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NOTES ON THE THEORY OF THE "BIG PUSH"

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Natura fecit saltus . . .

### 1. Methodology

"There is a minimum level of resources that must be devoted to . . . a development program if it is to have any chance of success. Launching a country into self-sustaining growth is a little like getting an airplane off the ground. There is a critical ground speed which must be passed before the craft can become airborne. . . ." <sup>1</sup> Proceeding "bit by bit" will not add up in its effects to the sum total of the single bits. A minimum quantum of investment is a necessary (though not sufficient) condition of success. This is in a nutshell the contention of the theory of the big push.

It seems to contradict the conclusions of the traditional static equilibrium theory and reverses its famous motto: "natura non fecit saltus." It does so for three reasons: First because it is based on a set of more realistic assumptions of certain indivisibilities and "non-appropriabilities" <sup>2</sup> in the production functions even on the

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<sup>1</sup>The Objectives of U. S. Economic Assistance Programs (Center for International Studies, M.I.T., Special Committee to Study the Foreign Aid Program, Washington, D. C. 1957) p. 70.

<sup>2</sup>Impossibility to appropriate.

level of a static equilibrium theory. These indivisibilities give rise to increasing returns and to (technological) external economies. Second because dealing with problems of growth it examines the path towards equilibrium and not only the conditions at a point of equilibrium. At a point of static equilibrium net investment is zero. The theory of growth is very largely a theory of investment. The allocation of investment, however, - unlike the allocation of given stocks of consumer goods (equilibrium of consumption), or of producers goods (equilibrium of production) - is necessarily an imperfect market, i.e. a market on which prices do not signal all the information required for an "optimum" solution.<sup>1</sup> Additional signalling devices apart from market prices are required.<sup>2, 3</sup> The author and many economists believe that those can be

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<sup>1</sup> See P. N. Rosenstein-Rodan, "Programming in Theory and in Italian Practice" in Investment Criteria and Economic Growth, Center for International Studies, M.I.T., Cambridge (Massachusetts), 1955.

<sup>2</sup> Futures markets and futures prices could perhaps provide such signalling devices. It is a moot point whether perfect futures markets for all goods can exist. The author's suspicion (without proof) is that they cannot exist for the same reasons for which perfect foresight is impossible. In reality they certainly do not exist.

<sup>3</sup> "In an economy in which economic decisions are decentralized, a system of communications is needed to enable each person who makes economic decisions to learn about the economic decisions of others and coordinate his decisions with theirs. In the market economy, prices are the signalling device that informs each person of other people's economic decisions; and the merit of perfect competition is that it would cause prices to transmit information reliably and people to respond to this information properly. Market prices, however, reflect the economic situation as it is and not as it will be. For this reason, they are more useful for coordinating current production decisions, which are immediately effective and guided by short-run considerations, than they are for coordinating investment decisions which have a delayed effect and--looking ahead to a long future period--should be governed not by what the present economic situation is but by what the future economic situation is expected to be. The proper coordination of investment decisions, therefore, would require a signalling device to transmit information about present plans and future conditions as they are determined by present plans; and the pricing system fails to provide this." (T. Scitovsky, "Two Concepts of External Economies," Journal of Political Economy, 1954.)

provided by programming. - Given the imperfect investment market, pecuniary external economies have the same effect in the theory of growth as technological external economies; they are a cause of a possible divergence between the private and the social marginal net product.<sup>1</sup> Since pecuniary (unlike technological) external economies are all-pervading and frequent, the price mechanism does not necessarily put the economy on an optimum path.

[Thirdly, in addition to the risk phenomena and imperfections characterizing the "investment equilibrium," markets in underdeveloped countries are even more imperfect than in developed countries. Price mechanism in such imperfect markets does not provide the signals which guide a perfectly competitive economy towards an optimum position.

## 2. Terminology

Indivisibilities and external economies are porte-manteau expressions which are loosely used in literature. Fortunately, recent publications have clarified the concepts<sup>2</sup> so that terminology may be settled in a shorthand way. Not all indivisibilities give rise to external economies and not all external economies are due to indivisibilities; some external economies are due to the impossibility to appropriate a factor--even if divisible. Pecuniary external economies are an almost superfluous concept

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<sup>1</sup>See T. Scitovsky, op. cit., Journal of Political Economy, 1954.

