Journal of Economic Cooperation Among Islamic Countries **19**, 3 (1998) 95-112

FIXED INVESTMENT IN PAKISTAN'S AGRICULTURE SECTOR: THE ROLE OF EXOGENOUS SHOCKS

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The recent literature on private fixed investment emphasised the role of shocks in investment decisions that are associated with a number of factors arising from government fiscal and monetary policies, foreign policy and uncertainty. When variables associated with these factors vacillate, the quality and quantity of investment do not go unaffected. All such shocks render the decision-making process regarding investment highly complex and multifarious. The unsatisfactory performance of agricultural investment in Pakistan calls for a greater insight into the problem of low investment in this sector. In this paper, we focused on determining the impact of autonomous shocks caused by output growth, public investment, export penetration, real devaluation and uncertainty, etc. One of the important features of this research is that it employs the latest developments in the estimation and analysis of investment demand functions. So far, these developments have been used in the estimation of total fixed investment functions. Here, the techniques will be applied to estimate the agricultural sector investment demand functions.

1. INTRODUCTION

The recent literature on private fixed investment emphasised the role of shocks in investment decisions that are associated with a number of factors arising from government fiscal and monetary policies, foreign policy and uncertainty. When variables associated with these factors vacillate, the quality and quantity of investment do not go unaffected. All such shocks render the decision-making process regarding investment highly complex and multifarious. Pre-Keynesian theory provided a simple explanation of this complex behaviour: the level of investment spending is determined by the community's decision to save[1]. Though the statement gave a superficial account of reasons to invest, that does not comment on the cyclical performance of investment spending. Later, Keynesian theory attributed erratic fluctuations in investment demand to

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[1] See Junankar (1972), p. 12.

capricious shifts in business expectations arising from change in different exogenous variables (autonomous shocks)[2].

[2] Historically, investment has been the least stable component of aggregate demand (Hall & Taylor, 1991).

It is argued that in the case of the developing countries, the development of new theoretical models had not been accompanied by any significant improvement in their empirical performance. A major reason for this breach is that the critical assumptions underlying standard theoretical models, i.e., perfect competition, constant returns to scale and laissez faire, etc., are not satisfied in the developing countries. Thus, the widening gap between theoretical models and empirical performance has given rise to the need for further examination of the dynamics of the investment process[3]. Researchers in developing countries have focused mainly on testing various hypotheses propounded to explain the volatility of investment spending in developing countries. These hypotheses revolved around output growth, availability of credit to private sector, real devaluation and uncertainty.

Recent studies addressed the issues in investment demand modelling with respect to the following issues: (1) consistency of the theoretical model, (2) characteristics of the technology, (3) treatment of expectations, and (4) the impact on investment spending of prices, quantities and shocks.[4] Out of these issues, the role of autonomous shocks on investment, in other words, the study of erratic fluctuations in investment demand has not received due attention in investment modelling. Although most of the studies on Pakistan have taken into account the first three issues, hardly anyone considered the last in detail: the impact of shocks on private fixed investment spending decisions especially at sector level[5].

In Pakistan, the sectoral distribution of investment has shown capricious movements. During the 1970s and early 1980s the overall distribution suggests that the composition of fixed investment is tilted in favour of the public sector, which comprised more than 50 per cent of the total fixed investment. The private fixed investment that comprised 52.23 per cent of the total fixed investment in 1971-72 started to decline; its share became as low as 32.35 per cent in 1975-76 and 48.28 per cent in 1992-93. The investment rate in the private sector has also fluctuated from 7.94 per cent in 1972-73 to 5.66 per cent in 1979-80 and 8.17 per cent in 1992-93. This has a cost in terms of low

[3] A long list of models can be found in surveys by Greenberg (1976) and Fisher (1983). They have provided a historic account of the development in the models used for the analysis of private fixed investment behaviour along with innovation in methodologies.

[4] See Chirinko (1993) for a detailed discussion on these issues.

