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# IMPLICATIONS OF NEW TRADE AND ENDOGENOUS GROWTH THEORIES FOR DIVERSIFICATION POLICIES OF COMMODITY-DEPENDENT COUNTRIES

**Jörg Mayer**

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## CONTENTS

# IMPLICATIONS OF NEW TRADE AND ENDOGENOUS GROWTH THEORIES FOR DIVERSIFICATION POLICIES OF COMMODITY-DEPENDENT COUNTRIES

***Jörg Mayer***

*United Nations Conference on Trade and Development (UNCTAD), Geneva*

*New trade and endogenous growth theories are discussed, and their findings taken to interpret technological innovation and human-capital accumulation as being the engines of structural diversification. Structural diversification is seen as being the result of dynamic learning sequences, where introducing new technology provides learning-by-doing benefits which, however, peter out once activities associated with the new technology have been repeated many times; new and more sophisticated technology is needed to continue reaping learning effects. Diversification policy should encourage skill-upgrading, for example by refocusing education policy and fostering the production of products that are one step higher on the skill ladder than those presently produced, independently of whether those products are considered commodities or manufactures in common product classifications. Associated policy actions for technology development and human capital accumulation are outlined.*

## INTRODUCTION

Both the economic policy adopted by many developing countries to foster growth and comparative advantage in international trade and the findings of economic theory regarding the role of government in this process have undergone substantial change over the last few years. Many developing countries have adopted an economic policy stance that emphasizes the importance of liberalization and "getting the prices right" for the attainment of overall economic efficiency. By contrast, findings of new trade theory have led some economists to raise questions such as "is free trade *passé*?", while endogenous growth theory has shown that economic policy in general, and under certain conditions specific support to selected economic sectors, can raise the rate of growth.

A basic contribution of new trade and endogenous growth theory has been to allow for the formal modelling of divergences from standard neoclassical assumptions, for example that technological change is exogenous (a function of elapsed calendar time), that the same technological opportunities are freely available and can be used efficiently in all countries of the world, and that firms operate in an environment of perfect competition. Economists working with such models have thus succeeded in incorporating into "formal theory" elements of what has long been emphasized by development economists doing "appreciative theory" - to follow the terminology of Nelson and Winter (1982) - namely, the consideration that technological change has to be "analysed as the joint outcome of innovation and learning activities within organizations, especially firms, and interaction between these and their environments" (Fagerberg, 1994, p. 1156).

According to both strands of theory, the persistent poverty and low degree of diversification in developing countries can partly be explained by differences in technology. However, traditional neoclassical theory considers such technological differences as gaps in the endowment of objects, such as factories or roads; diversification policy should therefore concentrate on promoting physical investment. By contrast, appreciative theory considers poverty and dependence as gaps in the endowments of ideas and of the limited capability of developing countries to absorb new knowledge. Diversification policy should therefore concentrate on the interaction between technology and skills with a view to facilitating the reduction of the idea gap. Achieving structural diversification, and hence moving comparative advantage more and more towards products based on skill-intensive technology, depends on a country's relative endowment with skilled labour, which may be altered by policy. Recent literature also discusses the interdependence of economies which undergo structural change and engage in international trade and capital movements, as well as the role of direct and indirect learning at the national and international levels in this process. In recognizing that ideas are of central importance in growth and development (Romer, 1993), recent work on trade and economic growth has moved formal economic theory part way toward the position advocated by appreciative economists and made those positions more explicit and precise as to how each component of the whole system works.

In common language, diversification refers to the expansion of the range of goods made and sold in order to reduce any commercial risk which would result from relying on sales of one, or a few, goods only. However, producing and exporting a wider range of goods would, at first, appear to contradict the fact that the basis of all trade is specialization, which implies producing and exporting a narrower range of goods. It thus seems clear that diversification, though it might be defensible in special cases as a way of reducing risk, is not a sensible general development strategy in a world which offers the possibility of trade. And yet, that is what often has been advocated. As a matter of fact, one might expect the secular process of product upgrading or structural diversification to involve an initial rise in the number of goods, followed by a levelling out approaching a steady state in which the number of new products introduced in each period is largely offset by the number of old products dropped; the number of goods produced and exported will fluctuate within a narrow band. However, even in the initial stage, the important factor for growth and development is the efficient use of more advanced technology leading to product upgrading, rather than the rise in the number of goods as such. In addition, product upgrading continues apace in the steady state, even though the rise in the number of goods produced and exported has ceased.[1]

The objective of this paper is to discuss the recent theories on trade and economic growth as they apply to structural diversification in developing countries with a view to conceptualizing for diversification the issues raised in these contributions and highlighting their policy implications. The focus of attention will centre on the interrelationship between structural changes in developing

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[1] See Mayer (1996a) for a more detailed discussion of the concept of diversification.

countries' exports, learning and technical progress.[2]

The structure of the paper is as follows: chapters I and II review the main theoretical approaches and findings of recently developed trade and growth models. This is followed in chapter III by an application of these theories to the evolution of comparative advantage and diversification potentials in developing countries, highlighting their implications for diversification policies. Chapter IV briefly discusses marketing aspects related to diversification, an issue which has not been tackled in either new trade or endogenous growth theory. Chapter V summarizes the main conclusions.

## I. TRADE THEORY AND STRUCTURAL DIVERSIFICATION

The fact that some economic sectors generate positive externalities and that these externalities may not spread rapidly around the globe can act as a constraint to structural diversification since they cause technological disparities to persist.[3] The traditional interpretation of comparative advantage is based on the assumption of constant returns to scale, i.e. assuming that when inputs to production are doubled output doubles as well. In the presence of economies of scale, the larger the scale on which production takes place, the more efficient is production - i.e. doubling the inputs to production will more than double its output. Economies of scale at the firm level - internal economies of scale - must be distinguished from those occurring at the sectoral level - external economies of scale or external economies - in order to analyse their impact on market structure and structural diversification. "*External economies of scale* occur when the cost per unit depends on the size of the ... [sector] but not necessarily on the size of any one firm. *Internal economies of scale* occur when the cost per unit depends on the size of an individual firm but not necessarily on that of the [sector]" (Krugman and Obstfeld, 1994, p. 115; emphasis in original). Internal economies of scale allow large firms to obtain a cost advantage over small ones and are therefore likely to give rise to an imperfectly competitive market structure. By contrast, external economies of scale need not lead to imperfect competition because individual firms may remain small, even though important advantages for the large scale arise at the sectoral level.

The limited size of a market constrains both the variety and quantity of goods that a country can produce efficiently when there are *internal* economies of scale. Firms operating on a relatively large domestic market will tend to have more sales and hence lower average unit costs than those

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2 A great variety of other factors (such as macroeconomic and trade policies, the availability of financial resources for investment, physical infrastructure, resource endowments, market access conditions, etc.) impact on structural diversification. However, these factors will not be addressed here in order to concentrate on the implications of learning and innovation for diversification. UNCTAD (1995a) discusses issues related to ready market access, while Mayer (1996b) analyses the impact of resource endowments and trade policy.

3 Another such mechanism regards the fixed-cost expenditure associated with bringing new kinds of activities or goods into existence. This mechanism will be discussed below.

operating on a small domestic market. Given their cost advantages, these firms will be more competitive on international markets and therefore find it easier to establish export activities. This suggests that countries with a relatively large domestic market will find it easier to diversify into activities were internal economies of scale are large.

Economies of scale arise at the sectoral rather than at the firm level, for example when production is concentrated in one or a few locations, thereby reducing the sector's cost without necessarily affecting the size of individual firms in this sector. The geographical concentration of production sites may give rise to a local market for a greater variety of support services (e.g. packaging, transportation, banking services) or for a larger supply of specialized skilled labour. The presence of strong external economies of scale tends to lead to a situation where a country that has established a large production of a good will produce it at a low cost, since its producers are able to take advantage, for example, of the easy and cheap availability of both support services and skilled labour. This cost advantage constitutes a barrier to entry for other countries to this sector even though the sector may have a perfectly competitive market structure; this is because the country that is trying to enter production in this sector will not have the gradual accumulation of networks of firms that gives rise to external economies, like the country with long established activities in this sector.[4]

The accumulation of knowledge is probably the main source of dynamic scale economies. Dynamic internal economies of scale arise when the costs of a firm depend on production experience, i.e. its cumulative output to date, rather than on the scale of its current output.[5] The inverse relationship between unit cost and cumulative output can be expressed through a downward-sloping learning curve. Dynamic external economies arise when the improvement which an individual firm achieved in its products or its production technique is imitated by its competitors; as a result, knowledge spills over from the firm that initially invested in knowledge accumulation to other firms that have not made any specific investment in such knowledge.