<sup>2</sup>See H. Arndt, "External Economies Reconsidered," Economic Record, 1954; T. Scitovsky, op. cit., Journal of Political Economy, 1954; F. Bator, "Element of the Pure Economics of 'Social Overhead Capital,'" Part III of M.I.T. Ph.D. Thesis, 1956; L. Lefebvre, "External Economies and Transportation," Part I of M.I.T. Ph.D. Thesis, 1956; M. Fleming, "External Economies and the Doctrine of Balanced Growth," Economic Journal, 1955 confines his analysis largely to conditions of a static equilibrium.

in static equilibrium theory. They refer to those interindustry relations which are due to the fact that production functions of different industries are not linear<sup>1</sup> and homogeneous. Their true function in the theory of static equilibrium is to mark a place for a concept which will become important in the theory of growth. Technological external economies are rare in a static competitive economy with one important exception: training of labor<sup>2</sup> and education. In the theory of growth, however, external economies abound because given the inherent imperfection of the investment market, imperfect knowledge and risks, pecuniary and technological external economies have a similarly disturbing effect on the path towards equilibrium. While the distinction between pecuniary and technological external economies becomes practically irrelevant in the theory of growth, three different kinds of indivisibilities and external economies may be distinguished.

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<sup>1</sup>This is almost but not quite the same as saying that there are indivisibilities in the production functions. There can be continuous though non-linear production functions where for instance inputs and outputs are non-linearly linked. The decisive criterion is non-convexity of production possibility curves. In most cases that is due to indivisibilities.

<sup>2</sup>In a slave economy investment in training slave workers may pay. In a non-slave economy in which mortgages on workers do not exist, a trained worker may contract at a higher wage rate with another firm which did not invest in his training. The supply of training facilities in a competitive economy will therefore be normally below optimum. The best way of training workers is probably "on the job." Industrial workers in towns with many establishments and industries acquire skill by working, by talking to each other, exchanging experiences and changing jobs, much more quickly than isolated peasants. This fact alone, apart from better division of labor, is a source of increasing returns to the industrial system as a whole and a differential advantage of industrialization.

- 1) Indivisibility in the production function especially the indivisibility of supply of Social Overhead Capital (lumpiness "capital") - discussed under 3.
- 2) "Indivisibility" of Demand (complementarity of demand) - discussed under 4)
- 3) "Indivisibility" (kink in the) Supply of Savings - discussed under 6.

In one way the first indivisibility is fundamental; if it did not exist the others would not arise. Linear homogeneous production functions are basic in this sense, but they are completely unrealistic. They imply no economies of scale or of agglomeration, no entrepreneurship, no phenomenon of minimum quantum or threshold, so that they threaten to obscure the nature of economic process and the risks involved rather than to throw light on it. In reality there are indivisibilities in the production function. They create not only non-constant returns but also risks of investment and imperfect markets which give rise to the "indivisibility" (complementarity) of demand.

### 3. Indivisibility in the Production Function (Lumpiness of Capital)

1) Indivisibilities of inputs, processes or outputs give rise to increasing returns, - i.e. economies of scale - and may require a high optimum size of a firm. This is not a very important obstacle to development since with some exceptions (for instance in Central America) even in small and poor countries there is usually sufficient demand for at least one optimum scale firm in many industries. There may be room, however, only for one or few firms with the obvious danger of monopolistic markets.

Increasing returns accrue to a firm not only with the growth of its size but also with the growth of the industry and with the growth of the industrial system as a whole (Allyn A. Young). Better specialization, better use of resources become possible when growth helps to overcome indivisibilities generating pecuniary external economies. The range of increasing returns seems to be very wide indeed.<sup>1</sup>

2) Social Overhead Capital is the most important instance of indivisibility and externalities on the supply side. Its services are indirectly productive with long gestation periods and delayed yields. Its most important "products" are investment opportunities created in other industries. Social Overhead Capital comprises all those basic industries like power, transport, communications, etc. which must precede the more quickly yielding, directly productive investments and which constitute the framework or "infrastructure" and the "overhead costs" as it were of the economy as a whole. Its installations are characterized by a sizeable initial lump and low variable costs. Since they require a great minimum size, excess capacity will be unavoidable over the initial period in underdeveloped countries.<sup>2</sup> Over and above a high minimum quantum of each firm or

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<sup>1</sup> The capital-output ratio in the United States has fallen over the last eighty years from around 4 to around 3:1, while income per head, wage-rates and the percentage of "heavy industries" was rising. This is due to technical progress (change in production functions), increasing returns on balance (increasing returns prevailing over decreasing returns) and to the rising demand for labor-intensive services characteristic of high-income economies. It is my conviction that increasing returns played a considerable part in it.

