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International capital movements and trade in an intertemporal setting

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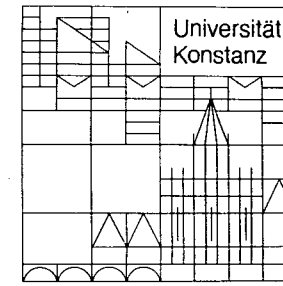

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I. Introduction

The following remarks concentrate on an aspect of the relation between trade and factor movements, which has been neglected in the literature so far. It is the intertemporal dimension of factor movements, which in turn is closely linked to the relation between real and financial capital movements. The focus is on capital as a factor of production - analogies with labor and other factors will only be touched upon.

Capital movements in this context are defined in the wide (Boehm-Bawerkian) sense. It is immaterial whether investment or consumption goods are traded internationally. All that is necessary to transfer "capital" is a positive balance on current account and an excess of savings over domestic investment in the capital exporting country - and the reverse in the capital importing country. This corresponds of course to net financial capital movements during the process of "real capital" transfers. It is modelled in a simple way by introducing as the one financial asset an equity share.

The paper attempts a critique of the comparative static modelling of the substitution vs. complementarity relation between trade and capital movements. It therefore starts from the same Heckscher-Ohlin framework where factor price equalization is granted. It looks primarily at the conditions for efficiency in the world economy, which is attained if all the marginal equivalences are realized, especially if in addition to commodity prices factor prices are equalized across countries. If factor price equalization (FPE) is brought about by trade alone, there is thus no incentive - and no need - for international factor movements; the two are substitutes. On the other hand they are complements if because of non-FPE by trade alone factor movements are induced and are necessary to attain an efficient situation.

The argument will be developed in several steps.

First, the comparative static results will be reviewed using a convenient graphic illustration developed by Dixit and Norman (1980). It will then be shown that the comparative static procedure is inadequate, as capital movements in an essential way involve time. The intertemporal framework will be formulated in terms of a neoclassical growth model. Following Oniki and Uzawa (1965) it will be demonstrated that a trade pattern of specialization is particularly interesting for our problem. This scenario of growth cum trade with specialization exhibits non-FPE. If the possibility of capital movements (implying trade in securities and trade imbalances) is introduced, using a procedure suggested by Hori and Stein (1977), a factor movement will materialize, which is complementary to trade. In conclusion some open questions and possible extensions will be sketched.

II. Factor Price Equalization and the Comparative Statics of International Factor Movements

Our framework is the battle-proven 2 x 2 x 2 model of international trade. We start by briefly describing the static stationary equilibrium in this miniature Walras world, which we assume to be fully integrated. This means that both, the two products and the two factors of production, can move freely and costlessly between the two sectors and between the two countries, resulting in a uniform commodity price ratio p and in equal factor prices w for labor and r for capital services. The world stocks of factors labor N and capital K are given and constant.

As we assume to know the (well behaved) constant-returns-production functions for both products - consumption good C and investment good I - in the two countries as well as the corresponding preference = resp. demand-functions, we are able to calculate equilibrium prices p, w, r as well as factor allocations, and quantities of production, consumption and trade (cf. Dixit-Norman [1980], pp. 100ff).

To illustrate, we use Dixit's and Norman's extension of McKenzie's diversification cone to a world of two countries. From the commodity terms of trade p the unique factor price ratio w/r is determined, if production functions are equal across countries. This ratio in turn fixes the input-coefficients $a_{ij}(w/r)$, equal in both countries ($i = K, N$ for factors, $j = C, I$ for sectors). In the world factor endowment box of Fig. 1 a parallelogram can be drawn, where the rays through origins O^H (home country) and O^F (foreign country) have slopes equal to sectoral factor proportions $k_j(w/r) = \frac{a_{Kj}(w/r)}{a_{Nj}(w/r)}$ (here expressed as capital intensities).

Recall that nothing has been assumed so far about the distribution of factor endowments beween countries. If the endowment point is situated within the parallelogram $O^H A O^F B$, say at Q, we have a situation where production in both countries is diversified: Point Q is within both diversification cones. On the parallelogram's boundaries at least one country is specialized; in points A and B complete specialization obtains.

This integrated world equilibrium has been determined on the assumption that not only free trade is realized, but also that factors are internationally completely mobile, resulting in factor price equalization. If we now drop the assumption of international factor mobility, but instead introduce a given international distribution of factor quantities, it turns out that only endowment points within the diversification parallelogram (including its boundaries) lead to factor price equalization (FPE). It is easily verified that points outside the parallelogram imply quantities of production in both countries which are not compatible with equilibrium of world supply and demand and thus do not lead to FPE.

The foregoing argument illustrated by Fig. 1 (Dixit-Norman [1980]; p. 112) establishes the famous FPE-theorem, making use of all the well-known assumptions, such as

- constant returns and well behaved production functions, different between sectors, equal across countries
- equal preference resp. demand functions across countries, assumed homothetic
- free trade of commodities
- intersectoral factor mobility, but international factor immobility.