Whether or not externalities in this learning process spill over internationally has important implications for trade patterns. With a full international spillover of learning externalities, producers in all countries have access to the same body of technical information; as a result, the accumulation of knowledge through learning does not affect their relative abilities to produce any specific good. A country's trade pattern must then be determined by other factors, such as its initial conditions in terms of factor endowment. By contrast, if the extent of knowledge spillovers is limited to national borders, sector-specific knowledge stocks accumulate in proportion to local activity in this sector alone. Both domestic and foreign producers learn and become more productive in sectors in which

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[4] Examples of geographical concentrations of economic activities without obvious resource reasons include the ceramic tile agglomeration in Sassuolo (Italy), European carpet production in Flanders, or the production of watches in Switzerland.

[5] It is important to note this difference since arguments following the traditional interpretation of comparative advantage also sometimes invoke economies of scale, referring, however, to the current scale of output.

they always have been active; as a result, initial patterns of trade get locked in - history matters for the determination of a country's opportunities for structural diversification. The dismal conclusion would be that countries which, for whatever historic reasons, are late-comers in the process of structural diversification risk being trapped in a low-development equilibrium.[6]

To summarize, the argument that an initial advantage in structural diversification will perpetuate itself and serve as a barrier to competitive entrants is based on two assumptions: first, the learning-by-doing benefits of skill-intensive activities are assumed to accrue entirely to producers within a country, i.e. knowledge spillovers across national boundaries are assumed to be zero. Where knowledge spillovers are concentrated within national borders, countries' learning experience differ and the historical coincidence of inheriting even a small lead in knowledge puts a country in a position of self-perpetuating structural diversification and development, thereby increasing the gap in other countries. By contrast, where knowledge spillovers are international in scope, other countries can share in the benefits of knowledge accumulation and thereby improve their structural diversification and development opportunities, provided their social capability in knowledge absorption allows them to master this knowledge. Second, the argument of the perpetuation of an initial advantage in structural diversification is further based on the assumption that learning-by-doing is unbounded and that therefore producing different goods is associated with permanently differing learning potentials. The following chapter will show that this latter assumption may be unrealistic.

## II. NEOCLASSICAL AND ENDOGENOUS GROWTH THEORY[1]

### A. *Neoclassical growth theory in the Solow tradition*

The neoclassical growth theory in the Solow-tradition is based on the following production function:

$$Y(t) = F[K(t),A(t),L(t)]$$

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6 Krugman (1987) provides a formal model for this argument.

7 Ploeg and Tang (1995, pp. 546-547) situate the two strands of growth theories in a wider context of economic theory on the basis of the Harrod-Domar condition. According to this, the warranted growth path of an economy reflects the ratio between the aggregate savings rate and the capital-output ratio, while the natural growth path reflects the sum of the rate of population growth and the rate of labour-augmenting technical progress. The situation where the warranted and the natural growth paths are equal is called a balanced growth path. Economic growth theories may be distinguished according to the channel by which balanced growth can be ensured. Focusing on the warranted growth path, theories in the "UK Cambridge" tradition emphasize adjustments in the aggregate savings rate arising from changes in the functional distribution of income, while theories in the "US Cambridge" tradition, including the Solow-type growth theory, emphasize adjustments in the capital-output ratio arising from changes in the substitution of production factors, caused by changing relative prices. Focusing on the natural growth path, theories in the Malthusian tradition emphasize adjustments in the rate of population growth, while the new theories of endogenous growth emphasize adjustments in the rate of technical progress.

where $Y$ is output, $K$ is physical capital, $A$ is an index of overall productivity, and $L$ is the labour force; there are constant returns to scale and decreasing returns to capital. With these assumptions, income growth can come from the increased efficiency of productive inputs, i.e. an increase in $A$, or the augmentation of such inputs, i.e. an increase in $K$ and/or $L$. Positive growth rates can be sustained if and only if the decreasing returns to the accumulation of capital are offset by population growth, or if the marginal productivity of capital is constantly shifted upwards by technical progress. In a balanced growth equilibrium - i.e. given a constant savings rate - there will be no depreciation of the capital stock and, assuming $A(t)$ as constant, output and capital will grow at the rate of population growth. Differences in the time path of the scale factor $A(t)$ explain countries' different growth experiences. This exogenous source of growth has been interpreted as technical progress. Policy has little scope in affecting long-run growth in this setting. Investment and savings behaviour impacts on the level of per capita income, but has no effect on the long-run growth rate. Policies can raise the long-term growth rate by speeding up technical innovation or knowledge accumulation, but the theory itself suggests no mechanisms whereby this could be achieved. There are neither invention costs - costs associated with the development of new technologies - nor adoption costs - costs associated with making use of new technologies.

Arrow (1962) was among the first economists who relaxed the assumption of decreasing returns to capital by incorporating the concept of learning-by-doing.[8] He argues that the level of knowledge is itself a productive factor and that new technology is discovered as investment takes place. However, knowledge gains are exogenous because a producer can increase his efficiency only through an increase in the cumulative aggregate output of capital goods, whereby the quality of each new capital good is superior to that of previous ones. A knowledge gain is assumed to be a public good, with the result that the benefits of a firm's investment spill over to the rest of the economy. This means that the production function of the economy as a whole displays increasing returns, while the production function of each individual firm demonstrates constant returns to scale.[9] However, despite the introduction of knowledge as a production factor, Arrow's conclusion about the ultimate determinant of economic growth does not diverge from that of the Solow model: given the assumption of an exogenous and fixed labour quality, the marginal product of capital diminishes with a fixed supply of labour; as a result, the rate of growth of per capita output is a monotonically

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8 The technical progress function which was presented in Kaldor and Mirrlees (1962) and which reflects a relationship between the rate of change of gross investment per worker and the rate of increase in labour productivity on newly installed equipment is a concept close in spirit to Arrow's model. Kaldor and Mirrlees dispute the neoclassical view that productivity gains resulting from capital accumulation are separable from those caused by technical advance; they argue that the pace of applied technical progress depends on the rate of investment in physical capital, because the knowledge required to increase productivity is acquired through a learning process that is inseparable from the process of investment.

9 Making the assumption of constant returns to scale at the individual firm level and of increasing returns to scale at the aggregate level allows one to preserve the competitive equilibrium solution, and at the same time to relax the assumption of decreasing returns at the aggregate level. Since only capital and labour are financially compensated according to their marginal product, while knowledge is treated as a public good, total factor payment does not exceed total output.

increasing function of the growth rate of population. Like conventional models with diminishing returns, it predicts that the rate of growth is zero in an economy with zero population growth. Like in the Solow-model, there are no invention costs (since the supply of technologies expands jointly with that of capital goods) or adoption costs (meaning that all countries apply state-of-the-art technology).

## *B. Endogenous growth theory*

The new growth theory drops two central assumptions of the Solow model, (i) that technological change is exogenous, and (ii) that the same technological opportunities are available in all countries. In addition, the assumption of decreasing returns to a narrow concept of capital (including only physical capital) is replaced by the assumption of constant returns to a broad measure of capital (including also human capital and infrastructure). New growth models treat technology and knowledge as economic goods in an attempt to understand the determinants of long-term growth based on learning-by-doing or investment in human capital and new technologies. Contrary to the standard neoclassical models and that by Arrow (1962), there are invention costs in the creation of new technology, and there are adoption costs associated in particular with creating the human capital required to use a new technology. Adoption costs have a direct component in the form of investment outlays for schooling, on-the-job training, etc., as well as an indirect component, such as in the form of foregone output. Endogenous growth models can be distinguished according to whether they emphasize invention costs or adoption costs.[10]

New growth models differ as to what mechanism is employed to endogenize the impact of technical progress on growth. The mechanisms in early models (Romer, 1986; Lucas, 1988) are dynamic externalities at the aggregate level, i.e. technology is endogenously provided as a side-effect of private investment decisions. Romer (1986) assumes that the stock of knowledge of a firm increases in proportion to the firm's expenditure on research and development, while spillovers from these private investments increase public knowledge. In the absence of an effective patent market, the stock of knowledge is like a public good. Even though Romer's model is similar to Arrow's, technological change is endogenized, since in his model long-term growth is driven primarily by the creation of new knowledge by forward-looking, profit-maximizing, private agents. The investment which creates new knowledge displays diminishing returns. But, given the knowledge spillovers due, for example, to the inadequacy of patent protection, the production of goods from new knowledge exhibits increasing returns. Since new knowledge is produced from investment with diminishing returns, each profit-maximizing private agent who invests in knowledge creation - and hence incurs invention costs - faces an optimal upper limit to his investment. Thus, technical change should be responsive, endogenously, to policy, such as tax and fiscal incentives.