<sup>2</sup> We may distinguish in fact between the "developmental" Social Overhead Capital which provides for a hoped for but uncertain future demand and the "rehabilitation" Social Overhead Capital which caters to an unsatisfied demand of the past. The first with its excess capacity will necessarily have a big sectorial capital-output ratio (10-15:1); the second breaking bottlenecks has a certain high indirect productivity and a much lower capital-output ratio.

industry there is also an irreducible minimum industry mix of different "public utilities," so that an underdeveloped country will have to invest between 30 and 40 per cent of its total investment into these channels. Since vision at large is required as well as good foresight of future development, programming is undoubtedly required in this "lumpy" field; "normal" market mechanisms will not provide an optimum supply.

Social Overhead Capital presents in sum four characteristic indivisibilities:

- 1) It is "indivisible" (irreversible) in time; it must precede other "directly productive" investments.
- 2) Its equipment has high minimum durability; lesser durability is either technically impossible or much less efficient. For this and other reasons it is very "lumpy."
- 3) It has long gestation periods.
- 4) An irreducible minimum S.O.C. industry mix (of various public utilities) is a condition for getting off the "dead end."
- 5) Services of Social Overhead Capital cannot be imported.

A high initial investment in Social Overhead Capital must therefore either precede or be known to be certainly available in order to pave the way for additional more quickly yielding directly productive investments. This indivisibility constitutes one of the main obstacles to development of underdeveloped countries.

#### 4. "Indivisibility" of Demand (Complementarity of Demand)

- 1) Relatively few investments are made in a small market of an underdeveloped country. If all investment projects were independent (which they are not) and if their number grew, the risk of each



investment project would be declining by simple actuarial rules.<sup>1</sup> The lower marginal risk of each investment dose (or project) would lead to either higher or cheaper credit facilities and would thus constitute "internal economies."

2) In reality, however, various investment decisions are not independent; investment projects have high risks because of uncertainty whether their products will find a market.

Let us restate our old example,<sup>2</sup> at first for a closed economy.<sup>3</sup> If a hundred workers who were in disguised unemployment<sup>4</sup> (i.e. with marginal productivity of their labor equal to zero) in an underdeveloped country were put into a shoe factory, their wages would constitute additional income. If the newly employed workers spent all of their additional income on shoes they produce, the shoe factory would find a market and would succeed. In fact, however, they would not spend all of their additional income on shoes; there is no "easy" solution of creating in this way an additional market.<sup>5</sup> The risk of not finding

<sup>1</sup> See T. M. Whitin . . .

<sup>2</sup> See my "Industrialisation of Eastern and Southeastern Europe," Economic Journal, 1943; and R. Nurkse, Problems of Capital Formation in Underdeveloped Countries, Oxford, 1953.

<sup>3</sup> The assumption of a closed economy will be dropped in 5.

<sup>4</sup> On the concept and measurement of disguised unemployment, see my "Notes on Disguised Unemployment," Part I, Center for International Studies, Cambridge (Massachusetts), 1956.

<sup>5</sup> In an open economy the shoe factory may, of course, efficiently substitute former shoe imports, or may be efficient enough to find export markets, although this too is uncertain. (See 5.)

a market reduces the incentive to invest - the shoe factory investment project will probably be abandoned. - Let us vary the example: instead of a hundred (unemployed) workers in one shoe factory, let us put ten thousand workers in say one hundred factories (and farms) who between them will produce the bulk of such (wage) goods on which the newly employed workers will spend their wages. What was not true in the case of one single shoe factory will become true for the complementary system of one hundred factories (and farms). The new producers would be each other's customers and would verify Say's Law by creating an additional market. The complementarity of demand would reduce the risk of not finding a market. Reducing such interdependent risks increases naturally the incentive to invest.

3) If one unit of any (wage) good could be produced as efficiently as many units - i.e. if there were no indivisibilities in the production functions of wage goods - a relatively small investment might suffice to produce a product mix which would satisfy (and create) the additional market. Indivisibilities make the minimum investment much larger.