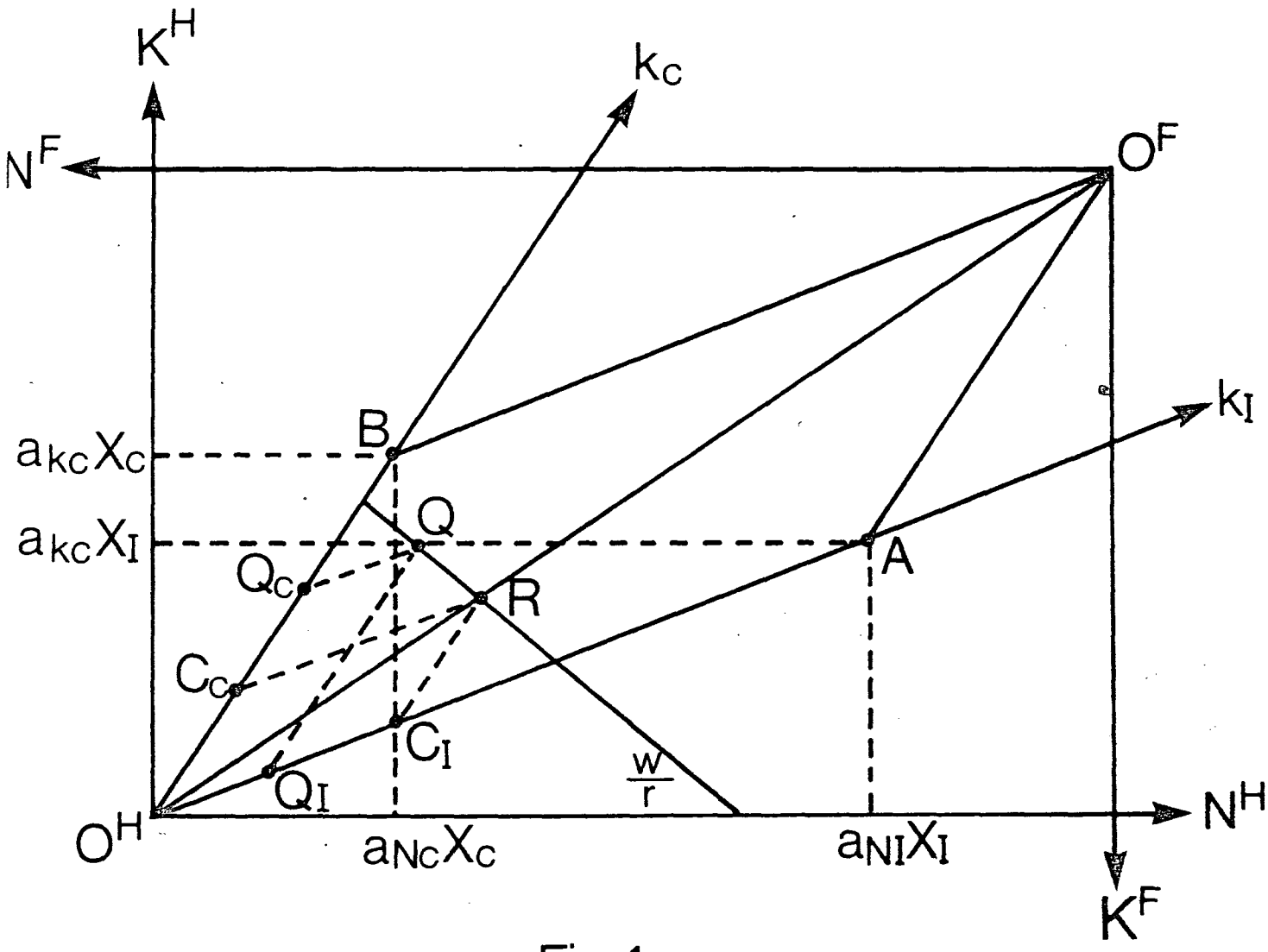

Fig. 1

Q_C, Q_I Production Points

C_C, C_I Consumption Points

It focuses on the international endowment of factors and specifies those endowments within the parallelogram which are compatible with diversified production and thus imply FPE, and distinguishes them from those on the boundaries which imply specialization and FPE, and finally those outside the parallelogram which preclude FPE.

It should be noted that the arguments can be extended to n factors and m commodities (n, $m > 2$), but as we confine the subsequent dynamic model to $n = m = 2$, we need not generalize here. Similarly, we generally exclude other reasons for non-FPE, such as intersectoral factor immobilities, international differences in technology and preferences, obstacles to trade such as tariffs and taxes.

With these self-imposed limitations our main result may be stated as follows: Two countries which are very similar in every respect except their factor endowment proportions will as a consequence of free trade in commodities experience FPE - provided their endowment differences do not exceed certain limits, defined by our parallelogram boundaries, which depend on the characteristics of technology, preferences, etc. Within these limits there are no incentives for international factor movements. If the endowment point is outside the FPE-region, factor price differentials will induce international factor movements, which in turn will move the point of factor availability towards the FPE-region. Here trade and factor movements coexist: they are complements in the sense that FPE and thus world efficiency cannot be achieved by trade alone, but needs international factor movements in addition. Within the parallelogram on the oher hand, FPE is achieved by free trade alone, which can be substituted by factor movements - if these are induced by means other than factor price differentials.

This latter proposition, the long dominant substitution thesis (Mundell [1957], Kemp [1966], Chipman [1971]) may be illustrated by adding to the production points in Fig. 1 the consumption points for each country and commodity. They are derived by determining on the diagonal $O^H O^F$ the international income distribution. This is done by drawing through the endowment point Q a line with slope equal to the equlibrium factor price ratio w/r. The intersection point R of this factor price line with the diagonal marks on the latter the cross country income distribution. As consumption ratios in both countries are assumed equal, consumption points can be determined on the two rays by constructing suitable parallelograms. Trade in both commodities results by subtracting consumption from production.

It is easily verified that trade increases with the distance between Q and R. If this distance is reduced by factor movements, the basis for trade shrinks: complementarity obtains.

III. Critique of the Comparative Static Procedure

In spite of the apparent limitations underlying the substitution thesis as sketched above there seems to be a widespread feeling among economists that there is some truth in it: somehow factor movements remove some of the reasons for trade. At least in the more popular discussion that feeling manifests itself again and again.