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[10] For a classification of new growth models according to invention costs and adoption costs, see also Jovanovic (1995).

The model by Lucas (1988) is also similar to Arrow's (1962). However, the spillover effects which increase the level of technology stem from investment in human capital rather than in physical capital. The model focuses on general skills and in particular those which cannot be separated from the worker who has acquired them. Knowledge grows with the time spent on education and the efficiency with which this time is translated into human capital. This efficiency is associated with different factors depending on whether education is understood as schooling or as learning-by-doing. Regarding schooling, efficiency increases with the quality of schooling which, in turn, improves with increased general knowledge. Here, the mechanism of raising long-term growth is learning or doing rather than learning-by-doing. Differences in long-term growth are the result of different rates of human capital accumulation, stemming from differences in countries' time-allocation decisions. Regarding learning-by-doing, efficiency is associated with the type of process workers are engaged in: "one might think of some activities as carrying with them a high rate of skill acquisition and others, routine or traditional ones, as associated with a low rate. If so, the mix of goods a society produces will affect its overall rate of human capital accumulation and growth" (Lucas, 1993, p. 258). A country's initial comparative advantage determines the goods it produces, and hence its rate of human capital accumulation and growth.[11]

Neo-Schumpeterian growth models employ temporary monopoly profits, which motivate the discovery of new technology, as the mechanism to endogenize the impact of technological progress on growth.[12] This branch of new growth models introduces conditions of imperfect competition at the micro-level of production, emphasizing the importance of temporary monopoly power as a motivating force for the intentional investment of resources by profit-seeking firms or entrepreneurs in the innovative process. In these models, growth depends on the incentives to invest in improving technology. It is also important to note that the appropriability of (new) knowledge is related to lead times over rival inventors and imitators rather than to effective patent protection. The models are based on the assumption that there are invention but no adoption costs. The invention costs are fixed-cost expenditures which occur, for example, through the need to conduct research and development for the invention of new designs; the inventors sell these designs to producers of goods that are new (Romer, 1990, and Grossman and Helpman, 1991, chapter 3) or of superior quality (Grossman and Helpman, 1991, chapter 4). The competitive equilibrium solution of the neoclassical model cannot be sustained where such fixed costs are important because, if this is the case, decentralized market valuations of the economic efficiency of an investment project diverge from valuations at the aggregate level. As a result, no such investment will take place if at least part of the expenditure cannot be recovered through monopoly profits.[13]

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[11] Since Lucas (1988) does not distinguish technology from human capital, it is not immediately clear whether costs associated in his model with technical progress come from invention or adoption. However, intuitively it appears more convincing to consider them as adoption costs.

[12] See, for example, Aghion and Howitt (1992), Grossman and Helpman (1991), Jones (1995), and Romer (1990).

[13] However, this does not imply that market power is good for growth because monopolists have no incentives for further innovative activity if their market position is not threatened by competitors. See also section C.2 below.

The approach focusing on invention emphasizes ideas which can be used by many workers once they are created, i.e. disembodied human capital, through a research and development effort by a small subset of educated workers. Policies that raise the incentive of this group of workers to innovate consciously raises the question of long-term growth. Romer (1990) explains that the basic difference between ordinary tangible goods, such as capital and knowledge, is that the latter is a non-rival and partially non-excludable good. The feature of non-rivalry means that knowledge can be used in more than one place at any one time, while the feature of non-excludability means that the creators or owners of knowledge can exclude others from making unauthorized use of it only with difficulty. Knowledge may be considered a *partially* non-excludable good because one type of knowledge, namely product-specific information, can be protected through patents, while more general technical information which may allow for subsequent inventions cannot be hidden from rival innovators and is much more difficult to appropriate. Technological spillovers associated with the latter feature maintain investment incentives endogenously and allow successive inventions to use fewer resources than their predecessors because, contrary to inputs of capital and labour, it is not necessary to replicate non-rival inputs. The resulting fall in the real cost of invention counteracts the falling marginal product of investment. "In short, the process of knowledge accumulation generates *endogenously* the productivity gains that sustain growth in the long run" (Grossman and Helpman, 1991, p. 336; emphasis in original).

A third class of new growth models distinguishes human capital from technology as well as different types of each. They include both invention and adoption costs but focus on the latter. Young (1993a and b) and similarly Lucas (1993) criticize the discussed models of invention and models of learning as focusing on two extreme cases of the process of accumulation of human capital. In particular, Young (1993a, p. 444) points to the unrealistic assumption in the learning approach "that the potential productivity gains from learning are essentially unbounded", since making this assumption does not allow "to explain the recurring pattern of technological improvement and stagnation apparent in pre-modern history".[14] This approach also implies the assumption that, contrary to the invention approach, new technologies are not considered to attain their full production potential at the moment of their invention but that they initially are broadly inferior to the older technologies they seek to replace. This means that these models add a complementarity element of innovation to the Schumpeterian emphasis on substitution.

Young concentrates on the interaction of factors emphasized in the learning and invention approach, starting from the basic assumption that the potential of "learning in the production of any particular good, using any particular process, is in fact finite and bounded. When a new technical process is first invented, rapid learning occurs as, by virtue of experience, the productive potential of

14 This assumption is required in approaches where the state of technology is linked to cumulative investment experience, such as in Romer (1986). In that approach, long-term growth can be sustained as long as the state of technology is sufficiently responsive to capital accumulation in the sense that the externalities associated with knowledge accumulation provide the offsetting device to the falling marginal productivity of capital in the process of capital accumulation. This device, however, will not be strong enough if learning is bounded.

that process is explored. After some time, however, the inherent (physical) limit on the productivity of technology will be approached and learning will slow and, perhaps, ultimately stop. In the absence of the introduction of new technical processes, it is unlikely that learning-by-doing can be sustained" (Young, 1993a, p. 445). This means that Young emphasizes the existence of a technology ladder in the production of goods ordered by increasing technical sophistication, with the result that countries have to combine efforts at learning-by-doing and innovation in order to fully exhaust their potential in human capital accumulation.

The consideration that, in the absence of further invention, learning is bounded has important implications for diversification. If the potential for learning-induced productivity improvements in each good is finite and bounded, then the potential maximum accumulation of knowledge in an economy is determined by the number and variety of activities as well as by the level of technology mastered by the labour force, compared to that required to exhaust fully the learning potential incorporated in the production of a given set of goods. Accordingly, if an economy continues to produce the same narrow range of goods, its learning-induced productivity improvements are likely to peter out. It also means that neither the presence of state-of-the-art technology or a highly-skilled labour force alone is sufficient for the full exhaustion of an economy's learning potential, but that the introduction of new technologies and the commensurate up-grading of skill-related knowledge must go hand in hand.

## III. IMPLICATIONS FOR THE EVOLUTION OF COMPARATIVE ADVANTAGE

### *A. The flow of capital from developed to developing countries*

The assumptions and results of neoclassical growth theory in the Solow tradition lead to an optimistic view of the long-term convergence of the levels of per capita income between rich and poor nations. According to this view, the poor state and low level of the capital stock in developing countries create many investment opportunities and lead to a high real rate of interest; the latter creates strong incentives for economic agents to save and postpone consumption, with the result that investment may be financed relatively easily. Moreover, since technology is assumed to be both universally available and applicable, the levels of per capita GDP in different countries will have a natural tendency to converge through a process of multiple catching-up. This process may be retarded because in developing countries a large part of income needs to be spent to satisfy basic needs and is therefore not available for investment. However, foreign direct investment may fill the gap. As a result, development policy designed to further the process of catching-up would concentrate on removing the restrictions to the flow of capital from developed to developing countries.