The risk of any single investment in one product is increased by the fact that various goods are highly imperfect substitutes for each other in low income underdeveloped countries. The "South-West" corner of the indifference line map shows very high degrees of convexity; demand for most goods will therefore be highly inelastic. The low elasticities of demand make it much more difficult to fit supplies to demands. The difficulty of fitting demand to supply on a small-scale constitutes a risk which is higher on a small than on a large

and growing market. The complementarity of demand will reduce the marginal risk of growing and diversified investments, but it will be below a "minimum sensible" for small doses of investment. There is therefore a minimum threshold at which the complementarity of demand manifests itself. The discontinuity in the complementarity of demand may therefore be called "indivisibility" of demand.

4) A minimum quantum of investment is required to produce the bulk (or a good bundle) of additional wage goods on which additionally employed workers will spend their additional income. Unless it is probable that other investments will take place many single investment projects may be too risky to be undertaken. The need to mobilize investment sufficient to provide this minimum quantum is the first hurdle which underdeveloped countries must overcome, but it is not the only one. Even if savings and investment sufficient for a minimum quantum of wage goods were forthcoming, the need to create beforehand a minimum quantum of Social Overhead Capital constitutes a second hurdle which must be overcome. While the first minimum quantum of investment in wage goods may amount to say \$20 million, the minimum quantum of investment in Social Overhead Capital may amount to say \$60 - \$80 million. The effective minimum of total investment may thus amount to - and to require a "big push" of - \$80 - \$100 million.

5. International trade reduces the size of the minimum push.

Complementarity of demand was examined in paragraph 4 under the assumption of a closed economy. In an open economy a shoe factory might

substitute former imports or may be efficient enough to find export markets. The world market can be a substitute for the additional domestic market required in a closed economy. Can it then provide enough continuity to dispense with the need for a minimum quantum of investment? It is submitted that the mobility of products is in reality an imperfect substitute for the mobility of factors. International trade undoubtedly reduces the range of the "minimum-push" required, so that not all the wage goods need be produced in the developing country, but it does not eliminate it.

The great expansion of international trade in the nineteenth century has led to neither an equalization or even to a reduction in the inequality of factor rewards. Theoretically this fact may be due to three reasons:<sup>1</sup> 1) transport costs as impediments to the mobility of factors, 2) complete rather than partial specialization of production, 3) different production functions in different countries.

Transport costs were sharply reduced during the last 150 years; this should have led to a growing equalization of factor rewards.

In the same way partial specialization of production accounted for a growing proportion of the volume of international trade in the nineteenth century. The English Industrial Revolution may have increased the share of complete specialization; export gainers expanded in England more than import-savers at that time. Subsequent industrializations, however, for instance in Germany, showed a greater expansion of import-saving than of export gaining production, although

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<sup>1</sup>See P. A. Samuelson, "International Trade and the Equalization of Factor Prices," Economic Journal, 1948 and 1949.

exact statistical information does not seem to exist.<sup>1</sup> There can hardly be any doubt that the share of complete specialization in international trade was falling during the last hundred years. This should have led to a growing equalization of factor rewards in the world economy.

The main burden of explaining why this tendency did not materialize at all - labor rewards in fact showed the opposite tendency of becoming more unequal<sup>2</sup> - seems to fall on the assumption that production functions are different in various parts of the world. "The laws of nature may be the same 'everywhere,' but the laws of nature and the economically relevant production functions relating maximum output obtainable from specified concrete inputs are two quite different things. Effective knowledge ('know-how') is probably as important a variable in understanding economic history and geography as is specific factor endowments .... The effective organization is different."<sup>3</sup> There is no doubt that differences in effectiveness of organization do exist in different countries and that effective knowledge "cannot be acquired by reading a book or by editorial exhortation." It can be acquired, however "on the job" !

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<sup>1</sup> Much depends, of course, on the definition of the "same" or "similar" products in various countries.

<sup>2</sup> This was not due to a differentially higher increase in population in the underdeveloped countries. On the contrary, their increase in population was smaller than that of developed countries.

<sup>3</sup> P. A. Samuelson, op. cit., (1948), p. 181.

This possibility is a major source of increasing returns to the industrial system as a whole - and perhaps the most important yield of "development" is a cumulative increase in effective knowledge. The growth of international trade during the last 150 years has not reduced the inequality in this field.

