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Thomas, Zieseimer

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A HISTORY OF ECONOMIC THEORIZING ON THE PREBISCH-SINGER THESIS*

THOMAS ZIESEMER

Rijksuniversiteit Limburg, Faculty of Economics and Business Administration and MERIT, P.O. Box 616, 6200 MD Maastricht, the Netherlands, phone 31-43-883872, e-mail T.Ziesemer@ Algec. RuLimburg.NL.

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I. Introduction

When D. Senghaas (1982) published his big summary of an interdisciplinary project entitled "Von Europa lernen" (Learning from Europe) he could have put a question mark at the end of the title. The reason is not to doubt that there may be something to be learned from European history. The reason is to point to the fact that there might be some things that developing countries can learn only from their own history. The example par excellence is the fact that developing countries are importers of capital goods to a much greater extent than European followers have ever been. The crucial point to be learned is the working of economic growth through imported capital goods that have to be paid for by exports. The best known proponents of this view were Singer, Prebisch and Myrdal. The view has three parts:

i) Singer, working on UN documents, and Prebisch (1950), found that the terms of trade of developing countries' primary goods in relation to developed countries' manufactured goods were falling when considering long-run data. The debate on whether or not this is true is still going on. Roughly one hundred contributions of the old literature have been briefly summarized by Nguyen (1981): One third of them saying that terms of trade fall, one third seeing constancy and the rest even increasing returns to time-series analysis. Cuddington and Urzua (1989) emphasized stationarity.

However, Sapsford, Sarkar and Singer (forthcoming) criticize the data and methodology used, and Ardeni and Wright (1992) use non-stationary methods allowing for decomposition into trends and cycles. Both find a small rate of decreasing terms of trade in the long run. The order of magnitude that is under discussion is between zero and less .8 percent. These results are supported by Bleany and Greenaway (1993) and Barros and Amazonas (1993), who provide some estimates and tests and a review of some literature. When going to manufactures the debate between Sarkar and Singer (1993) on the one side and Athukorala (1993) and Bleany (1993) on the other reveals that there is a decline in the terms of trade of non-ferrous metals and a slight or no decline in other manufactures. Unless quality-measurement issues bias the whole data analysis, which is unclear up till now (see Bleany and Greenaway, 1993), the inclusion of manufactures does not reverse the impression of falling terms

of trade from analyses of primary commodity prices only.

ii) The second debate that has taken place began with the view that the terms of trade are indeed falling. If so, investment should be shifted away from the primary to the secondary sector. To give (infant) industry a chance, tariffs seemed to be desirable. The exact concept has never really been presented, at least not in terms of dynamic theory. The history has been disappointing (see Ernst 1973 for a summary) because protectionism led to imports of capital goods that were higher than the imports substituted away by domestic production. Trade theorists always criticized this idea because of distortions generated by tariffs. The same distortions when used for export promotion, however, often seemed acceptable to them, a view that frequently undermined the credibility of anti-protectionist arguments. Recently, more successful NICs (newly industrializing countries) seem to have in common human capital investment at all levels combined with a strategy to go from less to more sophisticated technologies (see Verspagen, 1993, Table IX.6.). This was accompanied by tariff protection and realistic exchange rates (see Sachs 1989).

iii) The third part of the view concerns the exact relation between the terms of trade, growth and welfare. Falling terms of trade in themselves are not bad if they are the result of superior technical progress which enables the country to export more (Kravis 1970 and Evans 1987) and improve its world market position. A positive correlation between the terms of trade, growth and welfare needs to be derived under plausible assumptions. Prebisch (1950, 1959 at UNECLA and later at UNCTAD) and Myrdal (1956, then at UNECE) argued that low income and price elasticities are unfavourable to economic growth because the capacity to pay for imported capital goods is lowered by them. This is what this paper intends to show for the reason that the theoretical state of the art of the literature is not very well developed.

Spraos (1983, p.99) recently noted that there has been no formal theorizing on the Prebisch-Singer Thesis, except for Bhagwati's "Immiserizing growth" and an analysis within the static neoclassical trade model (e.g. Bell, 1979; Södersten, 1980; Spraos, 1983). Spraos excluded the papers by Findlay (1980, 1981) from his observation because Findlay assumed unit income elasticities, an assumption that is at variance with the Prebisch-Singer Thesis. Södersten (1981, p. 462), commenting on Findlay's paper (1981), argued that the assumption of unlimited supply of labour (also used by others as discussed below) could not be valid in the long run and asked whether it would not "be more interesting to have two Solow-type economies trading with each other instead". In the Solow (1956) model, the central variables that indicate an improvement in economic well-being - the wage rate and per capita income - grow at the rate of technical progress. The main challenge from the Prebisch-Singer Thesis is that there may be foreign trade conditions which cause these variables to grow at a slower rate than in the Solow model. One such condition is the scarcity of imported inputs which can be reduced by increasing exports. This point, which Prebisch emphasized in his 1950 paper, has recently been reemphasized by Linnemann (1993) and Athukorala (1993), the former pointing to empirical research by Esfahani (1991).