By contrast, the newer theories emphasize that even in the presence of unrestrained capital flows structural diversification and long-term growth rates can differ between countries if technological progress is modelled endogenously as a function of the level of a country's human capital. For example, different levels of human capital lead to differences in the capacity of countries to invent new technologies suited to domestic production, as well as to adapt and implement new technologies developed elsewhere.

### *B. The interplay of economies of scale, externalities and national or international spillovers of knowledge and technology*

Combining the findings of new trade and endogenous growth theory suggests that the interplay of economies of scale, externalities and national or international spillovers of knowledge and technology can be crucial for the diversification experience of "late-comers", i.e. less diversified developing countries compared to developed countries, or relatively less diversified developing countries compared to both more diversified developing and industrialized countries.

As mentioned in the Introduction to this paper, the process of structural diversification is characterized by adopting the production of technologically more sophisticated goods and abandoning that of less sophisticated ones. This means that the most advanced countries using the most sophisticated best-practice technology adopt an even more sophisticated technology once this becomes available, and abandon the production of, for them, technologically least sophisticated goods. The space vacated by these countries will be taken by countries which are relatively less advanced in the process of structural diversification, thereby themselves vacating space for the even less advanced ones. This suggests that all developing countries can achieve structural diversification by taking over space which has been vacated voluntarily by more advanced countries. In addition, developing countries can drive out more advanced ones from certain economic activities by imitating the technologies used in developed countries; given the lower level of wages in developing countries, they will be able to produce the same products at lower cost and slice off economic activities from developed countries.

The question arises as to what economic mechanisms drive this process. Following the neo-Schumpeterian view of economic growth, the process of structural diversification may be considered as being governed by the interplay of innovation in developed countries and imitation in developing ones.[15] In contrast to the perspective taken in chapter I, trade has a direct effect on structural diversification, even in the absence of spillovers of disembodied knowledge since, in this view, knowledge is embodied as technical progress in intermediate goods serving as production inputs.

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[15] In addition to engaging in intentional and costly imitation, developing countries can upgrade their technologies by technology imports from developed countries through direct foreign investment or licensing. Such import is likely to speed up the loss of the innovator's monopoly position; on the other hand, the innovator raises profits by shifting the production to developing countries with lower wage costs; however, these profits are not likely to arise in all developing countries since the efficient implementation of new technology often seems to require the use of highly-skilled labour which may not be readily available in many developing countries. Thus, in this case technology transfer to and structural diversification in developing countries is governed by differences in production costs between developed and developing countries and driven by the way an innovator weighs profit gains associated with lower production costs against potential losses from losing a monopoly position more rapidly.

Hence, technology can be transferred internationally through trade and imitated by late-coming countries. The imitation of technology has two opposing effects on the incentives of innovating firms in developed countries. On the one hand, imitation reduces the duration of the innovator's monopoly profits, thereby slowing down innovative activities in developed countries. On the other hand, only part of the innovative technologies are imitated; as a result, part of the resources set free in those activities in the developed country's economy which have been taken over by the developing economy can be employed by the developed country in the production of as yet unimitated products, thereby raising sales and profits; the other part of the resources thereby liberated can be employed in conducting more research and development. These effects spur innovative activities in developed countries.

Grossman and Helpman (1991, chapters 11 and 12) show that the effect stimulating innovation always prevails when innovation is directed towards expanding the variety of available goods; trade between innovating developed and imitating developing countries is motivated by a preference for diversity.[16] By contrast, efficient imitation in developing countries can slow down innovation in developed countries when innovation is designed to lead to quality improvements in intermediate goods serving as productive inputs. This is the case when imitation releases resources, which were previously engaged in activities where the developed country could enjoy monopoly profits, into alternative manufacturing activities which do not allow for monopolistic pricing.

Particularly important for the policy implications of this approach is Grossman and Helpman's (1991, chapter 9) discussion of the allocation effect of trade policy reform in a setting where the economy has three sectors: (i) an agricultural sector which is intensive in unskilled labour, (ii) a manufacturing sector which is intensive in skilled labour, and (iii) a research-and-development sector which also uses skilled labour and specializes in inventing intermediate goods produced under monopolistically competitive conditions. Activity in the research-and-development sector determines the economy's growth rate, as this activity determines the rate at which new goods are produced and hence the rate at which production costs fall. Trade is done at exogenously given world prices. A country poorly endowed with skilled labour experiences a fall in the relative wages of skilled labour when it opens up to trade - doing research and development becomes cheaper and the economy grows faster. This means that engaging in "trade is likely to enhance growth to the extent that innovative activity is more closely linked to the exporting sector than the import-competing sector, and diminish it otherwise" (Rodrik, 1995, p. 2955). In other words, countries poorly endowed with skilled labour and richly endowed with natural resources, therefore having a comparative advantage in natural-resource based goods rather than in import-substituting manufacturing, may find it advantageous to give greater weight to innovative activities related to agriculture and mining, i.e. their exporting sector.

16 Growth is represented by an increase in the total number of varieties available, i.e. old goods are never dropped from production. Strictly speaking, the variety-approach taken by Grossman and Helpman (1991) is therefore not fully applicable to structural diversification. However, there is no evident reason to expect that adding the assumption that old goods are dropped from production would drastically change the qualitative properties of their approach.

An alternative way of explaining the interplay of structural diversification in developed and developing countries follows the models by Young (1993a and b) and Lucas (1993). Learning and invention or imitation may be considered as being interdependent. Learning can continue only when technical progress is sustained, while the rate of invention or imitation depends on the rate of learning. The faster learning occurs, the faster existing technologies become unproductive and the greater the need for, and the incentives to, engage in costly invention or imitation. Moreover, new technologies cannot be used as productively as old ones, unless the economy has accumulated a certain amount of production experience to allow the production costs of advanced goods to fall to acceptable levels. This consideration may also explain why developing countries cannot take advantage of the large stock of knowledge capital already accumulated in the developed countries until their labour force is skilled enough to do so.

The interdependence between learning, innovation and imitation suggests that there is an infinite continuum of goods ranked hierarchically according to their level of technical sophistication. The technical progress embodied in the process or good being imitated by the labour force is a function of the levels of technology of all lower-ranked goods. A country's cumulative learning experience is reflected by the technological sophistication of the good last adopted, and this learning experience is bounded by the total number of goods the country has invented or imitated. Accordingly, if an economy continues to produce the same narrow range of goods, its learning-induced productivity improvements are likely to peter out. It also means that neither the presence of state-of-the-art technology nor a highly skilled labour force is alone sufficient for the full exhaustion of an economy's learning potential, but that the introduction of new technologies and the commensurate up-grading of skill-related knowledge must go hand in hand. This implies that accumulating human and physical capital will not lead to structural diversification if this means investing in more of the same machines and shopfloor skills; accumulation needs to have an aspect of innovation to be conducive to structural diversification and development.[17]

The question is whether the process of structural diversification in developing countries is more likely to follow the mechanism outlined by Grossman and Helpman (1991) or that based on Young (1993a and b) and Lucas (1993). It may be helpful to look at economic history and in particular at the factors which determined the emergence of the United States to a position of world economic pre-eminence at the turn of this century. Wright (1990) and Crafts (1996), for example,

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[17] See Mayer (1996a) for a full statement of this argument. It should be noted that the described process has a much wider scope than that associated with the so-called "flying-geese paradigm". This paradigm is closely associated with foreign direct investment and the development of a country's industrial sector: it says that a more advanced country voluntarily shifts - via foreign direct investment - the production of certain goods to a less developed countries, and that it becomes the main market for the export of these goods from the less developed country. By contrast, the present approach discusses mechanisms through which a less developed country can actively slice off economic sectors from more advanced countries. Moreover, it specifically addresses issues related to the primary sector where domestically developed technology may play a more important role than in manufacturing, and where goods are produced which cannot be produced in more developed countries, for example, because of differences in climate. Finally, the process described by the flying-geese paradigm is driven mainly by production costs, while the process analysed in the present approach is driven by learning potentials and capabilities.

conclude that the United States derived its advantages mostly from relatively strong learning effects associated with natural-resource-intensive technology favoured by the country's factor endowment.[18] This suggests that the process of catching up by natural resource-rich countries is more likely to follow the mechanism outlined on the basis of the Young-Lucas models focusing on learning effects. According to Crafts (1996, p. 30), the Grossman-Helpman models, by contrast, are better suited to explain the technology relationships between industrialized countries in the second half of this century.