[5] Khan (1989) has criticised earlier studies on Pakistan that they have estimated investment functions with no sound theoretical foundations, e.g., Naqvi et al. (1982) Naqvi et al. (1984) and Naqvi & Ahmad (1986). The present study will take into account all the latest developments in the analysis of investment demand.

levels of investment across various sectors of the economy[6]. The agricultural sector has suffered the most.

[6] For details, refer to Janjua (1997).

Regarding the share of the agricultural sector in total private fixed investment, it has fluctuated erratically from 15.30 per cent in 1972-73 to 33.31 per cent in 1977-78. Later, it started to decline and reached as low as 14.41 per cent in 1992-93. The agricultural sector investment rate has remained as low as 0.76 per cent in 1975-76 and could not go beyond 2.08 per cent in 1978-79 and 1.18 per cent in 1992-93. Such a performance of agricultural investment calls for a greater insight into the problem of low investment in this sector.

The paper is organised as follows. Section II of this paper provides a theoretical framework to develop a model in the next section and the hypotheses to be investigated. Beside the model, Section III presents the empirical results as well. Finally, the conclusions and policy implications are summarised in Section IV.

2. DETERMINANTS OF PRIVATE FIXED INVESTMENT IN PAKISTAN

So far, Naqvi et al. (1983) and (1986) estimated the investment function for the private fixed investment in the agricultural sector (which, henceforth will be referred to as agricultural investment) and found that it was a function of value added in agriculture, relative prices, and remittances. In Naqvi et al. (1993) the choice of explanatory variables for agricultural investment was: value added in agriculture, remittances from abroad and the total public investment.

Khan (1988) also studied the behaviour of the private fixed investment in the agricultural sector. He focused on the responses of investment to output, changes in private sector credit, general market conditions, and public investment.

Improving upon their work, the present study will focus on determining the impact of autonomous shocks caused by output growth, public investment, export penetration, real devaluation and uncertainty, etc. One of the important features of this research is that it employs the latest developments in the estimation and analysis of investment demand functions. So far, these developments have been used in the estimation of total fixed investment functions, except for Janjua (1997). Here the techniques will be applied to estimate the agricultural sector investment demand functions.

It is argued that sustained economic growth is not possible unless investment maintains a growing trend. It has been suggested that private fixed

investment is directly proportional to the growth of real output and vice versa (Harrod R., 1939, and Domar, E., 1947). It is believed that countries with higher per capita income could save more to finance investments (see, for example, Khan and Reinhart, 1990).

In developed countries real interest rates and policies affecting them can influence private investment, but there is no empirical finding supporting this relation for developing countries. This is because of repressed financial markets in these countries, where credit policy (and not interest rates) directly affects the investment level (Serven and Solimano, 1991). Credit policy affects investment directly through the stock of credit available to private sector firms. A significant and positive relationship has been established between business fixed investment and the availability of credit to the private sector by Blejer and Khan (1984), Fry (1980), Khan (1988) and Matin & Wasow (1992).

An overvalued exchange rate can also be a factor in determining the low levels of investment because it reduces the returns in local currency received by exporters. Exchange rate management policy, as it is being pursued in Pakistan nowadays, affects private investment through several channels. It is simultaneously an expenditure-reducing and expenditure-switching policy. It may reduce private investment through its negative impact on domestic absorption. However, the expenditure-switching aspect may produce completely different results and induce investment in tradable activities (Aizenman, 1992).

It is argued that macroeconomic stability (low rates of inflation, external and internal balance, etc.) is of paramount importance in ensuring a strong response of private investment to economic incentives[7]. In favour of the above argument, Pindyck (1991) emphasised that uncertainty, arising from macroeconomic instability, plays a key role in investment decisions. Uncertainty inherent to investment spending comes from its irreversible nature. Capital once installed is immobile as compared to labour[8]. Therefore, the study of an irreversible type of investment in an uncertain environment becomes necessary. Investment is considered to be negatively proportional to the perceived degree of uncertainty as the fixed investment decisions cannot be 'undone' if future events turn out to be unfavourable[9].

[7] Khan & Reinhart (1990) argued that market forces will stabilise shocks and enhance economic growth and if the economy is market-oriented the private sector will play a greater role in capital accumulation and business expansion.