This paper, in its second part, adds the lacking theoretical underpinnings to the literature on exports and growth. It attempts to demonstrate why most of the theoretical analyses of the terms of trade phenomenon has been inadequate from the development point

of view. It then presents in its third part, an open Solow-type model in which the arguments of Prebisch and Singer, income and price elasticities of export demand, are indeed the reason for lower growth rates in comparison to those of the closed Solow model. Part IV draws some conclusions with respect to policies and research requirements.

II. The Terms of Trade and Economic Development - A Brief Critique of the Literature

1. The Static Neo-Classical Trade Model

Theorizing on the terms of trade within the static neo-classical trade model aims to derive conditions under which the terms of trade rise or fall. The model used by Spraos (1983, p. 85), for example, yields the condition that after an increase in labour productivity the terms of trade will fall if the ratio of world income elasticities for commodities and for manufactures is smaller than their respective labour productivity ratios, under the assumption that the two countries are perfectly specialized. If specialization is imperfect, the condition becomes more complicated (see Södersten 1980, Chapter 9, appendix).

Whichever one of the models mentioned above one considers, they all suffer from a serious deficiency: in order to find out whether or not the terms of trade fall one has to know the changes in labour productivity and national income in terms of domestic goods beforehand. But the question raised by Prebisch and Singer was quite the other way around: they asked to what extent could per capita income grow in capital importing developing economies with limited exports, given a certain rate of technical progress; the terms of trade were taken as an indicator or explanatory variable that might point to an answer.

If one simply transformed the static model into a dynamic one, not much would be gained. With some modifications, the Ricardian argument of diminishing returns to scale could be considered in the static model, as was done by Jorgenson (1961) in a dynamic model. Dynamics under decreasing returns, however, would favour the classical view of increasing prices of primary products, the opposite of the Prebisch-Singer Thesis.

Brecher and Choudhri (1982) consider a Heckscher-Ohlin model with both manufactured and primary products. Foreign investment by northern citizens in the South increases production of capital-intensive primary products. Incomes are increased by the more efficient use of world capital.

Demand shifts to manufactures imported by the South and the terms of trade and welfare in the South fall in that model. However, this is a once-and-for-all effect because once interest rates are internationally equalized the capital movement stops. Therefore the long-run growth effects of the terms of trade movements are completely deemphasized as is admitted by the authors. However, it is exactly this aspect which forms the main challenge of the P-S thesis.

The question which may be raised is whether there are more distinguishing characteristics of developing countries than the comparative statics of productivity and returns to scale. At least two directions of thought, that deviate from the purely neo-classical line may be considered: firstly, the unlimited supply of labour

tradition following Lewis (1954); and secondly, the impact of capital goods importation. It is shown below that the terms of trade cannot be an indicator of development in the first case without including the second, leaving as the more promising aspect the importation of capital goods. The main difference between our interpretation of Prebisch-Singer and the neoclassical one is that it is not a simple demand- supply exercise but instead exports also have an influence on productivity via the amount of capital goods imported. To some extent all these requirements are fulfilled in Evans' (1987) static trade model. Evans does not discuss the welfare and dynamic growth effects of the terms-of-trade changes. However, this is the crucial question of the whole debate. The direct connection between exports and productivity is the reason why income and price elasticities of export demand are part of the common driving forces behind growth rates and the terms of trade and make the latter an interesting indicator of development.

2. Growth in Dualistic Neoclassical Models

It has been pointed out repeatedly (see Södersten, 1980, p.51), that before Prebisch's and Singer's publications a rise in the terms of trade has always been expected for the countries that export primary products. Ricardo argued that diminishing returns from the exploitation of primary products will increase their price relative to the price of other products. This argument has been formalized in the theory of dualism by Jorgenson (1961) and has been extended to open economy models by Zarembka (1972).

In Zarembka's model (1972, chapter 5) land may be used for agricultural export production or domestically sold agricultural products. In the large country, case a high international income elasticity for exports would pull agricultural production more and more into the cost increasing influence of decreasing returns to land and increase the relative price of agricultural products via costs. This, of course, decreases the real wage measured in agricultural goods because the labour demand from industry shrinks due to its falling relative price. Thus high income elasticities for export products may be a serious disadvantage for the workers, if the export product accounts for the bulk of their consumption basket and exhibits diminishing returns.

Prebisch (1959, p.263) subsumed this Ricardian argument under "compensatory forces". It was just the opposite of what he believed to be relevant for his argument. There may be countries where the Ricardian problem is predominant and others where the Prebisch-Singer argument is predominant. This is an empirical question.