Moreover, according to Wright (1990) it is a mistake to view resource abundance and resource-based production as an alternative to technology-based manufacturing. Rather, "much of the early use of science by American industry did not deploy new knowledge at the scientific 'frontier', but involved repetitive procedures (such as grading and testing materials) for which scientific training was needed but where the learning was specific to the materials at hand. The abundance of ... resources, in other words, was itself an outgrowth of America's technological progress" (Wright, 1990, p. 665). This shows the complementary nature of resource endowments, skills, and research and development, and suggests that national strategies of human capital accumulation need to be designed and implemented with a view to improving the ability to convert information into an effective knowledge base for developing indigenous technological capabilities.

Empirical evidence on the discussed models is scarce. An exception is Foster and Rosenzweig (1995), who present a model describing the behaviour of farmers and the profitability of introducing new high-yielding wheat and rice varieties at the onset of the "Green Revolution" period in India. Their model is in the Young-Lucas tradition, given that farmers can use the traditional and the new technologies simultaneously. Using household panel data, they show that the effects of experience with new technology on its profitability fall rapidly over time as new experience is acquired, i.e. the learning effects diminish, and that farmers with experienced neighbours are significantly more profitable than those with inexperienced neighbours, i.e. learning effects spill over. Foster and Rosenzweig (1995, p. 1204) also find evidence suggesting that the initial fixed-cost expenditure related to experimenting with the new technology determines whether and when this technology will be adopted: consistent "with the finding that wealthier farmers adopt more rapidly and the learning externalities are not internalized in the village, the simulations also indicate that poor farmers with wealthy neighbours are slower to adopt than those with poor neighbours. ... [A] farmer who is able to initially rely on his neighbours to undertake experimentation when it is costly (because little experience has been accumulated) will be subsequently wealthier on average than a farmer who has to rely on his own experimentation."

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[18] According to Romer (1996), the development of the Untied States may be explained on the basis of the interaction between natural resource abundance and scale effects, which was unique to this country at the end of the 19th century. Large markets mattered because they raised the potential of firms to recoup the up-front costs for designing and setting-up production runs, and because they allowed a larger number of specialized production inputs to be sold. Regarding developing countries in today's world, this suggests that regional and other forms of South-South cooperation could be crucial for achieving structural diversification and sustained economic growth.

## *C. Policy implications*

An important feature of the theories and views surveyed above are the ideas that technology and human capital are key engines of structural diversification, and that investment in technology and human capital is associated with positive external effects on production possibilities. Where this is the case, the outcome of decentralized decisions by private agents is suboptimal from the point of view of aggregate welfare. As a result, the government has an active role and can improve upon the intertemporal allocation of resources, as well as shape a country's dynamic comparative advantage and influence its rate of long-term growth. The objective of this section is to make use of these theories and views in order to discuss policy issues and actions designed to further structural diversification.

The principal objective of such policies would be to upgrade a country's production and export pattern by successively moving up the technology and skill ladder of products, consistent with the country's endowment with human and natural resources and taking into account the dynamic demand potential in world markets. Policy reform at the macroeconomic level can hardly be separated from diversification policy; in addition, such reforms and the policy actions discussed here generally reinforce each other. Therefore, in what follows it will be assumed that countries already have adopted the typical package of macroeconomic reform and that they are now making additional efforts to address supply-side constraints to structural diversification. Industrial-policy type interventions, which could be used to alter countries' patterns of specialization on a sectoral level, will first be analysed before turning the focus of attention to microeconomic policy, which can influence technological development and equipment investment as well as the accumulation of human capital.

### *1. Industrial-policy type interventions*

A country which for historical reasons specializes in activities with a low level of learning benefits, but which is close to the margin of competitiveness in activities with a higher level of learning benefits, would gain from any policy, e.g. subsidies or tax rebates designed to make up for the fixed-cost expenditure associated with the introduction (be it through invention or imitation) of new technology that induced its producers to switch over to the higher-learning activity. Such policy measures would be targeted to sectors where producers could, within a short period of time, accumulate the knowledge required to make up for any deficiency in intrinsic capabilities or experience that has so far prevented them from being competitive in such activities. Such a temporary policy measure could allow the late-coming country to slice off economic sectors from more advanced countries until the social cost of capturing the next sector exceeds the benefit. The policy intervention would correct for the inefficiency that results from the failure of domestic producers to account for the learning externalities associated with their production decisions. However, dynamic externalities are difficult to measure and, therefore, suitable sectors difficult to choose; as a result, there is no agreement as to whether a real government could implement such sophisticated intervention in a way that the potential gains would be worth the risk of choosing the wrong sectors (see also Annex).

The above discussion suggests, none the less, that there are certain considerations a government can make when deciding on its diversification policy. Firstly, it is important to recognize that the explanation of structural diversification through learning sequences implies that the nature of the production process, rather than that of the product itself, is key to product upgrading. Hence, diversification policy should try to encourage engaging in production processes which are one step higher up the skill ladder than those presently executed, independently of whether the goods resulting from such production processes are considered commodities or manufactures in common product classifications.

Secondly, whether such production processes can be found in agriculture, minerals or light manufactures is likely to depend on a country's resource base. One which is poorly endowed with natural resources, or a mineral-dependent country whose non-renewable resources are approaching depletion but whose human capital base is relatively well developed, will probably find such processes in the sector of light manufactures (such as clothing or toys). By contrast, a country which is relatively well endowed with renewable natural resources may have more alternatives; and it is debatable whether such a country could be advised to go into manufacturing under all circumstances. It may be argued, for example, that for countries which for many years have exported unprocessed "traditional" commodities (such as cocoa, coffee or cotton), producing and exporting high-value agricultural items (such as fresh fruit and vegetables or cut flowers) would trigger higher learning effects, and probably be more compatible with the country's comparative advantage, than diversification into the relatively standardized sewing of clothing or, for that matter, processing of primary products, such as tinning of fruit and fish. This is because exporting high-value agricultural products demands an intimate knowledge of the commodity and the appropriate agro-ecological conditions of its production, as well as mastering an information system and communication networks for effective product management in order to deliver an aesthetically perfect, high-quality product at the right time. By contrast, the acceptable standard of produce serving as input to tinning is much lower, and the production process of tinning or sewing probably less skill-intensive. In conclusion, a diversification

**TEXT BOX**

***Dynamic scale economies and the infant industry argument for protection***

Situations where dynamic externalities exist have sometimes been used as a basis for the infant industry argument for temporary protection. Corden (1974, chapter 9) points out that this argument can rest on dynamic internal economies or on dynamic external economies. The case of dynamic internal economies refers to the process through which the average costs of a firm fall from its setting up through continued production because the firm learns from experience, i.e. through learning-by-doing. The argument then goes that new entrants to the market should be protected during the early stages of the production process, when they face higher costs than those faced by foreign competitors. The counter-argument usually raised is that, unless potential private producers are misjudging the benefits of their possible future gains, they may obtain finance from the capital market to cover initial losses. Capital market imperfections may make this impossible and hence prevent potential investors from establishing themselves. However, capital market imperfections are domestic distortions which should be countered by domestic rather than trade policy measures.

Dynamic external economies, in particular technological externalities frequently associated with knowledge diffusion, have often been the main basis for the infant industry argument for temporary protection. As Baldwin (1969, p. 297) explains, its supporters believe that a potential producer has to incur costs in order to discover the best way to produce a particular product in a competitive manner, and that this information becomes freely available to potential competitors who are then able to utilize it at the same time as the firm that incurred the investment. The ensuing competition will prevent the initial firm from recovering its total costs, including the sunk cost incurred for obtaining the knowledge. Firms will therefore be reluctant to invest in knowledge acquisition, with the result that investment in knowledge will fall short of its social optimum. A variant of this argument is the case where knowledge diffusion arises from the inability of firms that provided on-the-job training to tie the workers, who enjoyed the training, to the firm. Baldwin (1969, p. 298) stresses that protection provides no guarantee that a firm would invest more in knowledge acquisition. However, what "is needed, of course, is a subsidy [related in some way to knowledge creation, such as research or training of researchers] to the initial entrants into the industry for discovering better production techniques". However, no amount of subsidy will induce a firm to provide the required training if, in any case, it stands to lose the skilled workers to other firms when it tries to recoup the investment.

