ELSEVIER

Journal of Development Economics
Vol. 49 (1996) 3–32

JOURNAL OF
Development
ECONOMICS

The division of labor and economic development

Andrés Rodríguez-Clare *

Graduate School of Business, University of Chicago Chicago IL, USA

Received 15 May 1994; revised 15 August 1995

Abstract

Building on three widely accepted premises (productivity gains from the division of labor, efficiency gains derived from the proximity of suppliers and users of certain inputs, the division of labor is limited by the extent of the market) this paper shows that a small, open economy may be caught in an underdevelopment trap in which a shallow division of labor (i.e., a low variety of specialized inputs) is self-reinforcing. In turn, the shallow division of labor leads to a relatively low rate of return to capital, so foreign investment or domestic capital accumulation may not materialize.

JEL classification: 011; F21; L16

Keywords: Returns from the division of labor; Non-tradable intermediate goods; Decreasing average costs; Multiple Pareto-rankable equilibria

1. Introduction

The neoclassical growth model implies that automatic mechanisms will take an underdeveloped economy out of poverty. According to this model, an economy is poor because of a lack of capital. This implies that in poor economies the rate of return to capital is high, generating strong incentives for foreign investment and

* Corresponding author. 1101 East 58th St., Chicago, IL 60637. Phone: (312) 702-88, fax: (312) 702-0458 e-mail: andres.rodriguez@gsb.uchicago.edu.

SSDI 0304-3878(95)00051-8

domestic capital accumulation. [1] Yet, a casual look at the experience of many underdeveloped economies since World War II calls into doubt these automatic mechanisms: in many poor economies per capita income has remained stagnant for decades and both foreign and domestic investment have been relatively low as a percentage of total production. A more systematic look at the data also reveals a lack of convergence across all countries (Barro, 1991).

There have been several attempts to explain this lack of convergence across countries: some authors have introduced human capital into the neoclassical growth model to reconcile the model with the stylized facts (e.g., Barro et al., 1995), while others have focused on externalities (e.g., Lucas, 1990) and yet others have stressed differences in economic policy (e.g., Parente and Prescott, 1994; Sachs and Warner, 1995). This paper considers another possible explanation: it builds a model to show how an economy with a low division of labor may be stuck in an underdevelopment trap, where *both* wages and the rate of return to capital are low so that there may be no incentives for foreign investment or for domestic capital accumulation.

The argument presented in this paper is based on three widely accepted premises. The first, which dates back to Adam Smith, is that the wealth of nations is partially explained by the division of labor or, in other words, by the production of goods and the use of techniques that rely intensively on a wide variety of specialized intermediate goods and services. Today this is as clear as ever: in developed economies most firms use roundabout production methods, in which many different specialized inputs are used to produce final goods. In recent years, this old piece of wisdom has regained center stage in many fields; this paper follows this trend. [2]

It is evident that some economies have not reaped the benefits that can be derived from the division of labor. In these economies few resources are allocated to produce specialized inputs, and most firms produce goods or use techniques that rely intensively on direct or 'raw' labor. A natural question arises: why is it that poor economies do not import the specialized inputs produced in developed economies to benefit from the division of labor existing there? One possible explanation, which constitutes the second premise of our argument, is that for many inputs it is important that the supplier be near the final producer.

Producer services (e.g. banking, auditing, consulting, wholesale services, transportation, machine repair), which are usually regarded as *non-tradable* goods, are

[1] See Lucas (1990), Romer (1991) and Stiglitz (1988).

[2] The idea that efficiency is enhanced by the division of labor was introduced by Adam Smith and revived this century by Young (1928) and Stigler (1951). This idea has been recently formalized and used in Growth Theory by Romer (1990) and in International Economics by Ethier (1982a) and Helpman and Krugman (1985) (among others).

a clear example of such inputs. [3] But even acquiring physical intermediate goods not produced locally may be quite costly. Given that many producer services are involved in taking those goods from the point of production to where they will be used, if these services are lacking or costly, using imported physical inputs may be costly. Moreover, when inputs have to be imported, there is a higher risk that they will not arrive at the right time or with the correct specifications, forcing firms to hold high inventories of such inputs. [4] As Porter (1992) argues, the domestic presence of suppliers is an important determinant of the comparative advantage of nations because it provides ''efficient, early, rapid, and sometimes preferential access to the most cost-effective inputs'' (p. 102). [5]

Our first two premises imply that the *local* production of a wide variety of specialized inputs improves the efficiency of local firms producing final goods, an idea that dates back at least to the work of Marshall (1920), and has been reexamined more recently by Jacobs (1969), Jacobs (1984), Porter (1992), Rivera-Batiz (1988) and Fujita (1989), among others (see Holmes (1995) for some recent evidence in support of this hypothesis). But if this is to provide an explanation for the difference in economic performance across rich and poor countries, we must first explain why poor economies themselves do not produce a wide variety of specialized intermediate goods.

This paper will show that if specialized intermediate goods are produced with decreasing average costs, there may be an equilibrium in which few of such goods are produced (i.e., an equilibrium with a shallow division of labor). [6] The low variety of specialized inputs leads to the production of goods and the use of

---

[3] The seminal contribution on the role of producer services in a modern economy is Greenfield (1966), who viewed producer services as intangible inputs whose production cannot be separated in time or place from their use, and therefore regarded them as nontradable goods. More recently, one can find this view in empirical studies on real exchange rates of national price levels, which usually treat services as nontradable goods (see Kravis and Lipsey, 1988). It may be argued that there actually is trade in services but such trade is better conceived as the result of foreign investment rather than pure trade (see Hindley, 1990; Kravis, 1985). As will become clear below, this distinction is important in the context of this paper. Rodríguez-Clare (1993) reviews the empirical literature on the importance of the location of producer services for the location of industry (see also Daniels (1985)).

[4] See Greif and Rodríguez-Clare (1995) and Wilson (1992, pp. 101–104), for some concrete examples.

[5] In regional economics, the conventional wisdom seems to be that when the value/weight ratio is low, when the time of need of inputs is uncertain, when low quantities are needed and quality and time of delivery are essential, then it is very convenient to have the source of the input close by (see Vernon, 1966; Scott and Storper, 1987).

[6] There is evidence that many intermediate goods are produced with decreasing average costs, particularly for producer services. Faini (1984) mentions various studies which support the assumption that increasing returns to scale prevail in the production of producer services (banking, accounting, transportation, electricity,...). Moreover, professional services (consulting, auditing, engineering,...) are intensive in information as an input of production (see Romer, 1991).

techniques that do not require a wide variety of these inputs. This in turn limits the size of the market for specialized inputs and the incentives to undertake their production. This is just a reflection of another old idea, which constitutes the third premise of our argument, namely, that the division of labor is limited by the extent of the market. A similar logic establishes that there may be an equilibrium in which a large variety of intermediate goods are produced (i.e., an equilibrium with a deep division of labor). Therefore, there is the possibility of multiple equilibria.

When there are multiple equilibria and the returns from the division of labor are sufficiently high, both the wage and the rate of return to capital are higher in the equilibrium with a deep division of labor than in the equilibrium with a shallow division of labor. In this case, the equilibrium with a deep division of labor is Pareto-superior to the equilibrium with a shallow division of labor. Furthermore, as long as there are positive returns from the division of labor, the former equilibrium dominates the latter according to the potential-Pareto criterion; in the context of a small, open economy, this just implies that production valued at world prices is higher in the equilibrium with a deep division of labor. [7]

The situation of an economy in the 'bad' equilibrium could be improved through an increase in the capital stock. Intuitively, a higher capital stock would expand the market and allow a deeper division of labor, which would allow some firms to produce goods and use techniques that rely intensively on a wide variety of specialized inputs. In turn, this would make the production of specialized inputs more profitable, thereby deepening the division of labor in the intermediate goods sector even more. This virtuous circle could take the economy out of the bad equilibrium. In formal terms, a sufficiently high capital stock rules out the existence of an equilibrium with a shallow division of labor.

The problem is that the rate of return to capital in a poor economy is low, for exactly the same reasons that the economy is poor; namely, because the shallow division of labor renders primary factors less productive. As a consequence, capital does not necessarily flow from abroad. Formally, the paper shows that there exists an allocation of capital across economies such that the capital–labor ratio and the wage rate are higher in rich economies than in poor ones and yet, in contrast to the neoclassical growth model, there is equalization in the rate of return to capital. In the working paper version of this paper I show that, for similar

[7] One empirical implication of the model, taking producer services as main class of non-tradable inputs produced with decreasing average costs, is that countries with higher income per capita should have a higher proportion of the labor force devoted to the production of producer services. Singlemann (1970) provides empirical support for this prediction: "among countries, the higher the level of per capita income, the larger the proportion of the labor force in producer and social services" (p. 94). More recent data for a subset of producer services, business services, also verifies this prediction (see Rodríguez-Clare, 1993). Kubo et al. (1986) provide additional evidence that development is associated with a deepening division of labor.

reasons, domestic capital accumulation does not necessarily take the economy out of the bad equilibrium. [8]

The rest of the paper is organized as follows. The next section relates the main results of this paper to the previous literature. Section 3 presents the basic model and Section 4 characterizes its equilibria, showing the conditions under which there are multiple equilibria. Section 5 focuses on the case in which there are multiple equilibria and shows that the equilibria are Pareto-rankable. Section 6 shows that the model is consistent with the absence of large capital flows from rich to poor countries. That section also discusses informally the implications of extending the model to allow for capital accumulation.

