PART 2
Chapter 2:

Modern theories of Investment and Developing countries

2.0.1: Introduction

A large body of the existing theoretical and empirical literature on investment behavior has been carried out in the context of industrial countries[20]. In the literature, two approaches dominate. The first approach originates from the work of Jorgenson (1963). This approach referred to in the literature as the neoclassical theory, links investment to variables that determine its profitability subject to production function parameters as discussed below. Generally, the neoclassical model holds that the demand for capital is positively related to the firms' output and inversely to related to the user cost of capital. The second approach is attributed to Tobin (1969). According to Tobin, investment is a function of the increase in the market value of the firm as a result of installing or acquiring new capital/equipment relative to the cost of the equipment (the ratio called q). This q theory, as it is called, predicts that when the value of the firm (as a result of increased capital installation) exceeds the replacement cost, firms increase their capital stock. Each of these theories has led to new theoretical developments and empirical analysis of their econometric relevance. In empirical work, the neoclassical theory has received more attention.

In the vast literature, another approach analyzes the determinants of private investment from the perspective of Keynes and Kalecki. In these studies which could be termed as Kaleckian-Post-Keynesian investment models, demand expectations relative to the existing

[20]Relatively little empirical work has been carried out in the context of developing countries. Data limitations and the need to make necessary modifications in the context of developing countries are possible obstacles (Blejer and Khan (1984). A survey of empirical studies on investment in developing countries is provided in Rama (1993) .

capacity and the firm's ability to generate or obtain funding are the main determinants of investment. (Fazzari and Mott, 1987).

These alternative theories of investment behavior agree on the validity of the accelerator principle. However, it is in the specification of the determinants of desired capital that the theories diverge. If we denote desired capital stock at end of period t by K_t^* and the actual capital stock at the beginning of the period by K_{t-1}, capital stock is adjusted to its desired level by a certain proportion of $(K_t^* - K_{t-1})$ that is, the discrepancy between the actual capital stock and desired capital stock in each period. The simple accelerator principle can be presented as;

$$K_t - K_{t-1} = \lambda(K_t^* - K_{t-1}) \quad \text{.....(2.1)}$$

Where λ is the adjustment coefficient and $K_t - K_{t-1}$ is the net investment.

The lag pattern of adjustment may reflect the way expectations about the future are formed[21]. There may also be lags due to decision making and planning lags. Lags also arise because certain capital goods have a long gestation period. The existence of lags imply that, say, a change in output usually makes its maximum impact after some period. That is, private investment responds with a lag to changes in the economy.

As stated above, it is in the specification of the determinants of the desired capital stock that the different theories differ. For example, in the neoclassical framework capital stock is a function of output and user cost of capital, while in accelerator-profit theory (Kaleckian-Post-Keynesian Approach), desired capital stock is a function of profits and capacity utilization or output. Jorgenson and Siebert (1968); Jorgenson (1971) and Elliot (1973) provide a comparative study of these alternative theories of investment behavior.

[21]For example only a sustained increase in demand will convince firms that capital stock has to be increased.

Jorgenson's (1971) ranking of the alternative theories is 1. Neoclassical; 2. Accelerator; 3. Liquidity[22]. In a more recent study on OECD countries, Ford and Poret (1991) finds empirical support for the accelerator but only limited support for the profit theory.

2.1.1 The Neoclassical Model

In the neoclassical model, a firms' demand for capital is set at the point where the marginal product of capital equals the user cost of capital. It is assumed that the firm chooses inputs and output to maximize profits. Suppose that $Q, K, L,$ and p, r, w represent output, capital, labor and their prices respectively and given a production function;

$$Q = Q(K, L) \quad \text{.....(2.2)}$$

If (2.2) above is a linearly homogeneous function, the profit function may be expressed as:

$$\pi = pQ - rK - wL \quad \text{.....(2.3)}$$

Then the firm maximizes (2.3) subject to the constraints that inputs and output satisfy the production function (2.2). Considering the Lagrange;

$$H = pQ - rK - wL - \lambda(Q - Q(K, L).$$

The first order conditions for a maximum require that:

$$\frac{\partial H}{\partial L} = -w + \lambda \frac{\partial Q}{\partial L} = 0,$$

$$\frac{\partial H}{\partial K} = -r + \lambda \frac{\partial Q}{\partial K} = 0$$