On the other hand there is the observation of parallel expansion of trade and factor movements in reality, e.g. within the EEC and possibly within other integration areas. In economic history there are several examples of massive capital (and labor) movements across borders which were accompanied by an expansion of trade,

e.g. between Europe and the U.S. in the 19th century, England and Australia in the 19th and 20th century, the U.S. and Canada in the 20th century.

To account for this discrepancy a variety of models have been developed during the last decade, which generate some kind of complementarity between trade and factor movements. They may be grouped together according to the kind of assumption necessary for FPE which they drop. Here we propose a dynamic extension.

There is an inherent contradiction in the comparative statics treatment of the relationship between trade and capital movements. The exclusion of balance of payments adjustments implies that two points in time are contemplated which are so far distant from each other that the transition process has worked out, i.e. the current balance is in equilbrium again, and the only difference compared with the initial situation is a net foreign ownership of assets with a corresponding capital income stream.

But historically these processes may take decennia or even a generation. Thus the underlying ceteris paribus assumption is hard to justify. At least phenomena of accumulation and growth must be taken into account. And when this is done, it turns out that the results differ markedly from the comparative static results. Specifically, the prospects for complementarity between trade and capital movements will be much broader. And this holds true irrespective of all other possible reasons for complementarity - it just depends on the recognition of inter-temporal aspects.

In introducing intertemporal considerations we start from the pure-theory or barter-trade framework, which will be extended only in one way, viz., the recog-

nition of several time periods. It will be seen later that this opens the way to incorporate monetary considerations as well as uncertainty at a later stage.

Before introducing the dynamic model it may be helpful to remember what is in effect implied by the comparative statics procedure: Two situations are compared, which differ with respect to one of the data, say the distribution of capital goods (a factor of production) between the two countries. If the distribution (within the limits of the FPE-parallelogram) is more equal, this is interpreted as a movement of "capital" from one country to the other. This international "movement" is then compared with trade, i.e. movements of commodities. Although some authors qualify by stating that they disregard balance of payments adjustments associated with the capital transfer, usually these adjustment processes are forgotten and the whole problem thus is obscured instead of elucidated.

One can of course think of examples, where a factory is dismantled in the home country and immediately thereafter rebuilt abroad. This happened to some extent after the Second World War, when German reparations, in order to avoid the transfer problems of reparation payments after the First World War, took the form of physical plant transfers (of course unilateral, i.e. without corresponding ownership transfers and dividend payments). But in all practical cases, the transfer of "capital" is a time consuming process, involving an excess of savings over home investment in one country and a corresponding surplus of investment over domestic saving in the foreign country. During this process of international "capital" movements there has to be an equivalent surplus on current account in one country and a deficit in the other. So the relation between capital movement and trade is directly affected, as it were by definition. Besides, it is quite irrelevant whether the export surplus consists of capital goods or of consumption goods.

In order to model explicitly the time consuming process of a capital transfer betweeen two countries and thereby illuminate its relationship with commodity trade, the static 2 x 2 x 2 HOS-model has to be supplemented minimally by

(1) treating at least one factor, say capital, as an endogeneous variable

(2) permitting net-ownership of capital to be transferred between countries, which is equivalent to

  (a) distinguishing within the balance of current account between commodity trade and factor income, and

  (b) allowing for a surplus resp. deficit on current account, corresponding to a deficit resp. surplus on capital account.

The first extension means of course that growth is introduced, and we can draw on the literature on neoclassical (ond other) growth models of twenty years ago. We will briefly review those results which are of interest for our problem.

Together with the second extension this means that we take explicit account of intertemporal trade. This could be done by analyzing the economic relations between countries period-by-period, an approach which has been initiated recently by Chipman (1985) and which might be linked to the overlapping generations framework. The other approach - which will be followed here - is to cast the model in continuous-time formulation, in order to facilitate the connection with growth theory. (Of course, the two approaches do not exclude each other, they are rather complements).

IV. Growth with Balanced Trade: Patterns of Production

The simplest way to introduce growth into a two-country world whose stationary equilibrium was described above, is to define savings as a constant proportion of national income and identify savings - equalling the production of investment goods - with additions to the stocks of capital in both industries. This applies to both countries. Labor, measured in efficiency units if Harrod-neutral technical progress is incorporated, grows at a constant exogeneous relative rate in both countries. All the static equilibrium conditions and the ensuing marginal equivalences are holding. Each country's growth path in autarky can be described by a Feldman-Uzawa-type two-sector growth model. Especially there exist stable steady-growth solutions for each country characterized by constant capital intensities. When free trade is permitted, certain patterns of specialization resp. diversification will emerge, which are the dynamic (steady-state) analogs to the static patterns described above.

The factor endowment box of Fig. 1 would have to expand, if accumulation and growth were to be taken into account. In order to avoid this cumbersome procedure, factor quantities are replaced by factor intensities. (They would be graphed as rays through the origins in Fig. 1.)

In the general case of diversification (production of both commodities in both countries) there is a complicated relationship between production and export resp. imports of investment goods, savings and accumulation in the two countries, which - depending on initial endowments, technology, savings-ratio, and labor growth - may change over time until a steady state is attained. Oniki and Uzawa (1965) have shown (for the case of relatively capital-intensive consumption goods production and relatively labor-intensive investment goods production) that there will be a

region of diversification for combinations of capital intensities not too different in the two countries (Fig. 2) and regions of specialization for very different capital intensities. This holds for any given initial endowment - as in the stationary case.

But when accumulation is taken into account, this implies variable factor supplies. The capital rich country which according to the Heckscher-Ohlin-theorem will export the capital-intensive commodity will experience a rise in the rental rate for capital. In the static context with fixed factor supplies this has no consequences, but in the present dynamic framework, the supply of capital will rise by accumulation. The resulting process may change relative endowments to such an extent that even specialization obtains after some time.