2. Relation to previous literature

As is well known in the international-trade literature, multiple Pareto-rankable equilibria may arise in a model of a small, open economy where there are positive technological externalities in one sector. When more resources are devoted to the production of the good that has externalities, production costs for this good decrease; this complementarity leads to the possibility of multiple Pareto-rankable equilibria. Since its original formulation by Graham (1923), this model has been criticized because of the vague nature of the external economies considered (see Scitovsky, 1954).

In their formalization of Rosenstein-Rodan's Big Push theory, Murphy et al. (1989) show that even with no technological externalities there may be multiple Pareto-rankable equilibria. [9] In their model the economy is closed to international trade and there are many different sectors which can use a simple constant-returns technology or an increasing returns technology (called an industrial technology). Complementarities may arise because as one sector adopts the industrial technology it may increase demand for the goods of other sectors. This would make it more likely that other sectors adopt the industrial technology, leading to the possibility of multiple Pareto-rankable equilibria. In essence, this theory asserts

[8] Specifically, in Rodríguez-Clare (1995b) I construct a dynamic version of the model presented in this paper to show that when the economy inherits a low capital stock, there are two paths of capital accumulation: one which leads to a low steady state capital stock with a shallow division of labor and a low rate of return to capital, and another path in which the capital stock increases beyond the low steady state, leading to a deeper division of labor and to the production of goods and the use of techniques that use more roundabout methods of production.

[9] There are also models in macroeconomics in which there are multiple Pareto-rankable equilibria owing to the existence of increasing returns to scale. See for instance Cooper and John (1988). Stiglitz (1991) contains several suggestions of feedback mechanisms that may generate multiple equilibria and discusses the importance of this approach for development economics.

that in the low-development equilibrium there is no industrialization because of a lack of domestic demand.

This paper presents an alternative approach. It is assumed that the economy is open to international trade in final goods. The domestic market does play a critical role here, but because of the importance of domestic inputs in the production of final goods. The obstacle to development arises from the shallow division of labor in the intermediate goods sector rather than from the constraint imposed by low domestic demand. This difference between this model and the Big Push model leads to very different policy implications: in this model it is the creation of the appropriate linkages and not a policy of 'balanced growth' that should be the major concern of underdeveloped countries. [10] In this sense, this paper is closer to the literature that developed from the seminal contribution of Hirschman (1958), who emphasized the importance of forward and backward linkages in the process of economic development.

A related model has been proposed by Okuno-Fujiwara (1988), who shows that the presence of a non-tradable intermediate good produced with decreasing average costs may lead to multiple Pareto-rankable equilibria in a small, open economy. Okuno-Fujiwara was concerned with the obstacles to the development of a particular sector of the economy and to study this he developed a model of interdependence of two industries: a final-good industry and a non-traded input industry. In contrast, the emphasis of this paper is on the problems of development for a whole economy. Accordingly, we emphasize the importance of the division of labor (i.e. the variety of non-tradable intermediate goods) and its effects on wages and the rate of return to capital. [11]

Also related are papers by Ciccone and Matsuyama (in this issue) and Rodrik (1995). Ciccone and Matsuyama show the existence of multiple equilibria in a dynamic model that exhibits complementarities that are related to the ones that arise in this paper. The complementarities in their model arise because of a relatively high aggregate elasticity of substitution between labor and intermediate goods, whereas in this paper complementarities arise because of the expansion of the sector that uses intermediate goods intensively. Rodrik (1995) shows the existence of multiple Pareto-rankable equilibria in a model that is similar to the one presented here. Rodrik's objectives are different, however, in that he is interested primarily in understanding how the education level of the workforce

---

[10] Indeed, this seems to have been one of the main corners in the industrial policy of the South-East export-oriented economies. Wade (1990) makes this argument for the particular case of Taiwan.

[11] A similar model is the one developed by Murphy et al. (1989) in section IV of their paper. In this section they explore the interdependence between investment in infrastructure and industrialization. Since infrastructure is clearly non-tradable, this model comes closer to the model by Okuno-Fujiwara and to the model developed in this paper.

determines whether there are multiple equilibria, and on how a high-wage policy may help the economy select the Pareto-dominant equilibrium.

3. The basic model

There are two final goods, z and y, and one intermediate good x, which comes in a continuum of varieties. Variety is indexed by the real number j. Since we will assume below that all varieties of x are identical, without loss of generality we can represent the set of varieties available by the interval $[0, n]$, where n is a positive real number. The primary inputs are labor and capital, whose total supply is fixed at quantities L and K respectively.

Goods z and y can be traded freely in the world market, and the domestic economy is 'small' in the sense that it does not affect the international prices of z and y, denoted respectively by P_z and P_y (in terms of some international numeraire). To capture in a simple way the importance of proximity between suppliers and users of inputs, we will assume that all varieties of x are non-tradable. [12] We will let $p(j)$ denote the price of variety j of intermediate good x.

Intermediate good x is produced with a simple decreasing average cost technology: there is a fixed requirement of 1 unit of capital and each unit of $x(j)$ requires one unit of labor: $x(j) = L_{x(j)}$, where $L_{x(j)}$ is the quantity of labor used in the production of $x(j)$. This specification of the technology is introduced to capture in a simple way the idea that the division of labor is limited by the extent of the market.

Both final goods are produced with a Cobb–Douglas production function using capital, labor and a composite intermediate good, H, which in turn is assembled from a continuum of differentiated intermediate goods:

$$Q_s = K_s^{\delta(s)} L_s^{\beta(s) - \delta(s)} H_s^{1-\beta(s)}, \tag{1a}$$

$$H_s = \left(\int_0^n x(j)_s^{\alpha} \mathrm{d}j \right)^{1/\alpha}, \tag{1b}$$

where $\beta(s)$ and $\delta(s)$ are parameters in $[0, 1]$, with $\beta(s) > \delta(s)$, for $s = z, y$ and $\alpha \in (0, 1)$. [13] It is assumed that $\beta(z) > \beta(y)$ and $\delta(z) < \delta(y)$, which implies that

[12] The reader should keep in mind that the assumption of non-tradability is made to simplify the analysis; less extreme assumptions would lead to the same results. As long as transport costs for intermediate goods are significant, firms prefer to set up in countries that produce these inputs so as to save on those transportation costs. Non-tradability is an extreme assumption that considerably simplifies the analysis but milder assumptions suffice for the results of the model.

[13] The composite intermediate good H uses the functional form introduced by Dixit and Stiglitz (1978) first proposed as a specification for a utility function and later applied to production theory by Ethier (1982a).

the y-industry uses intermediate goods and capital more intensively than the z-industry. [14] [15] [16]

The specification of the production function in (1) implies that there are returns from the division of labor in the production of intermediate goods. Because of the symmetric way in which different varieties of x enter in (1) and convexity ($0 < \alpha < 1$), efficiency requires firms producing final goods to use the same quantity of all available varieties. Letting $X = \int_0^n x(j)\mathrm{d}j = nx$ be the amount of labor devoted to the production of intermediate goods, the production function for s can be written as

$$Q_s = n^{\phi(s)} K_s^{\delta(s)} L_s^{\beta(s) - \delta(s)} X_s^{1 - \beta(s)} \tag{2}$$

where $\phi(s) = (1 - \beta(s))(1 - \alpha)/\alpha$, $s = z, y$. Eq. (2) clearly shows that an increase in the measure of varieties available increases total factor productivity in the production of final goods – the same quantities of K, L and X produce a higher quantity of the final good when n increases. This arises because inputs are imperfect substitutes amongst themselves ($\alpha < 1$). Therefore, the fewer varieties available in the marketplace, the more intensively the firm will have to use the available intermediate goods to substitute for the 'missing' inputs and the more the firm will 'lose' in imperfect substitution. [17] This property of the production function in (1) is commonly referred to as *love of variety for inputs* and is introduced in this model to capture the existence of returns from the division of labor.

[14] An alternative interpretation of the model is that there are two methods of production (rather than two goods), which differ in the intensity with which they use specialized inputs; in this case we would have $P_z = P_y$.

[15] Grossman and Helpman (1991) in chapter 6 present a similar model (although with different aims), but with $\beta(z) = \beta(y)$. Because of this there is a unique equilibrium. Markusen (1990) presents a model that comes closer to our model. In fact his model can be seen as a particular case of our model with $\delta(z) = \delta(y) = 0$ and $\beta(z) = 1$. We will comment further on the relation between our paper and Markusen's below. Helpman and Krugman (1985) show that the existence of non-tradable intermediate goods may lead to multiple equilibria in model of two-country trade. The multiple equilibria result they obtain concerns only the way in which the integrated equilibrium is reproduced in the two country model, and hence does not have any welfare implications.

[16] The results do not change significantly when $\delta(z) > \delta(y)$; see footnote 21.

[17] One alternative modelling strategy would be to assume that each firm producing a final good will need different inputs at different times. At any time, a given firm wants an ideal specialized input; if it is not available in the market, the firm will buy the 'closest' one it finds and transform it, at a cost, into the desired input. The more varieties available of the input, the less the firm will have to incur into this transformation cost and hence the more efficient the firm will be. This alternative model is based on a reinterpretation of Lancaster (1979) proposed by Weitzman (1991).