Eliminating, λ, the Lagrange multiplier, the marginal productivity conditions are given by

$$\frac{\partial Q}{\partial K} = \frac{r}{p} \text{ or } p\frac{\partial Q}{\partial K} = r \quad \text{..... (2.4) and}$$

$$\frac{\partial Q}{\partial L} = \frac{w}{p} \text{ or } p\frac{\partial Q}{\partial L} = w$$

Since we are interested in investment behavior, subsequent analysis will concentrate on demand for capital. According to the neoclassical theory, each factor is utilized up to the point

[22]Elliott (1973) was not able to reproduce the ranking in an enlarged time series and cross sectional analysis. His results are inconclusive.

where the value of its marginal product equals its price or alternatively where the marginal product equals the real price of the factor. Solving (2.4) yields the profit maximizing values for K. Whenever, the value of the marginal product exceeds the rental cost of capital it is profitable to increase the capital stock. Among the assumptions of this theory is competitive markets and unitary elasticity of substitution between labor and capital.

Jorgenson (1963) derived the desired capital from profit maximization conditions above. He assumed a Cobb-Douglas function implying that the elasticity of substitution between labor and capital is unitary. In empirical work, Eisner and Nadiri (1968, 1970) have criticized derivation on the grounds that the elasticity of substitution is less than one and thus this (Jorgensons') method overstates the response of investment to the user cost of capital. To briefly discuss the empirical debate, let us suppose we have a Constant Elasticity of Substitution (CES) Production function[23] under perfect competition and constant returns to scale. The production function can be formally presented as;

$$Q = a[\delta K^{-\rho} + (1-\delta)L^{-\rho}]^{-1/\rho} \quad \text{.....(2.5)}$$

Where as before Q, K and L stand for output, capital and labor respectively. α , δ and ρ are constant parameters. The marginal productivity conditions for capital can be derived from 2.5 above. Using the notation u for $\delta K^{-\rho} + (1-\delta)L^{-\rho}$,

$$\frac{\partial Q}{\partial K} = -\frac{1}{\rho} a[u]^{-\frac{1}{\rho}(\rho+1)} . -\rho\delta K^{-(\rho+1)} = \quad \frac{r}{p}$$

To be able to simplify the equation above, a can be expressed as; $\frac{a^{\rho+1}}{a^{\rho}}$. Then

$$\frac{\partial Q}{\partial K} = -\frac{1}{\rho}\frac{a^{\rho+1}}{a^{\rho}}[u]^{-\frac{1}{\rho}(\rho+1)} . -\rho\delta K^{-(\rho+1)}$$

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[23]We opt for a CES production function because Jorgenson (1963) assumed a Cobb-Douglas function and a Cobb-Douglas function is a special case of CES as $\rho \to 0$. CES also allows different elasticities unlike Cobb-Douglas where the elasticity is constant and unitary.

$$= \frac{\delta}{a^{\rho}}(a[\delta K^{-\rho} + (1-\delta)L^{-\rho}]/K)^{(\rho+1)}$$

$$= \frac{\delta}{a^{\rho}}\left(\frac{Q}{K}\right)^{(\rho+1)} = \frac{r}{p} \quad \text{.....(2.6)}$$

Under CES production function, the elasticity of substitution between capital and labor is equivalent to $\frac{1}{1+\rho}$ Thus if we let $x = \frac{1}{1+\rho}$, equation (2.6) can be solved for K, the steady state capital stock:

$$K^* = (\frac{\delta}{a^{\rho}}) \cdot \frac{p^x Q}{r^x} \quad \text{.....(2.7)}$$

Equation (2.7) provides the steady state capital stock (K^*) which is a function of output and the user cost of capital. In the case of a Cobb-Douglas production function $K^* = \gamma \frac{pQ}{r}$[24]. Where γ is the share of capital in total output, Q is output.

