian overtones, suggesting that an increase in effective demand will directly increase the value added in this sector. These results accord with common knowledge about the behaviour of the "Other Sectors" that include small-scale manufacturing which assumed the role of 'leading' sector during the Seventies.

Table 10.3

Output Elasticities (η), Average Contribution (AC) and Marginal Contribution (MC) of Value Added in "Other Sectors" with respect to Selected Variables

Variables	η = MC/AC	(AC)	(MC)
A. Construction			
a. Total Consumption	1.04	0.048	0.05
b. Total Investment	0.31	0.258	0.08
B. Wholesale and Retail Trade			
a. GNP	2.50	0.052	0.13
C. Public Administration and Defence			
a. Public Consumption	2.32	0.185	0.43
D. Agriculture (Non-crop)			
a. Total Consumption	0.26	0.135	0.035
b. Total Investment	0.05*	0.680	0.034*
c. Total Exports	0.09	1.389	0.125
E. Mining and Quarrying			
a. Total Consumption	0.60	0.005	0.003
b. Total Investment	0.55	0.029	0.016
F. Ownership of Dwellings			
a. Total Consumption	1.20	0.014	0.017
b. Total Investment	0.47	0.076	0.036
G. Small-Scale Manufacturing			
a. Total Consumption	5.02	0.007	0.036
b. Total Investment	1.51	0.039	0.059
c. Total Imports	0.056*	0.054	0.003*

Note: The elasticities and marginal productivities reported here are based on equations (2.12′), (2.13′), (2.14′), (2.15′), (2.16′), (2.17′), (2.18′) in Chap. 5.

*Denotes that the coefficient is statistically insignificant.

Expenditure Block

(i) Consumption

(a) *Private Consumption*

The estimation of consumption function has played a vital role in the development of macroeconomic policies in the Keynesian tradition. The income elasticity of consumption and the marginal and average propensities to consume out of disposable income are key parameters in determining the size of the multiplier and level of savings. Table 10.4 reports that (i) as expected, the elasticity of consumption with respect to disposable income is less than unity; (ii) both the average propensity to consume (APC) and the marginal propensity to consume (MPC) are less than unity; and (iii) the former is higher than the latter. In sharp contrast, both the marginal and average propensities to consume out of the remittance income are much higher than unity. However, the value of elasticity of private consumption with respect to the remittance income is much lower than that with respect to the disposable income, which is largely an arithmetical property.[5] However, for purposes of policy-making, it is meaningful to look at the values of MPCs from both types of income. Note that the sum of the elasticities of consumption out of the disposable income *and* remittances is equal to unity!

Table 10.4

Income Elasticities (η), Average Propensity to Consume (APC) and Marginal Propensity to Consume (MPC) for Private Consumption with respect to Selected Variables

Variables	$(\eta = \frac{MPC}{APC})$	(APC)	(MPC)
a. Disposable income adjusted for remittances	0.93	0.785	0.73
b. Remittances	0.07	33.143	2.32

Note: The results given here are based on equation (2.26′) in Chapter 5.

[5]This is because the average propensity to consume out of the remittance income exceeds the marginal propensity to consume by a wide margin since the mean value of the remittance income is much smaller than that of private consumption.

These results have at least two policy implications. (i) The value of 'simple' investment multiplier is 3.70. This implies that a one-unit increase in investment expenditure tends to increase GNP by a multiple of 3.70![6] This value is somewhat low; because the marginal propensity to consume out of disposable income in Pakistan is lower than expected.[7] However, the relatively lower marginal propensity to consume out of disposal income is more than compensated by a very high marginal propensity to consume out of remittances, which may be treated as a sort of 'transitory income' (ii) The government should aim at lowering the marginal propensity to consume out of remittance income by creating avenues for profitable investment of such income.

(b) *Public Consumption*

Table 10.5 presents the relevant information concerning the behaviour of public consumption.

Table 10.5

Elasticities (η), Average Prospensity to Consume (APC) and Marginal Propensity to Consume (MPC) for Public Consumption with respect to Selected Variables

Variables	$(\eta = \frac{MPC}{APC})$	(APC)	(MPC)
a. Total Public Revenue	0.59	0.712	0.42
b. Foreign Capital Inflow (gross)	0.13	1.077	0.14

Note: The elasticity and MPC reported here are taken from equation (2.29') in Chapter 5.

The values of elasticities, APC and MPC reveal interesting aspects of public consumption. First, public consumption is primarily influenced by the availability of public revenue, raised through taxation etc., while a part of foreign aid is also diverted into public consumption. Secondly, the marginal propensity to consume out of public revenue is quite high, and is much higher than that out of foreign aid. Thirdly, public consumption bears all the characteristics of private consumption: the MPC is less than unity and lower than the APC.

[6]It may be noted that the concept of investment multiplier refers strictly to partial-equilibrium implications of equation (2.26').

[7]For example, the multiplier calculated from the MPCs reported by Naqvi and Khan for India, Bangladesh and Sri Lanka [6] are 4.35, 8.33 and 3.57 respectively. Furthermore, the MPCs reported in the UNCTAD study for Argentina and Nigeria [7] yield 3.82 and 2.99 respectively as values of multiplier. For Greece [8] this value is 3.92.

These findings show that the public consumption behaviour in Pakistan has *not* been entirely extravagant: only 42 percent of the public revenue is devoted to public consumption incurred to meet the normal requirements of non-development expenditure – mainly salaries of government servants. This ratio is not unduly high by international standards.[8] Furthermore, contrary to popular views, only a small proportion of foreign capital inflows has 'leaked' into public consumption. It has been used mostly, and appropriately, for developmental purposes and to repay foreign debt. However, this finding does emphasize the need for a more economical and productive use of foreign capital.

(ii) Investment

(a) *Private Investment*

As pointed out in Chapter 5, instead of an aggregate private investment function, two functions have been estimated for private investment in the agriculture and large-scale manufacturing sectors. This is because of the different sets of conditions determining private investment in the two sectors.

The information set out in Panel A of Table 10.6 shows that private investment in agriculture is most sensitive to changes in the value added in that sector: investment elasticity is greater than unity. However, private investment responds inelastically, though significantly, to changes in the relative prices of tractors. On the other hand, remittances do not exercise a significant effect on agricultural investment. This is consistent with the earlier finding that an overwhelming part of the remittance income is devoted to private consumption. In sharp contrast, private investment in large-scale manufacturing (Panel B) is predominantly affected by the relative prices of investment goods: the relevant elasticity is (–2.14). Furthermore, a change in manufacturing output directly stimulates private investment through the accelerator effect: a one-unit increase in manufacturing output *directly* increases investment in this sector by 0.25 units. This relatively high accelerator effect is explained by the high *average* efficiency (i.e. productivity) of capital (3.289) in Pakistan.

The policy implications of these findings are clear: (i) an increase in the agricultural and manufacturing outputs is a precondition for large private investment in these sectors; and (ii) the importance of adopting appropriate pricing policies for stimulating private investment in both these sectors comes out clearly from the above-mentioned findings.

[8]For example, the UNCTAD study for India [7] estimates the marginal propensity to consume out of tax revenue to be 0.86. Also, Marzouk [4] found it to be 0.462 for Sudan.

Table 10.6

Elasticities (η), Average Efficiency of Capital (AEC) and Marginal Efficiency of Capital (MEC) for Various Categories of Private Investment, with respect to Selected Variables

	Investment Categories and Variables	$(\eta = \frac{MEC}{AEC})$	(AEC)	(MEC)
A.	Investment in Agriculture			
	a. Value Added in Agriculture (Crop) Sector	1.45	0.034	0.05
	b. Relative Prices of Tractors	–0.70	215.71	–151.0
	c. Remittances	0.10*	0.400	0.04*
B.	Private Investment in Large-scale Manufacturing			
	a. Changes in the Value Added in Large-scale Manufacturing	0.076	3.289	0.25
	b. Relative Prices of Investment Goods	–2.14	617.35	–1321.14

Note: The information given here is based on equations (2.30′) and (2.31′) in Chapter 5.

*Denotes that the coefficient is statistically insignificant.

(b) *Public Investment*

The behaviour of public investment is governed by an altogether different set of variables: availability of public revenue and foreign capital inflow. The findings are reported in Table 10.7 and are consistent with those given in Table 10.5. Changes in public investment are predominantly influenced by the changes in total public revenue: the elasticity is greater than unity. This underlies the importance of domestic resource mobilization effort for securing a substantial increase in public investment. Foreign capital inflows also help public investment significantly, but the relevant elasticity is much below unity. A comparison with Table 10.5 shows that foreign capital inflow contributes only moderately to public investment and public consumption. This makes sense because the bulk of foreign capital goes to repay and service (net) outstanding foreign debt.

Table 10.7

Elasticities (η), Average Propensity to Invest (API) and Marginal Propensity to Invest (MPI) of Public Investment with respect to Selected Variables

Variables	$(\eta = \frac{MPI}{API})$	(API)	(MPI)
a. Total Public Revenue	1.21	0.349	0.423
b. Foreign Capital Inflow (gross)	0.29	0.389	0.113

Note: The information given here is based on equation (2.33′) in Chapter 5.

(iii) Public Subsidies

Public subsidies have mostly been given on agriculture inputs – e.g. fertilizers.

The results reported in Table 10.8 are highly interesting: (i) the high elasticity of public subsidies with respect to the value added in agriculture (–2.64) suggests that the policy of withdrawing subsidies has followed a counter-cyclical pattern; and (ii) a substantial increase in the value added in agriculture should facilitate a withdrawal of subsidies, while in periods of low agricultural growth a rise in the size of subsidies should be expected. If, for example, the value added in agriculture increases (decreases) by 4 percent per annum the government can reduce (increase) subsidies by 10.6 percent per annum. The implication of this result is clear: the rate and level of subsidies should be adjusted in response to changes in agricultural output.

Table 10.8

Elasticity (η), (AAC) and (MAC) of Public Subsidies with respect to Selected Variables

Variables	$(\eta = \frac{MAC}{AAC})$	(AAC)	(MAC)
a. Value Added in Agriculture	–2.64	0.053	–0.14

Note: 1. This elasticity is based on equation (2.34′) in Chapter 5.
2. ACC = Average Contribution to Value Added in Agriculture; and MAC = Marginal Contribution to Value Added in Agriculture.

INTERNATIONAL TRADE SUB-MODEL

Import Block

Three equations have been estimated for the imports of consumer goods, intermediate goods and capital goods. The results, presented in Table 10.9, have important policy implications. First, in the *long run*, consumer-goods imports (Panel A) are highly sensitive to changes in their effective exchange rate, even though much less so in the short run: a one-percent increase in the effective exchange rate lowers consumer goods imports by 1.62 percent in the long run but by only 0.8 percent in the short run. This suggests that there is ample room for policy-makers to influence consumer goods imports by changing the relative prices, i.e. by manipulating the tariff/subsidy rates. Even more important are changes in disposable income whose elasticity with respect to consumer goods is greater than unity in the short run and tends to increase considerably with the passage of time: a one-percent increase in income increases imports by 1.09 percent in the short run and by 2.17 percent in the long run.[9]

Secondly, changes in the imports of intermediate goods are *insensitive* to changes in the effective exchange rate. This stands to reason because the demand for intermediate goods is *derived* demand. It is, therefore, not surprising that such imports are highly responsive to changes in manufacturing output: the relevant elasticity is 7.32.[10] Incidentally, this finding provides a striking corroboration of the hypothesis that import substitution of final goods may impose an even greater strain on the balance of payments by opening up the floodgates for the imports of intermediate goods. Indeed, this is what has actually happened in Pakistan.

Thirdly, capital goods imports are highly sensitive to changes in relative prices: the price elasticity is greater than (minus) unity. However, the elasticity is even higher for changes in manufacturing output, which exercises a positive influence on imports of capital goods. The results suggest that the import bill for capital goods is best regulated by an increase in the *effective* exchange rate, which can offset the expansionary effect of a rise in manufacturing output. By the same token, when final output is rising, a substantial reduction in the effective exchange rate can have an explosively expansionary effect on imports.

[9]Incidentally, this finding supports the view that remittance income may have contributed to the sharply rising import bill in the Seventies. Recall from Table 10.4 that private consumption rises, though inelastically, in response to remittance income.

[10]The high value of import elasticity also explains to some extent the statistical insignificance of the price effect in this class of imports.