4. Market equilibria

Each firm producing a variety of x is better off choosing a variety that is not already being produced by another firm; therefore, variety j of x, if it is produced, is produced by a single firm which then chooses the price $p(j)$ to maximize profits. Since we assume free entry into the intermediate goods sector, the equilibrium for this economy is defined as a measure of varieties produced (n), an allocation of L and K among the production of z, y and x $(L_z + L_y + L_x = L$, $K_z + K_y = K - n)$, a production level of each variety of x and its allocation among sectors $(x(j) = x_z(j) + x_y(j))$, a rental rate for capital (r), a wage (w), and prices for each variety of x $(p(j))$, such that: (i) $p(j)$ maximizes profits from producing variety j of the intermediate good; (ii) given $(n, r, w, \{p(j);\ j \leq n\})$, the inputs K_s, L_s and $\{x_s(j);\ j \leq n\}$ are determined to minimize the unit cost of producing final good s, c^s; (iii) if both z and y are produced, then $c^z = P_z$ and $c^y = P_y$, while if there is complete specialization in s, then $c^s = P_s$ and $c^{-s} = P_{-s}$, where $-z = y$ and $-y = z$; and (iv) zero profits in the production of intermediate goods.

To analyze the equilibria of this economy we will first characterize a quasi-equilibrium in which n is taken as given; this quasi-equilibrium will be referred to as an n-equilibrium. We will then complete the characterization of equilibrium by introducing condition (iv) above. This condition will determine levels of n for which the n-equilibrium constitutes a general equilibrium.

4.1. n-equilibrium

It is well known (see Helpman and Krugman, 1985, chapter 6) that in this type of model, each variety is going to be priced at a constant markup $(1/a)$ over the marginal cost, which here is simply the wage:

$$p(j) = p^* \equiv \frac{w}{\alpha} \quad \text{for} \quad \text{all } j \in [0, n]. \tag{3}$$

Given that all varieties are priced at p^*, producers of final goods will use all varieties available in the same quantity: $x(j) = x$ for all j.

From (2) we can obtain the minimum unit cost of s as a function of n, r, w and p^*:

$$c^s(n, r, w, p^*) = a(s) n^{-\phi(s)} r^{\delta(s)} w^{\beta(s) - \delta(s)} (p^*)^{1-\beta(s)} \tag{4}$$

where $a(s) \equiv \delta(s)^{-\delta(s)}(\beta(s) - \delta(s))^{-(\beta(s) - \delta(s))}(1 - \beta(s))^{-(1-\beta(s))}$. As is well known, the unit demand function for K, L or X by sector s can be obtained from (4) as $\partial c_h^s \equiv \partial c^s(n, r, w, p^*)/{}^*h$ for $h = r$, w or p^*. Since the demand for X is in fact an indirect demand for labor, producers of final good s will use $(c_w^s + c_{p^*}^s)/c_r^s$ units of labor per unit of capital. Using (3) we can obtain that

$$\frac{L_s + X_s}{K_s} = \frac{c_w^s + c_{p^*}^s}{c_r^s} = \gamma(s)\left(\frac{r}{w}\right) \tag{5}$$

where $\gamma(s) \equiv [\beta(s) - \delta(s) + \alpha(1 - \beta(s))]/\delta(s)$. Given our assumptions that $\beta(z) > \beta(y)$ and $\delta(y) > \delta(z)$, then $\gamma(z) > \gamma(y)$, which implies that the z sector's total use of labor (directly and indirectly through X) per unit of capital is higher than for sector y. [18]

Using (5), the labor market clearing condition entails

$$\gamma(z)\left(\frac{r}{w}\right)\left(\frac{K_z}{K-n}\right) + \gamma(y)\left(\frac{r}{w}\right)\left(\frac{K_y}{K-n}\right) = \left(\frac{L}{K-n}\right). \tag{6}$$

To examine the properties of the n-equilibrium, it is useful to derive the cost of z relative to y when the economy is completely specialized in the production of final good s given K and n, which we denote by $\rho_s(K, n)$. To derive $\rho_s(K, n)$, first notice from (4) that

$$\frac{c^z(n, r, w, w/\alpha)}{c^y(n, r, w, w/\alpha)} = \left(\frac{a(z))}{a(y)}\right)\alpha^{\Delta\beta} n^{\Delta\phi}\left(\frac{r}{w}\right)^{\Delta\delta} \tag{7}$$

where $\Delta\delta \equiv \delta(y) - \delta(z) > 0$ and $\Delta\phi \equiv (y) - \phi(z) > 0$. Complete specialization in final good s entails $K_s = K - n$, and plugging this into (6) yields (r/w) for the case in which there is complete specialization in final good s. Plugging this into (7) finally yields

$$\rho_s(K, n) = \mu\gamma(s)^{\Delta\delta} n^{\Delta\phi}\left(\frac{K-n}{L}\right)^{\Delta\delta} \tag{8}$$

where $\mu \equiv [a(z)/a(y)]\alpha^{\Delta\beta} \cdot \gamma(z) > \gamma(y)$ then implies $\rho_z(K, n) > \rho_y(K, n)$. In words, the relative cost of the simple good z is higher when there is specialization in z than when there is specialization in y, a reflection of the concavity of the production possibilities frontier for a given level of n.

Since K is fixed (for now), we will suppress the argument K in $\rho_s(K, n)$ when it does not lead to confusion. From (8) we can see that the curves $\rho_s(n)$ have the shape of an inverted U (see Fig. 1). The reason for this is that, as n increases, there are two opposite effects on ρ_s. First, an increase in n implies a decrease in the capital stock devoted to the production of final goods ($K - n$ decreases). As we know from neoclassical trade theory, this leads to a decrease in the relative cost of the good that uses capital less intensively, that is, a decrease in $\rho_s(n)$. This

[18] There are two reasons for this. First, $\delta(y) > \delta(z)$ implies that the relative demand for (direct) labor is higher in the z sector than in the y sector. Second, $\beta(z) > \beta(y)$ implies that the z sector uses more direct labor relative to the use of X (indirect labor) than the y sector.

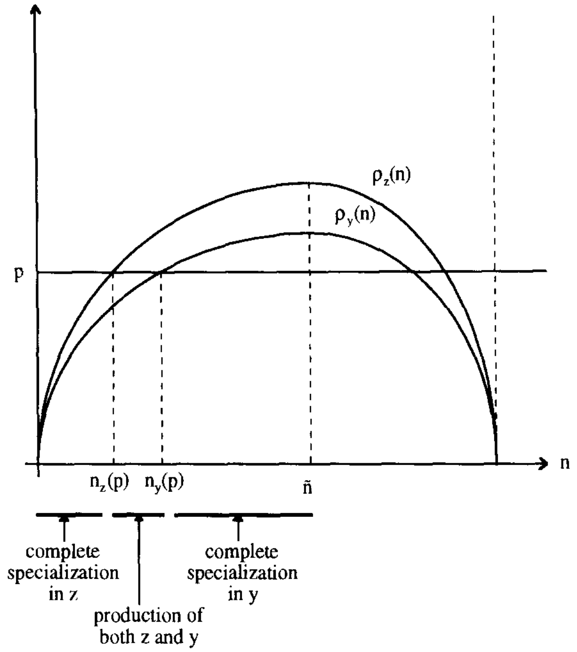

Fig. 1.

is the 'neoclassical' effect. Second, because of love of variety, an increase in n decreases production costs for both final goods. Since the production of y uses intermediate goods more intensively than the production of z (as reflected in $\Delta\phi > 0$), the cost of production for y decreases relatively more, leading to an increase in $\rho_s(n)$. We refer to this effect as the 'love of variety' effect. For low n, a high quantity of capital is left for the production of final goods and the love of variety effect dominates. Therefore, $\rho_s(n)$ is upward sloping. For values of n close to K, most of the capital stock is devoted to the production of intermediate goods and there is little left for producing final goods. Hence, the neoclassical effect dominates and $\rho_s(n)$ slopes downward.

Let $\tilde{n}_s$ be the level of n at which the curve $\rho_s(n)$ attains its maximum. From (8) it should be clear that $\tilde{n}_z = \tilde{n}_y = \tilde{n} \equiv (\Delta\phi/(\Delta\phi + \Delta\delta))K$. Since we are interested in exploring the situation in which the introduction of the division of labor into the neoclassical model affects the results in a significant way, we will later on make the necessary assumption to ensure that the equilibrium will always involve a level of n smaller than $\tilde{n}$, so that we are in the region where the love of variety effect dominates the neoclassical effect. Therefore, the following discussion is restricted to levels of n for which $n \leq \tilde{n}$.

For any level of n, the n-equilibrium may entail complete specialization in z, complete specialization in y or diversification (production of both z and y), depending of course on the relative price of z, which we denote by p ($p \equiv P_z/P_y$). To see this formally, let $n_s(p)$ denote the level of n that satisfies $\rho_s(n) = p$ for $n < \tilde{n}$ (see Fig. 1). We then have the following characterization of the $n-$ equilibrium:

1. If $n \le n_z(p)$, then $\rho_z(n) \le p$ and there is complete specialization in z.
2. If $n_y(p) \le n \le \tilde{n}$, then $p \le \rho_y(n)$ and there is complete specialization in y.
3. If $n_z(p) < n < n_y(p)$, then $\rho_z(n) > p > \rho_y(n)$ and there is production of both z and y.

Fig. 1 illustrates these results.

4.2. General equilibria

To characterize the general equilibria for this economy, we need to introduce the zero-profit condition in the production of intermediate goods. Denoting profits in the intermediate goods sector by π, we have

$$\pi = \left[(w/\alpha) - w\right] X/n - r. \tag{9}$$

X/n is the quantity sold by each monopolist in the intermediate goods sector, w/α is the price charged, w is the unit cost and r is the fixed cost (i.e. the cost of the one unit of capital required to produce a variety of x).