To revisit Jorgenson, Eisner and Nadiri debate, it can be seen from (2.7) that if the elasticity of substitution is one, i.e, the Cobb-Douglas function case, then the response of investment to output and user cost is equal and proportional except for the sign. However, when the elasticity is less than unity, that is, $x<1$, then a proportional increase in the factor price ratio leads to a less than proportional increase in investment and that the responsiveness[25] of investment to output is greater than the responsiveness to changes in the user cost.

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[24]From the presentation above, in the case of Cobb-Douglas function, $\frac{\partial Q}{\partial K} = \gamma \frac{Q}{K} = \frac{r}{p}$. K can not be determined unless we assume Q is exogenous since Q is a function of K and L. Thus, Jorgenson assumed Q is exogeneously determined.

[25]Note that, in the general case, elasticity of substitution between labor and capital is given by;

$$\frac{d(K/L)}{K/L} / \frac{dMRS}{MRS}$$

Where MRS is the marginal rate of substitution and is equal to the factor price ratio ($\frac{w}{r}$). Elasticity of substitution is thus the proportionate change in capital labor ratio divided by the proportionate change in factor prices. Remember under CES elasticity of substitution is x.

Thus constraining the elasticities with respect to user cost and output to equal magnitudes tends to overstate the contribution of user cost whenever $x<1$. Eisner and Nadiri argue that x is closer to zero. However, Jorgenson and Stephenson (1969) claim to find empirical support for unitary elasticity. Biscoff (1969) has shown that the null hypothesis of the long run unitary elasticity can not be rejected. Biscoff concludes that, the elasticities with respect to relative prices and output are different in the short run but they are the same in the long run.

Let us revert back to the main model. In the case of perfect competition without any market constraints, the demand for capital depends only on factor prices. This kind of model could be referred to as *pure neoclassical model.* From an empirical point of view this model has been unsuccessful, see discussion by Gould and Waud (1973). In the empirical literature, the neoclassical model combines the effects of factor prices and output.

Another special case of the neoclassical model is the *accelerator model.* In the accelerator model, investment is a function of changes in output and is not affected by user cost of capital. The accelerator theory can be depicted by equating the exponent of r, (x), to 0 in equation (2.7) above. That is, changes in capital stock only relate to the output variable. In the rigid accelerator model, investment adjusts instantly to the desired levels. In such a rigid accelerator model adjustment lags or costs are non existent and $\lambda = 1$(equation 2.1) . This specification has been rejected as implausible.

Another hypothesis that stems from the neoclassical is the so called *Putty-clay* model of investment. According to the Putty-Clay model ex ante capital and labor like putty, are substitutable while ex post substitutability is difficulty to achieve. In this hypothesis, capital labor substitution occurs only with new capital (investment) but not total capital. The required

labor for the current installed capital is assumed to remain constant. This is because production techniques become rigid once capital is installed (fixed proportions). Consequently, substitution can only occur with new capital. In this case, the firms' optimization is applied to the equipment's profitable lifetime (Ando, Modigliani, Racshe and Turnovsky (1974)).

2.1.2: The Q theory of Investment

The other alternative theory of investment suggested by Tobin (1969) is the so called q theory of investment. According to this theory, investment is an increasing function of q, where q is defined as the ratio of increase in the market value of the firm as a result of installing new capital to the equipment cost. A value maximizing firm will acquire more capital as long as an additional unit of capital increases its market value than the cost of acquiring the new capital. In this theory, the firm will continue to increase (decrease) the capital stock as long as q is greater than 1 (less than 1). The *q theory* thus links investment activity to the asset markets. Particularly, the stock and bond markets are usually relied upon to provide a measure for the firms' value.