[8] Capital equipment becomes industry-specific and can hardly be put to another use or productive process or activity without incurring a substantial cost.

[9] Rodrick (1990) argued that 'a macroeconomic adjustment program may increase uncertainty in the short run as private investors start receiving mixed signals some associated with the previous policy rules, some with the stabilization package, and the structural reform aimed at restoring medium term growth'.

The following hypotheses are being tested in the study: i) public policies affect real private fixed investment, ii) autonomous shocks play an important role in private fixed investment decisions, iii) uncertainty reduces the credibility of investment incentives.

3. THE MODEL AND EMPIRICAL RESULTS

3.1. The Model

Most of the studies for developing countries have utilised the Implicit Dynamics Benchmark Model (IDBM), specified in Chirinko (1993), to study the aggregate investment function as follows:

$$K^{\ll}_t = f\,[\text{Prices, Quantities}] \qquad ...(3\ 1)$$

Where $K^{\ll}_t$ is the desired capital stock. The element of dynamism is introduced in the prototype model while specifying it for investment demand. The model can be excelled into a standard accelerator model and a modification may be introduced for the inclusion of shocks as follows[10]:

$$I_t = f\,(Y_t, dS_{it}) \qquad ...(3.2)$$

Where Y_t is the output in period 't' and S_{it} is some unidentified autonomous shock in period 't'. Agricultural investment functions are specified to incorporate the impact of autonomous shocks on the basis of (3.2). These specifications provide a framework to examine the impacts of different shocks, generated by the tools of monetary, fiscal and commercial policies aimed at the correction of unsustainable macroeconomic imbalances, on investment. Based on the theoretical reasoning in Section II, an investment demand function in the agriculture sector is specified as follows:

$$I_{pag} = f\,\{(Y_{agt}), I_g, Cr_{agrt}, \sigma_{xgt}, RELP_{agn}, RER_{t-1}, I_{pag(t-1)}\} \qquad ...(3.3)$$

That is investment in agriculture is a function of output growth in agricultural sector (Y_{ag}) public investment (I_g), growth rate of agricultural

[10] For a detailed mathematical exposition one may refer to Khan (1989).

credit, (CR_{agr}), coefficient of variation in export to GDP ratio (σ_{xgt})[11], relative price of capital in the agriculture sector ($RELP_{ag}$), and real exchange rate (RER_{t-1},). [For the construction of variables like σ_{xg} and RER, etc., please refer to the appendix at the end]. The specification is consistent with the theoretical developments described earlier and the neoclassical tradition. The model described here takes into account autonomous shocks relating to public investment, agricultural credit policy, exchange rate variability, price uncertainty and terms regarding economic instability, etc. These variables have been considered by a number of researchers, (for a careful review see Serven, 1990; Rama, 1990; Serven and Solimano, 1991). All such innovations in the investment function are found useful in explaining the aggregate investment behaviour in the agricultural sector. The inclusion of real exchange rate and uncertainty terms in the aggregate investment function may, however, raise the aggregation problem. The problem can effectively be dealt with by imposing restrictions specified by Rama (1990).

3.2. Empirical Results

A number of specifications for the agricultural investment demand function are estimated by introducing innovations regarding real exchange rates, variation in export to GDP ratio, and relative price of capital in agriculture. These variables are found to be significant along with other conventional variables, i.e., growth rates of GNP in the agricultural sector, growth rates of stock of agricultural credit and investment in the government sector, etc. The introduction of new variables not only improved the test statistics but also the significance of all the other variables as well. The inclusion of new variables is tested for restrictions imposed by Rama (1990) for the aggregation problem using the Wald test, validating thereby the new specifications.

The equation (1) reported below is estimated by OLS technique, while equation (2) & (3) employing the Cochrane-Orcutt process for auto-correlation correction. After correction, the equations have passed the goodness of fit tests, i.e., the LM test for serial correlation; the ARCH test for heteroscedasticity; the Ramsey RESET test for specification errors; and the Chow forecast test.

[11] Malik et al. (1994) analysed that fluctuations during the 1960s and 1970s illustrated our agriculture dependence specially in exports. It has been demonstrated that Pakistan's export performance has been vulnerable to the vagaries of nature that affect agriculture.

