DOES INVESTMENT CAUSE GROWTH? A TEST OF AN ENDOGENOUS DEMAND-DRIVEN THEORY OF GROWTH APPLIED TO INDIA 1950-96

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1. Introduction

From the early development literature of the 1940s and 1950s, notably that of Paul Rosenstein-Rodan (1943), Ragnar Nurkse (1953) and Arthur Lewis (1954), a mainstream view emerged that capital accumulation was the key to growth. Capital was regarded as the "missing component" which if applied in adequate amounts could help break the vicious circle of poverty. The diagnosis of the problem of underdevelopment was in terms of acute shortage of material capital, and this was in turn directly responsible for the low level of productivity prevailing in such economies. So the key to enhanced productivity lay in increased use of physical capital in the production process.

Rosenstein-Rodan, while emphasising indivisibilities and externalities in the production process, suggested that though small, isolated efforts at industrialisation may yield insignificant contributions to growth, a "big push" (the minimum quantum of investment needed "to jump over the obstacles to economic development") might launch an underdeveloped country into self-sustaining growth.

For Nurkse (1953), the theme of capital accumulation lay at the very centre of the problem of development in economically backward countries. In his words: "The so-called underdeveloped areas, as compared with advanced, are underdeveloped with capital in relation to their population and natural resources" (p.1). Further, the emphasis was on accumulation of physical capital to the neglect of investment in education, health and skills (human capital) or technical progress. The idea was to divert a part of society’s currently available resources to increase the stock of capital goods so as to make possible an expansion of consumable output in the future.

Nurkse did mention the vicious circle of poverty on the demand side but his solution was a supply-side strategy of balanced growth -- "a more or less synchronised application of capital to a wide range of different industries" -- which he took to be an implication of Rosenstein-Rodan’s theory. His view was that though "capital formation is not entirely a matter of capital supply... this is no doubt the more important part of the problem." To finance the required investment a high savings ratio (or massive foreign borrowing) would be necessary.

Likewise, in Lewis’s (1954) theory of economic development the central problem was the process by which a community which was previously saving and investing only around 4 or 5 per cent of its national income converted itself into an economy where voluntary saving was 12 to 15 per cent of national income or more. The main source of saving would be the capitalist surplus. He describes the process of economic expansion thus:

"The key to the process is the use which is made of the capitalist surplus. In so far as it is reinvested in creating new capital, the capitalist sector expands, taking more people into capitalist employment out of the subsistence sector. The surplus is then larger still, capital formation is still greater, and so the process continues until the labour surplus disappears" (pp.151-2).

This too was primarily a supply-side view of development; with demand constraints either not considered important or ignored. Lewis discounted Ricardian and Malthusian concerns over a potential fall in the rate of profit, and the consequent emergence of a stationary state,[1] in the following words: "If we assume technical progress in agriculture, no hoarding, and unlimited labour at a constant wage, the rate of profit on capital cannot fall. On the contrary it must increase, since all the benefit of technical progress in the capitalist sector accrues to the capitalists" (Lewis, 1954, p. 154).

The Harrod-Domar growth model (Harrod, 1939; Domar, 1946) also emphasised saving and investment in growth. Given a constant capital-output ratio, the rate of growth becomes dependent on the saving rate. In this line of thinking, the higher the saving rate, the higher the rate of economic growth. This model has also been used to determine the additional savings (or foreign exchange in the form of foreign aid) required to achieve a targeted rate of growth.

Along with the desirability of high savings and investment ratios, a major role for state intervention in resource mobilisation and economic development was also thought necessary. The state was not only expected to push up the rates of saving and investment through appropriate policies, it was also expected to intervene directly through public sector investment. Further, trade-pessimism philosophies of Nurkse (1962), Raúl Prebisch (1950), Hans Singer (1950) and Gunnar Myrdal (1957) implied an import-substitution model of growth, and typically this also involved a greater direct and indirect role for the public sector.

In 1956 Robert Solow published his seminal paper on neoclassical growth theory (Solow 1956). This invoked an aggregate Cobb-Douglas production function with constant returns to scale but diminishing returns to each input. He then published a related paper (Solow 1957) that, following similar work by Moses Abramovitz (1956), attempted to measure the predicted contribution of capital to growth, again based on the underlying assumptions of the neoclassical growth model that factors are paid their marginal product (an alleged measure of their contribution to growth), but that this marginal product is subject to diminishing returns if one factor should grow faster than coöperant factors. The implication was that capital deepening (a secular rise in the overall capital-labour ratio) would involve diminishing returns. Thus, unlike the Harrod-Domar assumption of a constant capital-output ratio, capital accumulation tends to lower capital’s productivity and has a positive but declining effect on the rate of growth.

Thus, a rise in the savings and investment rates boosts the growth rate only temporarily. In the long run, absent (exogenous, unexplained) technical progress, the rate of growth could be sustained only at the rate of growth of the labour force. Growth of output and income *per worker* would be zero. Still, the theory did predict that capital accumulation would boost the growth rate in the short run, and so put countries on to a higher *level* of income per head even in the long run. So the conclusion was that even if the savings rate has no effect on the growth rate it should be encouraged for its desirable levels effect.