Hayashi (1982) has shown that the q theory is a modified version of the standard neoclassical theory, when the costs of installing new capital are introduced in the firms' optimization function. From an empirical point of view, the q theory has not enjoyed much success. In practice, the Tobin's q (marginal q) is not observable. Only average q (that is, the ratio of the market value of the existing capital to its replacement cost) can be observed . Empirical tests of this theory use the average q is a proxy for marginal q. Some of the empirical studies include; Von Furstenberg (1977) and Summers (1981). In these studies, the estimated investment equation leaves a large unexplained residual, implying that all relevant information is not captured by q. Artus and Muet (1990) referring to a study by Artus

(1988- in French on France) notes that "he shows that if we add to Tobin's q variable, the standard determinants of the basic model (such growth rate and profit rate) the weight of Tobin's q becomes extremely small or even nonexistent" (Artus and Muet (1990), page 276). Hayashi (1982) shows that under conditions of constant returns to scale and price-taking marginal q equal to average q, otherwise if the firm is a price maker, average q is greater than marginal q. The difference being monopoly rent.

2.1.3: Kalecki- Keynesian theories of Investment

Keynes and Kalecki, writing independently in 1930's identified demand expectations as well as financial conditions as the major determinants of the firm's investment behavior (Keynes (1937), Keynes (1939) and Kalecki (1971). Keynes argued that investment is determined by the return to capital (marginal efficiency of capital, in Keynes words) and interest rate. Investment is undertaken up to the point where marginal efficiency of capital is equal to the prevailing rate of interest. The marginal efficiency of capital in turn depends on the aggregate demand and the stock of capital that has already been accumulated, among other things. Kelecki emphasized savings from profits and availability of funds as the main determinants of investment. The theories that combine profits and aggregate demand conditions are among the various alternatives tested in several comparative studies (Jorgenson and Siebert (1968); Jorgenson (1971), and Elliot (1973)).

The justification for introducing the profit variable as a determinant of investment decisions lies in the imperfect nature of capital markets, there is a tendency for firms to prefer self-financing to borrowing[26]. Savings by firms from the flow of profits becomes a source of internal finance, which is reinvested. Investment may also be financed by borrowing or

[26]Firms may prefer internal finance due to fear of bankruptcy, or outside control and borrowing incurs fixed charges which may affect cash-flow.

external finance on the strength of the investors wealth or equity.[27] Therefore, savings out of current profits may either be used for investment or increase the capital of the firm which improves the capacity to access external finance.

To invest, firms must obtain the necessary finance to implement their investment decisions. As a result the availability of self-financing and borrowing opportunities may determine the feasible investment. If we ignore stock market issues then;

$$rI_t = CF_t + D_{t+1} - D_t \quad \text{.....(2.8)}$$

Where rI_t is nominal Gross investment, CF is the gross cash flow and D is net indebtedness. This financial constraint imposes a maximum ratio of medium and long-term debt to equity ratio beyond which the firm will not borrow. The financial risk to the firm may grow in proportion to indebtedness (Kalecki, 1937). If we represent the maximum indebtedness ratio by D_{max}, then for a financially constrained firm, $\frac{D_t}{Equity} \leq D_{\max}$. This ratio is an increasing function of expected profits, asset liquidity and debt maturity (Artus and Muet 1990).

On the other hand, if we assume that investment is constrained by the demand for the firm's product in the product market (Keynesian disequilibrium) then demand expectations are also taken into account. Models that combine the demand expectations and financial conditions are sometimes referred to as 'accelerator-liquidity' or accelerator-Profit Models. In comparative empirical work, Jorgenson (1971) argues that where internal finance variables appear significant in investment functions, they represent the level of output. However, Fazzari

[27]The access of a firm to the credit market depends to a large extent on its amount of equity capital, i.e. the amount owned by the firm. It is easier for a firm with large equity capital to obtain funds for investment while a firm with small entrepreneurial capital can not. In developing countries, the banking system is the major source of credit. Such banks usually need collateral and or a 'track record' or information on the credit worthiness of the potential borrower.

and Mott (1987) using time series cross-section data, report independent effects for the cash flow variables.