In the Ricardian context, the terms of trade are an sense: the lower the terms of trade, the higher the real wage. Up to now, no model has been discussed in this paper in which an increase in the terms of trade is an indicator of the well-being of the people in the sense meant by Prebisch, Singer and Myrdal.

3. Labour Surplus and Monopoly Conditions

E. Bacha (1978) has interpreted the Prebisch-Singer Thesis within a framework where labour is the only factor of production and - at a fixed wage - unlimited in supply. Imports by the periphery depend

on fixed labour productivity, the relative price of import and export goods, and on employment; its exports depend on the relative price. For each employment level the relative price will be such that trade is balanced. Monopolists knowing this, determine employment in a way that maximizes profits, thereby determining the equilibrating relative price.

In a model with an unlimited supply of labour and a fixed wage rate the fate of the poor is best indicated by the level of employment; the question thus arises, as to whether technical progress will increase employment or not. Two effects must be considered; first, increased labour productivity has a positive income effect on imports; if this were the only effect, the relative price would have to decrease to balance trade again; at this lower price the monopolist would hire less labour; on the other hand increased productivity reduces costs and therefore has a negative impact on the relative price and a positive impact on employment because of a higher marginal product of labour. The employment level at which equilibrium will be reached depends on the income elasticity of import demand in the periphery and the price elasticity of the trade balance; if the former exceeds the latter, the net impact on employment is negative, because then the first impact discussed above outweighs the second. A similar result has been derived by Taylor (1981), in a three-region model. In either of the two cases of falling or increasing employment, the terms of trade will fall; so they are not indicators of the well-being of the people. This casts doubt on Bacha's interpretation of the Prebisch-Singer ideas. Therefore it is doubtful whether they should be interpreted within a fixed wage framework. However, a shift in export demand would supposedly lead to higher terms of trade and employment in Bacha's monopolistic model. Bacha has not investigated this effect. In the sequel we show that this does not lead to higher terms of trade under perfect competition if wages are fixed, but it does if wages are flexible. P-S ideas are shown to be valid without resorting to a monopoly assumption at the firm level. Of course such an assumption could be justified for some sectors. The rest of this paper will show that flexible wages and the importation of capital goods are the key elements of the Prebisch-Singer Thesis.

4. Labour Surplus and Capital Imports: Growth in the Classical Phase

Findlay (1980, 1981, 1983) has shown, that the optimistic result of vanishing disguised unemployment under exogenous technical progress, usually obtained from the closed classical dualistic growth model (see Petralias 1973 or Ziesemer 1987), no longer holds, if this Lewis economy must import its capital goods from a developed economy represented by a Solow model.

It is well known that in the closed Lewis model with a fixed real wage, technical progress increases the marginal product of capital which is equal to the rate of profit. If savings are a fixed proportion of profits and investment equals savings, an increase in the marginal product of capital induces a continuous increase in the rate of growth. At some stage, this rate of growth becomes greater than the rate of population growth. This diminishes unemployment until it vanishes.

In the Findlay model imported capital goods are different from the LDC output. Therefore one is required to multiply the marginal product of capital, f' , with the terms of trade, p , in order to get

the rate of profit, r , so that

$$r = p f' \quad (\text{II.1})$$

The growth rate of the LDC, g , is the rate of profit multiplied by the rate of savings of capital owners, s , using a classical savings function:

$$g = sr = sf'p \quad (\text{II.2})$$

An important result derived by Findlay is that there exists a stable equilibrium growth path in which the South's growth rate is equal to the rate of growth in the North, which in turn is the usual natural growth rate of the labour force measured in efficiency units, thus yielding

$$n = g = sf'p \quad (\text{II.3})$$

This determines the terms of trade as

$$p = n / sf' \quad (\text{II.3}')$$

Given that the natural rate of growth is exogenous, an increase in the marginal product of capital induced by technical progress (which is so crucial in the Lewis model) must inexorably lead to a fall in the terms of trade. This is very important because it inhibits the rate of growth in the South permanently. This is in stark contrast to the closed Lewis model. The terms of trade are only influenced by the supply side in this formulation whereas elasticities of export demand have no impact on the terms of trade and the growth rate. Recall that the terms of trade are important in the model because capital goods are imported. Moreover, the steady-state result has been derived under the additional assumption that all goods have unit income elasticities. Findlay's slow-growth result, if compared to the closed Lewis model, would probably be strengthened if different (low) income elasticities were introduced. The result is also valid in the case of capital mobility (see Burgstaller and Saavedra-Rivano, 1984 and Burgstaller 1985).