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[1] Malthus was the first to visualise that the process of capital accumulation could not go on for ever as it may result in an embarrassing glut of commodities – a demand constraint. By contrast, Ricardo focused on diminishing returns and envisaged a falling rate of profit and an eventual stationary state not because of rising wages as capital accumulates, but because of rising rents as demand increases for a fixed supply of land of variable quality and locational advantage.

Without abandoning the general neoclassical framework, modern endogenous growth theory seeks to explain why per capita income growth continues in capital-abundant countries, and is often faster than in capital-poor countries. It suggests that capital deepening may not encounter diminishing returns thanks to various kinds of externalities and "endogenous" improvements to productivity. These permit the aggregate production function to exhibit increasing rather than constant returns to scale. While Allyn Young (1928) is often cited as an early exponent of this general insight (e.g., Romer, 1987, 1989; Murphy, Shleifer and Vishny, 1989; Krugman, 1990, 1993; Shaw, 1992; Aghion and Howitt, 1998), modern theorists claim to explain what he had in mind in greater detail, depth and rigor.

However, Sandilands (2000) claims that these writers miss some of Young's deeper insights, in particular his rejection of the whole notion that factors' contributions to overall growth can be measured by their marginal product as perceived by individual entrepreneurs. As Young (as published in 1990) expressed the problem in respect of wages, and more generally for an understanding of factor productivity and pricing in general:

"One may discuss relative wages in terms of supply and demand, but wages in general involve the circumstance that, under modern conditions, supply in itself creates a large part of the demand (p.20)… Marshall's supply and demand curves hold ceteris paribus, and cannot be integrated to give the whole economic structure" (p.26).

Young's paper on increasing returns was an amplification of Adam Smith's insight that the division of labour is limited by the size of the market, and of Alfred Marshall's distinction between internal and external economies. He insisted that growth of the market explained the fuller exploitation of the cost-reducing economies to be gained from more specialized, roundabout, capital-intensive methods. Thus demand was at least as important as supply-side considerations in explaining growth. Young's conception of a market, and its growth, was as "an aggregate of productive activities tied together by *trade*" (Young, 1928, p. 533; italics added). Thus demand involved the exchange of real products for other products, a variant on Say's law that supply creates its own demand:
"The capacity to buy depends on the capacity to produce. In an inclusive view, considering the market not as an outlet for the products of a particular industry, and therefore external to that industry, but as the outlet for goods in general, the size of the market is determined and defined by the volume of production… Adam Smith's dictum amounts to the theorem that the division of labour depends in large part upon the division of labour. This is more than mere tautology. It means… that the counter forces which are continually defeating the forces which make for economic equilibrium are more pervasive and more deeply rooted in the constitution of the modern economic system than we commonly realise… Thus change becomes progressive and propagates itself in cumulative ways" (Young, 1928: p. 533).

Two of Young's own students have contributed to this cumulative-causation, demand-side approach to growth: Lauchlin Currie (1902-93) who studied under Young at Harvard, 1925-27; and Nicholas Kaldor (1908-86) who studied under him at the LSE from 1927 until Young's untimely death in 1929. The present paper is based largely on Currie's interpretations of Young's seminal 1928 paper on increasing returns and economic progress (Currie, 1966, 1974, 1981, 1997), and offers an alternative to the mainstream views outlined above.[2]

[2] Nicholas Kaldor also developed a growth theory that emphasised the role of demand and increasing returns (see, for example, Toner 1999). Sandilands (2000) explains the important

Young attempted to explain growth not in terms of the apparent measured contributions of increased supplies of labour and capital that are subject to diminishing returns absent some exogenous technical progress, but as a process which is self-perpetuating rather than self-exhausting[3]. He built on Adam Smith's famous insight that the division of labour is limited by the extent of the market and concluded that "the division of labour depends in large part upon the division of labour" (Young, 1928, p.123). Currie (1981, 1997) drew the implication that "growth begets growth", or that there is a built-in tendency for the trend rate of growth, whether fast or slow, to be perpetuated absent exogenous shocks or significant policy changes that widen the size of the market and enhance competition and mobility. In this view, increased factor inputs (and technology too) were largely the consequence of the growth process rather than its cause.

Young thought that while the law of diminishing returns may apply to individual inputs employed by individual firms at a particular time, it did not characterise the dynamic laws of motion of the whole economy. For the individual firm an increase in output may typically appear to be obtainable only at rising marginal cost while also tending to depress the product price. An increase in *aggregate* output, however, may engender productivity-enhancing changes in organisation and methods, via increased specialisation and aggregate exchange (or aggregate real demand)[4] that could offset the microeconomic tendency to diminishing returns that would be expected under the theoretical assumption of static ceteris paribus conditions.