From (4) we can obtain the demand for X per unit of K by sector s:

$$\frac{X_s}{K_s} = \frac{c^s_{p^*}}{c^s_r} = \alpha\xi(s)\left(\frac{r}{w}\right) \tag{10}$$

where $\xi(s) \equiv (1 - \beta(s))/\delta(s)$. Plugging this into (9) we obtain

$$\pi = r\left(\frac{1-\alpha}{n}\right)\left(\xi(z)K_z + \xi(y)K_y\right) - r. \tag{11}$$

Let $n(s)$ be the value of n for which $\pi = 0$ if the economy were to specialize completely in final good s ($K_{-s} = 0$). From (11) and the capital market equilibrium condition $K = n + K_z + K_y$ we obtain

$$n(s) = \tau(s)K \tag{12}$$

where

$$\tau(s) \equiv \frac{(1-\alpha)\xi(s)}{1 + (1-\alpha)\xi(s)}.$$

Since $\beta(z) > \beta(y)$ and $\delta(y) > \delta(z)$, then $\xi(y)$ can be larger of smaller than $\xi(z)$. From (12) this implies that $n(y)$ could be larger or smaller than $n(z)$. Intuitively, when there is complete specialization in good y as opposed to good z, there are two opposing forces on profits in the intermediate good sector. $\beta(z) > \beta(y)$ implies that demand for X by the y industry is higher than demand for X by the z industry and this tends to make profits higher when there is complete specialization in y than when there is complete specialization in z. $\delta(y) > \delta(z)$

implies that demand for capital by the y industry is higher than demand for capital by the z industry and this makes the rental rate for capital – and hence also the fixed cost of producing a variety of x – higher when there is complete specialization in good y than with complete specialization in good z. Depending on which effect dominates, $n(y)$ could be larger or smaller than $n(z)$. Since this paper is motivated by the importance of the division of labor, we assume that the effect that arises through the difference $\beta(z) > \beta(y)$ dominates. Formally, we assume that

$$\xi(y) > \xi(z) \tag{I}$$

This condition ensures that $n(y) > n(z)$. Condition (I) also ensures that $n(s)$ will be on the side of the curve $\rho_s(n)$ where the love of variety effect dominates the neoclassical effect; that is, $n(s) < \tilde{n}$ for $s = z, y$. [19]

The fact that $n(y)$ is higher than $n(z)$ leads to the possibility of multiple equilibria. Intuitively, if there is complete specialization in final good y – which uses intermediate goods intensively – the demand for intermediate goods is relatively high, leading to the production of a large variety of intermediate goods. But given that y uses intermediate goods more intensively than z, this leads to a low relative cost of y, making complete specialization in y a possible equilibrium. The opposite happens when there is complete specialization in z, in which case there are few varieties of intermediate goods produced and the relative cost of y is high, making complete specialization in z a possible equilibrium. Notice from this discussion that we need $n(y) - n(z)$ to be large for there to exist multiple equilibria.

To see this formally, turn to Fig. 2, where we have assumed that $n(y) - n(z)$ is sufficiently large that $\rho_z(n(z)) \leq \rho_y(n(y))$. If $p \in [\rho_z(n(z)), \rho_y(n(y))]$, as we have in Fig. 2, then there are multiple equilibria. We can verify that all conditions for an equilibrium are satisfied at the $n(z)$-equilibrium: since $p > \rho_z(n(z))$, the $n(z)$-equilibrium involves complete specialization in z and, given the definition of $n(z)$, the zero-profit condition is satisfied. A similar argument establishes that all conditions for an equilibrium are satisfied at the $n(y)$-equilibrium. [20] [21] As one would expect, there is a third equilibrium, with $n = n^* \in [n_z(p), n_y(p)]$ and

[19] Simple algebra shows that $\tilde{n} > n(y)$ if and only if $\Delta\phi > \alpha\phi(y)\Delta\delta$. Condition (I) is equivalent to $\Delta\phi > \phi(y)\Delta\delta/\delta(y)$. Given that α, $\delta(y) < 1$, then $\phi(y)\Delta\delta/\delta(y) > \alpha\phi(y)\Delta\delta$, so condition (I) implies $\tilde{n} > n(y)$.

[20] Although the purpose of this paper is to show the possibility of multiple equilibria in a small-open economy, the results of this analysis do not depend on fixed relative prices. To see this, let the utility function of the representative consumer be $U(z, y)$, assumed to be homothetic, and let θ_s be the rate of substitution in consumption of z for y when the quantity of good s is zero ($\theta_z = U_2(0,1)/U_1(0,1)$ and $\theta_y = U_2(1,0)/U_1(1,0)$). Then, as long as $\rho_z(K, n(z)) <_y < \theta_z < \rho_y(K, n(y))$, both the complete specialization equilibria described above are general equilibria of this closed economy.

[21] This result is not dependent on the assumption that $\delta(y) > \delta(z)$: when $\delta(y) \leq \delta(z)$ and $|\Delta\delta|$ is small then $\rho_z(K, n) - \rho_y(K, n)$ will also be small and there will be multiple equilibria.

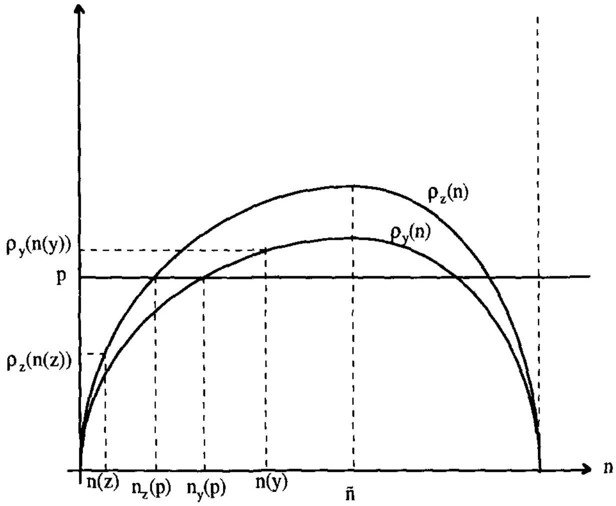

Fig. 2.

production of both z and y.

It can be shown that profits in the intermediate goods sector are increasing in n at $n = n^*$ (see the appendix). This implies that with 'naive Marshallian dynamics', where entrepreneurs slowly enter the intermediate good sector if profits there are positive and slowly exit when they incur losses in that sector, the equilibrium with $n = n^*$ is unstable: starting at the equilibrium with $n = n^*$, a slight perturbation in n would take the economy to one of the equilibria with complete specialization.

The following condition is sufficient (but not necessary) to ensure that $\rho_z(n(z)) \leq \rho_y(n(y))$:

$$1 + \frac{\Delta\phi}{\Delta\delta} > \frac{D[1 + (1 - \alpha)\xi(y)]}{\gamma(y)\Delta\xi} \tag{II}$$

where $\Delta\xi \equiv \xi(y) - \xi(z) > 0$ and $D \equiv \xi(y)\gamma(z) - \xi(z)\gamma(y) > 0$. Just as condition (I), condition (II) imposes an upper bound on $\Delta\delta$; it is trivially satisfied when $\Delta\delta = 0$. Moreover, condition (II) also guarantees that for $p \notin [\rho_z(n(z)), \rho_y(n(y))]$ there is a unique equilibrium, which entails complete specialization in z when $p > \rho_y(n(y))$ and complete specialization in y when $p < \rho_z(n(z))$. [22]

[22] When condition (II) is not satisfied there are several possibilities. If $1 + \Delta\phi/\Delta\delta < D[1 + (1 - \alpha)\xi(z)]/\gamma(z)\Delta\xi$ then there is a unique equilibrium for all prices. If $D[1 + (1 - \alpha)\xi(z)]/\gamma(z)\Delta\xi < 1 + \Delta\phi/\Delta\delta < D[1 + (1 - \alpha)\xi(y)]/\gamma(y)\Delta\xi$, then there may be a unique equilibrium or there may be multiple equilibria. Multiplicity of equilibria may involve two complete-specialization equilibria and one unstable (in the Marshallian sense) diversified equilibrium (i.e., with production of both z and y) or it may involve one equilibrium with complete specialization in z and two diversified equilibria (one unstable and one stable in the Marshallian sense). See Rodríguez-Clare (1995b) for a proof of these statements.

The following proposition which is proved in the appendix, summarizes the main results of this section:

Proposition 1. Assume conditions (I) and (II) hold. Then $\rho_z(n(z)) \leq \rho_y(n(y))$, and there is a unique equilibrium for $p \notin [\rho_z(n(z)), \rho_y(n(y))]$ and multiple equilibria for $p \in [\rho_z(n(z)), \rho_y(n(y))]$. In the latter case, there are three equilibria: an equilibrium with $n = n(z)$ and complete specialization in z (the z equilibrium), an equilibrium with $n = n(y)$ and complete specialization in y (the y equilibrium), and an equilibrium with production of both z and y (the diversified equilibrium). The latter equilibrium is unstable under 'naive Marshallian' dynamics.

We can now consider how the endowment of K and L affects whether there are multiple equilibria. From (8) and Proposition 1 we can see that there is multiple equilibria if and only if

$$p \in \left[\rho_z(K, n(z)), \rho_y(K, n(y)) \right] = \left[\Psi(z) K^{\Delta\phi} k^{\Delta\delta}, \Psi(z) K^{\Delta\Psi} k^{\Delta\delta} \right] \tag{13}$$

where $\Psi(s) \equiv \mu\gamma(s)^{\Delta\delta}\tau(s)^{\Delta\phi}(1 - \tau(s))^{\Delta\delta}$ and $k \equiv K/L$ (note that we are reintroducing K as a variable in the $\rho_s()$ function). This condition implies that there are multiple equilibria only for 'intermediate' economies; for very low levels of K or k there is a unique equilibrium, which entails complete specialization in good z, while for high levels of K or k there is a unique equilibrium, which entails complete specialization in y.