It is important therefore to note from the above theoretical discussion that, the factors that determine internal finance such as; flow funds, stock of liquid assets, profit, debt capacity, tax liability could be relevant in investment decision making. As far external finance is concerned, factors such as interest rates and stock prices may play an important role and so are demand expectations.

2.2.0: Characteristics of Investment Environment In developing Countries

In a comprehensive review of empirical investment studies on developing countries, Rama (1993) has raised an important question relating to the relevance of the industrial country investment theories discussed above for developing nations. According to Rama (1993), four important specific features of developing nations need to be considered. These are: financial repression, foreign exchange shortages, lack of infrastructure and economic instability. Earlier studies on developing countries, Tun wai (1982) and Blejer and Khan (1984) have attempted to account for specific developing country issues by analyzing complementarity or crowding out effects in their investment functions. Age'nor and Montiel (1996) have made further contributions to the theoretical debate, by emphasizing in addition, the underdeveloped nature of capital markets in developing countries, external debt overhang and dependence on imported capital goods. Most empirical studies on investment in developing countries, have been eclectical in the sense that, in the analytical framework different factors are taken into consideration depending on the researchers' view on the important characteristics; such as financial repression, foreign exchange shortages, infrastructure constraints, external debt burden and economic instability. This approach differs

from that of industrialized countries which are based on elaborate investment models. So far, the empirical evidence from developing countries as well as industrial countries suggest that aggregate demand is an important determinant of investment. (Rama 1993), Chhiber and Dailami (1993), Greene and Villanueva (1994). The coefficient of the aggregate demand variable is positive and highly significant in almost all the investment functions. Sometimes, data limitations dictate the functional form or the variables that can be included in an investment function in developing countries[28].

Referring to the discussion in chapter 1, section 1.1.0, the relevance of standard industrial country investment theories to developing countries could evaluated from an institutional point of view. First, as indicated above, there is an implicit assumption in mainstream economics that institutions do what they supposed to do. Perhaps we could start by asking whether the government in a developing country performs the same as an industrialized country government. One, area that there seems to be divergence is the contact of macroeconomic policy: fiscal, monetary and exchange rate policy. Macroeconomic stability in many developing countries is questionable especially in terms of high inflation rate, unsustainable budgetary deficits and overvaluation and exchange rate misalignment. Indeed, structural adjustment reform policies in developing countries aim at reducing macroeconomic imbalances. Macroeconomic instability may arise from political instability or poor macroeconomic management. When the future is highly uncertain investors take a 'wait and see' attitude. Analytical literature in recent years do emphasize the importance of uncertainty in determining investment (Pindyck, (1991), Serven and Solimano (1993), Dixit and Pindyck (1994)). Serven and Salimano (1993) show that macroeconomic stability as measured by the variability of inflation and exchange rate were much better in NIC's than in other developing

[28]For example, data on capital stock and private investment is not available on many developing countries.

countries, thus helping to explain the differences in capital formation performance. At a microeconomic level firms may decide to limit their capacity in the face uncertain demand (Pindyck ,1988), which thus leads to reduced investment activity. On Chile Solimano (1989) reports that exchange rate and output variability have a negative impact on private investment.

Also related to the operational effectiveness of the government is the provision of the basic infrastructure. Basic infrastructure in many developing countries which is essential for modern investment is either lacking or insufficient. Roads, electricity, ports, railways, telecommunications are important constraints in developing nations than they are in industrialized nations. Empirical studies on developing countries confirm the complementarity of investment on infrastructure and private profit oriented investment. In cross country studies, Blejer and Khan (1984) and Greene and Villanueva (1993) find support that public investment on infrastructure is complementary to private investment. Oshikoya (1994) finds empirical support for complementarity in a broad group of African countries. Shafik (1992) reports similar results for Egypt.