In the aggregate the whole economic environment is in continuous process of transformation (ceteris non paribus) through the interactive multiplicity of individual actions. Microeconomic diminishing returns may confront the individual firm as it expands output with given techniques and organisation (so there appears to be declining but positive marginal product, in physical and value terms). But if the effect of multiple individual actions is to increase aggregate output, then, in Young's theory, microeconomic constraints and rising supply price are converted into macroeconomic opportunities for economic progress with increasing returns and falling unit costs. This was his demand-based view of growth in which specialisation and division of labour (limited by, but also determining, the size and growth of the market) play a crucial role.

The individual widget maker knows that if she produces more widgets she does not thereby increase the market demand for them. There must already be a sufficient prospective market as to ensure that price will cover marginal costs. If the firm runs

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parallels, but also some important differences, in the "Youngian" interpretations of Kaldor and Currie. Space prevents a fuller exposition of that discussion in the present paper.

[3] Although Young's emphasis on endogenous growth, as opposed to the role of inputs and exogenous technical progress, was pathbreaking, his work suffered neglect until recently (see Merhling and Sandilands 1999). This may have been due to Young's untimely death in 1929, shortly after his theory was published, and because the world was then to become preoccupied with problems of depression rather than secular growth.

[4] Increased specialisation necessarily implies increased trade or exchange. Exchange implies a market demand. In the aggregate, this is defined by GDP. Thus if capital follows GDP we have that capital follows upon demand in the aggregate, Say-Young conception. (A related issue is how far real, Sayian demand is boosted when the government replaces the private market place. Note that Say's Law was fully expressed as Say's *Law of Markets*. While Keynes may have shown how Say's Law may be interrupted by cyclical, short-term monetary disturbances, he assuredly did not bury it as a long-term "law" for a world in which the demand for goods in general is still insatiable, and where government controls do not frustrate the operation of market forces.)

ahead of the given demand it can only sell its product by undercutting its rivals, but at a price that will not cover its costs (assuming no unexploited internal economies of scale or cost-cutting innovation on the part of the firm itself). By contrast, an increase in *aggregate* supply not only does increase aggregate demand for that supply, it is essentially the same aggregate, namely the volume and value of reciprocal trade.

Thus Young viewed the overall market size as flexible and extendable. By way of contrast, while Nurkse (1953) quotes Adam Smith with approval on the relationship between the division of labour and the size of the market, he comes, as we have seen, to a mainly supply-based prescription for growth that emphasises capital formation. Currie (1966) took Nurkse and others to task for this excessive preoccupation with capital formation in which investment is 'good' and consumption 'bad'. Nurkse overlooked the possibilities for boosting consumer goods as well as investment goods by providing incentives to the mobilisation and use of chronically underemployed labour and capital resources. In particular, he overlooked the possibility that labour may be unproductive or poorly employed not because of lack of capital but because of lack of effective demand in relation to supply. In Currie's words:

"A girl's labour may be worth almost nothing in agriculture but be quite remunerative as urban domestic labour, while utilising no more capital. What has apparently happened here is that the Keynesian identification of saving and investment by definition, which was a useful and satisfying tool of analysis, acquired a mystique of its own and resulted in a neglect of factors bearing on development which cannot be handled satisfactorily in the saving-investment and subsequent growth formulas" (Currie, 1966, p. 123).

According to Currie, given the gross inequalities in incomes and expenditures in developing countries and also the existence of idle labour, it makes little sense to talk of increasing saving by holding back consumption of the masses[5]. The solution may lie not in restraining consumption but by creating incentives to the provision of more remunerative work whether in consumption (textiles) or in investment (housing). Increases in saving and investment would follow as derivative rather than initiating factors of growth.

In his "leading sector" model of growth Currie (1974) distinguishes a "Keynesian" increase in money demand[6] from an increase in "Sayian" demand. While the former may be effective in stimulating an economy undergoing depression, it may have little impact on the underlying trend growth of intersectoral demand for products and services. In the classical, Sayian sense of demand, an increase in one sector's output constitutes its real demand for the products of other sectors. When and if this is met by an induced increase

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[5] Currie held that poverty is best eliminated by tackling the barriers to increased real demand for goods of mass consumption (cotton textiles, housing, etc), and by removing barriers to the movement of workers from low-paying to higher-paying sectors, rather than by a prior increase in supply of capital inputs. Increased saving and investment would be a consequence of such a shift in emphasis rather than the causal factor or an objective in itself.

[6] A "Keynesian" increase in monetary demand may be a misnomer in that the injection can come not only from fiscal policy (with which Keynesianism is most often identified) but also from pure monetary policy. The basic distinction, however, is between (i) an injection of monetary expenditures that is not preceded by an increase in real output, and (ii) an increase in real purchasing power as represented by real output itself, where the latter is brought about by some structural change in incentives to the fuller and better allocation of resources and techniques. The increased real ("Sayian") supply and demand may usually, but not necessarily, be accompanied by an increased money supply to take off the increased output at a constant nominal price level overall.

in the traded output of other sectors in exchange, then the overall rate of growth is raised by the weighted average of the “leading” and “following” sectors’ individual growth rates.