To understand better the conditions under which there are multiple equilibria, we need to consider how p is determined. Assume that the rest of the world is composed of a continuum of countries, all of which have an economy as described above with conditions (I) and (II) satisfied. Moreover, assume all countries (except the one we are considering) have an identical endowment of capital and labor, which we denote by K_w and L_w (with $k_w \equiv K_w/L_w$), respectively. Then, if both z and y are essential in consumption (i.e., their marginal utility goes to infinity as their consumption goes to zero), necessarily the world price p must satisfy:

$$p \in \left[\psi(z) K_W^{\Delta\phi} k_W^{\Delta\delta}, \psi(z) K_W^{\Delta\phi} k_W^{\Delta\delta} \right]. \tag{14}$$

This implies that our small economy will exhibit multiple equilibria if and only if it is similar to the rest of the world in terms of size (K) and the capital–labor ratio (k); that is, if and only if K and k are not too different from K_W and k_w.

This completes the characterization of equilibria for this model. The next two sections explore the implications in detail.

5. Welfare analysis

In the previous section we concluded that under some conditions there are multiple equilibria. A natural question arises: can the equilibria be Pareto ranked and if so, which one is Pareto superior? Given that the diversified equilibrium is unstable, we will restrict the welfare comparison to the two equilibria with complete specialization. To do so, we first compare the wage and the rate of return to capital across the z and y equilibria.

There are three different effects on the wage and the rate of return to capital as the economy switches from the z equilibrium to the y equilibrium. First, since $n(y) > n(z)$, there is a variety effect that tends to make both w and r higher in the y equilibrium than in the z equilibrium. Second, $n(y) > n(z)$ implies that the quantity of capital left to produce final goods $(K - n)$ is lower in the y equilibrium than in the z equilibrium, and this tends to make w/r lower in the y equilibrium. Third, the y sector is more capital intensive than the z sector (as reflected in $\gamma(z) > \gamma(y)$), and this also leads to a lower w/r in the y equilibrium than in the z equilibrium. Letting $r(n)$ and $w(n)$ denote the levels of r and w in the n-equilibrium, these three effects imply that $r(n(y)) > r(n(z))$. This is not necessarily the case with w, however, since the second and third effects tend to make $w(n(y))$ lower than $w(n(z))$. [23] But it can be shown that when α is sufficiently low, so that the variety effect is sufficiently strong, then $w(n(y)) > w(n(z))$, so the y equilibrium Pareto-dominates the z equilibrium. We state this result formally in the following proposition, which is proved in the appendix.

Proposition 2. Assume conditions (I) and (II) hold. (i) r is higher in the y equilibrium than in the z equilibrium. (ii) For any p there exists a level of α, $\alpha^*(p)$, *such that if* $\alpha < \alpha^*(p)$ *then the wage is higher in the y equilibrium than in the z equilibrium. (iii) As a consequence of (i) and (ii), if* $p \in [\rho_z(n(z)), \rho_y(n(y))]$ *and* $\alpha < \alpha^*(p)$, *both the rate of return to capital and the wage are higher in the y equilibrium than in the z equilibrium. Hence, the y equilibrium Pareto-dominates the z equilibrium.*

This proposition implies that when there are multiple equilibria and love of variety is sufficiently strong, if the economy is at the z-equilibrium there is another equilibrium in which everyone would be better off. There is a coordination failure: everyone would be better off in the equilibrium with complete specialization in y but no single individual wants to produce y given the small variety of specialized inputs available; since the production of y uses specialized inputs intensively, it is not profitable to produce y when n is low. But it is not profitable

[23] As an example, for parameters $\delta(y) = \delta(z) = 0.7$, $\beta(z) = 0.89$, $\beta(y) = 0.8$, $\alpha = 0.8$ and the highest level of p for which there is a y equilibrium we obtain $w(n(y))/w(n(z)) = 0.95$.

for anyone to produce a new variety of the intermediate good because since the economy is completely specialized in the production of z, and z uses intermediate goods with relatively low intensity, there is insufficient demand for intermediate goods. [24]

When love of variety is not strong enough, so that $w(n(y)) < w(n(z))$, the y equilibrium may still Pareto dominate the z equilibrium if workers own enough capital. And even if they do not own any capital, the y equilibrium may dominate the z equilibrium according to the potential-Pareto criterion. This would be the case if the value of domestic production is higher at the y equilibrium than at the z equilibrium. The following proposition, which is proved in the appendix, shows that this is always the case:

Proposition 3. The y equilibrium dominates the z equilibrium according to the potential-Pareto criterion.

If the price of good z increases sufficiently, p will become higher than $\rho_y(n(y))$. At that point, the international price of z is so favorable that the only equilibrium involves complete specialization in z. [25] But (by continuity) if p is not that much higher than $\rho_y(n(y))$, the value of production is higher when $n = n(y)$ and there is complete specialization in y than at the z equilibrium. This establishes a result that is similar to the *Dutch Disease* in that the high price of the simple good z prevents the economy from allocating resources to the production of good y, an allocation that dominates the z equilibrium according to the potential-Pareto criterion.

Starting from a situation in which there are multiple Pareto-rankable equilibria and the economy is located at the z equilibrium, an increase in the capital stock could take the economy out of the bad equilibrium. But given that the rate of return to capital is relatively low at the z equilibrium, allowing for capital accumulation does not necessarily lead to an increase in the capital stock that can solve this problem. Moreover, because of the low return to capital, capital will not necessarily flow from capital-abundant countries. We show this formally in the next section.

[24] A sufficiently high tariff on good y would rule out the z equilibrium, thereby leading the economy towards the y equilibrium. Still, closing the economy to international trade is not necessarily optimal when the economy is at the bad equilibrium. The condition for autarky to be better than trade with specialization in good z is that the relative price of z in autarky is higher than the international relative price of z (see Ethier, 1982b).

[25] In a similar model, Markusen (1990) explores whether an equilibrium with production of y exists, basically by endogenizing the relative price $P_z P_y$. He does not explore the multiple equilibria result of the model.

6. Why doesn't capital flow from rich to poor countries

As has been noted by many authors (e.g. Lucas, 1990; Romer, 1991; Stiglitz, 1988), the Solow model leads to very large differences in the rate of return to capital across rich and poor countries. For instance, Lucas (1990) estimates that if the difference in income per capita between India and the United States is to be explained by differences in capital–labor ratios, the marginal product of capital in India would be about 58 times the marginal product of capital in the United States. Without negating the importance of imperfections in the international capital market, this calculation suggests that it is important to construct a theory that can explain differences in income per capita across countries without generating these large differences in rates of return to capital.

As is well known, this can be done by introducing human capital into the neoclassical model. If both human and physical capital are scarce relative to labor in one country, the rate of return to physical capital can be equal to that in a country where there is abundance of both kinds of capital. This approach leads to another problem, however, since it implies that the rate of return to human capital in developing countries is higher than in developed countries, contradicting the impression that in many underdeveloped countries there is unemployment of skilled workers, or skilled workers are engaged in unskilled tasks (Stiglitz, 1988). This approach is also inconsistent with the fact that the relative wage of skilled versus unskilled workers in low-income countries is not significantly different than in industrialized countries (Jain, 1991). [26]

These problems do not arise if we allow human capital to generate positive aggregate externalities, as shown in Lucas (1990). In this section we will show that our model can generate this result without the need to postulate the existence of aggregate technological externalities.

Suppose we have two small, open economies, A and B, which are identical except for the fact that economy A is in the y equilibrium while economy B is in the z equilibrium. Proposition 2 implies that the rate of return to capital is higher in A than in B. With free capital mobility, this would generate a flow of capital from economy B to economy A, and this could lead to a situation in which the capital–labor ratio and the wage level are higher in A than in B and yet the rate of return to capital is equalized across the two economies.

To see this formally, first notice that, because of the love of variety effect, the rate of return to capital is not necessarily decreasing in K. But for there to exist a stable allocation of capital across A and B we need the rate of return to capital to

[26] The implication of the neoclassical model with human capital is also inconsistent with the impression that there are pressures for migration of skilled workers from underdeveloped to developed economies (see Romer, 1991). Of course, this would not arise if there were differences in taxes or technology across countries, but the point is that human capital by *itself* cannot reconcile the neoclassical growth model with the data.

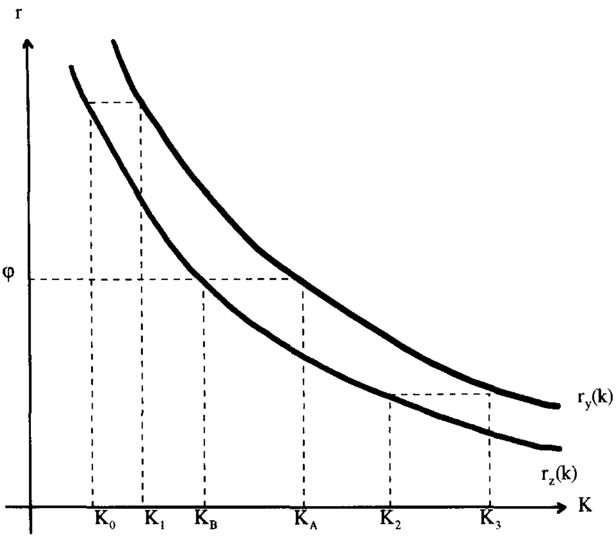

Fig. 3.

be decreasing in K. Let $r_s(K, n)$ be the rate of return to capital when there is complete specialization in final good s as a function of n and the capital stock K, and (with a slight abuse of notation) let $r_s(K) \equiv r_s(K, \tau(s)K)$ represent the rate of return to capital at an equilibrium with complete specialization in s. $r_s(K)$ is decreasing as long as love of variety is not too strong compared to the rate at which the marginal product of capital would decrease in a pure neoclassical setting; formally, $r_s'(K) < 0$ if and only if $\phi(s) < 1 - \delta(s)$. Since $\phi(y) > \phi(z)$ and $\delta(y) > \delta(z)$ then the condition

$$\phi(y) > 1 - \delta(y) \tag{III}$$

is sufficient to guarantee $\phi(s) < 1 - \delta(s)$ for both $s = z$ and $s = y$. In the rest of this section we assume that condition (III) is satisfied, so both $r_z(K)$ and $r_y(K)$ are decreasing in K (see Fig. 3).