Governments in developing countries not only operate public utilities but also participate in profit oriented activities on a wider scale[29]. Consequently, in many developing countries (as can be seen from the table below), public sector investment constitute a large share of total domestic investment. While investment on basic infrastructure and public goods should encouraged, other investments may crowd out private investment.

[29]In the ongoing policy reforms, governments in developing countries have been privatizing and divesting from commercially oriented enterprises.

Table 2.1: Shares of Public Investment in Total Fixed Investment: Selected Countries

Country	Public/Total Fixed Invest. %
China	66
Indonesia	32
Kenya	44
Korea	10*
Singapore	19
Thailand	17

* 1985-1987

Computed from World Bank, World Data, 1995

One of the central economic institutions is the financial system. The importance of the financial sector can not be overemphasized, as indicated above the financial enterprises provide finance and other financial services to government and to producers and merchants. Yet one finds big differences between the financial systems in developing nations and those in industrialized countries. Whereas in the industrial countries, capital markets are relatively well developed, in most developing countries these markets are either nonexistent or are shallow. See the discussion on the state of the financial sector in Kenya, in section 1.1.4.4. This implies that the q theory of investment may not be applicable objectively in some developing countries. Government intervention in the financial market through interest rate controls and credit allocation (which has been pervasive in developing countries) may have an important impact on private investment decisions. Mckinnon (1973) and Shaw (1973) have analyzed the adverse impact of financial repression theory and come up with the financial liberalization policy. Mckinnon and Shaw have argued that government intervention in the financial sector through the control of interest rates 'repress' the development of the financial sector, inhibiting its contribution to investment activity. Many empirical studies on developing

countries claim to have empirical support for 'financial repression'. This issue is discussed further below.

Recent literature on developing countries do point to debt overhang as one of the important determinants of private sector investment decisions. Debt overhang imply that there may be need for future policy changes in form of higher taxation or exchange rate change. Debt service payments require payments to be made abroad. A highly indebted country may also face credit rationing in international financial markets (Borenzenstein, 1990). Serven and Solimano (1993) confirm empirically the adverse impact of external debt on investment in a broad group of developing countries.

In World Bank's classification, a country is severely indebted if it meets either of the two criteria; present value of debt to GNP (80 percent) or present value of debt to exports of goods and all services is 200 percent (WDR, 1993). Indeed, from both the indicators of external debt (shown below), Kenya is a severely indebted low income country (SILIC).

Table 2.2: Kenya's External Debt Indicators

	1972	1982	1992
Debt/ Exports of G&S (%)	100	207	311
Debt/GNP (%)	28	55	89
Debt Service Ratio(%)	8	31	33
Interest Service Ratio(%)	4	15	13

Source: World Development Indicators, World Bank, 1997.

The underdeveloped nature of the capital goods industry in a developing country implies greater dependence on imported capital and intermediate goods. An increase in domestic investment activity is always associated with an increase in imports of capital goods. Thus the cost and availability of foreign exchange is likely to play a significant role in

investment decisions. The table below shows the reliance of selected developing countries on imported capital goods - mainly machinery.