Results for equation (1) are reported for the short run and of equations (2&3) for the long run[12]. The growth of agriculture income and agriculture credit has a positive and significant impact on agricultural investment both in the short and the long run. The short-run impact of public investment is, however, negative. The negative effect may come from the crowding out impact of public investment. The public sector may compete with the private sector for resources in the short run. Nevertheless, the situation may improve in the long run and investment in the infrastructure would promote private investment.

Real exchange rates, the relative price of capital in agriculture, the variation in export to GDP ratio, and the real exchange rate of imports (serving as a proxy measure for uncertainty arising from structural adjustment and instability in macroeconomic performance) have a negative impact on the private fixed investment in the agriculture sector. In addition, variations in several macroeconomic indicators, not reported here, were tested as a proxy for uncertainty due to macroeconomic instability, i.e., variations in the growth rate of GDP; commodity prices; real exchange rates; etc.

In equation (2) the long-run coefficient of public investment is positive which indicates complementarity between the public and the private fixed investment. Public investment in infrastructure would promote private investment and enhance growth.

The variation in export to GDP ratio was, however, found to be highly significant at 5% level. The export to GDP ratio is one of the key indicators for investment in agriculture because Pakistan's economy is an agro-based one. Commodity exports comprising a large part of agricultural commodities make a sizeable portion of our export such as rice and cotton. Bad performance in agricultural output badly affects our exports in commodities as well as in semi-manufactured commodities, such as coarse cloth in the textiles sector, etc. Though this variation in exports is due to unfavourable weather conditions, droughts, pests, and bad crops, these will be reflected in low output and consequently in less exports limiting thereby the possibilities of future investment[13].

The results of the 2nd and 3rd equations are also very important. Both equations are estimated using the Cochrane-Orcutt process for auto-correlation correction. The results of the second equation suggest that the elasticity of the

[12] Short-run impact is given by the coefficients of the first difference terms (equation 1: Table I)

[13] See, for example, Naqvi and Sarmad (1984).

growth rate of agricultural income to investment is 1.44 significant at 5% level. A one per cent change in the growth rate of output in the agriculture sector will bring about a 1.44 per cent change in the fixed investment in this sector. The elasticity of public investment to IP_{agt} is 0.76 and it is significant at a 1% level while the elasticity of the growth rate of agricultural credit is 0.22 significant at a 1% level.

Variation in the export to GDP ratio has a coefficient of -0.002, indicating that a one per cent change in σ_{xg} will decrease private investment in agriculture by only 0.002 per cent. The relative investment prices' coefficient (-1.14), significant at a 1% level, has a negative impact on the private fixed investment in agriculture.

Pakistan is a developing country suffering from a high and unpredictable inflation, which is usually matched by a high relative price variability in the post-structural adjustment and liberalisation period. Under such conditions, a relative price change will reduce the effectiveness of policy-induced incentives for different sectors and substantial time may elapse before investors become convinced that the change is permanent. The Government's pricing policies during the Seventies also hampered the growth of the agriculture sector. The negative impact of inflationary pressures on private fixed investment is also confirmed by the coefficients of relative price terms.

The real exchange rates bear a negative coefficient. The coefficient is, however, smaller in magnitude (-0.001) but highly significant. It is believed that expectations associated with exchange rate instability play an important role. One may anticipate capital flight in the wake of devaluation and fewer resources would be available for investment. A lagged RER term provides sufficient support for the negative impact of the expected devaluation on private investment[14]. A sharp increase in exchange rates leading to a real devaluation of the rupee affects the input market drastically; for example, the prices of fertilisers have increased markedly in the past (though provided on subsidies), the prices of agricultural tractors, their imported spare parts and pesticides have increased after the liberalisation of exchange rates.

The third equation was estimated to check the impact of expectations associated with the long-run public investment. The lagged values of public investment improved the elasticity estimates attesting to the long-run complementarity hypothesis. All the other coefficients behaved in the same manner as in the second equation.

[14] Here the lagged term implies a static expectation hypothesis.