By contrast, the Keynesian mechanism may not operate to increase real demand (hence real output) even when there is much slack in the system if this slack arises not because of deficient monetary demand but because of the chronic institutional barriers in underdeveloped countries that impede mobility or the better utilisation of existing equipment. In that case Keynesian demand may be dissipated in general inflation with no change in relative price signals (domestically and vis-à-vis the rest of the world) or incentives to better and fuller resource allocation. With no change in resource allocation there will be no increase in the real output that constitutes real demand. If, however, measures are taken that liberate real demand that was hitherto repressed by distorted relative prices or barriers to mobility and competition then incentives are introduced that expand output in the initially favoured sectors with relatively slight loss of output elsewhere. Viewed dynamically, these latter “following” sectors also benefit from the increased real incomes and expenditures that derive from the expansion of the “leading” sectors. In Currie’s words, one may expect that "measures to ensure better mobility or a better combination of factors will... lead to an increase in real output even while aggregate money demand may be falling" (*ibid*., p. 4).

We have seen that the neoclassical growth-accounting framework emphasises exogenous technical progress as the theoretically and empirically dominant element in growth rather than the traditional inputs of labour and capital, because with diminishing returns capital deepening leads to a steady-state of zero per capita income growth absent technical change. Modern endogenous growth models retain the neoclassical framework but try to explain the unexplained residual – variously called exogenous technical progress, a “measure of our ignorance” (Abramovitz, 1956), or “total factor productivity growth” – by giving even more emphasis on the supply of inputs but with the difference that capital inputs generate positive externalities, especially skilled human capital inputs engaged in the dissemination of “non-rivalrous” or non-excludable knowledge via investment in research and development activities.

Sandilands (2000) explains that while modern endogenous growth literature stresses patents, protectionism and subsidies to new knowledge and R&D expenditures, Young showed how the fuller exploitation and adaptation of existing as well as new knowledge is enhanced via greater rather than less competition, and by opening up rather than closing off markets. Thus the modern literature in this respect neglects or misrepresents Young’s concept of increasing returns in the process of self-sustaining growth.

Young’s vision is of a process in which competition and mobility hasten the overall increase in purchasing power by ensuring that resources flow to where they are used most efficiently – at lowest cost and lowest prices. As the size of the market thus increases so does the incentive to continue the process of innovation with cost and price reductions. These further enhance the size of the market via greater specialization within and between firms. This calls for new modes of industrial organization, with or without large investments in physical capital. But in any case the financing of new capital, new processes and new products comes largely from the increased sales revenues in the growing economy. This is an endogenous process in which growth itself breeds further growth, so that growth is self-sustaining rather than self-exhausting.

That is the theory. The need now is to consider the empirical implications of the theory and subject it to test. A major implication is that efficient capital accumulation – the kind that yields increased value to cover its cost, and so to increase GDP – is to a large extent induced by an increase in aggregate demand (as measured by overall real GDP) rather than being the main force determining an increase in GDP. Of course, investment is itself a part of GDP so an increase in investment spending will itself enhance GDP. But investment is only a fraction of GDP and in many countries where growth is strong this fraction is relatively small. We now look at our hypothesis in the light of the Indian experience.[7]

The Indian five-year plans did not diverge from the mainstream view on developmental issues. India's development strategy since the second plan (1956-61) has come to be known as the Nehru-Mahalanobis strategy. This strategy accorded primacy to the capital goods sector and advocated a socialist framework for India in which the public sector would play a dominating role. In line with mainstream thinking, her planners subscribed to the supply-side view of the growth process in which capital accumulation was key. Chakravarty (1987) summarises the importance of capital accumulation at the start of the planning process in the following words:

"First, the basic constraint on development was seen as being an acute deficiency of material capital, which prevented the introduction of more productive technologies. Secondly, the limitation on the speed of capital accumulation was seen to lie in a low capacity to save. Thirdly, it was assumed that even if the domestic capacity to save could be raised by suitable fiscal and monetary policies, there were structural limitations preventing conversion of savings into productive investment…A fifth assumption was that if market mechanism were accorded primacy, this would result in excessive consumption by the upper income groups, along with relative under investment in sectors essential to the accelerated development of the economy..." (p. 9).

Given the added assumption of low elasticity of export demand (i.e., elasticity pessimism) and the need to convert high savings into real investment, primacy to capital goods production at home was thought to be the logical outcome. In Chakravarty's words:

> "In such an economy, if savings were to be substantially raised from a low initial level of around 5 % in 1950 to 20% in 1975, inter-sectoral consistency over time would demand that the productive capacity of capital goods sector would have to rise at an accelerated rate to convert growing savings into additional real investment. It was therefore the need to raise the real savings rate that led Indian planners to accord primacy to a faster rate of growth in the capital goods sector, although doubtless there could be other considerations such as building up defence capability" (*ibid.,* p. 12).

As a result of policies resulting from this thinking, the planners succeeded in pushing up the rates of saving and investment from around 10% in 1950 to around 22 percent by 1980; but there was no commensurate increase in the growth rate. According to Bhagwati (1993), the weak growth performance reflects, not a disappointing saving performance, but rather a disappointing productivity performance.