In general, import substitution policies will lead to a shift of the workforce to formerly imported goods and rapid learning effects will occur. However, this shift represents a one-time stimulus to learning, while thereafter the production mix of the closed economy will change only slowly, i.e. at the pace of the economy's shifts in consumption pattern. This means that import substitution may stimulate growth in the short run, but will be detrimental to long-term growth. A policy of promoting export-oriented infant industries is likely to foster structural diversification much more than that of protecting import-substitute infant industries. Entering into competition with foreign firms is likely to generate more learning effects than living in autarky, and being active in the world, rather than only in the domestic market, is likely to give rise to more spillover effects.

strategy should be chosen according to the learning potential of production processes, and diversification within the commodities sector should not be considered inferior to diversification out of commodities into the manufacturing sector.[19]

### *2. Indigenous research and development activities*

Considerations influencing policies supporting a country's technological development are closely related to those outlined in the preceding paragraph. If a country's endowment with natural and human resources causes the products located on the next step of the skill ladder to be in light manufacturing, there appears to be no need for the country to develop new technology; rather, it may be advised to continue efforts towards importing technology (for example, through technical assistance contracts, technical license agreements and foreign direct investment) that can easily be adopted to local conditions and mastered with the skill level of the country's labour force. By contrast, if the products having the best learning potential and dynamic demand prospects are in the agricultural sector, different considerations may apply.

The high degree of sensitivity to the physical environment of much agricultural technology means that, in addition to an adequate level of human capital, innovative, technology-frontier-advancing research-and-development strategies may be required in developing countries for diversification based on the optimal development of their agricultural sector. One of the reasons why agricultural technology developed in industrial countries cannot easily be transferred to developing countries is that similar agro-ecological conditions in the country developing a new agricultural technology and in the country importing it are necessary to facilitate the transfer of crop varieties and cultivation techniques.[20] Another reason is that these technologies may have been developed in response to a different set of relative factor prices than that prevailing in developing countries; a simple transfer of technology would result in too much substitution of capital for labour (or high-skilled labour for low-skilled labour) and therefore in distorted domestic factor prices. Hence, transferring such technology - as well as technology for manufacturing - would imply changing and adapting it to domestic conditions, including domestic factor prices. None the less, the abundance of natural resources creates the opportunity for local technical innovation and technological accumulation in developing countries. The aim of such indigenous research and

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[19] It should be noted that in addition to looking at these supply-side factors, the government should assess whether those products are likely to enjoy dynamic demand on export markets. In addition, it has to be recognized that activities in the mineral and light manufacturing sectors tend to be more capital intensive than those in the agricultural sector. Hence, the availability of capital resources needs to be taken into account as well. However, as discussed in the following section, such more capital-intensive activities, and in particular manufacturing, will rely more on imported technology which may come with direct foreign investment, thereby making the required capital resources available.

[20] Experience has shown, for example, that basing pepper, strawberry or tomato production in Latin America on seeds developed in temperate-climate zones requires a very substantial and costly use of pesticides; by contrast, indigenous products can be grown in these countries with a much lower use of pesticides (Thrupp *et al.*, 1995). Hence, the challenge is to develop indigenous crops that have dynamic demand similar to that of these three products and/or to develop new seed varieties better suited to the agro-ecological conditions in Latin America.

development activities would be to develop agricultural products whose production and exports are more skill-intensive than those of traditional agricultural products.[21]

In conclusion, countries which are relatively well endowed with arable land and for which products with the best learning potential and dynamic demand prospects are in the agricultural sector -it would appear that many African countries trying to diversify are part of this group of countries - may be advised to reassess their diversification policy in the technology area with a view to:[22]

(i) strengthening *domestic* research capacity in the agricultural area, for example, by formulating a national agricultural research strategy, and giving national agricultural research institutes an autonomous management structure, as well as adequate and timely funding; bringing the objectives, nature of resources and available know-how into line with developmental requirements; determining priorities for national food security on the one hand, and for export crops on the other;

(ii) strengthening *regional* and other forms of South-South cooperation in agricultural research with countries with similar natural resources and agro-climatic conditions in order to achieve the economies of scale and critical mass required to overcome constraints;

(iii) making agricultural research *demand driven* by including farmers in the determination of research agendas, test runs, technology implementation, etc., with a view to ensuring wide dissemination and utilization of research results.

### *3. The accumulation of human capital*

The obvious fact that what countries can do depends to a large extent on the skills of their people and institutions has come back to the focus of attention of both economists and policy makers. One reason for this is that endogenous growth theory has shown that differences in the level of countries' education or human capital lead to differences in their capacity (i) to invent new technologies, (ii) to adapt and implement technologies developed elsewhere, and (iii) to attract other factors such as investment in physical capital, which also contribute to economic growth and development. Another reason is the rapid growth and diversification achieved in developing countries in East Asia, which are poorly endowed with natural or other resources apart from the skills of their working people. Therefore, it is important to recognize that outlays for human capital accumulation are not "welfare"; rather, they are productive investment with a very high payoff to both individuals and society.

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[21] Malaysia is an example of a developing country that has been successful in developing processed forms of natural-resource-based products, such as palm-oil products, rubber gloves and tires, chocolate, pewter, etc. For details, see UNCTAD (1995b).

[22] Weijenberg *et al.* (1995) recommend similar actions; however, they argue from a very different angle, i.e. analysing the contribution of agricultural research to improved food security, nutrition, employment, equity and environmental sustainability.

It is clear that successful accumulation of human capital is not just a matter of sending people to school. Several additional factors need to be taken into account when designing a policy strategy with a view to supporting the accumulation of human capital. Giving strong attention to the quality of education is one factor. Skill acquisition at school also depends on the quality of learning, rather than just on the time spent in it. The influence of school and teacher quality on a student's performance, for example in primary school, appears to be particularly strong in poor countries, while in developed countries the impact of these factors can be partly outweighed by the educational background of a student's family. Barro and Lee (1996) analyse data on quantitative measures of educational quality for 71 developing countries. They conclude that the number of school years is positively correlated with the indicators of school quality but that the correlation is not very high; therefore, wherever feasible, the influence of years of schooling should be separated from the effects of quality of schooling. Secondly, obtaining a high level of female education appears to be important for export diversification and export-led growth, because the rate of participation of women in export activities is often substantially higher than in economic activities in general. In addition, it is well known that educating women sets in motion a virtuous circle of improving health care, nutrition standards, productivity, etc.

Thirdly, school education is only one part of the stock of a country's human capital; the other part is training, which both builds on and adds specific knowledge to the more general knowledge imparted by school education. School education consists of basic and advanced (basically tertiary) education, while training can take three forms, namely apprenticeships (generally given to a young person who learns by working alongside an experienced worker), on-the-job training (giving further specific skills to a person who already has some knowledge of the work) and formal training courses (giving new or refreshing training and altering previously acquired skills, mainly to experienced employees).[23] The main conceptual difference between general and specific knowledge is in the degree to which such knowledge acquired under some circumstances can be applied in others. The more general knowledge is, the lower its degree of site specificity and therefore the lower the possibility of someone other than the individual being educated to receive the full returns of the investment in skill accumulation. This means that enterprises will normally not invest in the accumulation of general human capital because the return to such investments cannot be captured by enterprises; by contrast, investment in specific knowledge will be made, at least partly, by enterprises.[24]

The level of a country's human capital increases through extending both school education and training. However, it may be argued that the pay-off of different forms of human capital

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[23] See Barba Navaretti (1995) for a similar distinction.

[24] In reality, this distinction may be less clear. Bartel and Sichermann (1995) point out that the acquisition of general and specific knowledge is an interactive process. For example, having a high level of general knowledge appears to facilitate acquiring specific knowledge. On the other hand, since technological progress leads to a depreciation of accumulated knowledge, fully rational individuals will base the decision about how much they themselves invest in general knowledge on their expectations about the respective rates of depreciation of their general and specific knowledge.

accumulation varies with a country's stage of development and its endowment with natural resources. Regarding school education, there is widespread agreement that reaching universal basic education should be made a primary goal in all countries. Funding general basic human capital accumulation may not be beyond the capacity of developing countries other than the very poorest. However, in many cases this funding would imply a redistribution of public expenditures in the area of education where they are excessively skewed towards tertiary education, benefiting a small (and often relatively well-off) section of the population. Also, there appears to be room for greater efficiency in the management and use of resources in this field.