The ultimate result of these interactions may be described by means of steady state loci for both countries ($\dot{k}^H = 0$ for the home country and $\dot{k}^F = 0$ for the foreign country). In the present framework they are both negatively inclined in the region of diversification; positively inclined in the region where the country specializes in consumption goods; and parallel to the country's k-axis in the region of investment-goods specialization (Fig. 2).

With stability there is a movement towards this steady state loci. The ultimate outcome in the two-country world is described by the intersection of both loci. This point may be located within the region of diversification or in either of both specialization areas (point $\overset{*}{S}$ in Fig. 2).

Now let us look back to the question of factor - or more specifically: capital-movements. In our two-country cum-trade growth model, no factor movements across national boundaries are taking place - although there is trade in investment or capital goods. But all trade is balanced. Changes in relative endowments are

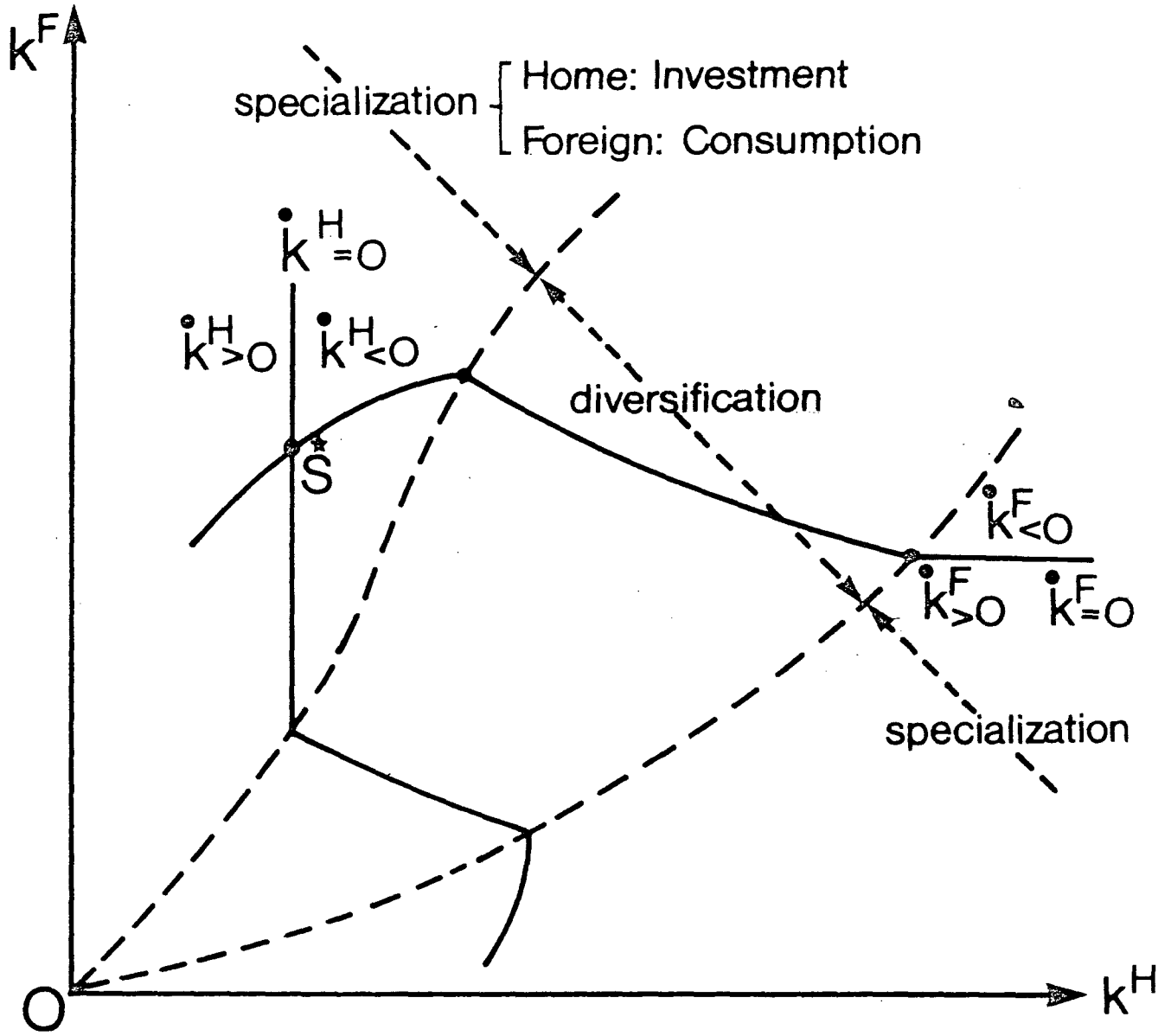
k^F
specialization
Home: Investment
Foreign: Consumption
$\dot{k}^H_{=O}$
$\dot{k}^H_{>O}$
$\dot{k}^H_{<O}$
diversification
S
$\dot{k}^F_{<O}$
$\dot{k}^F_{>O}$
$\dot{k}^F_{=O}$
specialization
O
k^H

Fig. 2

occurring only via different rates of capital accumulation. These are connected with trade - trade in physical capital goods - but there are no cross-country intertemporal exchanges, which we identified as the essence of capital movements proper.

Moreover, in the region of diversification there will be no incentive for capital movements. This is so because in this region, under our assumptions, FPE will obtain, with the consequence that factor movements and trade are substitutes.

But outside the diversification region where one or both countries are specialized we can expect factor price differences with the result that factor movements are induced in addition to free trade and without diminishing trade: complementarity obtains.