Table 10.9

Elasticities (η), Average Propensity to Import (APM) and Marginal Propensity to Import (MPM) for Various categories of Imports with respect to Selected Variables

Import Categories and Variables	$(\eta = \frac{MPM}{APM})$	(APM)	(MPM)
A. Consumer Goods			
a. Disposable Income	1.087 (2.17)	0.022 (0.022)	0.024 (0.048)
b. Effective Exchange Rate for Consumer Goods	–0.81 (1.62)	59.815 (59.815)	–48.45 (96.9)
B. Raw Materials and Intermediate Goods			
a. Total Manufacturing Output	7.32	0.062	0.456
b. Effective Exchange Rate for Intermediate Goods	–0.05*	20.96	–1.048*
C. Capital Goods			
a. Total Manufacturing Output	1.79	0.160	0.286
b. Effective Exchange Rate for Capital Goods	–1.10	62.850	–69.135

Note: 1 The information given here is based on equations (3.39'), (3.40') and (3.41') in Chapter 6. A star (*) indicates that the coefficient is statistically insignificant.

2. The figures in parentheses are long-run elasticities of the given variable.

These findings highlight the role of the price effect in regulating the size of the import bill. However, here is also a warning: imports of all kind are expected to rise substantially as disposable income and manufacturing output increase with the passage of time. It follows that for balance-of-payments reasons alone the growth of the manufacturing sector should take place proportionately at all stages of processing. However, as there are limits to such an autarkic pattern of industrialization, the need is great for promoting exports to pay for the rising import bill.

Export Block

The three estimated equations for exports of primary goods, manufactured goods and services show that while manufactured-goods exports are reasonably responsive to changes in relative prices, the exports of primary goods are not (Table 10.10). However, both types of exports are much more sensitive to changes in the value added in their respective sectors. Also, exports of services respond elastically to changes in GNP: the relevant elasticity exceeds unity. These results strongly suggest that although changes in relative prices do matter, the most effective way of expanding exports is to increase the GNP and its components. By the same token, changes in the exchange rates – i.e. a devaluation – should not have much effect on exports, even though they would have a definite effect on imports. It follows that a policy of stimulating domestic production and directly subsidizing exports is a surer way of expanding exports than a straight devaluation. In other words, what matters most for balance of payments is an adjustment in the *effective* exchange rate rather than in the nominal exchange rate.[11]

FISCAL AND MONETARY SUB-MODEL

Fiscal Block

This block deals with public revenue. The information given in Table 10.11 is extremely important for policy-making because the success of domestic resource mobilization effort depends crucially on the responsiveness of the tax structure to changes in the tax base and tax rates. In this section, elasticities have been computed with respect to the tax base, which shows the extent to which specific taxes recapture the marginal increments in the relevant base – e.g. value added, imports, etc.[12]

[11]This suggestion is strengthened by the fact that price elasticities are, on the average, much higher and significant for imports than for exports. (Compare Tables 10.9 and 10.10.) It follows that a corresponding policy on the import side would be to adjust *effective* exchange rates to get the desired result. A straight devaluation, which taxes imports and subsidises exports at the *same* rate, is clearly unsuitable when price elasticities are so different for imports and exports. However, this is not an argument for blocking any devaluation, no matter what. It only warns against relying too heavily on the depreciation of the *nominal* exchange rate to improve balance of trade.

[12]The effect of changes in tax *rates* on public revenue can be traced in the context of a 'simulation' exercise, which forms the subject matter of Volume II of the present study, which will be published by the end of 1983.

Table 10.10

Elasticities (η), Average Exports Contribution (AXC) and Marginal Exports Contribution (MXC) with respect to Selected Variables

Exports Categories and Variables	$(\eta = \frac{MXC}{AXC})$	(AXC)	(MXC)
A. Primary Goods Exports			
a. Total agriculture output	0.78	0.083	0.065
b. Relative price for primary-goods exports	–0.11*	11.991	–1.209*
B. Manufactured Goods exports			
a. Large-scale manufacturing output	0.93	0.325	0.302
b. Relative price of manufactured goods exports	–0.41	14.707	–6.03
C. Services Exports			
a. GNP	1.80	0.011	0.02

Note: The elasticities and MXC reported above are taken from equations (3.44′), (3.45′) and (3.47′) in Chapter 6.
*Denotes that the coefficient is statistically insignificant.

Even a cursory look at the contents of Table 10.11 is sufficient to show that all taxes are highly elastic with respect to their bases, except for income and corporation taxes which are inelastic (Panel D). It may be noted that the base elasticity is the highest for excise tax (2.38), followed by that for "Other Revenues" (1.62).

The sum of the elasticities of sales taxes with respect to their bases (i.e. manufacturing output and imports of goods) is 1.29. Similarly, the sum of the elasticities of customs duties with respect to their bases (i.e. imports of consumer, intermediate and capital goods) is 1.26. Conversely, income and corporation taxes have a base elasticity of only 0.85.

These findings are very important for policy-making. Firstly, contrary to the popular views, Pakistan's tax structure is by and large base-elastic. In other words, the government can effectively bring into the tax-net marginal increments in the GNP and its various components. Secondly, there is an imbalance between the so-called direct and indirect taxes due to the fact that income and corporation taxes have been 'incapacitated' by the contraction of the base through a system of over-liberal investment incentives – e.g. tax holidays. As pointed out in Chapter 7, so great has been this incapacity that the many efforts, particularly in the Seventies, to raise revenue from this source through sharp discretionary changes in the tax *rates,* by and large, failed to achieve their objectives. Indeed, in most cases, tax efforts have been counter-productive. (See equation (4.53′) where the rate dummy bears a negative sign.) Thirdly, in view of the well-known inflationary effects of indirect taxes, as opposed to direct taxes, it is suggested that a better balance be achieved between them by expanding the base of direct taxes. Among other things, this would require imposition of income tax on agricultural income.[13] Furthermore, to promote private investment, the standard policy should be to lower the marginal tax rate while expanding the tax base by withdrawing most of the fiscal incentives which are given in the form of exclusion and exemptions – i.e. tax holidays, accelerated depreciation allowances, etc.

Table 10.11

Elasticities (η), Average Revenue Contribution (ARC) and Marginal Revenue Contribution (MRC) of Various Taxes with respect to Selected Variables

	Taxes Variables	($\eta = \frac{MRC}{ARC}$)	(ARC)	(MRC)
A.	Customs Duties			
	a. Imports of Consumer Goods	0.115*	1.038	0.12*
	b. Imports of Intermediate Goods	0.74	0.500	0.37
	c. Imports of Capital Goods	0.41	0.600	0.245
B.	Excise Taxes			
	a. Manufacturing Output	2.38	0.105	0.249
C.	Sales Taxes			
	a. Manufacturing Output	0.687	0.039	0.027*
	b. Total Imports of Goods	0.605	0.039	0.024
D.	Income and Corporation Taxes			
	a. Non-Agricultural Income (Tax Base)	0.85	0.029	0.025
E.	"Other Revenues"			
	a. GNP	1.62	0.051	0.83

Note: The elasticities and MRC reported above are taken from equations (4.50′), (4.51′), (4.52′), (4.53′) and (4.54′) in chapter 7.

A (*) indicates that the coefficient is statistically insignificant.

[13]It may be noted that the need for achieving a proper balance between direct and indirect taxes is not a matter of equity, but of allocative efficiency. A disproportionate reliance on excise taxation may prove to be harmful because of its inflationary consequences. On the other hand, in so far as income and corporation taxes are not shifted, raising revenue from this source will be more efficient. However, this matter needs research, because many studies for developed countries show that corporation taxes also get shifted.

Monetary Block

(i) Money Supply

The elasticity of money supply with respect to its arguments is reported in Table 10.12. These elasticities are extremely important in determining the relative contributions of different variables in increasing money supply. The table shows that the main factor contributing to an increase in money supply is bank credit: the relevant elasticity is greater than unity. Positive (negative) changes in foreign exchange reserves also exercise an expansionary (contractionary) influence on money supply. On the other hand, deficit financing does not exercise a significant *direct* expansionary effect on money supply.[14] This result appears to be counter-intuitive but stands to reason because the relative effect of budgetary deficits on money supply may have been swamped by the influence of the other two variables. Furthermore, the amount of deficit financing, though substantial in absolute terms, is very low relative to the size of the money stock. As such, it exerts only an insignificant effect on the overall expansion of money supply. It may also be noted that the budgetary gap is mostly financed by borrowing from the banking system so that all of it is not immediately monetized. In other words, there is no one-to-one relation between budgetary deficits and *net* monetary creation.

Table 10.12

Elasticities (η), Average Rate of Change and Marginal Rate of Change of Money Supply with respect to Selected Variables

Variables	$(\eta = \frac{\text{MR change}}{\text{AR change}})$	(AR change)	(MR change)
a. Bank credit	1.05	1.695	1.799
b. Budgetary deficit	0.01*	9.00	0.09*
c. Foregin exchange reserves	0.28	7.500	2.10

Note: The elasticities reported here are calculated from equation (4.55′) in Chapter 7 at their mean values.

*Indicates that the coefficient is statistically insignificant.

[14] This result can not be attributed to any multi-collinearity between the budgetary deficits and bank credit variables. The variance-covariance matrix for money supply shows that the covariance between these variables is only −0.012, and that between foreign exchange and budgetary deficit is 0.015.

For policy purposes, three points need to be noted. First, the credit multiplier, implied by the credit elasticity, is 1.80. In other words, by the mechanism of multiple money creation, a one-unit increase in bank credit has a magnified effect on money supply. This relationship should be kept in view when planning credit expansion. Second, the implied foreign-exchange reserve multiplier is even bigger: it is 2.1. This shows that a substantial increase in foreign exchange reserves is not an unmixed blessing. The government should seek to neutralize its expansionary effects on money supply through some kind of 'sterilization' operations.

(ii) **Price Level**

As explained at length in Chapter 7, a notable finding of the present study is that the increase in money supply does not exercise a direct significant effect on the price level. This somewhat counter-intuitive result is not unreasonable when it is remembered that (i) the elasticity of demand for money with respect to an increase (decrease) in the GNP is substantially greater than unity,[15] and (ii) a part of the increase in money supply is required to *accommodate* the increase in the price level. It follows that if the economy continues to grow at a rate of, say, 6 percent per annum, the required increase in the money supply may be 12 percent per annum. However, these findings do not preclude the possibility that very high rates of monetary expansion, coupled with only moderate growth of the GNP, may push the price level upwards.[16]

Another interesting result is that the *negative* effect of changes in the level of imports on inflation is significant though less than unity. The negative sign of the coefficient contradicts the widely-held notion that inflation in Pakistan has been mostly imported. However, inflation can still be imported, although in an *accommodating* fashion, if, say, because of an increase in the effective exchange rate, imports of consumer goods fall significantly. (See Table 10.9.) Likewise, a fall in the imports of capital goods may increase the *relative* prices of those industries which are intensive in the use of imported goods. With all prices remaining unchanged, such an increase in relative prices must push the prive level up.

[15]The PIDE Model (1982) suggests that in Pakistan the long-run demand for money is 2.58, which is somewhat on the high side. However, other studies also suggest a value near 2.00. For instance, Khan [1] estimates it to be 1.78, while for India, Thailand, Malaysia and Korea these are 2.13, 1.62, 1.25 and 1.20 respectively. See Khan [2].

[16]See also footnote No. 5 in Chapter 7.

Table 10.13 suggests that the most important variable explaining changes in the price level is the *share* of commodity-producing sectors in the GDP. The relevant elasticities reported in Table 10.13 give more meaning to equation (4.57′), reported in Chapter 7. It shows that a one-percent increase (decrease) in the share of commodity-producing sectors *decreases* (increases) the price level by 1.66 percent.

Table 10.13

Elasticities (η), Average Rate of Change and Marginal Rate of Change of Price Level with respect to Selected Variables

Variables	$(\eta = \frac{\text{MR Change}}{\text{AR Change}})$	(AR change)	(MR change)
a. Total imports	–0.18	0.051	–0.009
b. Share of commodity-producing sectors in GDP	–1.66	344.728	–572.25
c. Money supply	0.05*	0.010	0.0004

Note: The elasticities reported here are calculated from equation (4.57′) in Chapter 7, at their mean values.

*Indicates that the coefficient is statistically insignificant.