Let $w_s(K)$ be the wage in the s equilibrium as a function of K. The following proposition, which is proved in the appendix, states the main result of this section:

Proposition 4. Assume conditions (I), (II) and (III) hold and let there be two economies, A and B with a total capital stock $K_T \in [K_{min}, K_{max}]$ which can flow freely between A and B (K_{min} and K_{max} are defined in the appendix). There is an equilibrium in which economy A is in the y equilibrium with capital stock K_A and economy B is in the z equilibrium with capital stock $K_B = K_T - K_A$, with $r_y(K_A) = r_z(K_B)$ and $w_y(K_A) > w_z(K_B)$.

This proposition implies that an economy in the y equilibrium with $K = K_A$ has a higher wage than an economy in the z equilibrium with $K = K_B$, but the rate of return is equal across these two economies. Therefore the model can account for differences in wages across economies without generating the implication that capital should flow from the economy with higher wages to the economy with lower wages. [27]

We can also use Fig. 3 to gain some intuition about what may happen once we allow for capital accumulation in this economy. If there are no international capital flows, as in the standard closed-economy neoclassical model, then there may be two steady state levels of K. For instance, with a time-separable utility function and an instantaneous intertemporal discount rate φ, then if $\varphi = r_z(K_B) = r_y(K_A)$ (as in Fig. 3) there is a steady state with $K = K_B$, specialization in final good z, a shallow division of labor and low wages, and another steady state with $K = K_A$, specialization in final good y, a deep division of labor and high wages. This suggests the existence of multiple equilibrium paths of capital accumulation for certain initial conditions. In the working paper version of this paper (Rodríguez-Clare, 1995b) I develop a dynamic version of the model presented here to derive these results formally.

7. Conclusion

This paper has developed a model that incorporates three basic premises into the neoclassical model of a small, open economy: that efficiency is enhanced by the division of labor, that there are specialized inputs for which the proximity of suppliers and users is essential and that the division of labor is limited by the extent of the market. The main implication of the model is that an economy may be stuck in an equilibrium with a shallow division of labor and specialization in labor intensive goods, where both the wage and the rate of return to capital are low

[27] When condition (III) is not satisfied, the model may lead to the same kind of destabilizing forces noted by Kaldor (1970) and Faini (1984). To see this, assume that $\phi(z) > 1 - \delta(z)$, which also implies $\phi(y) > 1 - \delta(y)$. This implies that $r_z(K)$ are both increasing in K. Therefore, there is an equilibrium capital allocation such that all capital ends up in one economy, say economy A. This is an extreme result. In the equilibrium where all the capital stock ends up in economy A, economy B produces nothing; the labor force in economy B is completely idle. The reason for this is that the absence of capital implies also that there will be no intermediate goods produced. Since in the Cobb–Douglas specification of the technology each input is essential, the lack of intermediate goods implies that the return to capital is zero, even when wages are zero. This extreme result is of course a consequence of the simplicity of the model. It would not hold in a more realistic model where, for instance, there is a sector where non-tradable intermediate goods are not essential or where such intermediate goods can be produced with labor alone. Similarly, this extreme result would not hold if we allow for some intermediate goods to be tradable internationally.

and, as a consequence, there are no capital inflows or domestic capital accumulation. Thus, the model gives one possible explanation for why some underdeveloped countries fail to grow as fast as the simple neoclassical model suggests.

One criticism of the model is that with the advance of communications technology and the decrease of transportation costs in the last decades, it may now be possible to trade most inputs, and even many services, on an international scale. [28] This would obviously eliminate the multiple Pareto-rankable equilibrium result. However, since transportation costs for final goods have also decreased, which by itself could lead to more economic agglomeration (as shown by Krugman (1991)), the effects of lower transportation costs may be ambiguous.

An essential assumption in this paper is that a firm cannot use cheap labor from the poor economy and simultaneously benefit from the abundance of specialized inputs available in the rich economy; this is the assumption that allows wages to differ across countries without generating capital flows that would restore equality in the wage level. It seems sensible, however, that by becoming multinational, or through international subcontracting, a firm could benefit from the cheap labor in the poor economy and the abundance of specialized inputs in the rich economy. In fact, this seems to be prevalent around the World. For instance, many American manufacturers of semiconductors have located assembly plants in countries of South-East Asia, where there is an abundant and well educated labor force. Textile 'maquiladoras' all around the world are another good example of this phenomenon. Even within the United States it is well documented that many firms, as they become mature, transplant the simpler, more labor intensive part of their production process to low-wage–low-density regions while maintaining their headquarters in centers of industrial concentration such as Silicon Valley. The question is whether this phenomenon weakens the results derived in this paper. Elsewhere (Rodríguez-Clare, 1995a) I have developed a similar model to the one presented in this paper but allowing for the formation of multinationals. It is shown there that the multiple Pareto-rankable equilibrium property still holds, and more importantly, that multinationals may have positive or negative effects on the host economy, depending on the characteristics of their home country and the type of good they produce.

[28] For those who find it hard to believe that proximity of suppliers and users of inputs is important, I suggest reading an article in the New York Times (8-4-1994), page A1) which reported how firms were coming back to New York because of the importance of having suppliers and customers close by. The article reports that when Mr. Volchik moved his knitwear company to New Jersey he found that his company "was losing touch with the tight network of garment makers, suppliers and customers in Queens and Brooklyn that helped him survive. Parts to repair his complex computer-driven knitting machines took days to arrive rather than hours. Sweater designers in Manhattan found the trek more burdensome and placed orders elsewhere. Special types of yarn were harder to come by".

8. For further reading

Romer, 1986, Spence, 1976

Acknowledgements

I especially thank Avner Greif, Rody Manuelli, Robert Staiger and Joseph E. Stiglitz for their helpful comments and encouragement. I have also benefited from discussions with Peter Hammond, Peter Klenow, Giovanni Maggi, July Schaffner and Alberto Trejos and from comments from Pranab Bardhan and two anonymous referees. I thank seminar participants at Boston University, Harvard University Northwestern University, University of California at Los Angeles, University of Chicago, University of Minnesota, University of Pennsylvania and Yale University for helpful comments. The usual caveat applies. Financial support from Alfred P. Sloan Foundation is gratefully acknowledged.

Appendix A

A.1. Proof of Proposition 1

We must first derive a precise formula for profits in the intermediate goods sector when both z and y are produced. In this case, we must have equality between relative cost and relative price, which from (7) implies

$$p=\left(\frac{a(z)}{a(y)}\right)\alpha^{\Delta\beta}n^{\Delta\phi}\left(\frac{r}{w}\right)^{-\Delta\delta}. \tag{A.1}$$

From this equation we obtain r/w as a function of n:

$$r/w=(\mu/p)^{1/\Delta\delta}N^{\Delta} \tag{A.2}$$

where $\Delta\equiv\Delta\phi/\Delta\delta$ and $\mu\equiv(a(z)/a(y))\alpha^{\Delta\beta}$. Plugging (A.2) into (6) and using the condition $K=n+K_z+K_y$ we obtain:

$$K_z=\frac{L-\gamma(y)(\mu/p)^{1/\Delta\delta}n^{\Delta}(K-n)}{\Delta\gamma(\mu/p)^{1/\Delta\delta}n^{\Delta}} \tag{A.3}$$

and

$$K_y=\frac{\gamma(z)(\mu/p)^{1/\Delta\delta}n^{\Delta}(K-n)-L}{\Delta\gamma(\mu/p)^{1/\Delta\delta}n^{\Delta}} \tag{A.4}$$

where $\Delta\gamma \equiv \gamma(z) - \gamma(y) > 0$. Plugging (A.3) and (A.4) into the expression for μ in Eq. (11) yields

$$\pi = r\left(\frac{1-\alpha}{\Delta\gamma}\right)\left(D\left(\frac{K}{n} - 1\right) - \left(\frac{\Delta\xi L}{(\mu/p)^{1/\Delta\delta} n^{1+\Delta}}\right)\right) - r. \tag{A.5}$$

Differentiating (A.5) with respect to n we obtain

$$\frac{\partial(\pi/r)}{\partial n} = \left(\frac{1-\alpha}{\Delta\gamma n^{2+\Delta}}\right)\left(-DKn^{\Delta} + \Delta\xi L(1+\Delta)/(\mu/p)^{1/\Delta\delta}\right). \tag{A.6}$$

Let $n_0(p)$ be defined implicitly by $\partial(\pi/r)/\partial n = 0$. Eq. (A.6) implies that $\partial(\pi/r)/\partial n > 0$ for $n < n_0(p)$ and $\partial(\pi/r)/\partial n < 0$ for $n < n_0(p)$. Define $\bar{p}$ as the maximum level of p for which there is an equilibrium with complete specialization in y; formally, $\bar{p}$ is defined implicitly by $n_y(\bar{p}) = n(y)$. Condition (II) implies that $n_0(\bar{p}) > n_y(\bar{p})$. To see this, note from (A.6) that

$$n_0(\bar{p})^{\Delta} = \frac{\Delta\xi L(1+\Delta)}{DK(\mu/\bar{p})^{1/\Delta\delta}}.$$

From $n_y(\bar{p}) = n(y)$ and (8) we obtain

$$n_y(\bar{p})^{\Delta} = \frac{L}{(\mu/\bar{p})^{1/\Delta\delta} K\gamma(y)(1-\tau(y))}.$$

From these two equations we immediately see that $n_0(\bar{p}) > n_y(\bar{p})$ is equivalent to condition (II). Now, $n_0(\bar{p}) > n_y(\bar{p})$ implies that for $p = \bar{p}$, π/r is increasing for all $n \in [n_z(\bar{p}), n_y(\bar{p})]$. We now use this fact to prove the different statements of the proposition.