Thus the theoretical, but also the empirical, question is: Is capital accumulation (or investment) really the main key to growth? The empirical literature seems divided on the issue. The observed strong relationship between fixed capital formation (as a percentage of GDP) and growth rates since World War II led DeLong and Summers (1991, 1992) to

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[7] Compare Currie (1997) for an empirical investigation of the theory in the context of the United States.

suggest that the rate of capital formation determines the rate of a country's economic growth. Lipsey and Kravis (1987), on the other hand, find that the observed long-term relationship between the capital formation rate and the growth rate is due more to the effect of growth on capital formation than to the effect of capital formation on growth. In a recent paper Blomstrom et al. (1996) test the causality between the fixed investment rate and the growth rate by using the Granger (1969) - Sims (1972) framework. They find that economic growth precedes capital formation and that there is no evidence that capital formation precedes growth.

Given the importance attached to capital formation in India's planning process and the evidence that the observed strong relationship between fixed capital formation rate and the growth rate since World War II does not prove causality, the objective of this paper is to explore whether higher investment leads to higher growth in India. We employ various concepts of investment such as private investment, government investment, total investment, and fixed investment. To investigate the issue of causality we employ cointegration and error-correction modelling. Our time period is 1950-96. The data on investment and GDP have been taken from the National Accounts Statistics, Central Statistical Organisation, Government of India, various issues.

2. Methodology

2.1 Definition of causality

We start by defining Granger's (1969) concept of causality. X is said to Granger-cause Y if Y can be predicted with greater accuracy by past values of X rather than not using such past values, all other relevant information in the model remaining the same. Consider the equation:

$$Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \alpha_2 Y_{t-2} + \beta_1 X_{t-1} + \beta_2 X_{t-2} + u_t$$

If $\beta_1 = \beta_2 = 0$, X does not Granger cause Y. If, on the other hand, any of the β coefficients are non-zero, then X does Granger cause Y. The null hypothesis that $\beta_1 = \beta_2 = 0$ can be tested by using the standard F-test of joint significance. Note that we have taken two-period lags in the above equation. In practice, the choice of the lag length is arbitrary. Varying the lag length may lead to different test results. As a practical guide one can include as many lags as are necessary to ensure non-autocorrelated residuals.

Another well-known test for causality is that of Sims (1972). This makes use of the notion that the future cannot cause the present. Consider another equation:

$$X_t = a_0 + a_1 X_{t-1} + a_2 X_{t-2} + b_1 Y_{t+2} + b_2 Y_{t+1} + b_3 Y_{t-1} + b_4 Y_{t-2} + e_t$$

Here X rather than Y is the dependent variable and the leading values of Y such as Y_{t+1} and Y_{t+2} are included. Here the F-test is H_0: $b_1 = b_2 = 0$. Rejection of H_0 must imply that X causes Y because non-zero b_1 and b_2 cannot be interpreted as implying that causation runs from leading values of Y to X. Since the Sims test includes leading values, it has the disadvantage of using more degrees of freedom as compared to the Granger test.

Bahmani-Oskooee and Alse (1993) have criticised studies based on the above procedures on the grounds that they do not check the cointegrating properties of the concerned variables. If these variables -- investment and GDP in our case -- are cointegrated then the standard causality techniques outlined above lead to misleading conclusions because these tests will miss some of the "forecastability" which becomes available through the error-correction term. Secondly, the traditional tests use growth of the concerned variables and this is akin to first differencing. This filters out the long-run information. To remedy the situation they recommend cointegration and error-correction modelling to combine the short-term information with the long run.

2.2 Cointegration and Error-Correction Modelling

Before cointegration is applied, it is essential to test a time series for stationarity[8]. At an informal level stationarity can be tested by plotting the correlogram[9] of a time series. At a formal level, stationarity can be tested by determining whether the data contain a unit root. This can be done by the Dickey-Fuller (1979), Augmented Dickey-Fuller (ADF) and Phillips-Perron (1988) tests[10]. The ADF test is used here for testing for stationarity as well as for the order of integration of a series[11].

We shall take the log of concerned variables so that the first differences can be interpreted as growth rates. If two variables LI (the log of real investment) and LY (the log of real GDP at factor cost) are integrated to the order one, i.e., I(1), then the next step is to find whether they are cointegrated. This can be done by estimating the following cointegrating equations by OLS and testing their residuals for stationarity.

$$LY = a + bLI + u \qquad (1)$$

$$LI = \alpha + \beta LY + e \qquad (2)$$

If LY and LI are both I(1), then for them to be cointegrated u and e should be stationary or I(0). Once it is established that two variables are cointegrated, the next issue is which variable causes the other. Before the advent of cointegration and error-correction modelling, the standard Granger or Sims tests were used widely to determine the direction of causality. However, as noted earlier, the standard Granger and Sims methods are likely to be misleading if the concerned variables are cointegrated. This is because the standard Granger or Sims tests do not contain an error-correction term. The error-correction models are formulated as follows:

$$\Delta LY = f(\text{lagged } \Delta LI, \text{ lagged } \Delta LY) + \lambda u_{t-1} \qquad (3)$$

$$\Delta LI = f(\text{lagged } \Delta LI, \text{ lagged } \Delta LY) + \phi e_{t-1} \qquad (4)$$

where the error-correction terms u_{t-1} and e_{t-1} are stationary residuals from the cointegrating equations. By introducing error-correction terms an additional channel is opened up through which causality is tested. For example, in equation (3), growth of real

[8] A time series is stationary (in the sense of weak stationarity) if its mean, variance and covariances remain constant overtime.