The pay-off to society of tertiary school education awarding degrees to scientists, engineers and technicians depends on the field of study and its relationship to the country's economic structure. It is probably highest when a country concentrates on relatively technology-intensive activities, such as electronics or car-making, while it appears to be relatively lower when a country concentrates on relatively less technology-intensive activities, such as garment-making, wood-working or metal-working. Biologists, chemists and mechanical engineers are clearly needed for such relatively low technology-intensive activities, as well as for the maintenance of a country's basic research capacity; however, their number required is likely to be lower than in countries which already are on higher rungs on the technology ladder.

Regarding the different forms of training, the availability of formal training courses is evidently important for skill-upgrading in all countries. By contrast, it would appear that apprenticeships and on-the-job training may be a better substitute for formal school education in countries applying relatively simple technologies, and whose activities concentrate on natural-resource-based activities, than it would be in other countries. In particular, apprenticeships appear to be well suited to the transmission of productive crafts.[25] A crucial question is whether an apprenticeship contract can transmit only traditional knowledge or whether it also can be a means of skill-upgrading. Both a well- educated master - i.e. having practical as well as theoretical knowledge, using new products and having an open mind for new developments and ideas - and a number of other more skilled workers in the enterprise would appear to be favourable to skill-upgrading. It would therefore probably not be beneficial to give particular incentives for such contracts to micro-enterprises. Regarding the relative shares of apprenticeship contracts being financed by the apprentice and the firm, it is probable that the more specific the training is, the lower the cost of training to be borne by the apprentice, because the greater the probability that the apprentice will continue working for the firm after training is completed. Regarding on-the-job training, it can be observed, mainly in sectors employing simple technology, that one individual - who may be called a "technological catalyzer" (Barba Navaretti, 1995, p. 20) - takes the technological lead, and hence has a crucial impact on the

[25] Analysing 1992 data on the apprenticeship contracts of 185 firms in Ghana engaged in food and beverage processing, metalworking, textiles and garments, and woodworking and furniture, Velenchik (1995, p. 455) shows that most "of the apprentices in the sample are training in skilled production activities: as bakers in the food processing sector, as tailors and dressmakers in the garment sector, as welders in the metalworking sector, and as furniture makers and joiners in the wood sector."

accumulation of technological knowledge within the enterprise. This person usually is the entrepreneur himself or a person working closely with him. Accordingly, the education of the entrepreneur can have a crucial impact on skill accumulation within enterprises.

The complementary character of improvements in skills and technology is underlined by the fact that rising demand for skilled, educated labour, coupled with higher wages, is a strong incentive for individuals to invest more in their own skill formation.[26] Such demand increases occur, for example, in response to productivity growth stemming from skill-biased technological progress. In addition, it has been shown that the incidence of training provided by enterprises is greatest in sectors where productivity growth is fastest, because rapid technological change leads to a high rate of obsolescence of previously acquired knowledge (Bartel and Sichermann, 1995).

The latter aspect underlines the fact that enterprises themselves are crucial sources of human capital accumulation via on-the-job training, learning-by-doing, adaptation and modification of technology developed elsewhere, etc. The success of such efforts crucially depends on whether the national and international business environment facilitates the development and flow of knowledge between firms and countries. The availability and quality of business support services facilitating access to individuals (experienced expatriate personnel, sub-contractors, and so on) and to new market connections are important factors in this regard. However, the training pay-off may not be fully reaped by the enterprise providing this kind of skill accumulation owing to worker mobility. Therefore, sector-specific formal training courses are probably best organized and funded by industry organizations, farmer associations, etc., or by the government. As long as such training is provided by public training institutions, care needs to be taken that it is demand-driven, so that effective and necessary institutions are established. Regarding training provided on a private basis, the government may encourage enterprises to train their employees through direct reimbursement of training expenses or the provision of training subsidies or tax write-offs.

Taking these considerations into account, policy action assisting human capital accumulation could include the following aspects:

(i) Whereas basic education for all should become universal, a government setting the priorities of further education needs to take into account the country's present position on the technology ladder and its endowment with natural resources: a country at an early stage of technology development and relatively well endowed with natural resources will probably require fewer scientists, engineers and technicians than countries well advanced in technology-intensive activities; similarly, the former countries may have to raise the importance given to sector-specific training activities, which implies strengthening the incentives for skill accumulation at the enterprise level;

(ii) Policies supporting the establishment of a training infrastructure may have to be

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26 More generally, according to human capital theory, investment in education by individuals is positively correlated with anticipated rates of returns, such as wages, as well as the level of their parents' education and their own or their parents' income, and negatively correlated with the amount of foregone income or tuition costs.

reassessed, giving appropriate weight to industry associations and similar institutions able to provide sector-specific training;

(iii) Policies encouraging enterprise-level training may have to be reassessed with a view to providing appropriate business support services;

(iv) Individuals may need better encouragement to upgrade their own skills, for example governments may manage technology and education policies with a view to ensuring that the level of technology employed by enterprises helps to stimulate the demand for skilled workers.

## IV. MARKETING ASPECTS AND DIVERSIFICATION

The foregoing discussion has emphasized the determination of comparative advantage in production focusing on a country's ability to produce goods at, or below, world market prices, and to take advantage of dynamic market demand for products which can trigger learning effects. This discussion has neglected the fact that marketing and the acquisition and processing of relevant information are essential and rewarding activities, and that search and transaction costs are associated with activities designed to find market outlets and penetrate new markets. Since these activities are crucial requirements for export activity and diversification to be sustainable, production and marketing can be considered two phases of one process leading to structural diversification into a quality product.

Issues associated with marketing and information processing have not been formally modelled in economic literature, such as those associated with production and the use of new technology. However, there appears to be no conceptual difference between adapting production technology as well as the quality, design and shape of a product to the best practice and learning how to use the marketing techniques applied on world markets. Both the conscious investment in training and the learning-by-doing required for successful marketing activities may be considered as being associated with learning sequences similar to that required for creating new or adapting existing production technology.

Horizontal diversification into an unprocessed commodity similar to that which a particular country already exports is presumably easier than other types of diversification requiring the acquisition of information and marketing skills that are essentially different from the stock of knowledge the supplier already possesses. For the successful diversification of those other types, a supplier will typically have to establish contacts abroad, for example, with a buyer who knows the quality and design required for the new product and who can provide the needed distribution network. Such a buyer may also advice the producer on how to adapt production and management processes in order to deliver the required commodity in a timely manner and with the desired quality. Moreover, the buyer may have to extent credit to the exporter for these purposes with the result that doing business becomes risky for both the supplier and the buyer. If the supplier is new in the market, the buyer will probably pay a low price in order to make up for the transfer of knowledge and the risk. Once the supplier has met the first orders and become familiar with the quality requirements, management tasks and marketing techniques involved, he may be able to capitalize on this and demand better prices, try to find other buyers for the same product, or build up his own distribution channels abroad. Alternatively, the supplier can try to build on the higher level of knowledge attained and move into supplying goods which are more demanding in terms of information and marketing.

Hence, a concept of evolving learning sequences can be established similar to that discussed in connection with skill-induced growth and trade. This concept is based on the consideration that the potential supplier has to fill skill gaps not only in production but also in marketing in order to become a successful exporter, rather than being just a competitive producer. The nature of information and marketing requirements can be related to both the characteristics of economic sectors and the level of development of the supplying economy. Such characteristics, which differ across different economic sectors, are related, for example, to quality requirements, packaging, distribution networks and marketing techniques, while the level of development refers in this context to the lack of accumulated experience and skills needed for the marketing of a particular commodity. Thus, where enterprises from developing countries have equal levels of competitiveness in the production of certain goods compared to the level of enterprises in more advanced countries, such enterprises will be successful in exporting some of these rather than other goods, because the gap in marketing practices between them and enterprises from more advanced countries is narrower and more easily filled for these goods than for others. However, given equal marketing gaps and production competitiveness, enterprises from some countries will be more successful exporters by virtue of their greater stock or faster learning of marketing skills. They will also, over time, vacate activities where relatively easy marketing advantages are challenged by new entrants, and move into activities where marketing barriers are higher and rewards greater (see also Lall, 1991).