These results strongly suggest that during the sample period inflation in Pakistan has been mostly of a stagflationary nature, caused mainly by a recession in the economy. If inflation was at all imported, it was imported only indirectly by inducing a slow-down of the commodity-producing sectors. It follows that an anti-inflationary policy-package should emphasize the increasing *share* of commodity-producing sectors in the GDP. If this share falls, as it did in Pakistan during the Seventies, then even a high rate of growth of the GDP will be inflationary. Economic stagnation will, of course, intensify the inflationary effects from this source. This analysis also suggests that there is much more room for non-inflationary monetary expansion than is generally realized. However, this should not make the monetary authorities "trigger-happy". Furthermore, the anti-inflationary policy-package should also ensure adequate availability of imported goods. Another thing that does not show up in Table 10.13 is the important role that a policy of containing inflationary expectations can play in any programme of reducing inflation. (See equation (4.57′) in Chapter 7.)

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PART VI

PART-WISE SUMMARIES OF THE MAJOR FINDINGS

SUMMARY OF PART II

Chapters 2, 3, and 4 in Part II are devoted to a detailed explanation of the system of 58 simultaneous equations which make up the econometric model. The size of the model has been determined mainly by the minimum number of the required strategic endogenous variables, whose explanation is crucial for understanding the behaviour of Pakistan's economy, by the availability of data and by the incremental cost-benefit ratio of including more behavioural equations.

For expositional purposes the model has been subdivided into three sub-models, viz. the Production-Expenditure Sub-model, the International Trade Sub-model, and the Fiscal and Monetary Sub-model. Each of these sub-models combines those sectors in which the intersectoral relationships are most direct.

The crucial Production-Expenditure Sub-model, which is explained at length in *Chapter 2,* is further subdivided into a Production Block and an Expenditure Block. The Production Block is divided into 10 sectors each of which makes value-added contribution to the GDP. For the Agriculture (Crop) and Large-scale Manufacturing sectors, the Cobb-Douglas production functions are postulated, with output depending mainly on input use. On the other hand, the input demand functions are derived through the marginal productivity condition. The value added in the remaining eight sectors is related to the relevant final expenditure.

The Expenditure Block of the sub-model specifies appropriate equations for consumption- and investment-expenditures. These expenditure categories are each subdivided into private and public components. In general, disposable income, home remittances, real balances, and inflation are postulated to determine the private consumption expenditures. Public consumption expenditures are assumed to be influenced by public revenue, foreign assistance and lagged consumption. Private investment is divided into three categories corresponding to the three major areas of investment. Each of these categories of private investment is determined by output, credit availability, relative prices and home remittances. Public investment, like public consumption, is specified as a function of internal and external resources available to the government and lagged public investment.

The International Trade Sub-model, which is discussed in *Chapter 3,* depicts in a rather disaggregated form the current account of Pakistan's balance of payments. It is subdivided into an Import Block and an Export Block. Within each of these blocks three categories of imports as well as exports are distinguished.

The import equations are formulated as demand functions depending upon disposable income, relative prices, effective exchange rates and lagged terms (reflecting habit persistence). On the other hand, export functions are supply-oriented, featuring relative prices, effective exchange rates, domestic consumption and domestic production as the most important variables in explaining changes in the level of exports. Trade deficit is defined as the gap between imports and exports of goods and services. The current account deficit is derived by adjusting the trade gap for net factor income from abroad. The capital account of the balance of payments is treated as exogenously determined.

In *Chapter 4,* the Fiscal and Monetary Sub-model is considered. The sub-model is subdivided into a Fiscal Block and a Monetary Block. The Fiscal Block focusses on the revenue receipts of the government, while the Monetary Block focusses on the money market and the level of prices. Five equations are specified to explain the behaviour of as many sources of government revenue. The four tax equations are specified to depend upon the relevant bases while "Other Revenues" are related to the general level of activity in the economy. The Monetary Block specifies an equation for money supply, which depends upon the various components of the monetary base – i.e. government budget deficit, bank credit, and foreign exchange reserves. The government budget deficit, defined as the excess of government expenditures over public revenue, is determined within the model. *It is assumed that money supply is always equal to money demand.* The final behavioural equation pertains to the price level, which is specified to depend on nominal money stock, the share of the commodity-producing sectors in the GDP, availability of imports and the past year's price level. This specification is designed to test the 'monetarist', 'structuralist' and the 'imported-inflation' hypotheses.

The model is fully simultaneous and the explicit inclusion of lagged variables and non-linear terms makes it dynamic. In modelling inter-sector and intra-sectoral relationships for Pakistan's economy, both *a priori* reasoning and extensive experimentation with alternative specifications have been used to establish the least distance between the model and the reality. (Some of these alternative specifications are given in Appendix B.)

While use was made of standard results reported in the economics literature as a guide to hypothesis formation, these were used mostly as a point of departure for a systematic attempt to evolve more 'realistic' hypotheses to explain the behaviour of the strategic macro variables in a developing economy like Pakistan's. The specifications used to explain the production behaviour of the agriculture and manufacturing sectors, the consumption and (private) investment functions and the movement of the price level provide helpful insights into Pakistan's economy. These specifications may be used to explain economic events in other developing countries as well. In this attempt for getting a firm hold on Pakistan's economy, a considerable degree of disaggregation has been achieved, particularly in the vital foreign-trade sector and the fiscal activities of the government. The results of estimation presented in Part III fully support the economic reasoning underlying the specifications outlined in Part II.

SUMMARY OF PART IIII

Chapters 5, 6, and 7 present estimates of each of the 58 equations specified in Part II. Out of the 53 estimated equations, there are 29 behavioural equations and 4 deterministic relations. These equations are estimated by using the instrument variable variant of the Two-Stage Least-Squares (2SLS) method. The estimated results of the Production-Expenditure Sub-model are given in *Chapter 5.* The estimates presented in the Production Block provide insight into the working of the 'real' sector in Pakistan. In particular, the estimated equations for agriculture and large-scale manufacturing throw fresh light on the factors that contribute to the value added in these sectors. The contribution of tractors to the value added in agriculture is minimal, though significant, while that of labour is very large. This suggests that the agricultural sector is still labour-intensive. The equation for the large-scale manufacturing sector, on the other hand, shows that this sector is highly intensive in the use of capital. Also, the effect of (autonomous) technological change on the value added is fairly substantial. The labour-intensiveness of the agricultural sector and the capital-intensiveness of the large-scale manufacturing sector are confirmed by the results. The values added in the remaining sectors have been related to the final demand components through input-output production processes. The results obtained are plausible and satisfactory; for example, in the Public Administration and Defence Sector, the results imply that approximately 43 percent of the public consumption expenditure, at the margin, is devoted to wages, salaries and other perquisites of the defence and public administration personnel.

In the Expenditure Block, various hypotheses about the determinants of consumption- and investment-spending have been tested. The estimated equation shows that private consumption expenditure is influenced significantly by the disposable income and home remittances. The equation shows that the marginal propensity to consume (MPC) out of the disposable income (adjusted for remittances) is 0.73 in Pakistan. However, the marginal propensity to consume out of remittances is a little over 2, which suggests that recipients of the remittance income tend to overspend, presumably in anticipation of the continuing income from this source. Public consumption is related to both public revenue and foreign-capital inflow. However, the widely-held notion that foreign aid has led to a *substantial* increase in public consumption is contradicted by the estimated equation.

The estimated equations for private investment in agriculture and large-scale manufacturing satisfactorily explain the private-investment behaviour – something which is unusual for developing countries. The results are interesting. In the agriculture sector, output and relative price of tractors are significant, but remittances do not contribute significantly to the private investment in this sector. In the large-scale manufacturing sector, changes in the level of output are a significant factor influencing private investment. Furthermore, the influence of relative prices is significant in both the sectors. The equation for Public Subsidies shows that they are inversely related to income in agriculture and tend to grow over time.

Chapter 6 takes up the estimation of the behavioural equations pertaining to the International Trade Sub-model. This sub-model describes the behaviour of Pakistan's foreign-trade sector as evidenced by three categories each of imports and exports. In the Import Block, all equations are significant in explaining the relevant imports. Imports of consumer goods are significantly explained by disposable income, effective exchange rate, and past levels of imports. Imports of intermediate and capital goods are influenced decisively by income in the manufacturing sector and the relevant effective exchange rates, which reflect the effect of relative prices, tariffs, and quantitative restrictions on the level of imports. The estimated equations also show that income elasticity of import is highest for intermediate goods, and is followed by those for capital goods and consumer goods. This result accords with expectations because the process of import substitution has curtailed the imports of consumer goods, while imports of intermediate goods and capital goods have sharply increased.

In the Export Block, three categories of exports are distinguished. The equations for these categories are basically supply-oriented and ignore the effect of foreign demand for the country's exports. Exports of both primary goods and manufactured goods are influenced significantly by domestic production and relative prices. Exports of services, on the other hand, depend upon the level of activity in the economy and have tended to grow over time. All the export equations fit the data well and have plausible coefficients.

The results of this sub-model offer some interesting information. Relative prices are significant in both import and export equations, thus undercutting much of the philosophy that gave birth to quantitative restrictions as the main policy instrument regulating foreign trade. This suggests that imports can be controlled effectively by manipulating relative prices through increased indirect taxes. However, this is not to gainsay the important role of quantitative restrictions in the foreign trade sector. (Note that the influence of quantitative restrictions is reflected in the calculations of effective exchange rate.)

Chapter 7 presents estimated equations included in the Fiscal and Monetary Sub-model. In the Fiscal Block the estimated equations for taxes show that the marginal contribution of changes in the base to tax revenue is statistically significant, except in the case of sales tax. Imports of intermediate goods and capital goods significantly contribute to the customs duties but those of consumer goods do not. The estimated coefficients, which are average tax rates, and their sizes indicate that taxes on imports of intermediate goods contribute most to the total public revenue and are, in order, followed by the taxes on the imports of the capital goods and consumer goods. The marginal contribution of the value added in manufacturing to excise taxes is highly significant. Total imports of goods and the value added in manufacturing explain the secular behaviour of sales taxes satisfactorily. Non-agricultural income is the relevant base for income and corporation taxes and the estimated coefficients are plausible. "Other Revenues" are estimated to contribute, on the margin, 8.3 percent of the GNP. These results suggest that there is considerable scope for revenue generation, particularly from indirect taxes, and that every effort needs be made to make income and corporation taxes much more elastic with respect to the change in the base.

In the Monetary Block, nominal money supply is explained in terms of bank credit, government budget deficit, and foreign exchange reserves. The co-efficients of both bank credit and foreign exchange reserves are highly significant, while budgetary deficit does not exert any significant effect on the money supply. *This last result contradicts the widely-held notion that deficit financing in Pakistan has significantly contributed to increases in money supply.* The implicit GNP deflator is an index of inflation which is explained in terms of the level of imports, money supply, past inflation and the share of commodity-producing sectors in the GDP. The equation shows that the *contribution of changes in money supply to inflation has been negligible and statistically insignificant,* contradicting the monetarist inflationary hypothesis. Also, the negative sign of import and the negligible size of the coefficient also refute the 'imported inflation' hypothesis. *The two most significant explanatory variables are the share of commodity-producing sector in the GDP and* *previous year's inflation.* This suggests that Pakistan has been plagued with stagflation, instead of pure inflation, and that inflationary expectations make a significant contribution to the actual inflation in the manner of self-fulfilling prophecy.

SUMMARY OF PART IV

In Part IV, the estimated equations of the model have been subjected to a detailed validation exercise to check on their within-the-sample predictive performance. Also sensitivity analysis has been done to test the dynamic stability of the estimated equations.

In Chapter 8, the validation results confirm the excellent track record of the model. Theil Inequality Coefficient (TIC) and the Root-mean-Square Proportional Error (RMSPE) statistics have been employed to ascertain the margin of error in predictions from the estimated equations. In addition,simulation graphs, portraying the historical and simulated behaviour of all the endogenous variables in the model, have been used to see whether the estimated equations capture the major 'turning points' in the time-series data. Of these, only eighteen graphs have been reproduced in the text. These relate to the GDP, value added in agriculture and manufacturing, private consumption, private investment in agriculture and large-scale manufacturing, public subsidies, imports and exports, various taxes, money supply and the price level. It is remarkable that the estimated equations have captured most of the turning points in the historical data caused by such extraordinary events as the two wars with India in 1965 and 1971, political turmoil in 1970, secession of East Pakistan (now Bangladesh), devaluation of national currency by 137 percent in 1972, large-scale nationalization, oil price crises, domestic and international recession, floods and drought, etc. In all, about 50 turning points can be counted on the eighteen graphs. Of these, the simulated series tracked at least 38 turning points. The Theil Inequality Coefficient indicates that about 90 percent of the variables have about 10-percent margins of error. The highest error margin does not exceed 20 percent (which is for imports of raw materials). The Root-Mean-Square Proportional Error also reveals that predictions from estimated equations of the model suffer from only small margins of errors.