[9] A correlogram is a graph of autocorrelation of a series at various lag levels. For a stationary time series, the correlogram tapers off quickly; for a non-stationary time series it dies off gradually.

[10] Perman (1991) suggests that if the diagnostic statistics (such as normality, autocorrelation etc) from ADF regression are not in order a prima-facie case exists for adopting non-parametric adjustments proposed by Phillips and Perron.

[11] If a time series has to be differenced once before it becomes stationary, it is integrated to the order one, i.e., I(1). In general, if a time series has to be differenced d times before it becomes stationary, it is integrated to the order d or I(d).

investment (ΔLI) is said to Granger cause real income growth (ΔLY) either when the coefficients of lagged ΔLI are positive and jointly significant through the F-test, or if λ is significant, or both. If income growth causes investment growth, either the coefficients of the lagged ΔLY are positive and jointly significant (F-test), or ϕ is significant, or both (equation 4). Thus error-correction models allow for the fact that causality can be manifest through the lagged changes of the independent variable, or through the error-correction term, or through both.

In the above analysis, it is important to distinguish between short-term and long-term causality. Following Jones and Joulfaian (1991), Bahmani-Oskooee (1993), Doraisami (1996), and others we interpret the lagged changes in the independent variable to represent short-run causal impact, while the error-correction term is interpreted as representing the long-run impact.

In the autoregressive models represented by the above equations where there is more than one lag on the right hand side, one has to devise an appropriate strategy for choosing the optimum number of lags on each variable. One way would be that followed by Hsiao (1987), Bahmani-Oskooee et al. (1991), and Love (1994) by employing Akaike's final prediction error (FPE) criterion to identify the optimum number of lags. Another way would be to include a sufficient number of lags on the right hand side of the equation to ensure that there is no autoregression in the estimated equation, and then proceed from general to specific search. Yet another way is the "simple to general" search recommended by Engle and Granger (1987) in which one starts with fewer lags and then goes ahead to test for added lags. The idea is that if non-autocorrelated residuals are achieved by a smaller number of lags then that model is preferred to one with a larger number, in the interests of parsimony. Moreover, this method has the added advantage of not overparameterising the model and preserving the degrees of freedom particularly if the sample size is relatively small. Keeping these considerations in mind, we shall follow the third method of simple to general search.

3. Results

As noted above, the standard Granger procedure is inapplicable if LY and LI are cointegrated. If the variables are not cointegrated, the standard procedure can be applied. As we shall see below, except for government investment all other proxies for investment cointegrate with real income. So in all cases, except the one involving government investment, cointegration and error-correction modelling will be applied.

Before cointegration can be applied it is essential to test a time series for stationarity as well as its order of integration. Table 1 presents the results of ADF test for unit root. It can be seen that since the ADF test statistic for all level variables is more than the 95% critical value, the null of non-stationarity is accepted. First differences are, however, stationary as the ADF statistic in all cases is less than the 95% critical value. Since first differences are I(0), the original series are all I(1). Given that all level variables are I(1), there is no problem in applying cointegration analysis.

Let us first take up the causality between the growth of government investment (ΔLGI) and income growth (ΔLY). Table 2 shows that LY and LGI are not cointegrated as the ADF test statistic in both regressions exceeds the 95% critical value. Moreover, the CRDW statistic is also quite low ruling out any cointegration between the concerned variables. So there is no long-term relationship between real government investment and real GDP. Therefore, the methodology of cointegration and error-correction modelling could not be applied[12].

Next, we take up the causality between the growth of private investment (ΔLPI) and growth of income (ΔLY). Table 3a shows that the CRDW statistic in both regressions is quite large and greater than the 95% critical value of 0.78. The ADF test statistic in both regressions is less than the 95% critical value. The conclusion is that LY and LPI are cointegrated and there is a long-term relationship between these variables. The next step is to estimate error-correction models. The results are shown in Table 3b. It can be seen that the error-correction term for the model with ΔLPI as the dependent variable is quite significant and has the correct sign, whereas the error-correction term for the model with ΔLY as the dependent variable is insignificant. This indicates that the direction of causality in the long run runs only in one direction, from ΔLY to ΔLPI. Results of the F-test show that there is no short-term causality in either direction. The conclusion emerging from this analysis is that private investment and GDP exhibit a long-term relationship with each other; and the direction of long-term causality runs from growth of income to growth of private investment.