Table 2.3: Imports of Machinery : Selected Developing Countries

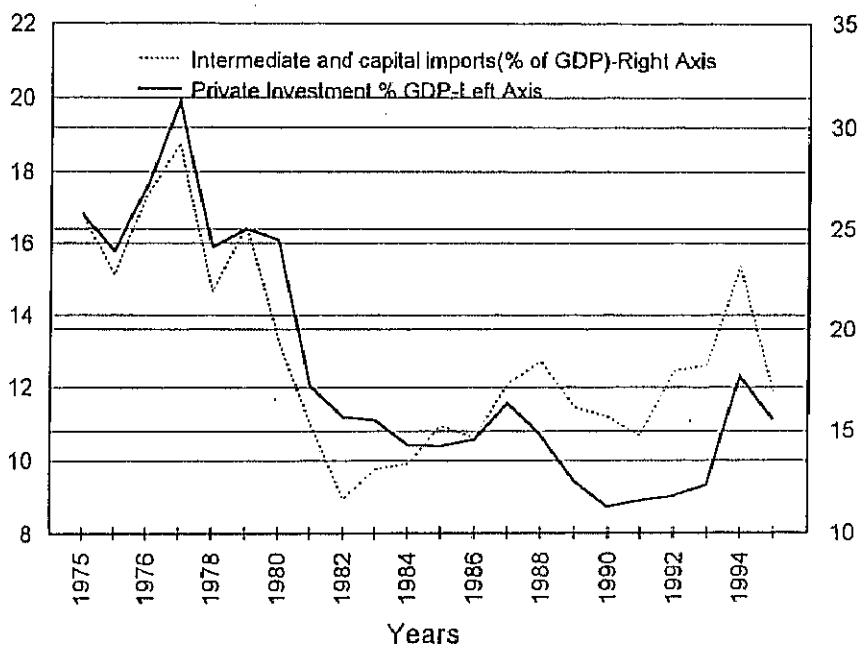
Country	Percentage of total Merchandise Imports (current prices US $)
China	41
Indonesia	42
Kenya	42
Korea	34
Malaysia	52
Mauritius	27
Singapore	42
Thailand	40

Source: Computed from World Development Indicators, World Bank, 1997

In the literature, there has been attempts to investigate the importance of the dependence of developing countries on the external sector for capital goods. In these studies, the importance of availability and cost of foreign exchange for investment have been used as proxies to asses this dependence. Fry (1980) in a study of 61 developing countries, finds that foreign exchange receipts as a ratio of GDP is an important determinant of investment. Love (1989) find that the variability of export earnings and international reserves are statistically significant in an investment function for a group of developing countries. Other studies too, have investigated the importance of the exchange rate. Among them is; Fain and De Melo (1990) who finds adverse impact exchange rate devaluation on investment. Solimano (1989), in the case of Chile, finds that exchange rate depreciation reduces investment in the short run, but recovers in the medium term. Other studies have shown that the effect of exchange rate change on investment is insignificant while its variability (instability) has a significant negative impact (Serven and Solimano (1995)).

The chart below shows the evolution of real imports of intermediate and capital inputs (deflated by the import price index 1982=100) as a ratio of GDP in Kenya. It can be seen that an increase in investment is generally associated with an increase in imports. There appears to be a high positive correlation between imports of inputs and investment. However, this does not imply causality. It is more reasonable to assume that imports do not cause investment but rather it is a result of investment decisions. Since a large share of the cost component of cost of investment may be consumed by capital imports, multiplier effect of most domestic investment activity dissipates to the industrial countries.

Chart 2: The trend in Imports of Capital and Intermediate goods, and Private Investment (1975-1996)



Data Source: Statistical Abstract and Economic Survey, Republic of Kenya, Various Issues

We can conclude the discussion in this chapter by noting that investment in developing countries, should be studied in relation to the specific circumstances in these countries. Although, in most theoretical analysis it is usually necessary to concentrate on certain important aspects of the problem, considering only the variables postulated in standard

industrial country investment functions, could be termed as 'pure' analysis. For such a study to have useful policy lessons, specific developing country characteristics have to be investigated. Within the context of the discussion above, economic stability, lack of infrastructure, foreign exchange constraints and financial crowding out are among the relevant variables for a developing nation.

The modern theories of investment are not concerned with the social benefits of investment and therefore are silent on what kind or direction of investment may be important for the society. The discussion in chapter 1 suggest that merchant capital especially in an 'inward looking' environment may not help expand the economy as its contribution to skill formation, complexity and quality of output is limited. Perhaps resources accumulated by merchants may be more productive at least from a social perspective by moving into direct production. However, the discussion in chapter 1, section 1.1.0 and section 1.3.0 suggests that this is an economic as much as a political process and thus political factors may be relevant.