International factor endowment distributions in the region of specialization may be transitory or permanent, depending on whether the intersection of the steady state lines is outside or within this region. We confine the subsequent analysis to this latter case.

V. Growth with Specialized Production

It has been observed early that specialization may be a result of trade in situations which are much more frequent than the predominant static trade framework would lead us to expect. Ohlin (1933) maintained that "as a rule supply reactions tend to offset the price-equalizing tendencies of trade" (p. 124) and that "trade means specialization" (p. 125).

The idea of specialization in a two-commodity world seems especially strange, so one should keep in mind that the main merit of this model is in the

fundamental insights it permits without becoming excessively complex. With an increasing number of commodities, specialization corresponds more and more to real world observations: intraindustry trade is an extreme case.

Returning to the two-commodity abstraction, it may be observed that the very long run steady state situation of specialization depends mainly on such growth parameters as the savings ratio and the rate of labor growth (which may include technical progress and the rate of obsolescence) (Negishi 1965, Ethier and Ross 1971).

If we want to add intertemporal aspects of capital movements to the growth cum trade model, an additional analytical advantage may be had if we start from the region of specialization. As there is an investment goods industry only in one - say the home - country, the two country-related differential equations may be solved consecutively, which simplifies the mathematics considerably, without reducing unduly its applicability to our problem. Our subsequent argument follows essentially Hori and Stein (1977).

1. General Formulation of the Model

The model will be formulated in per capita terms. It is assumed that the home country - designated by superscript H - specializes in investment goods, the foreign country - designated by F - specializes in consumption goods. Net per capita (of home country) ownership of foreign assets by home country residents is admitted from the outset and designated by $+v$ resp. $-v$, if there is net ownership of home country assets by foreign residents. $v \neq 0$ implies net factor income flows, and $dv/dt = \dot{v} \neq 0$ implies a positive or negative balance on current account.

With production functions per capita

$$(1) \qquad x_j^k = f_j^k(k_j^k) \qquad \begin{cases} k = H.F & \text{for countries} \\ j = C.I & \text{for sectors} \end{cases}$$

definitions

$$(2) \qquad k_j^k = \frac{K_j^k}{N_j} \quad ; \quad x_j^k = \frac{X_j^k}{N_j^k} \quad ; \quad y^k = \frac{Y^k}{N^k}$$

and full employment conditions

$$(3) \qquad \begin{cases} K_c^k + K_I^k = K^k \\ \\ N_c^k + N_I^k = N^k \end{cases} \qquad \text{remembering} \qquad \begin{cases} K_c^H = K_I^F = 0 \\ \\ N_c^H = N_I^F = 0 \end{cases}$$

we have domestic products per capita of the appropriate population - expressed in terms of consumption goods units, i.e. with p = relative price of investment good -

$$(4) \qquad \begin{cases} pf_I^H(k_I^H) & \text{in home country, and} \\ f_c^F(k_c^H) & \text{in foreign country} \end{cases}$$

National products per capita have to take into account factor income flows (per capita, in terms of consumption good)

$$(5) \qquad \begin{cases} y^H = pf_I^H(k_I^H) + iv \\ y^F = f_c^F(k_c^F) - iv\,\frac{N^H}{N^F} \end{cases}$$

where i is an interest rate, to be derived below.

The savings ratio s is assumed to be constant and identical between countries: thus the supply of savings in each country is easily calculated from (5).

The demand for savings is derived from the investment or capital accumulation equations

$$(6) \qquad \frac{\dot{K}_I^H}{N_I^H} = \dot{k}_I^H + nk_I^H \quad ; \quad \frac{\dot{K}_c^F}{N_c^F} = \dot{k}_c^F + nk_c^F$$

where $n = \dot{N}^H/N^H = \dot{N}^F/N^F$ may include Harrod-neutral technical progress and a proportional rate of obsolescence.

The following quantity restrictions have to be observed at every point in time

$$(7a) \qquad N^H f_I^H(k_I^H) = N^H(\dot{k}_I^H + nk_I^H) + N^F(\dot{k}_c^F + nk_c^F)$$

That is: investment good production (in home country) equals investment demand by both countries.

$$(7b) \qquad N^F f_c^F(k_c^F) = (1 - s)\,[pN^H f_I^H(k_I^H) + N^F f_c^F(k_c^F)]$$

Consumption goods production (by foreign country) meets world consumption demand. Note that the above formulation implies equal savings ratios in both countries, because only then the iv-terms from equation (5) cancel out. Equation (7b) may be used to solve for the equilibrium price or commodity terms of trade:

$$(7b') \qquad p = \frac{s}{1-s} \frac{N^F}{N^H} \frac{f_c^F(k_c^F)}{f_I^H(k_I^H)}$$

In addition, we have the balance of payments restrictions

$$(8)\qquad \begin{cases} spN^H f_I^H(k_I^H) + sivN^H - pN^H(\dot{k}_I^H + nk_I^H) = \dot{v} \\ sN^F f_c^F(k_c^F) - sivN^F - pN^F(k_c^F + nk_c^F) = \dot{v} \end{cases}$$

for the home and foreign countries respectively.