Now we turn to the causality between growth of total investment (ΔLTI) and growth of income (ΔLY). Table 4a shows that LY and LTI enter into a long-term relationship with each other. Again the direction of long-term causality runs from ΔLY to ΔLTI; there is no short-term causality in either direction (Table 4b). The same story is repeated if we consider fixed investment, FI (Tables 5a and 5b).

Some authors (for example Sheehey, 1990) have argued that there is bound to be a problem of built-in correlation between GDP and any category (such as exports or investment) which is a substantial portion of GDP. To take account of this objection the above regressions were re-estimated after netting out the relevant investment variable from the GDP. Although the results are not reported here, this adjustment makes no difference to our results. Moreover, when the income variable is defined in terms of per capita income in place of GDP and the investment variable is defined as investment/GDP ratio, the results remain the same. It thus appears that the results are quite robust to the way we define the investment or income variable.

So the basic conclusion which emerges is that in India capital accumulation is the result rather than the cause of growth. This finding is in line with that obtained by other researchers such as Lipsey and Kravis (1987) and Blomstrom et al. (1996). The findings are also in consonance with the Young and Currie view that saving and investment are derivative rather than initiating factors of growth.

Our finding that the rate of capital accumulation exercises an insignificant influence over the rate of growth of the Indian economy is similar to that obtained by Chandra (2000). In a multivariate model involving the investment ratio and trade policy variables, he finds that the investment ratio has an insignificant impact on per capita income growth. This

[12] However, the application of simple Granger-causality (minus the error-correction term) suggested that growth of government investment has a negative and significant impact on economic growth; i.e., government investment acts as a negative engine of growth. The sign of the reverse causality was positive and significant; i.e., economic growth had a positive impact on growth of government investment.

result contradicts the mainstream view that the investment rate is crucial to explaining growth, and this in turn requires an explanation.

This result, inter alia, may be the outcome of large unutilised capacity in Indian industry. Studies have shown that the protectionist policies of the past have had an adverse impact on capacity utilisation in India. For example, Paul (1974) and Goldar and Renganathan (1991) found a negative relationship between the effective rate of protection and the rate of capacity utilisation across industries. It appears that protection from foreign competition insulates domestic firms from any competitive pressures to reduce production costs by utilising capacity more fully. Moreover, protectionist policies do not allow imported inputs and intermediates to be readily available, resulting in large unutilised capacity.

Other factors inhibiting fuller utilisation of capacity may include infrastructural bottlenecks (in the form of power shortage or transportation difficulties), shortage of domestic demand, incompatibility of the structure of capacities with the evolving structure of demand, and management deficiencies.

Large unutilised capacity may also result from archaic policies that prevent redeployment of resources from unproductive uses to more productive ones. For example, an industrial unit in India cannot be closed down unless permitted by the government and such permission is rarely forthcoming. Similarly, labour laws are heavily loaded in favour of labour, as a result of which it is almost impossible to retrench labour[13]. Restructuring and redeployment of resources are an essential ingredient of competition; in India laws prohibit this. Competition is not only about easy entry but easy exit as well. In India an exit policy has yet to be evolved. As a result, large parts of her industry remain sick or unviable.

4. Conclusions

Development literature has regarded accumulation of material capital as the key to growth; the emphasis has therefore been placed on increasing the rates of saving and investment in strategies followed by developing countries in the post-war period.

Indian planning has not deviated from this mainstream thinking. Accordingly, policies aimed at pushing up the rates of savings and investment were vigorously pursued. While India succeeded in pushing up the these rates from a low of 10% in the 1950s to around 22% by the end of 1970s, there was no commensurate increase in the growth rate.

Empirical investigation shows that no doubt there is a long-term positive relationship between investment (except government investment where the relationship is negative) and GDP in India, but the causality is from the latter to the former and not vice versa. The evidence suggests that in India capital accumulation does not cause growth in the long run; rather growth is the cause of capital accumulation, in line with the Young-Currie view.

The emerging conclusion is that investment may be important; but it is important in a derivative sense and not as a causative factor. Policy makers in India need to pay as much

[13] Pro-labour laws are, however, against the long-term interest of labour as they inhibit employers from offering formal employment to labour which cannot be retrenched. Moreover, the labour laws inhibit rapid growth of the industrial sector thereby inhibiting rapid expansion of employment opportunities.

attention to the efficiency (or productivity) of investment as to investment itself. An environment needs to be created whereby those resources that are currently locked up in unproductive uses are allowed to be moved to more productive employments. The markets need to be enlarged and strengthened along with the institutional structures which are required for their efficient functioning. State intervention designed to replace and distort the markets is not likely to yield good results, as the Indian experience suggests.

It is not our intention to suggest that policy makers should deemphasise investment[14]; rather they should give equal importance to the demand-side view which regards higher saving and investment as a consequence of higher growth and not its primary cause. The policy-makers would therefore do well to give up their excessive obsession with a purely capital accumulation (supply side) approach and adopt a more balanced one which takes account of demand. Because increased demand in the overall sense means increased trade or reciprocal exchange, this requires that countries foster more competitive and internationally open markets.