Note that disguised unemployment will only vanish if the natural rate of growth in the North and the rate of growth in the South are higher than population growth in the South. Therefore Södersten's (1980, p.462) opinion, that disguised employment will vanish - the main feature of the closed Lewis model -, is no longer assured if LDCs have higher population growth rates than DCs. So, if there exists a labour surplus economy with a fixed real wage rate, this state may persist for longer. If, on the other hand, the steady-state rate of growth is higher than population growth in the South, sooner or later disguised unemployment vanishes if price elasticities of demand for imports are sufficiently high.

Darity (1990) modelled Keynesian and Kaleckian variants of Findlay's model. In the Keynesian version investment is exogenous and the terms of trade depend not only on southern technology but also on northern technology as in equation (II.3'). In the Kaleckian version there are mark-ups on all costs and the terms of trade depend on them only in the case of international capital movements and not

in the case of trade alone. In the first case there are parametrical cases where the terms of trade depend negatively and others where they depend positively on the mark-ups, leaving the reader with many open empirical questions. The most important question perhaps is why there is never a role for elasticities of export demand. This will be made explicit by offering two models below with imported capital goods and an export demand function which only differ in the closure rules. Under the classical rule (fixed real wages) the terms of trade will be independent of demand elasticities whereas they are dependent on them under an exogenous-employment closure. The reason, which is important to understand the models of this section, is, that under unlimited supplies of labour captured by a fixed wage assumption, export demand increases employment without driving up unit costs. Therefore prices are constant except in the case of a deviation of the growth rate of exogenous wage changes from that of technology. Under exogenous employment, wages are driven up through exports increasing labour demand and therefore competitive cost-prices are driven up in the case of high demand elasticities. If demand grows slower than cost reducing technical progress, the terms of trade fall. This is the essence of the demand considerations of the Prebisch-Singer Thesis.

Another North-South model has been presented by Molana and Vines (1989). The North produces manufactures which are consumed and invested in the North and also invested in the South. The South produces agricultural goods using capital, labour and land. These goods are consumed in the South and exported to the North to pay for the investment. Assuming constant real wages and classical savings functions in both countries the model has a stable steady state with constant values for the terms of trade and the rates of capital accumulation if there is a surplus of land. Constant terms of trade are at variance with the evidence (see Ardeni and Wright 1992 and Sapsford, Sarkar and Singer forthcoming). Comparative statics of technical progress in the South yields a lower terms of trade as in the models summarized above and those considered below. If land is growing at a constant exogenous rate of growth, capital in the North and the South will grow at the same rate and the terms of trade will be constant in the long run. This is the polar opposite of Findlay's case where the growth rate of the North provided the limits to growth. In this case the steady-state values of the terms of trade will be unaffected by technical progress in the South. Low price elasticities of demand for agricultural goods can lead to cyclical movements in the terms of trade. In both variants of the model the terms of trade are constant in the long run and imposing exogenous rates of growth on technical change would make the assumption of constant real wages unconvincing. The point would be to show that they are constant although they are endogenous. But the authors have not done this. A further drawback of the paper is the assumption of Cobb-Douglas preferences. They imply unit income elasticities which is clearly at variance with Prebisch's intentions. Therefore it is not surprising that no attempt is made by the authors to relate their model to the Prebisch-Singer Thesis discussion. Although the model has many interesting aspects it seems necessary to derive a model that is less complicated than two-country models and can take into account the intentions of Prebisch, Singer and Myrdal to include demand properties in the explanation of falling terms of trade.

III. How export demand elasticities determine long-run growth rates: Back to Prebisch

The models described above are not convincing in showing what the impact of export demand elasticities on long-run growth is. It is the suggestion of this paper to go back to the basic ideas of Prebisch, model them and show that under a classical closure rule, that of fixed real wages, the impact of export demand elasticities is limited to employment growth whereas under a neoclassical closure rule, that of exogenous population growth, export demand elasticities have an impact on the growth rates of the terms of trade, per capita income, real wages and the capital-labour ratio. It will be argued that the results of the latter case coincide with the impact of export demand elasticities on growth as suspected by Prebisch.

1. Back to Prebisch: Original ideas and a basic model

The consideration of capital goods imports recently used by Findlay (1980) and Taylor (1981) has a long tradition.

The importance of capital goods imports has been pervasive throughout Prebisch's papers and today is a common argument in the whole literature on dependency theory (see, e.g., Amin, 1972; Cordova and Michelena, 1967). A crucial problem for developing countries seems to be that the international allocation is such that they are importers of capital goods. This problem is repeatedly mentioned in Prebisch's papers (1950, pp.12,17; 1961, pp.5,11,12).

Prebisch obviously believed that this problem could be alleviated if imports of luxury consumption goods were reduced. This may be the case. However, we argue below that this does not change the impact of export demand elasticities on long-run growth rates. Or in modern parlance: tariffs would have only level but no growth rate effect.