We first check that condition (II) implies $\rho_z(n(z)) < \rho_y(n(y))$. Assume that condition (II) holds but $\rho_z(n(z)) \geq \rho_y(n(y))$. We will derive a contradiction. Assume $p = \bar{p}$. Then $\pi = 0$ for $n = n(y) = n_y(p)$ and π/r is increasing for all $n \in [n_z(\bar{p}), n_y(\bar{p})]$. But since $\rho_z(n(z)) \geq \rho_y(n(y))$ then necessarily $\pi \geq 0$ at $n = n_z(\bar{p})$ (this follows from the fact that $n(z) > n_z(\bar{p})$ and the fact that π is decreasing in n when there is complete specialization). Therefore, we have that π/r is positive at $n_z(p)$, increasing for all $n \in [n_z(\bar{p}), n_y(\bar{p})]$ and zero at $n_y(\bar{p})$, a contradiction.

We now check that there is a unique equilibrium when $p \notin [\rho_z(n(z)), \rho_y(n(y))]$. There are two cases. (i) If $p < \rho_z(n(z))$ then there is an equilibrium with complete specialization in y but no equilibrium with complete specialization in z. There cannot exist an equilibrium with diversification given the shape of the profit function. (ii) If $p > \rho_y(n(y))$ then there is an equilibrium with complete specialization in z but no equilibrium with complete specialization in y. Condition (II) implies that there is no diversified equilibrium. To see this, notice that $\pi \leq 0$ for $n = n_z(\bar{p})$ and $\pi = 0$ for $n = n_y(\bar{p})$; therefore, since π/r is increasing in n for $n \in [n_z(\bar{p}), n_y(\bar{p})]$ necessarily $\pi < 0$ for $n \in [n_z(\bar{p}), n_y(\bar{p})]$.

Since π is weakly decreasing in p for $n \in [n_z(p), n_y(p)]$ then for any $p > \bar{p}$ we have $\pi < 0$ for all $n \in [n_z(p), n_y(p)]$.

Finally, when $p \in [\rho_z(n(z)), \rho_y(n(y))]$ then there is an equilibrium with complete specialization in z, and an equilibrium with complete specialization in y. This implies that $\pi/r < 0$ for $n = n_z(p)$ and $\pi/r > 0$ for $n = n_y(p)$, and given the shape of the function π/r derived above, this implies there can be only one diversified equilibrium. Moreover, in this case necessarily we have $\pi'(n^*) > 0$. Q.E.D.

A.2. Proof of Proposition 2

Let $w_s(n, K)$ represent the wage when there is complete specialization in s, given n and K. From (2) we can derive

$$w_s(n, K) = P_s n^{\phi(s)} (K - n)^{\delta(s)} (\beta(s) - \delta(s)) L_s^{\beta(s) - \delta(s) - 1} X_s^{1-\beta(s)}. \tag{A.7}$$

But

$$\frac{X_s}{L_s} = \frac{c_p^s \cdot}{c_w^s} = \frac{\alpha(1 - \beta(s))}{\beta(s) - \delta(s)}. \tag{A.8}$$

Using $L_s + X_s = L$ we can obtain from (A.8) that

$$L_s = (\beta(s) - \delta(s)) L / \beta(s) \gamma(s). \tag{A.9}$$

Plugging (A.8) and (A.9) into (A.7) we obtain

$$w_s(n, K) = B_s \gamma(s) n^{\phi(s)} L^{-\delta(s)} (K - n)^{\delta(s)} \tag{A.10}$$

where $B_s \equiv P_s \alpha^{1-\beta(s)} \gamma(s)^{\delta(s)-1} / a(s)$. We will drop the argument K from the function $w_s(n, K)$ in the rest of this proof.

We need to show that, for any p, $w_y(n(y))/w_z(n(z))$ grows without bound as a approaches zero. We can express $w_y(n(y))/w_z(n(z))$ as

$$\frac{w_y(n(y))}{w_z(n(z))} = \left(\frac{w_y(n(y))}{w_y(n_y(p_0))} \right) \left(\frac{w_y(n) y) p_0))}{w_z(n_y) p_0))} \right) \left(\frac{w_z(n_y(p_0))}{w_z(n) z))} \right) \tag{A.11}$$

for any p_0. From (A.10) we obtain

$$\frac{w_y(n_y(p_0))}{w_z(n_y(p_0))} = \left(\frac{B_y \gamma(y)}{B_z \gamma(z)} \right) n^{\Delta\phi} \left(\frac{K - n_y(p_0)}{L} \right)^{\Delta\delta}$$

and using (8) we get

$$\frac{w_y(n_y(p_0)}{w_z(n_y(p_0)} = p_0 \left(\frac{B_y \gamma(y)}{B_z \gamma(z)} \right) \mu^{-1} \gamma(y)^{\Delta\delta} = \left(\frac{\gamma(y)}{\gamma(z)} \right)^{\delta(z)}.$$

Setting $p_0 = \bar{p}$ (defined above) gives $n_y(p_0) = n(y)$. Then from (A.11) we obtain

$$\lim_{\alpha \to 0} \frac{w_z(n(y))}{w_z(n(z))} = \left(\frac{\gamma(y)}{\gamma(z)} \right)^{\delta(z)} \lim_{\alpha \to 0} \frac{w_z(n(y))}{w_z(n(z))}.$$

From (12) and (A.10) we get

$$\frac{w_z(n(y))}{w_z(n(z))} = \left(\frac{1-\tau(y)}{1-\tau(z)} \right)^{\delta(z)} \left(\frac{\tau(y)}{\tau(z)} \right)^{\phi(z)}.$$

Because of condition (I), this term tends ∞ to as $\alpha \to 0$. Q.E.D.

A.3. Proof of Proposition 3

Let $w_s(n)$ and $r_s(n)$ be the wage and the rental rate of capital when the economy is completely specialized in final good s as functions of n, and let $T_s(n \equiv w_s(n)L + r_s(n)K$. Since there are zero profits both at the z and y equilibria, then the total value of production at the s equilibrium is necessarily $T_s(n(s))$. Therefore, all we have to do is to prove that $T_y(n(y)) > T_z(n(z))$. To do so, we first prove Claim 1:

Claim 1. $T_s'(n) > 0$ *for all n, for* $s = z,y$.

Proof. A similar procedure to the one we followed to get (A.10) yields

$$r_s(n) = B_s n^{\phi(s)} L^{1-\delta(s)} (K-n)^{\delta(s)-1}. \tag{A.12}$$

Eqs. (A.10) and (A.12) imply

$$T_s(n) = B_s n^{\phi(s)} L^{1-\delta(s)} (K-n)^{\delta(s)} (\gamma(s) + K/(K-n)). \tag{A.13}$$

From (A.13) we obtain (we momentarily drop the index for s to simplify the notation):

$$\begin{aligned} T'(n) &= BL^{1-\delta}\big[\phi n^{\phi-1}(K-n)^{\delta}(\gamma + K/(K-n)) \\ &- \delta n^{\phi}(K-n)^{\delta-1}(\gamma + K/(K-n)) + n^{\phi}(K-n)^{\delta-2}K\big] \\ &= BL^{1-\delta}n^{\phi-1}(K-n)^{\delta-1}[\phi(K-n)(\gamma + K/(K-n)) \\ &- \delta n(\gamma + K/(K-n)) + nK/(K-n)] \\ &= BL^{1-\delta}n^{\phi-1}(K-n)^{\delta-1}[\phi\gamma(K-n) \\ &+ \phi K - \delta\gamma n + (1-\delta)nK/(K-n)]. \end{aligned} \tag{A.14}$$

But $\gamma\delta = \beta - \delta + \alpha(1-\beta) = -\alpha\phi + (1-\delta)$, so $-\delta\gamma n = \alpha\phi n - (1-\delta)n$. Plugging this into (A.14) and rearranging yields

$$T'(n) = BL^{1-\delta} n^{\phi-1}(K-n)^{\delta-1}$$
$$\left[\phi\gamma K - n) + \phi K + \alpha\phi n + (1-\delta)n^2(K-n)^{-1}\right] > 0$$

which proves Claim 1.

Claim 2. Let m be defined implicitly by $\rho_y(m) = p$. Then $T_y(m) > T_z(m)$.