In Chapter 9, the stability of the model is tested by administering three different 'shocks', viz. (i) changing the value of the exogenous variable, (ii) changing the estimated coefficient in one of the equations and (iii) changing the base year of the time-series data. Simulation graphs, Root-Mean-Square Proportional Error and Theil Inequality Coefficient statistics are used to establish the final results. All the three experiments confirm the inherent stability of the model: the simulated values did not significantly diverge from those of the 'control solution', and the model did not 'explode' (mathematically) even when a relatively large shock – changing the MPC coefficient from 0.73 to 0.80 – was given.

In the first 'experiment', foreign capital inflow was increased by 10 percent. The resulting simulated series was then compared with the predicted series (control solution). The incremental TIC and RMSPE were relatively small. The second experiment consisted in changing the MPC from 0.73 to 0.80. Again, values of key variables such as GDP, total consumption, total investment, etc., did not diverge too much from the control solution. Finally, in the third experiment the base year 1959-60 was first changed to 1965-66 and then to 1969-70. In the first case, there was no difference while in the latter case the changes in the endogenous variables were relatively minor.

The 'tests' conducted in this section confirm that the model is good enough for forecasting and policy simulation and can be confidently used as a tool of econometric analysis. They also show that the estimated equations of the model have successfully captured the general 'drift' of Pakistan's economy during the sample period from 1959-60 to 1978-79. Considering the notoriously poor quality of data in a developing country like Pakistan, the econometric model presented in Parts II and III portrays reality quite 'faithfully'.

SUMMARY OF PART V

Part V consists of only one long chapter – Chapter 10. In this chapter, the linkages between various sectors of the economy have been highlighted by spelling out, in terms of marginal and average contributions and elasticities obtained from the estimated coefficients, the mechanism and magnitude of the response of endogenous variables to changes in various explanatory variables. These magnitudes also permit the analyst to draw policy implications of the individual estimated equations of a macro-econometric model such as have been presented in this study. (However, a fuller statement of the policy implications of the model can be made by doing policy simulations. The results of such an exercise will be presented in Volume II of this work.)

The findings in the Production-Expenditure Sub-model have far-reaching policy implications. Contrary to the popular opinion, the marginal and average productivities of labour in agriculture are greater than unity whereas those of tractors are significantly less than unity. Also, the output elasticity is much higher with respect to labour than with respect to tractors. *This suggests that labour can still be employed productively in agriculture.* By the same token, the policy of importing tractors indiscriminately needs to be carefully re-assessed. However, in doing so, the social utility of both on-the-farm and off-the-farm uses of tractors for the agriculture sector should be taken into account. On the other hand, the large-scale manufacturing sector is highly capital-intensive. While both government policies and the profit-maximizing calculus of investors explain this state of affairs, its social profitability is open to question in a labour-surplus economy like Pakistan. This suggests that appropriate pricing policies can raise social welfare by encouraging an *efficient* use of labour in large-scale manufacturing.

For the "Other Sectors" of the economy, the main findings pertain to the consumption-oriented nature of construction and the ownership of dwellings whose output elasticity is greater than unity. The output elasticity of small-scale manufacturing with respect to total consumption is even higher than unity: it is 5! This last result suggests that demand stimulation may evoke a very strong output response in this sector. The estimated equations in the Expenditure Block have important implications for policy. Firstly, the remittance income has a profound effect on private-consumption expenditures, suggesting the need for creating avenues for profitable investment of this income. Secondly, less than half of the public revenue and only a small proportion of the foreign-capital inflow is devoted to public consumption. *This shows that public consumption has not been extravagant and that foreign capital has not been wastefully used.* Thirdly, private investment in both agriculture and large-scale manufacturing is sensitive to changes in the value added in these sectors and relative prices. This suggests that, more than anything else, government should concentrate on increasing the value added in these sectors to promote private investment. However, this consideration does not minimize the importance of proper pricing policies, particularly with respect to investment in large-scale manufacturing, which is highly responsive to changes in the relative prices of investment goods.

The export equation shows the predominant effect of supply factors in increasing (decreasing) the size of exports. However, the supply elasticities are less than unity for exports of both agricultural and manufactured goods. However, the exports of services are much more responsive to supply-side factors: the supply elasticity with respect to the GNP is greater than unity. However, contrary to the popular belief, the price elasticity of export is very low. When compared with the much higher elasticities of demand for imports of consumer goods and capital goods, it becomes clear that *exchange rate depreciation will be only partially beneficial for balance of trade.* Indeed, it will move the terms of trade against the country. This suggests that a superior balance-of-payments policy is to combine moderate exchange-rate adjustments with the imposition of import taxes and export subsidies. In other words, the emphasis should be on adjustment of effective rather than *nominal* exchange rates.

The equations in the Fiscal and Monetary Sub-model furnish interesting guidelines to policy-makers. The tax equations show that all taxes, except income and corporation taxes, are highly elastic with respect to their bases. These results show that tax structure in Pakistan is base-inelastic and suggest that domestic-resource mobilization efforts, if mounted properly, can be most rewarding. Also, there is a need for repairing the existing imbalance between direct and indirect taxes not only for resource-mobilization reasons but also to contain the inflationary effects of indirect taxes. This can be done, among other things, by expanding the base of direct taxes through imposition of income tax on agricultural income. Fourthly, public investment is highly sensitive to changes in public revenue, thus underlining the importance of domestic-resource mobilisation. Foreign-capital inflows contribute moderately to increasing public investment since a major part goes towards debt servicing. Fifthly, public subsidies are sensitive to agricultural output, tending to increase in years of low output and vice versa. This suggests that *the government policy should be to adjust the level of subsidies in a counter-cylical pattern rather than to abolish the subsidies altogether.*

The estimated equations in the International Trade Sub-model yield important policy implications. Imports of consumer goods are highly sensitive to changes in the effective exchange rate, particularly in the long run. They are also sensitive to changes in disposable income. This suggests that there is ample room for manipulating tariff/subsidy rates to regulate the size of the import bill. Similar results hold for imports of capital goods. However, imports of intermediate goods are *insensitive* to effective exchange rates. Instead, they respond very strongly to changes in manufacturing output. These results suggest that if only for balance-of-payments reasons a 'balanced growth' strategy, covering all stages of processing, should be pursued, *because import substitution of consumer goods may exacerbate, rather than relieve, the pressure on balance of payments by inducing an explosive rise in the imports of intermediate goods.*

One of the most important findings of the Fiscal and Monetary Sub-model is that the predominant factor influencing the price level is the share of commodity-producing sectors in the GDP. Another factor, though not equally important, is the positive effect of inflationary expectations on the price level. It is *not* an increase in money supply which, by and large, has *accommodated* itself to, rather than exerted an autonomous effect on, the price level. The supply of imports is also negatively and significantly related to the price level. However, the size of the coefficient is very small. These findings together suggest that an anti-inflationary policy should rely heavily on increasing the supply of goods and services. The role of a contractionary monetary effect is limited. Also, outside factors cannot be blamed for inflation in Pakistan.

PART VII

APPENDICES

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Comparison between the Present Model and the PIDE Model (1982)

Equation (Dependent Variable)	Model	Functional Form	Results of Estimation	$\bar{R}^2$	*D.W.*	*F*
				Explanatory Power		
1. Value Added in Agriculture (Crop) Sector	Present	Log-Linear	$0.448 + 0.089\ Ln(T_r/L_a) + 0.41\ Ln(Q)$ (4.38) (1.89)	0.570	2.26	13.05
	PIDE (1982)	Log-Linear	$0.6 + 0.614\ Ln(A_i/L_a) + 0.24\ Ln(A_u/L_a) + 0.127\ Ln(F/L_a)$ (5.47) (2.15) (4.84) $+ 0.189\ Ln(T/L_a) - 0.14\ Ln(TR/L_a) + 0.554\ Ln(Q)$ (4.68) (3.48) (2.30)	0.996	2.00	755.6
2. Value Added in Construction	Present	Linear	$-469.263 + 0.05\ C + 0.08\ I$ (9.78) (1.89)	0.96	1.36	247.56
	PIDE (1982)	Log-Linear	$-2.95 + 0.633\ Ln(Y) + 0.09\ Ln(R) + 0.36\ Ln(I)$ (1.98) (1.26) (1.67)	0.95	1.62	116.69
3. Value Added in Wholesale and Retail Trade	Present	Linear	$89.99 + 0.131\ (Y)$ (20.64)	0.92	1.44	216.77
	PIDE (1982)	Log-Linear	$-2.036 + 1.018\ Ln(Y)$ (103.86)	0.983	0.51	1078.9
4. Value Added in Public-Administration and Defence	Present	Linear	$-360.28 + 0.43\ C_g + 132.37t$ (2.51) (2.85)	0.56	1.46	12.69
	PIDE (1982)	Log-Linear	$4.545 + 0.303\ Ln(C_g) + 0.064t$ (2.06) (8.06)	0.936	0.86	132.35

Continued–

Appendix A – *Continued*

Equation (Dependent Variable)	Model	Functional Form	Results of Estimation	Explanatory Power $\bar{R}^2$	Explanatory Power D.W.	Explanatory Power F
5. Value Added in Agriculture (Non-crop) Sector	Present	Linear	$2162.18 + 0.035\,C + 0.125\,X_T + 0.034\,I$ (16.11) (2.97) (1.26)	0.99	1.60	528.0
	PIDE (1982)	Log-Linear	$7.955 + 0.022\,t$ (23.14)	0.979	–	535.4
6. Value Added in Mining and Quarrying	Present	Linear	$-9.57 + 0.003\,C + 0.016\,I$ (10.65) (7.29)	0.98	2.54	416.5
	PIDE (1982)	Log-Linear	$4.373 + 0.053\,t$ (16.73)	0.94	–	280.08
7. Value Added in Ownership of Dwellings	Present	Linear	$495.18 + 0.017\,C + 0.036\,I$ (11.57) (3.32)	0.95	1.52	181.5
	PIDE (1982)	Log-Linear	$Ln\,(Y_{od})\,t = Ln\,(Y_{od})_o + 0.03\,t$	–	–	–
8. Value Added in Small-scale Manufacturing	Present	Linear	$0.036\,C + 0.059\,I - 0.003\,M_T$ (8.73) (2.08) (0.12)	0.70	1.29	23.14
	PIDE (1982)	Log-Linear	$Ln\,(Y_{sm})_t = Ln\,(Y_{sm})_o + 0.03\,t + 0.073\,t'$ $t = 1 \ldots. 11$ and $t' = 12 \ldots. 20$	–	–	–

Continued–

Appendix A – *Continued*

9. Private Consumption	Present	Linear	$750.39 + \underset{(28.77)}{0.73\, Y^D} + \underset{(9.05)}{2.32\, R}$	0.993	1.74	1368.61
	PIDE (1982)	Log-Linear	$4.153 + \underset{(6.13)}{0.89}\ Ln\,(Yd) + \underset{(2.78)}{0.022}\ Ln\,(P_g) + \underset{(3.30)}{0.429}\ Ln\,(r)$ $\underset{(1.25)}{-0.114}\ Ln\,(R) \ \underset{(2.43)}{-0.046}\ Ln\,(F_k) \ \underset{(2.65)}{-1.309}\ Ln\,(MO/P_g)$	0.950	2.65	498.0
10. Private Investment in Agriculture	Present	Log-Linear	$-7.84 + \underset{(1.99)}{1.45}\ Ln\,(Y_a) - \underset{(1.80)}{0.702}\, Ln\,(P_r/P_a) + \underset{(0.76)}{0.10}\ Ln\,(R)$	0.71	1.74	16.89
	PIDE (1982)	Log-Linear	$-1.535 + \underset{(3.39)}{0.757}\ Ln\,(Y_{ac}) \ \underset{(-4.83)}{-0.973}\, Ln\,(P_t/P_a)$ $\underset{(0.02)}{+0.003}\, Ln\,(P_{tr}/P_a) + \underset{(2.73)}{0.099}\, Ln\,(R)$	0.58	1.082	5.85
11. Private Investment in Large-Scale Manufacturing	Present	Linear	$2076.38 + \underset{(1.73)}{0.25}\ \Delta Y_{lm} - \underset{(7.56)}{1321.14}\, (P_i/P_{gd}) - \underset{(5.48)}{496.46}\, D_2$	0.81	1.33	27.08
	PIDE (1982)	Log-Linear	$5.14 + \underset{(1.40)}{0.456}\ Ln\,(Y_{lm}) \ \underset{(3.96)}{-0.393}\, Ln\,(R) \ \underset{(2.47)}{-1.192}\, Ln\,(P_i/p_{gdp})$	0.782	0.66	17.732
12. Consumer Goods Imports	Present	Linear	$176.456 + \underset{(3.52)}{0.024}\ Y_d \ \underset{(2.09)}{-48.455}\, E_c + \underset{(2.11)}{0.50}\ M_{c-1}$	0.52	1.86	7.54
	(PIDE 1982)-	Log-Linear	$-3.606 + \underset{(5.97)}{1.208}\ Ln\,(C) \ - \underset{(6.70)}{0.962}\, Ln\,(E_{mc}) \ \underset{(7.23)}{-0.52}\ D_1$	0.489	2.18	6.63