If investment goods are imported and debt can only shift the date of payments imported capital goods finally have to be paid for by exports. In this sense investment and growth are limited by exports, valued in terms of imported capital goods (see Prebisch, 1950, p.2). Of course this limit would not exist under the typically neoclassical assumption of a small country defined such that terms of trade are given and the country can export as much as it wants. However, when export demand consists of a demand function with finite price elasticities a country cannot export as much as it wants to, but only as much as is demanded. How strong the growth of the demand is, depends on the growth of the income of country's customers and the income elasticity of the export demand function. Prebisch assumed a low income elasticity of export demand (Prebisch, 1959, pp.251/2) and a price elasticity greater than minus infinity, (1961, p.5) and even greater than minus one; in short, he assumed low income and price elasticities of export demand (1959, p.256). Faini et al. (1992, Hentschel (1992) and Stern, Francis and Schumacher (1976) found indeed that the values of price elasticities of exports are in the neighbourhood of minus one.

The argument that exports limit growth has been challenged by Kravis (1970). Kravis argued that the role of exports is only to pass on the price decrease generated by technical progress: export as handmaiden of growth. The immediate effect of technical progress

is to reduce production costs; it reduces the terms of trade, at least if prices are competitive. This was recognized by Prebisch (1950, p.5, fn.4). Therefore he must have believed that export can have a second role: export as engine of growth. We argue below that the introduction of imported capital goods and limited export demand into a model with a neoclassical production function and goods market equilibrium indeed generates results that include both roles, engine and handmaiden of growth, under classical as well as neoclassical closure rules.

As capital goods imports and low elasticities of export demand were the main issues presented by Prebisch (1950, 1959) and Singer (1950, 479), it is clearly the task of a theoretical interpretation to centre a model around these two assumptions. A crucial question is whether the closure of the model should be of the classical or neoclassical type: i.e. exogenous real wages or exogenous population growth. Prebisch (1950) argued that wage growth may be low because of an absence of union power (see also Bardhan 1982 on union power in a closely related context). In modelling work this has very often been interpreted by using an exogenous real wage. We show below what the implications of such an assumption are that export demand elasticities have an impact on the growth of employment under a classical closure rule whereas there is an impact on real wages, per capita income, capital-labour ratios and the terms of trade under a neoclassical closure rule.

The question then arises whether tariffs and import substitution based industrialization are a way out of the growth problem. This is dubious because tariffs would have to be increasing over time to have growth effects instead of only level effects. In view of the possibility that they encourage the development of competing (synthetic) substitutes it is questionable however, whether they are helpful at all. Encouragement of the supply of synthetic substitutes may decrease the income elasticity of export demand.

Moreover, if luxury goods imports are reduced by tariffs or taxes, resources shift to its import competing sector Prebisch criticized this, arguing that this discriminated against exports (1961, p.5). Instead he favoured a different type of import-substitution industrialization policy than the one actually carried out: New export goods especially, should have been promoted more strongly. Is this not what the more successful NICs did later (see also Sachs, 1985, on this point with an emphasis on the role of non-tradables)?

This might have induced a shift to products with higher income elasticities. However, it is questionable whether we can say much more about it than Prebisch (1961, p.5) did: 'This is admittedly a problem for which there is no simple practical solution, but it is undoubtedly true that the lack of subsidy policy, especially for new exports ... have caused ... countries to miss export opportunities.'

From now on we concentrate on the growth effects of imported capital goods and limited export demand.

Most of the points discussed so far can be illustrated by considering a model with the following four elements (for a formal representation see Ziesemer 1994):

- i) A neoclassical production function where output is produced by capital and labour with labour augmenting technological progress;
- ii) investment takes place in goods which are different from those produced and has to be financed by domestic savings (results carry

over to models with perfect capital market; see Ziesemer 1986 and 1995);

iii) the importation of capital goods besides saving requires payment by exports equal to investment and savings;

iv) to bring income and price elasticities of export demand into the model, an export demand function with the income of the countries' customers and the terms of trade as arguments is introduced.

Finally, one has to make a decision whether to close this model using a fixed real wage, measured in terms of domestic goods to which entrepreneurs equate the marginal product of labour (classical closure) or to close it by assuming exogenous efficient labour supply. We discuss both cases.