2. *Solution for Balanced Trade*

We first set $v = \dot{v} = 0$, i.e. we impose balance of payments equilibrium and zero net ownership of foreign assets. From (8a) we derive the accumulation equation for the home country

$$(9a)\qquad sf_I^H(k_I^H) = \dot{k}_I^H + nk_I^H$$

which is identical to Solow's equation for a one-sector closed economy. From (8b) on the other hand we derive the growth path for the foreign country, using (7b')

$$(9b)\qquad \dot{k}_c^F = (1-s)\, f_I^H(k_I^H)\frac{N^H}{N^F} - nk_c^F$$

It is easily seen that - because of specialization - (9a) can be solved independently of (9b) for $k_I^H(t)$, which then can be inserted into (9b) for the foreign country's accumulation path. Alternatively, we may look at the steady state values $\overset{*}{k}{}_I^H$, $\overset{*}{k}{}_c^F$ in both countries, where capital intensities cease to change ($\dot{k}_I^H = \dot{k}_c^F = 0$ in (9a) resp. (9b)).

$$(10)\qquad \frac{f_I^H(\overset{*}{k}{}_I^H)}{\overset{*}{k}{}_I^H} = \frac{n}{s} \quad \text{for the home country, and}$$

$$(11)\qquad \overset{*}{k}{}_c^F = \frac{1-s}{s}\frac{N^H}{N^F}\overset{*}{k}{}_I^H \quad \text{for the foreign country.}$$

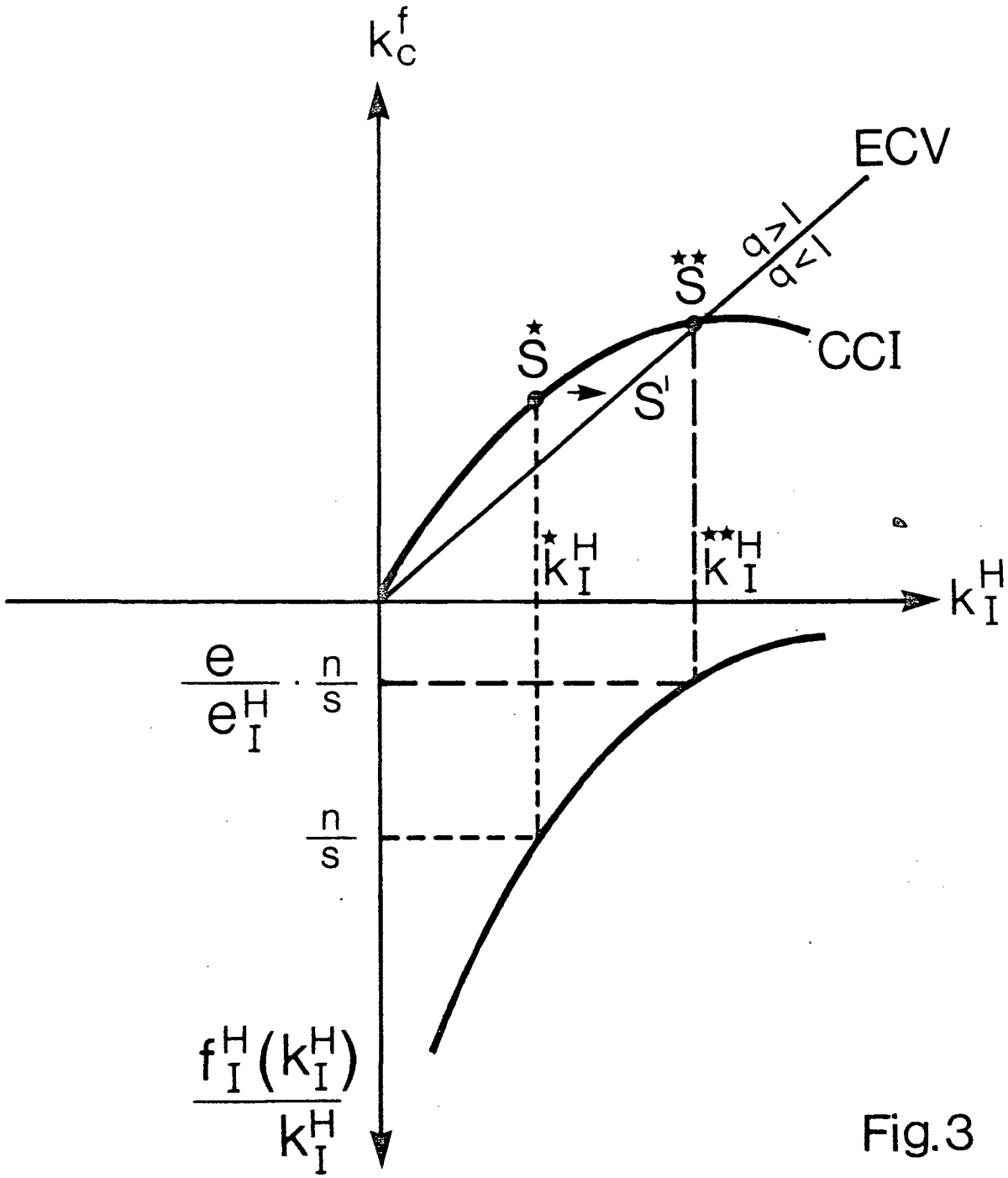
k_c^f
ECV
q>1
q<1
$\star\star S$
$\star S$
CCI
S'
$\star k_I^H$
$\star\star k_I^H$
k_I^H
$\frac{e}{e_I^H} \cdot \frac{n}{s}$
$\frac{n}{s}$
$\frac{f_I^H(k_I^H)}{k_I^H}$

Fig.3

In order to describe the long term outcome of this growth-cum-trade model with specialization we impose the steady state condition $\dot{k}_I^H = \dot{k}_c^F = 0$ on the investment equation (7a), which gives a relationship

$$(12) \qquad k_c^F = \frac{N^H}{nN^F} \left[f_I^H(k_I^H) - nk_I^H \right]$$

which may be graphed in (k^F, k^H)-space, where it identifies those combinations which imply constant capital intensities in both countries.