Continued–

Appendix A – *Continued*

Equation (Dependent Variable)	Model	Functional Form	Results of Estimation	Explanatory Power $\bar{R}^2$	*D.W.*	*F*
13. Capital Goods Imports	Present	Linear	$751.96 + \underset{(5.49)}{0.286}\,Y_m - \underset{(4.41)}{69.135}\,E_k$	0.47	1.94	9.43
	PIDE (1982)	Log-Linear	$3.543 + \underset{(13.71)}{0.768}\,Ln\,(I) - \underset{(8.23)}{1.221}\,Ln\,(E_{mk})$	0.788	1.15	34.11
14. Exports of Primary Goods	Present	Linear	$313.84 + \underset{(2.79)}{0.065}\,Y_A - \underset{(0.32)}{1.209}\,(P_{xp}/P_{gn})$	0.60	1.91	15.00
	PIDE (1982)	Log-Linear	$1.616 + \underset{(4.40)}{5.183}\,Ln\,(Y_{ac}) - \underset{(4.60)}{4.278}\,Ln\,(C) - \underset{(3.31)}{3.075}\,Ln\,(P_{xp}/P_g)$	0.195	3.07	2.37
15. Exports of Manufactured Goods	Present	Linear	$695.26 + \underset{(3.41)}{0.302}\,Y_{lm} - \underset{(1.65)}{6.03}\,(P_{xm}/P_{gn})$	0.43	1.91	7.69
	PIDE (1982)	Log-Linear	$1.345 + \underset{(6.64)}{1.914}\,Ln\,(Y_m) - \underset{(7.84)}{0.893}\,Ln\,(P_{xm}/P_g) - \underset{(3.36)}{1.046}\,Ln\,(C)$	0.858	1.34	36.67
16. Customs Duties	Present	Linear	$\underset{(0.54)}{0.12}\,(M_c \cdot P_{mc}) + \underset{(2.61)}{0.37}\,(M_i \cdot P_{mi}) + \underset{(1.67)}{0.245}\,(M_k \cdot P_{mk})$	0.96	2.00	204.0
	PIDE (1982)	Log-Linear	$2.353 + \underset{(3.03)}{0.484}\,Ln\,(M_g) + \underset{(1.03)}{0.123}\,D_1 + \underset{(0.38)}{0.06}\,D_2 + \underset{(5.04)}{0.405}\,D_3 + \underset{(2.97)}{0.44}\,D_4 + \underset{(1.20)}{0.237}\,D_5 - \underset{(0.85)}{0.144}\,D_6$	0.906	2.65	38.72

Continued–

17.	Excise Taxes	Present	Linear	$-151.461 + 0.249\,(Y_m \cdot P_{gn}) + 43.385\,D_8$ (18.94) (0.268)	0.94	1.50	150.17
		PIDE (1982)	Log-Linear	$-4.292 + 1.359\,Ln\,(Y_{lm}) + 0.303\,D_1 - 0.018\,D_2 + 0.173\,D_3$ (8.81) (1.93) (0.13) (1.96) $-\,0.276\,D_4$ (4.16)	0.953	1.86	71.69
18.	Sales Taxes	Present	Linear	$246.586 + 0.027\,(Y_m \cdot P_{gn}) + 0.024\,(M_g \cdot P_m)$ (1.33) (1.65)	0.84	1.59	51.06
		PIDE (1982)	Log-Linear	$-0.404 + 0.365\,Ln\,(Y_m) + 0.455\,Ln\,(M_g) - 0.08\,D_1$ (1.49) (2.20) (0.42) $-0.349\,D_2 + 0.02\,D_3 - 0.117\,D_4$ (2.42) (0.13) (1.12)	0.363	2.03	2.59
19.	Income and Corporation Taxes	Present	Linear	$132.40 + 0.025\,(Y_n \cdot P_{gn}) - 279.73\,D_9$ (22.51) (1.56)	0.96	1.70	204.0
		PIDE (1982)	Log-Linear	$-2.059 + 0.881\,Ln\,(Y - Y_d) - 0.0789\,D_1 + 0.216\,D_2$ (5.42) (0.784) (3.13) $-\,0.033\,D_3 - 0.425\,D_4 + 0.083\,D_5 - 0.018\,D_6$ (0.32) (3.72) (0.72)	0.683	2.47	6.29
20.	"Other Revenues"	Present	Linear	$-773.44 + 0.083\,Y$ (16.21)	0.93	1.83	267.02
		PIDE (1982)	Log-Linear	$6.154 + 0.154\,t$ (1.82)	0.968	–	405.51

Continued–

Appendix A – *Continued*

Equation (Dependent Variable)	Model	Functional Form	Results of Estimation	Explanatory Power $\bar{R}^2$	Explanatory Power *D.W.*	Explanatory Power *F*
21. Money Supply	Present	Linear	$-220.56 + \underset{(30.28)}{1.799\, C_r} + \underset{(0.214)}{0.095\, D} + \underset{(11.58)}{2.105\, F_{er}}$	0.997	1.90	2098.61
Money Demand	PIDE (1982)	Log-Linear	$-4.972 + \underset{(2.918)}{0.831\, Ln(Y)} \underset{(1.743)}{-0.332\, Ln(r)} + 0.678\, Ln(MO/P_g)_{-1}$	0.957	2.38	133.89
22. Price Level	Present	Linear	$353.37 \underset{(2.30)}{- 0.009\, M_T} \underset{(3.80)}{- 572.25\, C_s} + \underset{(0.87)}{0.0004\, MS} + \underset{(7.81)}{0.92\, (P_{gn})_{-1}}$	0.99	1.76	631.63
Inflation	PIDE (1982)	Log-Linear	$-8.093 + \underset{(0.31)}{0.004}\, Ln\left[(\dot{E_m \cdot P_m}) - \dot{P}_g\right] \underset{(2.33)}{- 8.293}\, Ln(Y/Y^T) + \underset{(3.05)}{4.883}\, Ln(E/E^T) + \underset{(0.77)}{1.036}\, Ln(MO)$	0.43	2.58	4.28

Appendix B

Selected Alternative Estimated Equations*

PRODUCTION BLOCK

Agricultural Sector

1. $$Ln(Y_a) = -1.137 \underset{(3.27)}{+ 0.877\, Ln(L_a)} \underset{(2.60)}{+ 0.217\, Ln(Y_w)} \underset{(1.27)}{+ 0.038\, Ln(T_u)}$$

$\bar{R}^2 = 0.99$; $D.W. = 0.87$; $F = 612.33$

2. $$Ln(Y_a/L_a) = 0.63 \underset{(7.29)}{+ 0.074\, Ln(T_u/L_a)} \underset{(3.76)}{+ 0.65\, Ln(Q)}$$

$\bar{R}^2 = 0.88$; $D.W. = 1.30$ $F = 71.928$

3. $$Ln(Y_a/L_a) = 0.964 \underset{(1.48)}{- 0.045\, Ln(T_r/L_a)} \underset{(4.829)}{+ 0.107\, Ln(F/L_a)} \underset{(3.03)}{+ 0.395\, Ln(Q)}$$

$\bar{R}^2 = 0.95$; $D.W. = 1.72$; $F = 114.65$

4. $$Ln(Y_a) = -3.12 \underset{(1.79)}{- 0.086\, Ln(T_r)} \underset{(3.88)}{+ 1.20\, Ln(L_a)} \underset{(2.01)}{+ 0.06\, Ln(T_u)}$$
$$\underset{(2.26)}{+ 0.18\, Ln(Y_w)}$$

$\bar{R}^2 = 0.99$; $D.W. = 1.27$; $F = 523.89$

5. $$Ln(Y_a/L_a) = 0.97 \underset{(1.30)}{- 0.42\, Ln(T_r/L_a)} \underset{(4.21)}{+ 0.10\, Ln(F/L_a)} \underset{(3.03)}{+ 0.43\, Ln(Q)}$$

$\bar{R}^2 = 0.93$; $D.W. = 2.01$; $F = 92.98$

6. $$Ln(Y_a) = -3.299 \underset{(3.14)}{+ 0.943\, Ln(L_a)} \underset{(2.20)}{+ 0.427\, Ln(A_w)} \underset{(0.948)}{+ 0.047\, Ln(F)}$$
$$\underset{(0.314)}{- 0.004\, Ln(T_u)}$$

$\bar{R}^2 = 0.989$; $D.W. = 0.87$; $F = 449.69$

7. $$Ln(Y_a) = -4.82 \underset{(5.94)}{+ 1.087\, Ln(L_a)} \underset{(1.66)}{- 0.15\, Ln(TOT)} \underset{(0.605)}{+ 0.15\, Ln(T_u)}$$
$$\underset{(2.56)}{+ 0.46\, Ln(A_w)}$$

$\bar{R}^2 = 0.99$; $D.W. = 1.07$; $F = 505.23$

*A complete set of selected alternative equations is available at PIDE.

8. $Ln(Y_a) = 0.80 + \underset{(2.07)}{0.86}\, Ln\,(L_a) - \underset{(1.88)}{0.18}\, Ln\,(TOT) + \underset{(1.66)}{0.82}\, Ln\,(F)$

$+ \underset{(0.13)}{0.47}\, Ln(A_i)$

$\bar{R}^2 = 0.99;\quad D.W. = 1.16;\quad F = 414.73$

9. $Ln\,(Y_a) = -6.38 - \underset{(2.52)}{0.184}\, Ln\,(TOT) + \underset{(0.80)}{0.14}\, Ln\,(Q) + \underset{(5.80)}{1.75}\, Ln\,(L_a)$

$+ \underset{(1.02)}{0.361}\, Ln\,(F) - \underset{(2.67)}{0.13}\, t$

$\bar{R}^2 = 0.99;\quad D.W. = 1.89;\quad F = 527.9$

10. $Ln\,(Y_a/L_a) = 0.397 - \underset{(1.137)}{0.106}\, Ln\,(A_u/L_a) + \underset{(1.79)}{0.446}\, Ln\,(Q) + \underset{(3.13)}{0.056}\, Ln\,(T_u/L_a)$

$\bar{R}^2 = 0.88;\quad D.W. = 1.93;\quad F = 49.207$

11. $Ln\,(Y_a/L_a) = 0.909 - \underset{(1.49)}{0.45}Ln\,(T_r/L_a) + \underset{(4.44)}{0.099}\, Ln\,(F/L_a) + \underset{(2.70)}{0.36}\, Ln\,(Q)$

$- \underset{(1.86)}{0.13}\, Ln\,(TOT)$

$\bar{R}^2 = 0.94;\quad D.W. = 2.28;\quad F = 81.29$

EXPENDITURE BLOCK

Private Consumption

1. $C_p = 976.87 + \underset{(6.66)}{0.841}\, Y^D + \underset{(6.07)}{2.18}\, R - \underset{(0.036)}{0.005}\, C_{p-1}$

$\bar{R}^2 = 0.99;\quad D.W. = 2.00;\quad F = 881.03$

2. $C_p = -2197.78 + \underset{(30.72)}{0.975}\, Y_d - \underset{(1.83)}{75.76}\, P_{gn}$

$\bar{R}^2 = 0.988;\quad D.W. = 1.21;\quad F = 743.06$

3. $C_p = -0.417 + \underset{(4.62)}{0.92}\, Y_d + \underset{(0.56)}{0.11}\, C_{p-1}$