Table 1

Results of the Private Investment Function in the Agriculture Sector
Sample Size (1972-73 to 1992-93)

Dependent Variable Fixed Investment in Agricultural Sector

	Eq(1)	**Eq(2)**	**Eq(3)**
Constant	10.1	5.86	0.39
	(13.8)	(4.103)	(0.46)
Δ ($\Delta Y_{agt}/Y_{agt}$)	0.94		
	(2.3)*		
($\Delta LY_{ag(t)}$)		1.44	1.53
		(2.36)	(2.59)
$\Delta LI_{g(t)}$	-0.1		
	(-0.3)		
$LI_{g(t)}$		0.76	
		(9.46)	
$LI_{g(t-1)}$			0.76
			(9.46)
$\Delta(\Delta CR_{agr}/CR_{agrt-1})$	0.2		
	(2.2)		
($\Delta CR_{agr} / CR_{agrt}$)		0.22	
		(2.10)	
σ_{xgt}	-0.0002	-0.0002	-0.0002
	(-2.4)	(-3.3)	(-4.02)
$LRELP_{agt}$	-0.01	-1.14	-1.34
	(-1.61)	(-3.75)	(-4.60)
$RER_{(t-1)}$	-0.0002	-0.001	
	(-1.7)	(-6.98)	
$RER_{(t)}$			-0.003
			(-4.97)
$LIP_{ag(t-1)}$	0.86	-0.03	-0.46
	(-10.6)**	(-1.40)**	(-2.19)
R^2	0.94	0.98	0.98
Adjusted R^2	0.92	0.96	0.97
D.W. Statistics	2.6	1.90	2.0
SER	0.2	0.10	0.09
F-Statistics	29.5	77.14	85.42

Figures reported in parentheses refer to t-statistics.
All the coefficients are significant at 1 % except
'*' Significant at 5%.
'L' implies a lag operator and 'Δ' is the first difference operator.

4. CONCLUSIONS AND POLICY IMPLICATIONS

The conclusions are based on the empirical investigations of the model presented in Section II. The results reported are supporting the hypothesis that:

1. Public policies in fiscal and monetary sectors of the economy have a considerable positive impact on real investment.

2. Autonomous shocks, i.e, output growth shocks, relative price shocks, export instability, real exchange rates, etc., affect private fixed investment decisions badly.

3. Finally, it may be asserted that price uncertainty and instability arising from macroeconomic reforms reduce the credibility of investment incentives in the short run and have a significant negative effect on investment spending in the private sector.

The response of private fixed investment to output attests to the neo-classical accelerator notion of investment. There is evidence of a positive impact of public investment on private fixed investment in this sector. The results are consistent with that of Khan (1988) for Pakistan who had shown complementarity between public investment and private investment in all the sectors. In the long run, the public investment complements the private fixed investment in the agriculture sector. The long-run complementarity of public investment to private agricultural investment comes from investment in the farm to market roads, productive village infrastructures, i.e., land levelling, land reclamation, construction of canals, mini dams, water channels, etc., and calls for a continued emphasis in public policy.

The impact of credit availability suggests that the private fixed investment has always adjusted to credit availability mechanisms. However, a smaller significance of the credit availability variables may follow through the government policy of treating private sector credit demand as a residual till 1992-93.

Macroeconomic policies of exchange rate adjustment, government support prices, etc., may affect private fixed investment drastically. The results coming out of uncertainty factors suggest that the polices resulting into erratic and unpredictable inflationary bias in the economy may compound macroeconomic instability. In a country where inflation is on the rise firms cannot benefit from price changes resulting from real devaluation of currency.

The results suggest that macroeconomic policies should be pursued with great austerity. The results of real exchange rate, export instability and uncertainty validate the notion that these shocks may retard private fixed investment in the agricultural sector.

As this area of investment, i.e., the role of shocks, has been least explored, the results reported in this research suggest the need for understanding the role of shocks in investment in developing countries. The model employed was based on a single equation and cannot fully explain the behaviour of different shocks. It is therefore, needed that a bigger model that clearly incorporates all the behavioural relationships between different variables must be constructed. We admit that the present research has overlooked the supply of investment finance through different sources and concentrated only on the supply of credit by the banking sector. In future, a more desegregated model is required that may take into account the microeconomic foundations of investment finance.