In Fig. 3 the capital productivity schedule (10) is graphed in the fourth quadrant, while the constant capital intensity relationship (12) is drawn in the first quadrant. The steady state solution for exogeneously given n/s is designated as S^*. It corresponds to the intersection point for specialized steady states in Fig. 2.

3. *Growth with Trade in Ownership Claims*

We now account for the possibility of net ownership by home country residents of capital in the foreign country ($v > 0$) or for the reverse ($v < 0$), and for changes in net foreign ownership ($\dot{v} \neq 0$) implying a current account surplus for the home country when $\dot{v} > 0$, and a deficit when $\dot{v} < 0$.

In our highly aggregated and simplified model, home ownership of foreign capital goods and its rate of change over time can take many forms. A particularly natural and simple way to look at these phenomena is to think of equity shares, which are issued by firms, represent ownership of one unit of accumulated capital goods and entitle the holder to receive income equal to the rental rate of capital. The price of a share issued by home country (investment sector) firms is q_I^H, and the price of a foreign share is q_c^F. The rental rates of capital in a competitive

equilibrium are equal to the values of marginal products (expressed in terms of consumption goods units):

$$(13)\qquad \begin{cases} p\,\dfrac{df_I^H(k_I^H)}{dk_I^H} = pf_{Ik}^H(k_I^H) & \text{in the home country} \\ \dfrac{df_c^F(k_c^F)}{dk_c^F} = f_{ck}^F(k_c^F) & \text{in the foreign country.} \end{cases}$$

In order to secure this income from a unit of capital stock, the prospective shareholder has to pay price q per share. His income per unit of account (consumption good in our moneyless economy) will thus be

$$(14)\qquad \begin{cases} pf_{Ik}^H(k_I^H) \;/\; q_I^H = i_I^H \\ \text{and} \\ f_{ck}^F(k_c^F) \;/\; q_c^F = i_c^F \end{cases}$$

if he buys home or foreign equity respectively. In perfect capital markets we may assume that the q_j^k adjust very quickly, so that interest rates are equalized across countries:

$$(15)\qquad i = i_c^F = i_I^H \quad .$$

This is a condition for portfolio equilibrium. On the other hand, firms will issue equity in order to finance investment only if the price of a share is at least as high as the price per unit of investment good (both expressed in terms of the numeraire, i.e. consumption goods). Otherwise they would not be willing and able to invest.

Now let us distinguish two cases

$$(I)\qquad q_I^H > q_c^F \quad .$$

All the savings will be used to buy home-country equity, all investment will take place in the home country's investment goods sector, with the consequence of $p = q_I^H$. In this case the accumulation equation (9) reduces to

$$(16) \qquad \begin{cases} \dot{k}_I^H = f_I^H(k_I^H) - nk_I^H \\ \dot{k}_c^F = -nk_c^F \end{cases}$$

On the other hand, if

$$(II) \qquad q_c^F > q_I^H \ ,$$

savings of both countries would be channelled to finance investment exclusively in the foreign country: $p = q_c^F$ and from (9) we derive

$$(17) \qquad \begin{cases} \dot{k}_I^H = -nk_I^H \\ \dot{k}_c^F = f_I^H(k_I^H)\frac{N^H}{N^F} - nk_c^F \end{cases}$$

By comparing the pairs of differential equations in(16) and (17) we see that

$$(18) \qquad \frac{k_c^F}{k_I^H} \quad \left.\begin{matrix}\text{rises} \\ \text{falls}\end{matrix}\right\} \text{ when } \begin{cases} q_c^F > q_I^H \\ q_c^F < q_I^H \end{cases} \qquad \text{implying } \frac{q_I^H}{q_c^F} = q \lesseqgtr 1$$

From these assumptions about savers' and investors' behavior it follows that the endowment ratio (18) approaches a definite magnitude which is implied by $q = 1$, i.e. equal capital values in both countries. To bring this in the open, we insert the portfolio balance condition (15) and the terms of trade equation (7b') into the

capital rentals expression (14) to obtain

$$(19) \qquad q = \frac{q_I^H}{q_c^F} = \frac{s}{1-s} \cdot \frac{N^F}{N^H} \cdot \frac{e_I^H k_c^F}{e_c^F k_I^H}$$

using elasticities of production

$$(20) \qquad e_j^k = \frac{f_{jk}^k (k_j^k)}{f_j^j (k_j^k) / k_j^k} \qquad \begin{cases} k = H, F \\ j = I, C \end{cases}$$

The equation for equal capital values in both countries follows with $q = 1$

$$(21) \qquad k_c^F = \left[\frac{1-s}{s} \frac{N^H}{N^F} \frac{e_c^F}{e_I^H} \right] k_I^H$$

With a constant savings ratio, equal and constant labor growth rates and constant elasticities of production (as e.g. in Cobb-Douglas production functions), the term in square brackets in (21) is constant and (21) is a ray through the origin in the (k_c^F, k_I^H)-plane of Fig. 3.

It is apparent that $q > 1$ above that ray and $q < 1$ below; from the previous argument leading to (18) it follows that the ray is approached from either side. We may conclude that under our assumptions free trade in equities leads to constellations of capital intensities in our countries, which are on ray (21), where capital values are equal ("iso-capital-value"-curve in Hori-Stein [1977]).

VI. Effects of Free Trade in Securities

It follows from the preceding analysis and is obvious from Fig. 3 that the two steady state situations $\overset{*}{S}$ (free trade without capital movements) and $\overset{**}{S}$ (free trade in goods and securities) and their relative positions are crucial for the resulting growth equlibria. $\overset{*}{S}$ is determined by savings and labor growth, and so is $\overset{**}{S}$, if elasticities of production are equal across sectors - and in this model equivalently: across countries. (It is one of the limitations of this framework of complete specialization that one cannot distinguish between intersectoral and international differences in technology.) We rule out equal elasticities of production.