$\bar{R}^2 = 0.987;\quad D.W. = 1.66;\quad F = 677.68$

4. $C_p/N = -38.67 + 0.83\ Y_d/N \quad + 0.15\ (C_p/N)_{-1}$

$\qquad\qquad\qquad (4.55) \qquad\qquad (0.736)$

$\bar{R}^2 = 0.95;\ D.W.\ 1.44;\ F = 177.39$

5. $C_p/N = -27.92 + 0.94\ Y_d/N$

$\qquad\qquad\qquad (19.89)$

$\bar{R}^2 = 0.95;\ D.W. = 1.12;\ F = 395.76$

Private Investment in Large-scale Manufacturing

1. $I_{pm} = 1846.68 - 0.026\ C_r \quad + 0.025\ Y_{lm} \quad -1050.92\ P_i/P_{gd} \quad -245.82\ D_2$

$\qquad\qquad\qquad (0.765) \qquad\qquad (0.303) \qquad\qquad (2.58) \qquad\qquad (2.22)$

$\bar{R}^2 = 0.47;\ D.W. = 1.48;\ F = 5.18$

2. $I_{pm} = 1806.62 - 0.018\ C_r \quad - 974.92\ P_i/P_{gd} \quad - 230.91\ D_2$

$\qquad\qquad\qquad (0.818) \qquad\qquad (2.8) \qquad\qquad (2.29)$

$\bar{R}^2 = 0.49;\ D.W. = 1.47;\ F = 7.07$

3. $I_{pm} = 1861.57 + 0.2\ M_k \quad - 1341.11\ P_i/P_{gd} \quad - 227.84\ D_2$

$\qquad\qquad\qquad (2.01) \qquad\qquad (4.87) \qquad\qquad (2.51)$

$\bar{R}^2 = 0.62;\ D.W. = 1.85;\ F = 11.33$

4. $I_{pm} = 561.56 - 0.016\ C_r \quad - 263.1\ P_i/P_{gd} \quad - 212.82\ D_2 \quad + 0.72\ I_{pm-1}$

$\qquad\qquad\qquad (1.09) \qquad\qquad (0.68) \qquad\qquad (1.90) \qquad\qquad (3.54)$

$\bar{R}^2 = 0.87;\ D.W. = 1.89;\ F = 30.34$

Private Investment in Agriculture

1. $Ln\ (I_{pa}) = -4.31 + 1.065\ Ln\ (Y_a) \quad - 1.22\ Ln\ (P_u/P_a) + 0.10\ Ln\ (R)$

$\qquad\qquad\qquad (4.09) \qquad\qquad (4.97) \qquad\qquad (2.19)$

$\bar{R}^2 = 0.91;\ D.W. = 1.38;\ F = 62.72$

2. $Ln\ (I_{pa}) = 2.21 + 0.33\ Ln\ (C_r) \quad - 0.64\ Ln\ (P_u/P_a) \quad + 0.11\ Ln\ (R)$

$\qquad\qquad\qquad (3.49) \qquad\qquad (2.25) \qquad\qquad (2.27)$

$\bar{R}^2 = 0.89;\ D.W. = 1.54;\ F = 53.29$

MONETARY BLOCK

a. Money Supply

1. $$M_s = -1441.93 + \underset{(26.61)}{2.41\,C_r} + \underset{(1.23)}{0.24\,D}$$

$\bar{R}^2 = 0.98$; $D.W. = 2.096$; $F = 507.23$

2. $$M_s = -1218.98 + \underset{(20.59)}{2.37\,C_r} + \underset{(1.80)}{0.39\,D} + \underset{(0.72)}{0.47\,F_{r-1}}$$

$\bar{R}^2 = 0.99$; $D.W. = 1.22$; $F = 675.036$

3. $$M_s = 1186.85 - \underset{(0.258)}{0.238\,D} + \underset{(5.689)}{8.99\,F_r}$$

$\bar{R}^2 = 0.84$; $D.W. = 1.67$; $F = 50.88$

4. $$M_s = 1330.98 + \underset{(4.63)}{0.98\,R} + \underset{(0.287)}{0.126\,F_r} + \underset{(14.84)}{1.089\,C_r}$$

$\bar{R}^2 = 0.99$; $D.W. = 1.32$; $F = 1238.65$

5. $$M_s = -1125.49 + \underset{(12.31)}{2.29\,C_r} + \underset{(0.085)}{0.057\,F_r} - \underset{(0.208)}{0.05\,D_{-1}}$$

$\bar{R}^2 = 0.989$; $D.W. = 0.86$; $F = 554.236$

b. Price Level

1. $$P_{gn} = 352.43 - \underset{(2.03)}{0.50\,M_T} - \underset{(3.95)}{588.54\,C_s} + \underset{(14.65)}{0.98\,P_{gn-1}}$$

$\bar{R}^2 = 0.99$; $D.W. = 1.64$; $F = 799.75$

2. $$P_{gn} = -0.579 - \underset{(4.138)}{0.00339\,D} + \underset{(26.83)}{1.015\,P_{gn-1}}$$

$\bar{R}^2 = 0.99$; $D.W. = 1.514$; $F = 1163.72$

3. $$P_{gn} = 162.01 - \underset{(1.15)}{0.0033\,M_T} + \underset{(0.44)}{0.0002\,M_s} - \underset{(2.43)}{273.848\,C_s} + \underset{(10.34)}{1.018\,P_{gn-1}} + \underset{(4.79)}{24.12\,D_6}$$

$\bar{R}^2 = 0.99$; $D.W. = 2.4$; $F = 1240.0$

Following Variables of Appendix B are not previously defined:

Y_w = Wheat Production.

T_u = Number of Tubewell.

F = Fertilizer use (in N/Tones)

A_w = Total Wheat Area

TOT = Terms of Trade between Agriculture and Manufacturing Sectors.

A_i = Irrigated Area

A_u = Unirrigated Area

P_u/P_a = Price Index of Tubewell/Price Index of Agriculture Output.

APPENDIX C

(DATA APPENDIX)

Appendix C

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Table A

Appendix C

National Income Aggregates (at Constant Prices of 1959-60) and Population: 1959-60 to 1978-79

Years	National Income Aggregates (in Million Rupees)					Population (in Millions)
	Gross Domestic Product	Net Factor Income from Abroad/Foreign Capital Inflow	Gross National Product	Remittances	Disposable Income	
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1959-60	16826.0	–23.0	16803.0	31.0	16496.0	45.03
1960-61	17649.0	–25.0	17624.0	29.0	17316.0	46.20
1961-62	18710.0	–27.0	18683.0	35.0	18311.0	47.53
1962-63	20056.0	–48.0	20008.0	36.0	19591.0	48.90
1963-64	21356.0	–34.0	21322.0	103.0	20894.0	50.13
1964-65	23410.0	–61.0	23349.0	115.0	22866.0	51.76
1965-66	25126.0	–47.0	25079.0	186.0	24584.0	53.26
1966-67	25901.0	–48.0	25853.0	161.0	25374.0	54.79
1967-68	27659.0	–23.0	27636.0	230.0	27147.0	56.37
1968-69	29454.0	–29.0	29425.0	389.0	28864.0	58.00
1969-70	32336.0	2.0	32338.0	379.0	31638.0	59.70
1970-71	32434.0	–72.0	32362.0	233.0	31655.0	61.49
1971-72	32812.0	71.0	32883.0	306.0	32058.0	63.34
1972-73	35179.0	181.0	35360.0	894.0	34711.0	65.24
1973-74	37901.0	184.0	38085.0	703.0	37527.0	67.20
1974-75	39393.0	258.0	39651.0	1004.0	39133.0	69.21
1975-76	40699.0	711.0	41410.0	1164.0	40686.0	71.29
1976-77	41727.0	1295.0	43022.0	1783.0	42204.0	73.43
1977-78	44805.0	2675.0	47480.0	3404.0	46675.0	75.63
1978-79	47002.0	3062.0	50064.0	3891.0	49187.0	77.90

sources: For Cols. 2–4: [17] & [26].
For Col. 5: [25] and [26].
For Col. 6: Disposable income = GNP less direct taxes net of subsidies [18].
For Col. 7: [18].

Table B

Price Indices and Effective Exchange Rates : 1959-60 to 1978-79

Years	Price Index						Relative Prices Index			Effective Exchange Rate		
	Agricultural Crops	Fertilizer	Tubewells	Tractors	Investment	Manufactured Goods	Energy relative to Implicit GNP Deflator	Primary Goods Exports (adjusted for devaluation) to GDP Deflator	Manufactured Goods (adjusted for devaluation) to GDP Deflator	Consumer Goods Imports	Raw Material Imports	Capital Goods Imports
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
1959-60	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	8.326	5.998	7.390
1960-61	106.4	100.0	102.0	100.0	100.1	101.2	93.1	102.8	81.3	7.776	6.000	7.962
1961-62	97.3	100.0	100.0	98.9	100.0	102.1	94.6	108.5	87.4	7.729	6.054	9.368
1962-63	95.2	98.6	102.1	99.2	100.2	104.9	94.8	112.1	71.5	8.828	6.249	9.380
1963-64	108.3	96.4	106.7	99.8	106.0	105.8	90.1	102.9	82.6	8.694	6.577	9.027
1964-65	117.4	92.5	109.0	103.6	111.9	107.2	79.5	96.0	71.8	8.196	6.352	8.089
1965-66	118.8	90.5	118.0	105.7	118.6	112.8	71.4	100.4	114.3	9.168	6.529	8.489
1966-67	133.1	95.5	126.1	107.7	122.3	117.1	64.0	94.6	75.7	8.221	6.648	8.191
1967-68	126.8	113.3	132.6	105.1	123.2	121.7	60.7	98.4	66.5	9.979	7.542	8.434
1968-69	115.8	131.1	139.7	99.4	130.6	129.8	58.4	98.0	64.8	12.986	8.193	9.163
1969-70	124.5	131.0	147.6	122.9	134.0	134.3	54.1	94.6	65.0	12.528	9.353	8.775
1970-71	130.9	140.2	149.0	131.5	141.5	142.4	58.9	93.5	68.5	12.188	11.127	7.703
1971-72	141.1	162.9	152.2	146.0	143.7	151.6	63.0	85.6	68.6	11.130	12.125	8.392
1972-73	169.6	183.3	170.7	197.1	150.7	170.8	142.3	70.3	72.0	14.552	23.480	14.826
1973-74	202.7	284.8	230.1	311.2	221.1	209.0	237.8	97.2	96.3	17.132	29.752	23.353
1974-75	254.8	387.9	367.2	421.9	320.8	284.9	405.3	78.1	69.9	16.469	26.125	19.165
1975-76	275.0	378.5	398.6	505.0	403.7	321.8	385.8	68.1	68.3	12.990	23.166	15.401
1976-77	298.5	347.1	435.4	519.0	442.2	355.3	370.9	66.6	77.0	11.606	25.306	17.009
1977-78	342.6	347.1	455.5	555.8	475.1	370.0	375.5	66.0	75.5	12.672	24.506	18.137
1978-79	371.5	331.4	494.0	584.1	517.3	389.2	353.8	74.8	70.6	13.267	22.887	18.131

Note : Base year for the indices = 1959-60.

Continued –

Appendix Table B – *Continued*

Sources: : For Col. 2: The price index of the agricultural crops is the implicit GDP deflator in the crop sector. The relevant data were generated in the Pakistan Institute of Development Economics.

For Col. 3: [16] and [20].

For Col. 4: In the absence of any reliable price index for tubewells, one was constructed by using a weighted average of the prices of inputs required to install tubewells.

For Col. 5: Unpublished data obtained from the Agricultural Development Bank of Pakistan.

For Col. 6: Investment price index has been computed as a weighted average of the prices of capital equipment and the prices of construction materials. The prices of capital goods and prices of construction materials are taken from [18].

For Col. 7: Estimated as value added in large-scale manufacturing sector at current factor cost/value added in large-scale manufacturing sector at constant factor cost.

For Col. 8: [16] and [18].

For Cols. 9 & 10: [16] and [18]. These figures are adjusted for the inter-wing trade for the period up to 1970-71.

For Cols. 11 – 13: Real effective exchange rates were obtained in two stages: (i) nominal effective exchange rates were estimated by taking into consideration the tariff rates and the rate of bonus and premium on bonus vouchers; and (ii) nominal effective exchange rates were multiplied by the ratio of unit value index for each category to its respective domestic price.