APPENDIX-I

Let $K^*_t, = \alpha Y^e_t$ (1)

Assuming that capital stock adjusts to its desired level with a lag, the stock adjustment mechanism will be:

$(K_t, - K_{t-1}) = \beta (K^*_t - K_{t-1}) \ldots$ (2)
$Kt = \beta K^*_t + (1 - \beta) K_{t-1} \ldots$ (3)

K_t is the actual capital stock; therefore $\Delta_t K$ is net private investment and β is the adjustment parameter such that

$O \leq \beta \leq 1$

We know that

$I_t = \Delta K_t + \sigma K_{t-1}$

Where σ is the rate of depreciation.

$I_t = K_t - K_{t-1} + \sigma K_{t-1} \ldots$
and
$I_t = K_t - (1 - \sigma) K_{t-1} \ldots$ (4)

Now let;

$LX_t = X_{t-1}$ $L^2X_t = X_{t-2}$

Where L is a lag operator.

$$I_t = [\ 1 -(1 - \sigma)\ L]K_t \ldots \quad (5)$$

Rearranging (5) we get

$$K_t = I_t / [1 - (1 - \sigma)L]. \ldots \quad (5,a)$$
$$K_{t-1} = I_{t-1} / [\ 1 - (1 - \sigma)\ L\ ]. \ldots \quad (5,b)$$

Putting Eq. (5a; b) in Eq. (3)

$$I_t [\ 1 -(1 - \sigma)\ L\ ] = \beta\ K^*_t + (1 - \beta)\ I_{t-1} / [\ 1 -(1 - \sigma)\ L\ ]$$

$$I_t = \beta\ [\ 1 - (1 - \sigma)\ L\ ]\ K^*_t + (1 - \beta)\ I_{t-1} \ldots \quad (6)$$

We still arrive at the above equation using a partial adjustment mechanism. Let

$$\Delta I_t = \beta\ [I^*_t - I_{t-1}] \ldots \quad (7)$$

Where I^*_t is the desired level of investment. In the steady state desired investment is given by

$$I^*_t = [\ 1 - (1 - \sigma)\ L\ ]\ K^*_t \ldots \quad (8)$$

If we combine Eq. (7) & (8) and solve for I_t we get Eq. (6)

$$I_t = \beta\ [\ 1 - (1 - \sigma)\ L\ ]\ K^*_t + (1 - \beta)\ I_{t-1}$$

The above equation was estimated by Khan Ashfaque (1988)[15] with a modification following Coen's (1971) argument. Khan argued that the gap between the desired and the actual investment as measured by the coefficient of adjustment B to which private investors react in order to achieve the desired and actual level of investment is constrained by i) general market conditions ii) the availability of credit to the private sector; and iii) the level of public sector investment i.e.

[15] Khan, A. (1988), pp. 278-279.

$$\beta = f [Y_g, \Delta Cr, I_{g0}], \ldots \quad (9)$$

and

$$\beta = f \{(1/I^*_t - I_{t-1}) [Y_g, \Delta Cr, I_{g0}]\} \quad (9,a)$$

$$\beta = \pi_0 + (1/I^*_t - I_{t-1}) [\pi_1 Y_g, \pi_2 \Delta Cr, \pi_3 I_{g0}]\}. \ldots \quad (9,b)$$

We argue that in addition to i) general market conditions ii) the availability of credit to private and public sector, i.e., the gap between desired and actual aggregate investment as measured by the coefficient of adjustment B to which decision making agents, firms, individuals, and governments react in order to achieve the desired and actual level of investment, is constrained by a variety of shocks. In this regard we will follow the work of Cordoso (1993)[16].

Therefore, we can specify equation (9) in general as:

$$\beta = f [Y_g, \Delta Cr, S_i], i=1,2,\ldots,n \quad (10)$$

where S_i refers to different shocks.