We may conclude that international trade does not eliminate - although it reduces - the "indivisibility" of demand, even if markets other than the investment market were more or less perfect. In reality of course markets are imperfect - and those in underdeveloped countries are probably more imperfect than in the developed ones. International trade does much to reduce the danger of monopolies - it also effectively reduces the size of the "minimum quantum" of investment<sup>1</sup> - but it does not dispense with the need for a "big push".

#### 6. "Indivisibility" in the Supply of Savings

A high minimum quantum of investment requires a high volume of savings, which is difficult to achieve in low income underdeveloped countries. The way out of the vicious circle is to have first an increase in income (due to an increase in investment which mobilizes additional latent resources) and to provide mechanisms which assure that at the second stage the marginal rate of savings be very much higher than the average rate of savings. Adam Smith's dictum that frugality is a virtue and prodigality a vice has to be adapted to a situation of growing income. Economic history does not show that

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<sup>1</sup> It reduces it to such an extent that "balanced growth" is not required, although "big growth" is. "Balanced growth" and "big push" are not the same thing.

the English Industrial Revolution was preceded by a period of falling consumption; it only shows that the proportion saved from the increase in income was higher than previous average savings.

The zero (or very low) price elasticity of supply of savings and the high income elasticity of savings may be described as a third "Indivisibility" in the Supply of Savings.

The three indivisibilities (under 3, 4, and 6) and the external economies to which they give rise (plus the external economies of training labor) form the characteristic pattern of models of growth of underdeveloped countries.

#### 7. Psychological "Indivisibility" of the Development Drive

The economic factors discussed so far give only the necessary, but not sufficient, conditions of growth. A "big push" seems required to "jump" over the economic obstacles<sup>1</sup> to development. There may be finally a phenomenon of indivisibility in the vigor and drive required for a successful development policy. Isolated and small efforts may not "add up" to a sufficient impact on growth - an "atmosphere" of development effervescence may also only arise with a minimum speed or size of investment. Our knowledge of psychology is far too deficient to theorize about this phenomenon. This does not make it a less important factor. It may well constitute the difference between necessary and sufficient conditions of success.

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<sup>1</sup>The extent and relative importance of the three indivisibilities and external economies is greater in underdeveloped than in developed countries. The same applies to the degree of imperfect knowledge and of imperfect competition.

## 8. A Glance at the Economic History of the Nineteenth Century

Let us glance at the economic history of the last 150 years and see how the absence of a "big push" in underdeveloped countries prevented them from having a rate of growth comparable with that of the advanced Western world. The classical economists have taught us that given a long period of peace, order and security and a reasonable economic policy of free trade and not too much Government interference, the wealth of nations will increase and, moreover, the difference in income per head among different parts of the world will tend to diminish. This would be the effect of international trade even without major capital movements, since the mobility of products is a good (if not perfect) substitute for the mobility of factors. Between the Congress of Vienna in 1815 and the outbreak of the First World War in 1914, we had a century of peace, order and security which is a period long enough even for classical economists. It was moreover a century of maximum international trade, technological progress and in addition also very large movements of factors, both movement of capital and migration of labor. Abundant manpower should result in low wages which should attract capital and thereby increase employment, wages and income. Yet international income differences have increased over the nineteenth century instead of decreasing, since slightly over a quarter of the world population increased its income per head considerably, while the rest had to run very fast in order to stand still. Lower wages in underdeveloped countries did not attract enough capital to reduce the inequality in factor rewards nor did international trade achieve fully this effect.



The classical economists' forecast proved wrong because they neglected external economies. The deficiency of Social Overhead Capital caused diseconomies on capital account which more than compensated the economies on wage accounts. The Western industrialists were not induced to invest much in industries of underdeveloped countries. Take for example the Lancashire textile industrialists in the middle of the nineteenth century. India was firmly under the British Rule. There were neither insecurity nor balance of payments or transfer risks, and wages in India were very much lower than in Lancashire. Yet any textile mill project in India would have found an obstacle in the deficiency of Social Overhead Capital which, for this single project alone, was unsurmountable so that it could not avail itself of the advantage of lower wages. The lumpiness of Social Overhead Capital would, however, have made one hundred single project investments pay if there had been a sufficiently integrated force to organize it. An investment trust like the East India Company might have done it, but the single project approach of the City of London made this integration impossible. Had there been an integrating, synchronizing "big push," the course of economic history of the world would have been different.