Table C

Imports Deflators: 1959-60 (base year) to 1978-79

Years	Foodgrains Imports	Energy Imports	Raw Material Imports	Capital Goods Imports	Consumer Goods Imports	Total Imports
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1959-60	100.0	100.0	100.0	100.0	100.0	100.00
1960-61	80.3	96.8	198.0	106.9	97.5	120.561
1961-62	100.2	96.8	106.2	127.1	98.1	112.782
1962-63	51.5	96.8	110.1	132.3	109.2	120.901
1963-64	97.1	96.8	118.1	129.2	112.4	122.120
1964-65	100.2	89.2	122.1	116.4	113.1	116.960
1965-66	81.0	82.3	116.0	120.9	109.8	117.473
1966-67	106.4	80.6	122.0	123.0	109.6	119.339
1967-68	89.4	78.0	118.7	128.4	116.04	122.553
1968-69	85.9	75.3	118.6	121.5	108.9	118.884
1969-70	72.8	72.5	138.5	108.5	121.5	120.021
1970-71	75.0	83.0	146.0	98.5	122.9	114.665
1971-72	99.9	94.4	164.5	111.4	117.7	127.329
1972-73	212.7	246.2	281.9	275.0	280.4	379.598
1973-74	383.4	504.7	469.2	549.5	430.1	479.654
1974-75	356.0	1076.7	546.2	591.3	614.0	572.785
1975-76	446.3	1151.1	540.5	526.8	532.2	533.844
1976-77	498.5	1206.0	562.4	580.0	502.9	558.335
1977-78	331.7	1317.3	555.6	637.3	542.9	577.671
1978-79	466.8	1329.9	578.2	662.7	569.9	599.353

Source: Cols. 2 and 7 are based on data obtained from [11], [16], [18] and [25].

Table D

Exports Deflators : 1959-60 (base year) to 1978-79

Years	Primary Goods Exports	Manufactured Goods Exports
(1)	(2)	(3)
1959-60	100.0	100.0
1960-61	106.9	84.5
1961-62	111.0	89.4
1962-63	114.5	73.0
1963-64	110.5	88.7
1964-65	107.7	80.5
1965-66	115.8	131.8
1966-67	119.1	95.4
1967-68	126.4	85.5
1968-69	126.3	83.6
1969-70	126.8	87.2
1970-71	131.7	96.5
1971-72	156.3	125.3
1972-73	271.5	275.1
1973-74	428.9	425.1
1974-75	431.6	385.9
1975-76	526.7	423.8
1976-77	450.4	520.9
1977-78	481.8	551.0
1978-79	584.9	551.9

Source: Cols. 2 and 3 are based on data obtained from [16], [18] and [25].

Table E

Implicit Deflators of GNP and GDP: 1959-60 (base year) to 1978-79

Years	GNP	GDP
(1)	(2)	(3)
1959-60	100.0	100.0
1960-61	103.96	103.97
1961-62	102.29	102.29
1962-63	102.15	102.16
1963-64	107.44	107.45
1964-65	112.22	112.17
1965-66	115.31	115.29
1966-67	125.99	125.95
1967-68	128.52	128.50
1968-69	128.98	128.96
1969-70	134.04	134.04
1970-71	140.96	140.91
1971-72	149.82	149.85
1972-73	173.24	172.82
1973-74	212.83	212.24
1974-75	266.79	265.63
1975-76	300.44	298.34
1976-77	328.12	325.18
1977-78	356.59	350.79
1978-79	386.65	380.96

Source : For Cols. 2 and 3: The data have been obtained as ratios of GNP and GDP at current factor cost to GNP and GDP at constant factor cost. See [18].

Table F

Value Added in Various Sectors at Constant Factor Cost of 1959-60: 1959-60 to 1978-79

(Million Rupees)

Years	Agriculture (crop) Sector	Agriculture (non-crop) Sector	Large-scale Manufacturing	Small-scale Manufacturing	Construction Sector	Wholesale and Retail Trade Sector	Public Administration and Defence	Mining and Quarrying Sector	Ownership of Dwellings Sector	Services Sector
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1959-60	4775.0	2936.0	1159.0	859.0	427.0	2105.0	1048.0	70.0	837.0	2610.0
1960-61	4709.0	2986.0	1394.0	884.0	612.0	2251.0	1062.0	81.0	858.0	2812.0
1961-62	5127.0	3044.0	1671.0	910.0	596.0	2427.0	1103.0	86.0	888.0	2858.0
1962-63	5486.0	3111.0	1934.0	936.0	700.0	2665.0	1134.0	96.0	916.0	3078.0
1963-64	5638.0	3175.0	2233.0	963.0	897.0	2935.0	1244.0	113.0	943.0	3215.0
1964-65	6018.0	3258.0	2523.0	991.0	1029.0	3166.0	1465.0	122.0	976.0	3862.0
1965-66	5993.0	3325.0	2796.0	1020.0	1079.0	3440.0	2293.0	133.0	1006.0	4041.0
1966-67	6421.0	3408.0	2982.0	1050.0	1039.0	3621.0	1962.0	133.0	1039.0	4246.0
1967-68	7484.0	3498.0	3209.0	1080.0	1037.0	3754.0	1912.0	137.0	1067.0	4481.0
1968-69	7924.0	3554.0	3548.0	1111.0	1317.0	4020.0	2008.0	141.0	1099.0	4732.0
1969-70	8916.0	3658.0	4042.0	1144.0	1357.0	4457.0	2080.0	157.0	1112.0	5413.0
1970-71	8463.0	3725.0	4090.0	1228.0	1390.0	4469.0	2133.0	156.0	1149.0	5631.0
1971-72	8843.0	3768.0	3813.0	1317.0	1163.0	4447.0	2278.0	159.0	1188.0	5836.0
1972-73	8951.0	3870.0	4265.0	1413.0	1346.0	4743.0	2599.0	161.0	1231.0	6600.0
1973-74	9429.0	3928.0	4585.0	1516.0	1490.0	5449.0	2983.0	180.0	1275.0	7066.0
1974-75	9134.0	3940.0	4509.0	1627.0	1754.0	5622.0	3972.0	181.0	1321.0	7333.0
1975-76	9672.0	3987.0	4486.0	1745.0	2094.0	5724.0	3854.0	175.0	1369.0	7593.0
1976-77	9864.0	4134.0	4385.0	1873.0	2076.0	5660.0	4135.0	206.0	1418.0	7976.0
1977-78	10077.0	4287.0	4823.0	2010.0	2248.0	6180.0	4657.0	212.0	1469.0	8842.0
1978-79	10338.0	4523.0	5006.0	2157.0	2371.0	6477.0	4906.0	221.0	1522.0	9481.0

Source: [18].

Table G

Agricultural Inputs, Wages and Wheat Production: 1959-60 to 1978-79

Years	Irrigated Area (thousand hectares)	Unirrigated Area (thousand hectares)	Total Cropped Area (thousand hectares)	Labour Force in Agriculture (thousands)	Tubewells (Nos.)	Tractors (Nos.)	Fertilizer Consumption (N Tons)	Water availability (Million acre-feet)	Nominal Wages in Agriculture (Rupees)	Wheat Production (000 Tons)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1959-60	10540.0	4150.0	14690.0	4890.0	5624.0	3642.0	19.4	48.17	498.0	3909.0
1960-61	10400.0	4460.0	14860.0	4971.0	13056.0	4192.0	31.4	50.28	510.0	3814.0
1961-62	10750.0	4500.0	15250.0	5239.0	18928.0	6495.0	37.5	52.39	587.0	4026.0
1962-63	11010.0	4450.0	15460.0	5473.0	26608.0	8943.0	40.2	52.88	610.0	4170.0
1963-64	11030.0	4110.0	15140.0	5632.0	33824.0	11180.0	68.7	59.66	666.0	4162.0
1964-65	11440.0	4800.0	16240.0	5858.0	40424.0	12593.0	87.2	61.49	731.0	4591.0
1965-66	11470.0	4070.0	15540.0	5954.0	49583.0	13990.0	70.5	63.87	801.0	3916.0
1966-67	12030.0	4380.0	16410.0	6195.0	61831.0	17753.0	111.8	67.54	876.0	4335.0
1967-68	12490.0	4450.0	16940.0	6617.0	76995.0	18991.0	190.4	68.54	949.0	6418.0
1968-69	13070.0	3170.0	16240.0	6860.0	93013.0	22420.0	244.6	72.79	1028.0	6618.0
1969-70	12780.0	3990.0	16770.0	7207.0	104287.0	26485.0	307.7	75.50	1114.0	7294.0
1970-71	12950.0	3670.0	16620.0	7215.0	115265.0	28535.0	283.2	69.95	1207.0	6476.0
1971-72	12990.0	3610.0	16600.0	7458.0	125383.0	30277.0	381.9	71.10	1308.0	6890.0
1972-73	13060.0	3870.0	16930.0	7649.0	139077.0	29879.0	436.5	81.17	1417.0	7442.0
1973-74	13640.0	4640.0	18280.0	7666.0	150794.0	33173.0	402.7	80.06	2469.0	7629.0
1974-75	13340.0	4030.0	17370.0	7686.0	176659.0	37877.0	425.5	77.02	2851.0	7673.0
1975-76	13630.0	4390.0	18020.0	8024.0	184097.0	46032.0	553.8	85.94	3233.0	8691.0
1976-77	13830.0	4380.0	18210.0	8225.0	197390.0	58047.0	631.3	84.57	3302.0	9144.0
1977-78	14220.0	4270.0	18490.0	8443.0	207645.0	65759.0	717.4	89.44	3899.0	8367.0
1978-79	14370.0	4890.0	19160.0	8736.0	213088.0	76209.0	879.8	87.39	4208.0	9994.0

Sources : For Cols. 2–4: [20].

For Col. 5: [4], which gives estimates of agricultural labour force based on labour force surveys up to 1973. These available estimates were extrapolated to 1978-79, using the "Trends in Labour Employed in Agriculture" as reported in the *World Bank Report*, 1979-80.

Continued –

For Col. 6: A fairly reliable estimate of the number of private tubewells in use in the country up to 1968-69 has been made by Jerry Eckert [2]. The data for the number of public tubewells installed were obtained from a report of the Central Monitoring Organization of WAPDA. For the rest of the years, the numbers of tubewells in the country were obtained from [18].

For Col. 7: [18]. The data on the number of tractors in the country were obtained by making adjustments for depreciation of the number of tractors imported in the country. The underlying assumption was that one-third of the tractors depreciate after eight years, another one-third after nine years and the rest after ten years.

For Cols. 8 & 9: [18] and [20]

For Col. 10: [3].

For Col. 11: [18].

Appendix C

Production Block

Table H

Manufacturing Inputs : 1959-60 to 1978-79

Years	Labour Force in Manufacturing (thousands)	Capital		Depreciation in Capital Stock in Large-scale Manufacturing (Million Rupees)	Real Wages in Manufacturing (Rupees)
		Estimate I (Non-Linear Depreciation) (Million Rupees)	Estimate II Straight-line Depreciation) (Million Rupees)		
(1)	(2)	(3)	(4)	(5)	(6)
1959-60	342	3418	3091	156	1231
1960-61	344	4137	3671	176	1251
1961-62	368	4763	4237	203	1271
1962-63	451	5272	4654	237	1291
1963-64	493	6035	5319	288	1613
1964-65	581	6831	6013	338	1631
1965-66	583	7437	6507	401	1557
1966-67	600	7917	6889	346	1525
1967-68	710	8460	7222	579	1506
1968-69	732	8687	7428	520	1650
1969-70	722	9108	7722	590	1854
1970-71	762	9465	7896	601	1872
1971-72	688	9640	8033	622	1937
1972-73	717	9584	7844	699	2131
1973-74	872	9238	7439	700	2182
1974-75	849	8887	7021	719	1967
1975-76	1094	8522	6627	734	1982
1976-77	1030	8172	6262	722	2094
1977-78	955	7819	5893	648	2237
1978-79	1037	7529	5522	670	2237

Note: Data in Cols. 3–6 are given in constant prices of 1959-60.

For Col. 2: Labour employed in the manufacturing sector has been estimated by multiplying labour per unit of value added by the value added in the large-scale manufacturing sector. The ratios of labour to value added in different years have been taken from the *Census of Manufacturing Industries* [14] relating to different years. For the years in which censuses were not taken, they were interpolated or extrapolated. Data on value added were obtained from [18].