In this way resources would flow more naturally to where they would yield the greatest social return with lowest prices and cost. The overall size of the market (reciprocal demand) is more rapidly extended if consumers' purchasing power is increased through lower prices and more remunerative employment. These are the fruits of product-market competition, factor-market mobility, low inflation, and flexible prices including realistic exchange rates. As the market grows, so does the opportunity to extend the division of labour in ever more elaborate and productive ways, making innovation and "factor-productivity growth" endogenous and cumulative. The role of the sate would then be to create conditions for the rapid realization of increasing returns by strengthening and enhancing the market system and its institutions. In this circumstance lies the possibility of economic progress, as Allyn Young would have put it.

[14] Especially of the market-enhancing kind such as on transport and communications. Such pul investments were viewed with approval even by Adam Smith.

Table 1 ADF test for unit root				
variable	**Test statistic** **Levels**	**first differences**	**95% critical value** **levels**	**first differneces**
LY	-1.216(0)	-7.611(0)	-3.522	-2.936
LGI	-2.285 (4)	-4.024(3)	-2.934	-2.936
LPI	0.481(3)	-5.637(2)	-2.934	-2.936
LTI	-0.397(4)	-5.561(3)	-2.934	-2.936
LFI	-0.126(3)	-5.570(2)	-2.934	-2.936

Notes:
1. Computations are performed by using Microfit 4.0 (Pesaran and Pesaran, 1997).
2. Terms in the parenthesis show the number of augmentations or lags (k) in ADF regressions.
3. k is chosen with the help of a model selection criterion such as Akaike Information Criterion (AIK), Schwarz Bayesian Criterion (SBC) and Hannan-Quinn Criterion (HQC).
4. Microfit 4.0 uses critical values from Dickey and Fuller (1979).

Causality Between Growth of Government Investment and Income Growth

Table 2 ADF test for cointegration				
regression	$\bar{R}^2$	**CRDW**	**ADF**	**95% CV**
LY=f(LGI)	0.908	0.302	-1.030(4)	-3.489
LGI=f(LY)	0.908	0.324	-1.962	-3.489

Notes:
1. Terms in brackets show the number of lags (k)used in ADF regressions.
2. k is chosen with the help of model selection criterion such as AIC, SBC and HQC.
3. Critical values are from MacKinnon (1991).
4. The critical values for CRDW in the vicinity of 50 observations are 0.78 at 5% and 0.69 at 10% levels of significance respectively (Engle and Yoo). CRDW is a useful test for cointegration if the disequilibrium errors of the cointegrating regression are generated by first-order AR process.

Causality Between Growth of Private Investment and Income Growth

Table 3a
ADF Test for Cointegration

regression	$\bar{R}^2$	CRDW	ADF	95% CV
LY=f(LPI)	0.958	1.114	-4.600(0)	-3.489
LPI=f(LY)	0.958	1.161	-4.897(0)	-3.489

Table 3b
Results of Error-Correction Models

regression	lags	E(-1)	F(i → y)	F(y →i)
ΔLY=f(lagged ΔLPI, lagged ΔLY) + λE(-1)	1	0.081(.160)	.740(.395)	
ΔLPI=f(lagged ΔLPI, lagged ΔLY) + ϕE(-1)	1	-0.908(.000)		.991(.326)

Notes:
1. E(-1) stands for the error-correction term
2. i stands for rate of growth of investment and y for rate of growth of income.
3. In Table 3a the terms in the brackets are the number of lags, while in Table 3b they are the probability values.

Causality Between Growth of Total Investment and Income Growth

Table 4a
ADF Test for Cointegration

Regression	$\bar{R}^2$	**CRDW**	**ADF**	**95% CV**
LY=f(LTI)	0.968	1.032	-4.217(0)	-3.489
LTI=f(LY)	0.968	1.064	-5.218(1)	-3.489

Table 4b
Results of Error-Correction Models

regression	**lags**	**E(-1)**	**F(i→y)**	**F(y→i)**
ΔLY=f(lagged ΔLTI, lagged ΔLY) + λE(-1)	1	0.086(.158)	.018(.893)	
ΔLTI=f(lagged ΔLTI, lagged ΔLY) + ϕE(-1)	2	-0.760(.000)		1.404(.258)

Table 5a
ADF Test for Cointegration

Regression	$\bar{R}^2$	CRDW	ADF	95% CV
LY=f(LFI)	0.983	0.673	-4.607(1)	-3.489
LFI=f(LY)	0.983	0.680	-5.065(1)	-3.489

Table 5b
Results of Error-Correction Models

regression	lags	E(-1)	F(i →y)	F(y →i)
ΔLY=f(lagged ΔLFI, lagged ΔLY) + λE(-1)	1	.063 (.432)	.009(.923)	
ΔLFI =f(lagged ΔLFI, lagged ΔLY) + φE(-1)	1	-0.443(.000)		.028 (.868)

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