If the elasticity of production is higher in the home country's investment goods industry - as is assumed in Fig. 3 - $\overset{**}{S}$ is to the right of $\overset{*}{S}$. More precisely, we have

$$(22) \qquad \frac{e}{e_I^H} = \frac{se_I^H + (1-s)\,e_c^F}{e_I^H} = s + (1-s)\,\frac{e_c^F}{e_I^H} \begin{Bmatrix} < \\ = \\ > \end{Bmatrix} 1, \quad \text{if} \begin{cases} e_c^F < e_I^H \\ e_c^F = e_I^H \\ e_c^F > e_I^H \end{cases}$$

The exact location of $\overset{**}{S}$ may be determined by inserting relation

$$(23) \qquad \dot{k}^F = [\,]\,\dot{k}_I^H$$

which is obtained by taking the time differential of (21), into (7a):

$$(24) \qquad \dot{k}_I^H = \frac{e_I^H}{e}\, sf_I^H(k_I^H) - nk_I^H$$

where e is defined by (22) as a weighted average of the elasticities of production. Economically, by (24) we describe a growth path, when free trade in securities has

equalized capital values. Its solution for the steady state $\overset{**}{S}$ follows from letting $\dot{k}^H = 0$ in (24):

$$(25) \qquad \frac{f_I^H(\overset{**}{k}_I^H)}{\overset{**}{k}_I^H} = \frac{e}{e_I^H} \cdot \frac{n}{s}$$

It is constructed in Fig. 3 with the help of the average capital productivity curve in the fourth quadrant.

A comparison of $\overset{*}{S}$ and $\overset{**}{S}$ shows that free trade in securities raises steady state values of capital intensities and therefore domestic products in both countries. This is because at $\overset{*}{S}$, where we have specialization, the value of capital in the home country exceeds that in the foreign country: $q = \frac{q_I^H}{q_c^F} > 1$. Consequently all savings and investment will be channelled into the home country, whose capital intensity k_I^H increases until the $q = 1$ ray (ECV) is attained. This implies capital imports into the home country, which insofar experiences a deficit on current account and a corresponding surplus on capital account: the home country's net indebtedness is growing during the approach to the $q = 1$ ray.

Once the world economy is on the ECV-ray, it may be assumed that it stays there, and that savings and investment are channelled into both countries in a proportion that maintains equal capital values ($q = 1$). The resulting growth path with free trade in goods and securities is described by (24). It ultimately ends up at $\overset{**}{S}$.

If we assume that equalization of capital values by portfolio adjustments is a quick process, we may conclude that the resulting movement towards the ECV-ray is more rapid than that towards the CCI-curve. From an arbitrary point in Fig. 3

the world economy will thus first move horizontally to the ECV-ray and then follow the latter towards S^{**}. Points in Fig. 3 describe of course the relative availability of physical capital per man as input to the production process in the two countries. This location of physical capital has to be distinguished from ownership of capital. It is the essence of free international trade in securities that the two may diverge.

The model can be used to derive interesting results about the development of wealth in both countries, yielding time paths of net foreign capital ownership resp. endebtedness. Implied are of course corresponding time paths of current and capital accounts.

Here we are mainly interested in the question of substitutability vs. complementarity between trade and capital movements. The answer may be stated as follows: if long run capital accumulation is taken into account, there may be states of specialization - such as S^* in Fig. 3 - which exhibit factor price differentials, even if all the other prerequisites for FPE are met. If there are no obstacles, international capital movements will result, which without diminishing trade will tend to equalize factor prices. The ensuing increase in efficiency shows up in a movement from S^* to S^{**} in Fig. 3, demonstrating a rise in capital intensity and per capita income in both countries.

VII. Concluding Remarks

In order to make some progress towards the aim of better understanding the dynamic interactions between international capital movements and trade, several simplifying assumptions had to be introduced, which may be subsequently relaxed in order to get a more comprehensive analysis. Some of them will be briefly commented upon.

Allowing for differences between countries of labor growth rates n (incorporating technical progress and obsolescence) and savings ratios s (perhaps introducing alternative savings functions) will certainly at the cost of some additional algebra permit a meaningful broadening of the model's applicability.

Allowing for diversification even in the ultimate steady state is probably the most desirable generalization. This would permit to analyze the dynamic relationship between capital movements and trade in a situation of FPE. Moreover, the existence of capital in different sectors and thus of different types of equity seems to be a prerequisite for analyzing phenomena of two-way capital flows in a growth context. (For a static analysis cf. Jones et al. [1983]). This seems particularly important because the reasonable counterpart of <u>two</u>-way trade is <u>cross</u>-hauling of foreign investment, and not <u>net</u> capital movements. Only when gross capital movements are taken into account do we have two-way intertemporal trade.

As in most growth models, in our analysis steady state solutions occupied a prominent place. This should not obscure the fact that transition processes towards steady states are what we are really interested in. To describe them by means of explicit functions of time might be enlightening in many instances. Results from simpler growth models suggest that the time required for some kind of approach to

steady states may be very, very long. An alternative approach might be to take as a foundation the two-period analysis of trade and factor-movements as in Chipman (1985) and generalize from there. Combinations with models of overlapping generations might be rewarding.

Still another way to generalize the analysis is to introduce several types of ownership claims, which are traded internationally. In addition to equity shares, e.g., bonds and money might be taken into account. This will not only permit to consider various institutional arrangements, but also provide a link with monetary aspects of trade and macroeconomic variables. The insight that intertemporal trade provides the link between real and monetary aspects may thus be fruitfully exploited. It should be added in conclusion that bringing the future into the analysis necessitates recognition of uncertainty and related concepts.

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