For Col. 3: These estimates have been obtained on the basis of the assumption that 25% of the capital stock depreciates during the first half of the plant's life, and 65% in the second half. The remaining 10% ends in scrap. Using these depreciation rates, investment indices for the period up to 1962-63 and investment from 1963-64 to 1978-79, estimates of capital stocks are obtained. For details of methodology, see [8] and [9].

Appendix Table H – *Continued*

For Col. 4:	Essentially the same as for column (3) with the exception that straight line depreciation rate is assumed.
For Col. 5:	Depreciation estimates are obtained on the basis of data on capital estimates and gross investment.
For Col. 6:	Wages for the period up to 1971 are taken from Irfan [7] which in turn are based on CMI data. Using the growth rates of wages in Punjab, the wages are estimated for the period up to 1977-78. It may be noted that wage rates, 50 estimated for 1975-76, are very close to those reported in the CMI for 1975-76 which reports wages for Pakistan as well. The wages for the year 1978-79 are extrapolated.

Appendix C

Expenditure Block

Table I

Public and Private Consumption and Investment at Constant Prices of 1959-60: 1959-60 to 1978-79

(Million Rupees)

Years	Consumption Expenditure			Investment						Investment in Fixed Assets	Inventory
				Private				Public	Total		
	Private	Public	Total	Agriculture	Manufacturing	Others	Total Private				
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1959-60	13408.4	1933	15341.4	061.2	730.0	8.8	800.0	1080	2416	1880	536
1960-61	13895.3	1848	15743.3	154.13	736.0	593.87	1474.64	1079	2769	2563	206
1961-62	14541.9	2025	16566.9	163.71	742.0	282.29	1385.28	1580	3191	2768	423
1962-63	14642.4	2227	16869.4	171.79	712.0	493.21	1377.25	2420	4051	3797	254
1963-64	15325.4	2589	17914.4	206.82	985.0	473.18	1665.09	2605	4415	4270	145
1964-65	17750.2	2741	20491.2	319.3	1061.75	339.95	1811.62	2748	4783	4469	314
1965-66	17708.4	3976	21684.4	266.19	914.01	1369.81	2549.75	1746	4625	4296	329
1966-67	18990.2	3201	22191.2	271.95	826.82	1478.23	2575.63	1864	5140	4441	699
1967-68	19913.9	3142	23055.9	256.82	852.92	1463.26	2573.05	2454	5296	5027	269
1968-69	21616.8	3377	24993.8	254.25	768.11	1382.64	2328.89	2507	5270	4912	358
1969-70	23616.5	3639	27255.5	344.98	875.44	1312.58	2531.19	2420	5464	4953	511
1970-71	23759.6	3738	27497.6	327.49	865.02	1303.49	2495.69	2484	5579	4980	599
1971-72	23590.9	4324	27914.9	372.44	707.24	1388.32	2467.51	2273	5333	4741	592
1972-73	24670.0	4458	29128.0	406.17	506.37	1560.46	2472.66	2601	5737	5074	663
1973-74	29380.3	4012	33392.3	333.74	315.38	1088.88	1736.77	3064	5254	4802	452
1974-75	30357.6	4479	34836.6	263.62	308.73	1051.65	1623.38	3432	5679	5056	623
1975-76	32170.6	4773	36943.6	334.04	324.25	947.71	1606.12	4034	5640	5640	0
1976-77	33920.0	4802	38722.0	361.83	345.16	1052.01	1759.32	4216	6201	5975	226
1977-78	38486.2	5040	43526.2	409.72	323.95	1085.33	1844.58	4280	6362	6099	263
1978-79	41485.4	5179	46664.4	399.03	303.33	1208.64	1847.26	4418	6615	6329	286

Continued –

Appendix Table I – *Continued*

Sources: For Cols. 2 & 3: [4; Table 11, Cols. 4 & 5].
For Col. 4: Sum of Cols. 2 and 3.
For Cols. 5–8: [21] and [22].
For Col. 9: [4; Table 13, Col. 3]. Estimates in [4] are obtained from [16] and [18].
For Col. 10: It is the sum of Cols. 8, 9, and 12.
For Col. 11: [4; Table 13, Col. 4]. These tables in turn are based on data obtained from [18] and [16].
For Col. 12: [4; Table 13, Col. 4]. These estimates in turn are based on the data obtained from [18] and [16].

Appendix C

Import Block

Table (J)

Value of Various Imports: 1959-60 to 1978-79

(Million Rupees)

Years	Imports of Foodgrains (at constant prices of 1959-60)	Imports of Consumer Goods		Imports of Intermediate Goods		Imports of Capital Goods		Imports of Energy (at current prices)	Imports of Services (at constant prices of 1959-60)
		(at current prices)	(at constant prices of 1959-60)	(at current prices)	(at constant prices of 1959-60)	(at current prices)	(at constant prices of 1959-60)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1959-60	311.0	626.014	626.014	490.454	490.454	687.247	687.247	198.0	307.0
1960-61	412.0	620.841	636.760	665.463	336.092	886.788	829.549	227.0	341.0
1961-62	262.0	539.805	550.260	631.105	594.261	1065.172	838.058	199.0	455.0
1962-63	385.0	515.504	472.073	770.446	699.769	1514.745	1144.930	176.0	415.0
1963-64	333.0	582.018	517.809	908.788	769.507	1490.621	1153.730	173.0	471.0
1964-65	597.0	953.081	842.689	976.592	799.829	1742.709	1497.170	87.0	920.0
1965-66	294.0	490.000	446.266	803.941	693.052	1586.592	1312.320	101.0	540.0
1966-67	511.0	818.700	746.989	1161.412	951.976	1646.479	1338.600	217.0	752.0
1967-68	549.0	739.132	636.963	1010.985	851.714	1638.188	1275.850	309.0	632.0
1968-69	9.0	337.000	309.458	1117.294	942.069	1592.429	1310.640	337.0	789.0
1969-70	98.0	335.215	275.897	1290.523	931.785	1659.342	1529.350	303.0	677.0
1970-71	107.0	393.000	319.772	1323.312	906.378	1886.439	1915.170	337.0	621.0
1971-72	300.0	787.875	669.392	1225.023	744.695	1482.468	1330.760	311.0	728.0
1972-73	527.0	247.311	881.955	3425.087	1215.000	2500.131	909.138	277.0	388.0
1973-74	406.0	3161.009	734.948	6340.029	1351.240	3978.173	723.962	209.0	361.0
1974-75	622.0	4428.328	721.225	10076.319	1844.800	6165.221	1042.660	317.0	314.0
1975-76	402.0	4339.901	815.464	8926.554	1651.540	7198.805	1366.520	329.0	537.0
1976-77	133.0	3661.357	728.049	10590.443	1883.080	8760.376	1510.410	344.0	587.0
1977-78	404.0	5609.684	1033.280	12893.928	2320.720	9311.115	1461.020	378.0	702.0
1978-79	751.0	7885.619	1383.680	17529.954	3031.810	10972.438	1655.720	401.0	860.0

Sources: For Cols. 2–9: [12]. The estimates in [12] are based on data obtained from [15].
For Col. 10: [4; Table 2, Cols. 2 and 4, deflated by the Import Price Index].

Appendix C
Export Block

Table K

Exports of Goods and Services at Constant Prices of 1959-60: 1959-60 to 1978-79

(Million Rupees)

Years	Exports of Primary Goods	Exports of Manufactured Goods	Exports of Services
(1)	(2)	(3)	(4)
1959-60	609	456	91.30
1960-61	547	609	99.13
1961-62	589	615	158.67
1962-63	936	684	199.41
1963-64	861	849	194.62
1964-65	791	1102	241.46
1965-66	908	666	187.19
1966-67	924	1145	242.33
1967-68	1022	1334	324.64
1968-69	882	1395	235.35
1969-70	1010	1664	358.56
1970-71	910	1721	416.70
1971-72	1275	1465	367.92
1972-73	842	1808	445.33
1973-74	891	1366	352.83
1974-75	1115	1374	569.09
1975-76	1308	1338	550.89
1976-77	1208	1124	475.53
1977-78	1121	1370	617.86
1978-79	1149	1849	717.82

Sources: For Cols. 2 and 3: [16] and [18]. These figures are adjusted for the inter-wing trade for the period up to 1970-71.

For Col. 4: [4; Table 2, Cols. 6 and 8, deflated by the Export Price Index].

Appendix C
Fiscal Block

Table L

Various Components of Public Revenue at Constant Prices of 1959-60: 1959-60 to 1978-79

(Million Rupees)

Years	Customs Duties	Excise Taxes	Sales Taxes	Income and Corpora-tion Taxes	Land Revenue	Other Revenues	Total Revenue
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1959-60	357	248	270	307	138.6	817	2138
1960-61	402	277	348	308	127.3	743	2205
1961-62	515	290	371	372	131.0	1087	2765
1962-63	531	379	391	417	141.8	787	2647
1963-64	449	520	391	428	106.2	1109	3003
1964-65	632	567	457	483	65.1	1270	3474
1965-66	612	683	533	495	98.8	1347	3768
1966-67	644	942	543	479	119.7	1081	3809
1967-68	607	1077	382	489	127.0	1279	3961
1968-69	891	1180	383	561	129.3	1885	5029
1969-70	925	1410	389	700	125.0	1809	5358
1970-71	1233	1490	532	707	146.6	1815	5924
1971-72	876	1437	321	825	101.6	1778	5339
1972-73	1530	1330	266	649	96.9	1778	5650
1973-74	1964	1317	326	558	88.3	2419	6672
1974-75	1851	1330	404	518	71.2	2386	6560
1975-76	1731	1478	402	724	63.0	2717	7115
1976-77	1752	1530	419	818	41.0	2938	7499
1977-78	2392	1802	453	805	32.8	3189	8674
1978-79	2660	1816	508	877	59.8	3741	9662

Source: For Cols. 2, 3, 4, & 5: [4, Table 15 cols. 2, 3, 4, and 5]. This in turn is obtained from the CBR unpublished reports for a few years and fiscal statistics of Pakistan [19] for the remaining years.

For Col. 6: (i) [16] for the period up to 1971-72 (ii) [1], [13], [9], [23] and [24] for later years.

For Col. 7: Other revenues include revenues other than principal heads of revenue under both the direct and indirect taxes.

For Col. 8: Sum Cols. 2, 3, 4, 5, 6, and 7.

Appendix C

Monetary Block

Table M

Money Supply and Inflation: 1959-60 to 1978-79

Years	Money Supply				Inflation	
	Real Money Supply; M_2 Definition (Million Rs.)	Total Bank Credit (Nominal) (Million Rs.)	Inter-Bank Call Money Rate	Average Interest Rate on Time Deposits	Inflation Rate (Base year= 1959-60)	Foreign Exchange Reserves (Nominal) (Million Rs.)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1959-60	5275	1020	2.39	2.67	–	1043
1960-61	5261	1372	3.63	3.01	3.97	1170
1961-62	5744	1951	3.74	3.21	–1.62	1225
1962-63	5588	2627	3.10	3.20	–0.13	1128
1963-64	7476	3446	3.31	3.20	5.17	1436
1964-65	8315	4842	4.70	3.52	4.40	1235
1965-66	9389	4837	5.12	3.96	2.78	952
1966-67	9500	6354	5.57	4.15	9.25	1263
1967-68	10085	6720	6.71	4.59	2.03	793
1968-69	11184	6591	5.65	5.09	0.36	864
1969-70	11839	7301	5.37	5.26	3.95	1423
1970-71	12382	7934	6.40	5.32	5.12	1368
1971-72	16404	11603	5.57	5.57	6.34	949
1972-73	16308	13231	5.68	6.21	15.33	3138
1973-74	14816	16194	8.48	7.36	22.81	4584
1974-75	13426	17552	10.50	8.44	25.16	3985
1975-76	15384	19805	9.15	8.96	12.31	4812
1976-77	17463	25117	10.03	9.28	9.05	6085
1977-78	19028	28439	11.20	9.54	7.88	4266
1978-79	21285	35098.8	8.99	9.65	7.16	8956

Sources: For Col. 2: Estimates of money (M_2 definition) are taken from [10] and deflated by the GDP Prices Deflator.

For Col. 3: [25] and [26].

For Col. 4: Unpublished data from the Research Department of the State Bank of Pakistan for a few years; [25] for other years.

For Col. 5: [25] and [26].

For Col. 6: Rate of inflation is the rate of change in the GNP deflator. The GNP deflator was obtained by dividing the GNP at current factor cost by the GNP at constant factor cost. The GNP estimates have been taken from [18].

For Col. 7: [18].

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