More specifically:

$$\beta = f \{(1/I^*_t - I_{t-1}) [Y_g, \Delta Cr, S_i]\} \quad (10,a)$$

$$\beta = \pi_0 + (1/I^*_t - I_{t-1}) [\pi_1 Y_g, \pi_2 \Delta Cr, \pi_i S_i] \ldots \quad (10,b)$$

Putting equation (10,b) in equation 7 we get:

$$\Delta I_t = [\pi_0 + (1/I^*_t - I_{t-1}) [\pi_1 Y_g, \pi_2 \Delta Cr, \pi_i S_i]\} [I^*_t - I_{t-1}] \quad (11)$$

Simplifying Equation (11) we get:

$$I_t = \pi_0 I^*_t + \pi_1 Y_g + \pi_2 \Delta Cr + \pi_i S_i + (1- \pi_0) I_{t-1}] \quad (12)$$

Putting $I^*_t = [1 - (1 - \sigma) L] K^*_t$ in equation (12)

$$I_t = \pi_0 (1 - (1- \sigma) L] K^*_t + \pi_1 Y_g + \pi_2 \Delta Cr + \pi_i S_i + (1-\pi_0) I_{t-1}]$$

[16] For a review of Fama (1992) and Cordoso (1993) see section above.

If we substitute the desired demand for capital (K^*_t) by αY^e_t as given in equation (1), we will end up with a basic dynamic accelerator model consistent with our assumptions.

$$I_t = \alpha\pi_0 [1 - (1 - \sigma) L] Y^e_t + \pi_1 Y_g + \pi_2 \Delta Cr + \pi_i S_i + (1-\pi_0) I_{t-1}]$$

We have assumed the following model:

$$I_{pag} = f \{(Y_{agt}), I_g, CR_{agrt}, \sigma_{xgt}, RELP_{ag}, RER_{t-1}, I_{pag(t-1)}\}$$

APPENDIX-II

1. Construction of Important Variables

The methodology regarding the construction of some of the important variables such as NER and (σ^2_{xg}/XGDP) needs to be highlighted. The series on NER is calculated using IMF's Multi-Exchange Rate Mechanism (MERM) given in the International Financial Statistics (IFS) of the International Monetary Fund (IMF).

2. Nominal Exchange Rate

The nominal exchange rate index series is defined as the nominal exchange rate of the jth reporting country deflated by a weighted geometric average of the nominal exchange rates of its 'n' partner countries:

$$NER_j = (ERI_j) / EXP \sum_{I=1}^{n} (WT_{jj} \text{ x } Ln(ERI_i)) \text{ x } 100$$

where	ERI	=	the exchange rate index with a fixed base (1980/81 in our case)
	J	=	index for reporting country
	n	=	number of partner countries to j
	I	=	index of partner country I = 1,. . .,n
	WT_{ji}	=	weight that country j attaches to country I

The weights taken for each country are based on the average trade flows (import + exports between Pakistan and the selected countries) in 1980/81. The ERI for Pakistan is divided by a geometric average of the weighted exchange rate index of its 15 major trading partners.

3. Real Exchange Rate

The real exchange rate index series is calculated by adjusting ERI for relative price changes in its trading partners. For the purpose, we have used a product of ERI and CPI. The CPI is the consumer price index in the ith country. The relative exchange rate index for Pakistan is divided by a geometric average of the weighted relative exchange rate index of its 15 major trading partners.

$$RER_j = \{CPI_j \times ERI_j)/EXP \sum_{I=1}^{n} (WT_{jj} \times Ln(CPI_i \times ERI_i)\} \times 100$$

4. Variation in Export to GDP Ratio

The series on the coefficient of variation of export to GDP ratio (X/GDP) is calculated by dividing a three-year moving standard error of X/GDP by a three-year moving average of X/GDP.

$\sigma_{xg} = (\sigma^2_{xg}/XGDP)*$
* Three-year moving average

Larrain and Vergara (1993) used (t) and (t-2) for calculating the variation coefficient. Cardoso (1993) and George and Morisset (1993) tried (t), (t-1), and (t-2) for the same. The present study used (t), (t-1), and (t-2) for calculating coefficient of variations for different variables.

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