2. Export Demand Elasticities in a Growth Model with Classical Closure: A Vent-for-Surplus model

Analysis of the fixed wage version of the model just described delivers the following results:

Under a Cobb-Douglas production function, a constant real wage and marginal product of labour implies a constant output per labour hour or per worker. The exogenous growth of real wages encourages substitution of labour for capital thereby increasing the capital-(efficient) labour ratio while the rate of technical progress decreases it. Capital productivity will increase (decrease) if the rate of technical progress exceeds (falls short of) that of the wage rate. These variables are all independent of the export demand elasticities because given the fixed per capita output and wages, exports can increase the imports of capital goods but not the unit costs. Therefore the terms of trade also are independent of export demand elasticities. As a consequence, only employment depends on export growth under a classical closure rule. Increased capital goods imports increase the demand for labour. Technical progress increases labour productivity and therefore also increases the demand for labour. The more price elastic export demand is the stronger the employment effect of technical progress, because the cost decreasing effect of technical progress as reflected in competitive terms of trade increase exports more strongly if they are more price elastic. Higher exports then allow for more capital goods imports and employment. Positive growth rates of wages increase unit costs and therefore the competitive terms of trade; the higher the price elasticity is (absolutely) the more negative the impact of wage increases is on employment. In sum, again, the terms of trade do not depend on export demand elasticity whereas the crucial variable for welfare, employment, does. Therefore the model under a classical closure does not seem to represent a good interpretation of the ideas of Prebisch, Singer and Myrdal, because the terms of trade only reflect the handmaiden part of exports.

However, the model captures the main idea of the classical theory on the relation between exports and growth: the main idea of the vent-for-surplus theory is that export increases employment.

If wage growth is lower than technical progress, the terms of trade will fall in this version of the vent-for-surplus model. Finally, if there are competitive factor markets, firms will equate their marginal product of capital to the rate of interest. The rate of profit will be constant in the long run. This model has a rather neoclassical spirit although wages have been fixed because excessively high growth rates of wages, net of technical progress

determine the growth of unemployment and of the terms of trade. What we are in search of, however, is a model in which indicators of well-being as well as the growth rate of the terms of trade depend on the elasticities of export demand. It is the assumption of fixed wages that produces Findlay's results and those of the model just presented. The question then arises as to whether imports of capital goods and low export demand elasticities may be a reason for slow growth in a model with flexible wages and exogenous employment. This will be discussed next.

3. A Neoclassical Interpretation of the Prebisch-Singer Thesis

The only models in which the terms of trade are an indicator of underdevelopment - although in an adverse way - are Findlay's contribution and the very similar vent-for-surplus model presented above. In his model the terms of trade are important - although independent of export elasticities - because the terms of trade indicate that advantages from technical progress are passed on to trading partners. Imported capital goods are not an element in the models of Spraos (1983), Södersten (1980), Maneschi (1983) and Bacha (1978). They have been considered by Zarembka (1972) but only in a model for small countries; exports thus being unrestricted, capital goods can be imported without a problem.

A first step in examining the consequences of the introduction of imported capital goods into the neoclassical growth model has been made by Bardhan and S. Lewis (1970) although they don't refer to the Prebisch-Singer Thesis. The variant with the neoclassical closure of the model presented above contains several modifications of theirs in a simplified way. It does not try to explain the importation of capital goods but rather examines its consequences for the terms of trade, accumulation and real wage growth; these are the important variables if the terms of trade are considered to be an indicator of development. In the sequel, results are reported which have been derived analytically in terms of growth rates in Ziesemer (1994), but also in terms of the level of the capital stock in Ziesemer (1987, chap. 7.5).

Under the neoclassical closure rule it is now assumed that population grows at an exogenously given rate.

The wage rate, used as a rough indicator of welfare here, will grow at the same rate at which the marginal productivity of labour grows. The latter is determined by the rate of technical progress and the growth rate of the capital-labour ratio. The rate of technical progress being given exogenously, the critical point is whether the growth rate of the capital-labour ratio is slowed down by low export elasticities which limit imports of capital goods. To answer that question the solution for the model under the neoclassical closure rule has to be considered.

The solution for the terms of trade, the capital-labour ratio and real wages can be computed and yields results with the following interpretation based on two arguments.

The first argument captures the "engine of growth" part in the spirit of Prebisch, Singer and Myrdal but also Lewis and others: Customers' income growth multiplied by the income elasticity drives the growth rates of the terms of trade, capital-labour ratios and the wage rate in a way to be explained below.

The second term captures the "handmaiden" part of the story - made possible here through the explicit introduction of

technical progress into the Bardhan-Lewis model - , which is more in the spirit of Kravis (1970) who argued that exports are merely driven by the price decreasing effects of technical progress and therefore the causality goes from growth to exports and not the other way around as emphasized by the 'engine of growth' proponents. This view has recently been supported by Evans (1987). Evans assumes that capital goods can be produced in the South. However, the assumption that they are not is crucial to the way in which this paper perceives the P-S Thesis. The model under a neoclassical closure rule contains both the handmaiden and the engine-of-growth arguments. Both will be discussed in greater detail now.