An additional basic problem that entrants from developing countries to new markets face is related to the development of quality and reputation which may help to overcome problems of asymmetric information between buyers and sellers, in the sense of Akerlof's (1970) lemon problem. The problem of asymmetric information consists in the fact that the seller knows more about his own honesty and quality consciousness than the buyer possibly can. The seller may thus have to sell at a price which is lower than that which his product could fetch if he had a reputation of consistently supplying high-quality goods. What is more, even if the individual supplier has a good reputation, he may still be penalized by a country-of-origin bias on the part of buyers, who may not rate the reputation of an individual supplier higher than that of the country from where the supplier comes. In addition to previous marketing experience and the already established level of reputation, the size of a seller can be a crucial determinant of success, since larger suppliers tend to have less quality variation and a better financial capacity of bearing the sunk cost involved in building up a reputation of being a reliable supplier of quality goods. Such sunk costs consist, for example, of the investment in a brand name. However, since these information asymmetries are linked to the producers' quality consciousness, governments trying to remedy this market failure would have to introduce differential incentives to produce goods of high rather than low quality. This means that instead of introducing a tax or subsidy to output or trade, the government might consider introducing minimum quality standards for some goods and greater involvement in the enforcement of warranties.

## V. CONCLUSIONS

The main conclusion of the paper is that technology and human capital are key engines of structural diversification. Differences in the level of countries' human capital lead to differences in their capacity to invent new technologies, to adapt and implement technologies developed elsewhere, and to attract investment in physical capital. An optimal policy for structural diversification would be to continue making efforts at raising the population's level of formal education and to concentrate the labour force in the production of goods close to their own quality frontier, thus allowing human capital to be accumulated rapidly through the high learning rates associated with new activities, and to introduce new technologies on a continued basis in order to avoid a cessation of learning effects to occur once the learning benefits of producing with existing technologies start to wear thin.

This interpretation implies that, from a theoretical point of view, the primary objective of a diversification policy should be to upgrade a country's production and export pattern by successively moving up the technology and skill ladder of products, consistent with the country's endowment with human and natural resources and taking into account dynamic demand potentials on world markets. This means that a government may try to encourage the production of products which are one step higher on the skill ladder than those presently produced, independently of whether those products are considered commodities or manufactures in common product classifications. Whether such products can be found in agriculture, minerals or light manufactures is likely to depend on a country's resource base. A country which is poorly endowed with natural resources, or a mineral-dependent country whose non-renewable resources are approaching depletion but whose human capital base is relatively well developed will probably find such products in the sector of light manufactures. By contrast, a country relatively well endowed with natural resources may have more alternatives, and it is debatable whether such a country could be advised to go into manufacturing under all circumstances.

Policies designed to foster technology development and human capital accumulation may need to be synchronized, since the use of more sophisticated technology requires having appropriately skilled labour, while at the same time it increases the incentives for enterprises to invest in training and individuals to invest in their own skill accumulation. Countries which are relatively well endowed with arable land and for which products with the best learning potential and dynamic demand prospects are in the agricultural sector may have to strengthen their domestic research capacity in agriculture, strengthen regional and other forms of South-South cooperation in agricultural research with countries with similar natural resources and agro-climatic conditions, and make agricultural research demand-driven. Whereas reaching a universal basic education should be made a primary goal in all countries, the pay-off to society of tertiary school education is probably highest in countries concentrating on relatively technology-intensive activities. By contrast, imparting knowledge through apprenticeships and on-the-job training may be a better substitute for advancing formal school education in countries applying relatively simple technologies and whose activities concentrate on natural-resource-based activities than it would be in other countries.

These theoretical considerations may justify government intervention in economic sectors where the externalities associated with learning-by-doing effects as well as the fixed-cost expenditure related to the introduction of new technology give rise to market imperfections. However, dynamic externalities are difficult to measure and, therefore, suitable sectors difficult to choose. As a result, there is no agreement as to whether a real government could implement such sophisticated intervention in such a way that the potential gains would be worth the risk of choosing the wrong sectors.

# ANNEX

## Knowledge accumulation, market failures and government intervention

The foregoing discussion has suggested that facilitating learning and the accumulation of knowledge may be crucial for diversification to be successful and that markets are not always very good at dealing with knowledge. There are thus good theoretical arguments for government intervention designed to foster diversification where such intervention can redress sources of market failures. However, it has sometimes been argued that government failures create far worse outcomes than market failures and that therefore the absence of government intervention is on balance preferable. More generally, advocates of the benefits of government intervention assume that the State will act to serve the public, while their opponents argue that: (i) there is divergence between the public interest and the objectives of the State because the State acquires autonomy from society and eventually acts as a predator; because public policy decisions will be determined by powerful interest groups; or because self-seeking bureaucrats will pursue their own rather than the society's interest; and (ii) even if the State tries to serve the public, it will fail to achieve its objectives (Chang, 1994). The latter, government-failure, argument is based on the view that the State will be able to collect and process all the information relevant for the correction of market failures and to implement effectively its policy only at a cost which exceeds the benefits of such a corrective exercise. Which of these two views comes closer to reality seems to be more of an empirical than a theoretical question and to depend on a country's institutional, political and socio-economic environment.

It would appear that successfully implementing measures designed to correct market failures requires that there be an appropriate institutional framework in place, in terms of both ensuring the quality of services offered and a proper management of the institutions, as well as mutual trust and a functional partnership between the public and private sectors. Successful diversification is usually accompanied by an increase in transaction, information and enforcement costs because diversification leads to a greater diversity in economic activities and a growing complexity of economic structures. Institutions designed to minimize these costs are therefore crucial if diversification efforts are not to be frustrated. Neoclassical economics do not address institutional considerations since they assume transactions to occur at zero cost. By contrast, considerations put forward within the framework of new institutional economics emphasize that the purpose of institutions is to reduce transaction and information costs with a view to providing the kind of fluidity and market efficiency underlying neoclassical models. Institutions may be considered "rules, enforcement characteristics of rules, and norms of behaviour that structure repeated human interaction. Hence they limit and define the choice set of neoclassical theory" (North, 1989, p. 1321). Given that an attempt to account for the various experiences of countries in diversification on the basis of new trade and endogenous growth theory may depend on the existence of different degrees of incentives for the accumulation of knowledge and that such an incentive structure may be partly derived from institutions, it seems that ensuring the efficient functioning of appropriately designed institutions is essential in a successful diversification strategy.

The importance of having properly working formal institutions that facilitate communication and cooperation between the private and public sectors for diversification is supported by evidence on the role deliberation councils have played in Japan, the Republic of Korea, Malaysia and Singapore, i.e. countries that have been successful diversifiers over the last three decades or so. Within these councils, private sector groups have had the opportunity to help shape and implement government policies directly affecting their economic activities. The repetitive nature of the collaboration has made allocation rules clear to all participants, as well as constrained self-interested behaviour and cheating by participants.[27] Rodrik (1994) argues that such councils have been used widely in developing countries, and that the real question is why have they worked satisfactorily in East Asian but not in other countries. He mentions that part of the explanation lies in the effects of a more equal distribution of income. However, it would appear that the high level of technical and administrative capacity, as well as of performance standards on the part of policy makers, and a clear understanding between firms, the government and the general public concerning the objectives, the effects of particular instruments on outcomes and performance requirements have also played a key role in the successful implementation of policy.

Stressing the importance of having appropriately functioning institutions in place also means that government officials need to learn how to operate in an environment that emphasizes cooperation between government and the private sector, if private-sector activities are crucial to

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[27] On this issue, see, for example, World Bank (1993, pp. 14 and 187).

closing idea gaps and fostering diversification. Such an environment may be substantially different from that in a more regulated, planned one, where the government either closely monitors production and marketing activities or actively intervenes in the pricing system. In particular, modalities of government intervention in such an environment should not be devised and enforced on behalf of the politically or economically advantaged regardless of their effects on economic efficiency. Governments in many countries may have a long way to go in the learning process, and should at the moment presumably consider very carefully whether or not to intervene.

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