A central puzzle facing development economists is why it is that the growth rates and income levels of various countries have not converged faster than they have. Indeed, there is some evidence that there has been divergence for many less developed countries (LDCs), rather than convergence. Traditional neoclassical growth theory (Solow, 1956) predicts that, in the long run, the growth rates in all countries should be related only to the rate of technological progress and of population growth; growth rates in per capita incomes should be related only to the rate of labour augmenting technological progress; and differences in levels of per capita consumption should be related to differences in savings rates. Even if the LDCs adopt the best practices of the developed countries with a lag, the rates of technological progress will be the same, and differences in levels of per capita income will then be related also to the length of the lag in the diffusion of technology.

This paper presents two different perspectives providing alternative explanations of the non-convergence. One is based on certain characteristics of technology. The other is based on socioeconomic considerations. The two perspectives have quite different policy implications.

1. THE TECHNOLOGICAL PERSPECTIVE

This perspective is based on three aspects of technology which have received insufficient attention in the literature:
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(i) Much of learning is a by-product of production. Though Arrow (1962) called attention to this phenomenon of learning-by-doing, it has played a minor role in the subsequent literature on growth theory.

(ii) Much of learning is localised, that is, accretions in knowledge that are relevant to one technology may have little bearing on other technologies. Spill-overs are far from uniform.¹

(iii) The process of learning is, itself, learned. Thus, just as Adam Smith emphasised the importance of specialisation in production, what has become increasingly apparent is the importance of specialisation in learning. Just as the worker who specialises in producing pins becomes more proficient in pin production, unless he suffers from boredom, so too the individual who specialises in research may become more proficient in doing it.²

These three simple observations concerning technological learning have important implications for economic theory and policy. We summarise the major implications below.

### 1.1 Optimality of Non-myopic Policies

The optimal policies (both at the firm level, and for the economy) are non-myopic; that is, the technology that a firm should employ, as well as its level of production (and, indeed, whether it should produce or not) cannot be decided solely by looking at current factor and commodity prices. If the firm believes that, at some future date, it will pay to switch to a more capital-intensive technology, then it pays to switch at some date prior to the date at which, at current factor prices, the more capital-intensive technology has lower costs.

If there are significant gains in learning-to-learn, or learning-by-doing, then it pays to produce more than the level at which price (or marginal revenue) equals short-run marginal costs. A corollary of this is that it may pay to enter into an industry, even when at current market prices the firm makes a loss, because of the learning or the increase in learning capacity which results.

These results follow from the localised nature of technological progress, and from the fact that there is learning-by-doing. The presence of learning-to-learn simply strengthens the arguments. It implies that it may pay to produce some commodity for which the country not only does not currently have a comparative advantage, but