The benefits from technical progress may be described as follows: The immediate effect of technical progress is to reduce production costs; it reduces the terms of trade which are equal to competitive cost prices. This was recognized by Prebisch (1950, p.5, fn.4). The question now, is whether this effect will lead to increasing or decreasing exports and investment; if exports are price-elastic they will be increased and will therefore enhance the rate of growth of the capital-labour ratio; if exports are price-inelastic, technical progress by decreasing the terms of trade has a negative effect on the rate of growth of the capital-labour ratio. Now technical progress has a direct and an indirect influence on the real wage growth rate, the indirect effect coming along via the capital- labour ratio. It can be shown that the direct effect outweighs the indirect effect if they go in different directions. Nevertheless, the smaller the price elasticity, the smaller the contribution of technical progress to real wage growth; in the limit, if price elasticities were zero, there would be no influence of technical progress on the growth rate of real wages. To summarize, technical progress has a negative impact on the terms of trade and a nonnegative influence on real wages. With respect to technical progress the terms of trade are obviously no indicator of development, because technical progress has opposing effects on the terms of trade and the real wage rate. What makes the terms of trade an indicator of development is the influence of the income elasticity of export demand and world income growth. A higher income elasticity yields a higher growth of export demand (for every given growth rate of world income) and a higher growth rate of capital imports, the latter leading to higher real wage growth and therefore higher growth rates of the terms of trade. A critical problem is whether the increase in exports, induced by the rate of growth of world income is higher than the rate of population growth because the difference determines the rate of growth of the capital-labour ratio; if this difference and the rate of population growth is negative because of a low income elasticity of export demand, this will have a negative impact on the terms of trade, the capital- labour ratio and growth in real wages. So, the terms of trade, the capital-labour ratio and the real wage, all depend in the same way on the income elasticity of export demand (see Prebisch, 1959, p.258).

To summarize, the terms of trade will decline if the rate of technical progress is not outweighed by a large difference between the growth rates of exports and population growth; low income and price elasticities may make the growth rates of the capital- labour ratio and the real wage rate negative. The terms of trade are an indicator of economic development here because their growth rate and that of the real wage are both driven in the same direction by all the arguments contained in the solution.

A comparison with the results of the Solow growth model is an

essential point of this paper and is therefore carried out next. In the closed economy growth model with a neoclassical production function the real wage, the capital-labour ratio and per capita income grow at the rate of labour-saving technical progress. There are two special cases in which this result can be achieved in the present model:

i) If the price elasticity of export demand is minus infinity, exports no longer limit capital goods imports. This is the neoclassical small country case.

ii) If we assume that the customer's income as a whole grows at the same rate as a closed Solow economy (rate of labour saving technical progress plus rate of population growth), we find that a unit income elasticity of export demand leads to constant terms of trade and an engine of growth that is as fast as the handmaiden of growth.

Whereas the small country case reflects the predominant traditional neoclassical view that exports do not limit growth (see Donges and Riedel, 1977), the latter case reminds us of a paper by Seers (1962), who argued that growth differences are due to differences in the income elasticities of export demand. An income elasticity lower (higher) than one yields lower (higher) growth rates than in the Solow model if capital goods are imported and the price elasticity is not minus infinity. The impact of the income elasticity on the growth rate is still higher if exports are less price elastic, because then price movements have a less smoothing impact on growth rates. As the model is not only driven by technical progress but by exports as well, such an impact of the income elasticity of export demand exists for the terms of trade as well as for real wages. Whenever the income elasticity of export demand is smaller than one, the terms of trade fall and the real wage grows slower than in the Solow economy, indicating the close relationship between real wages and terms of trade development; both governed by the income elasticity of export demand, whose impact is increased (decreased) through lower (higher) price elasticity of export demand.

Capital goods imports and low elasticities of export demand were the main issues presented by Prebisch (1950, 1959) and Singer (1950, 479). If we want to investigate their empirical relevance, some generalisations of the model would be necessary: consumption imports have to be introduced, as do domestic capital goods, indebtedness and so on. Data on customers' income Z would have to be computed for each country separately. The growth theoretic nature of the problem casts doubt on the usefulness of cross section studies, because taking an average of countries as diverse as Brazil and Mali is of little interest; countries will be interested in knowing whether they grow slowly because of low elasticities of export demand or because of diminishing returns in output production. If they knew this, they could start thinking about economic policy measures. Nothing in the model depends on primary products, which were used as an example in the 1950s, although primary products are still of great importance (see Barros and Amazonas 1993, p. 99-102, and Hoffmann and Zivkovic 1992). The strong growth of (semi-) manufactured industrial goods, is also a broadly accepted fact in recent years (see Donges and Riedel 1977 and Sapsford, Sarkar and Singer forthcoming). What matters are elasticities of export demand - regardless of the nature of the products - and their impact on real wages and per capita income as a measure of poverty or wealth (see also Kindleberger, 1958, esp. p.80 and the subsequent comment by Singer, esp. p.87 on these issues). Moreover, no presumptions are needed concerning long-run equality of growth rates between North

and South which feature so prominently in some recent models. Income elasticities of export demand seem to favour differential growth rates because different countries specialize in different products which have different income elasticities of demand. Finally, the models allow for decreasing, constant and increasing growth in the terms of trade and therefore may provide a good basis for empirical research. In this sense we hope that the models discussed may be viewed as a step towards an improved basis of formal theorizing for empirical research.

IV. Concluding Remarks on Economic Policy and Suggestions for further Research

Falling net barter terms of trade (NBTT) as shown in Gillis, Perkins, Roemer and Snodgrass (1992) have different interpretations depending on an application of either the vent-for-surplus model or the P-S growth model. The vent-for-surplus solution for the terms of trade suggests that wages grow more slowly than productivity. The P-S solution suggests that export growth is slower than supply growth in autarky. Empirical tests of the employment and terms-of-trade equations of the vent-for-surplus model and of the P-S model could perhaps show whether any of the models seem to be convincing from an econometric point of view. Testing price equations will result in the difficulties of obtaining quality adjusted price indices (see Grossman and Helpman, 1991, chap.1, and Kurz, 1993). The major question will be whether or not they play an equally strong role in all types of products: imports and exports, primary and manufactures. Evans (1987) argues that there is no reason why there should be a difference between primary commodities and manufactures when correcting for quality changes. Bleany and Greenaway (1993) state, that the opposite is more plausible. The contribution of this paper is theoretical and allows for increasing, constant and decreasing terms of trade and therefore does not depend on the quality issue.

The key to economic policy measures from the point of view of the model presented above is how we explain capital goods imports. This kind of specialization is often said to be due to the colonial heritage. But as far as the colonial heritage has survived up to now, there must be something efficient about it except for the possibility that there are Matthew's conditions yielding convex transformation curves and lock-in on the inefficient side of specialization. For example, learning effects produce a lock-in on the wrong end as in the models of Eaton and Panagariya or Kemp (see Bhagwati and Srinivasan, 1983, chap. 26). So the task for future research will be to explain the efficiency of capital goods imports.

It may be tempting to recommend to the developing countries a "reduction of the need for imported capital goods" (Taylor, 1981, p.601). But if we want to make this recommendation, we ought to know under which conditions the importation of capital goods is efficient. Griffin and Gurley (1985) argue that decreasing terms of trade lead to increasing relative prices of capital goods and therefore provide an incentive to start up a capital goods sector. However, we know from Ricardian trade theory that relative productivities matter. For each price path one can therefore imagine a path of relative labour productivities such that capital goods production does not

become profitable because productivity in that sector is growing at a low rate relative to others. Recall that within the framework of sound microeconomic theory only externalities and public goods justify government interference with the market allocation mechanism if the latter works under competitive conditions and insurance problems are not of immediate relevance to the specific problem discussed. The question therefore is what influence do externalities and public goods have on this kind of specialisation (imports of capital goods).

In the development literature it was T.W. Schultz (1964, 1981) who placed the greatest emphasis on public goods. In his theory, public goods are mainly necessary for human capital production which in turn enhances technical progress. Schultz's ideas may turn out to be useful in explaining the specialization problem assumed here. Imagine that capital goods are produced and that they are relatively intensive in human capital. Then the scarcity of human capital, representing technology in the Ricardian model here, due to a lack of the public goods "basic research" and "basic education", may make the production of capital goods too expensive to become internationally competitive. Then the import of capital goods is finally due to tax resistance which leads to a scarcity of public goods and human capital. This may be an interesting working hypothesis for the future. If it should turn out to be correct, the only way for a reduction of the need for imported capital goods would be a democratization process which diminishes tax resistance and increases investment in public goods which in turn enhances human capital. This should not be confused with direct investment in schooling at all levels. Such an interference with the market allocation mechanism which does not limit itself to public goods may clearly lead to what is now well known as "skilled unemployment". Of course, any other investment in public goods which have proven to be a bottleneck is welcome as well, especially if it increases technical progress. As far as this is not relevant, it is important to invest in those public goods which decrease the production costs of capital goods. The role of sector-specific infrastructure has also been emphasized by Evans (1987, p. 665/6) and Bardhan (1982, p.170), the latter emphasizing the role of social class structure and the state as well.

The critical question nowadays is whether or not there should be subsidies other than those for R&D. But public investment in human capital may also be a good step here.

Up to now there seems to have been a dichotomy in development economics: some emphasize that underdevelopment is due to internal factors. Others emphasize that it is due to external factors. If the working hypothesis presented here turns out to be correct, the two views may be reconciled: internal factors (lack of public goods) may be responsible for the lack of international competitiveness leading to the import of capital goods; and external factors (low export elasticities) may be important because of this lack of competitive ability. The final outcome of this line of thought may be that it is the sector-specific infrastructure which determines the comparative (dis-)advantage of goods. The disadvantage leads to imports of capital goods which are at the heart of the Prebisch-Singer view of growth.

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