Proof. From (8) we see that $\rho_y(m) = p$ implies

$$p = Q\gamma(y)^{\Delta\delta} m^{\Delta\phi}\left(\frac{k-m}{L}\right)^{\Delta\delta}. \tag{A.15}$$

Using (A.13) and (A.15) we obtain

$$\frac{T_y(m)}{T_z(m)} = \alpha^{-\Delta\delta}\left(\frac{\gamma(y)}{\gamma(z)}\right)^{\delta(z)-1}\left(\frac{\gamma(y)+K/(K-m)}{\gamma(z)+K/(K-m)}\right). \tag{A.16}$$

Given $\alpha^{-\Delta\delta} > 1$ (since $\alpha < 1$), then all that remains to show is that

$$\gamma(y)^{\delta(z)-1}[\gamma(y)+K/(K-m)] > \gamma(z)^{\delta(z)-1}[g(z)+K/(K-m)]. \tag{A.17}$$

To show that this inequality holds, let $g(x,m) \equiv x^{\delta(z)-1}[x+K/(K-m)]$. (A.17) is equivalent to $g(\gamma(y),m) > g(\gamma(z),m)$, which it turn is equivalent to

$$\int_{\gamma(y)}^{\gamma<(z)} \frac{\partial g(x,m)}{\partial x}\mathrm{d}x < 0. \tag{A.18}$$

We will now show that $\partial g(x,m)/\partial x < 0$ for all (x,m) with $x < g(z)$, which is obviously sufficient to prove (A.18). From (A.17) we get

$$\begin{aligned}\partial g(x,m)/\partial x &= x^{\delta(z)-2}[(\delta(z)-1)(x+K/(K-n))+x] \\ &= x^{\delta(z)-2}[\delta(z)x-(1-\delta(z))K/(K-n))].\end{aligned} \tag{A.19}$$

We can see from (A.19) that $\partial^2 g/\partial x\partial m < 0$, so $\partial g(x,m)/\partial x < \partial g(x,0)/\partial x$ for all m. But from (A.19) we obtain

$$\partial g(x,0)/\partial x = \delta(z)x - (1-\delta(z)). \tag{A.20}$$

From the definition of $\gamma(s)$ we get $\delta(z)\gamma(z) = \beta(z) - \delta(z) + \alpha(1-\beta(z))$, and plugging this into (A.20) yields

$$\partial g(\gamma(z),0)/\partial x = -(1-\alpha)(1-\beta(z)) < 0. \tag{A.21}$$

From (A.20) we see that $\partial g(x,0)/\partial x$ is increasing in x, so (A.21) implies $\partial g(x,0)/\partial x < 0$ for all $x < \gamma(z)$. This ends the proof of Claim 2.

When there are multiple equilibria, necessarily $n(z) < m \le n(y)$, so

$$T(n(y)) - T(n(z)) = \int_{n(z)}^{m} T_z'(n)\mathrm{d}n + \big(T_y(m) - T_z(m)\big) + \int_{m}^{n(y)} T_y'(n)\mathrm{d}n. \qquad \text{(A.22)}$$

Given Claims 1 and 2, we can conclude from (A.22) that $T(n(y)) > T(n(z))$. Q.E.D.

A.4. Proof of Proposition 4

We first define $K_{\min}$ and $K_{\max}$. There are multiple equilibria if and only if $K \in [K_1, K_2]$, where K_1 and K_2 are defined implicitly by $\rho_z(K_1, \tau(z)K_1) = p$ and $\rho_y(K_2, \tau(y)K_2) = p$, respectively. An equilibrium allocation of capital across economies A and B involves levels of K_A, K_B with $K_A > K_1$ and $K_B < K_2$ such that $r_y(K_A) = r_z(K_B)$. Now, if the total capital stock is too low or too high, there does not exist an allocation of capital that equalizes the rate of return to capital across the two economies. Let K_0 be defined implicitly by $r_z(K_0) = r_y(K_1)$ and let K_3 be defined implicitly by $r_y(K_3) = r_z(K_2)$ (see Fig. 3). When the total capital stock K_T is such that $K_T < K_{\min} \equiv K_0 + K_1$ or $K_T > K_{\max} \equiv K_2 + K_3$, there is no allocation of capital such that the rate of return to capital is equal across economies A and B.

With a slight abuse of notation, let $w_s(K) \equiv w_s(n(s), K)$. From (12) and (A.12) we obtain:

$$r_s(K) = B_s \tau(s)^{\phi(s)} (1 - \tau(s))^{\delta(s)-1} K^{\phi(s)+\delta(s)-1} L^{1-\delta(s)}, \qquad \text{(A.23)}$$

$$w_s(K) = B_s \gamma(s) \tau(s)^{\phi(s)} (1 - \tau(s))^{\delta(s)} K^{\phi(s)+\delta(s)} L^{-\delta(s)}. \qquad \text{(A.24)}$$

The condition $r_y(K_A) = r_z(K_B)$ implies

$$\left(\frac{J}{p}\right)\left(\frac{K_A^{\phi(y)+\delta(y)-1}}{K_B^{\phi(z)+\delta(z)-1}}\right) L^{-\Delta\delta} = 1 \qquad \text{(A.25)}$$

where

$$J \equiv \frac{B_y \tau(y)^{\phi(y)} (1 - \tau(y))^{\delta(y)-1}}{B_z \tau(z)^{\phi(z)} (1 - \tau(z))^{\delta(z)-1}}.$$

From (A.25) we obtain an implicit function $K_B(K_A)$, from which we get

$$\frac{w_y(n(y), K_A)}{w_z(n(z)), K_B(K_A))} = \left(\frac{J}{p}\right)^{1/\eta} E L^{-\Delta\delta/\eta} K_A^{(\Delta\phi+\Delta\delta)/\eta} \qquad \text{(A.26)}$$

where

$$\eta \equiv 1 - \phi(z) - \delta(z) \quad \text{and} \quad E \equiv \left(\frac{\gamma(y)}{\gamma(z)}\right)\left(\tfrac{1-\tau(y)}{1-\tau(z)}\right).$$

The fact that $\rho_y(K_A, n(y)) \geq p$ (necessary for there to exist an equilibrium with complete specialization in y in country A) implies a lower bound on K_A:

$$K_A^{\Delta\phi + \Delta\delta} p\gamma(y)^{-\Delta\delta}\tau(y)^{-\Delta\phi}(1-\tau(y))^{-\Delta\delta}L^{\Delta\delta}.$$

Using this inequality, we obtain from (A.26) that $w_y(n(y), K_A) > w_z(n(z), K_B(K_A))$ if and only if

$$JE^{\eta}\mu^{-1}\gamma(y)^{-\Delta\delta}\tau(y)^{\Delta\phi}(1-\tau(y))^{-\Delta\delta} > 1. \tag{A.27}$$

Plugging in for J, E and μ into the LHS of this inequality we can rewrite (A.27) as

$$\alpha^{-\Delta\delta}\left(\frac{\gamma(z)}{\gamma(y)}\right)^{\phi(z)}\left(\frac{\tau(y)}{\tau(z)}\right)^{\phi(z)}\left(\frac{1-\tau(z)}{1-\tau(y)}\right)^{\phi(z)} > 1$$

which is true given that $\alpha < 1$, $\gamma(z) > \gamma(y)$ and $1 > \tau(y) > \tau(z)$. Q.E.D.

References

Barro, R., 1991, Economic growth in a cross section of countries, Quarterly Journal of Economics 106, 407–444.

Barro, R., G. Mankiw and X. Sala-i-Martin, 1995, Capital mobility in neoclassical models of growth, American Economic Review 85, 103–115

Cooper, R. and A. John, 1988, Coordinating coordination failure in Keynesian models, Quarterly Journal of Economics 103, 441–464.

Daniels, P.W., 1985, Service industries: A geographical appraisal (Methuen & Co., New York).

Dixit, A. and J. Stiglitz, 1978, Monopolistic competition and optimum product diversity, American Economic Review 76, 297–308.

Ethier, W.J., 1982a, National and international returns to scale in the modern theory of international trade, American Economic Review 72, 389–405.

Ethier, W.J., 1982b, Decreasing costs in international trade and Frank Graham's argument for protection, Econometrica 50, 1243–1268.

Faini, R., 1984, Increasing returns, non-traded inputs and regional development, Economic Journal 94, 308–323.

Fujita, M., 1989, Urban economic theory: Land use and city size (Cambridge University Press, Cambridge).

Graham, F., 1923, Some aspects of protection further considered, Quarterly Journal of Economics 37, 199–227.

Greenfield, H.I., 1966, Manpower and the growth of producer services (Columbia University Press, New York).

Greif, A. and A. Rodríguez-Clare, 1995, A transactions-cost theory of agglomeration economies, Mimeo. (Stanford University and University of Chicago).

Grossman, G. and E. Helpman, 1991, Innovation and growth in the global economy (The MIT Press, Cambridge, MA).

Helpman, E. and P. Krugman, 1985, Market structure and foreign trade (The MIT Press, Cambridge, MA).

Hindley, B., 1990, Principles in factor-related trade in services, In: P. Messerlin and K. Sauvant, eds., The Uruguay Round: Services in the world economy (World Bank Publications, Washington, DC).

Hirschman, A.O., 1958, The strategy of economic development (Yale University Press, New Haven, CT).

Holmes, T., 1995, Localization of industry and vertical disintegration, Mimeo. (Federal Reserve Bank of Minneapolis, Minneapolis, MN) .

Jacobs, J., 1969, The economy of cities (Random House, New York).

Jacobs, J., 1984, Cities and the wealth of nations (Random House, New York).

Author, please complete, see ms, p. 21

Kaldor, N., 1970, The case for regional policies, Scottish Journal of Political Economy 17, 337–348.

Kravis, I., 1985, Services in world transactions, In: R.P. Inman, ed., Managing the service economy (Cambridge University Press, Cambridge).

Kravis, I. and R. Lipsey, 1988, National price levels and the prices of tradables and nontradables, American Economic Review 78, 474–478.

Krugman, P., 1991, Geography and trade (The MIT Press, Cambridge, MA).

Kubo, Y., J. de Melo, S. Robinson and M. Syrquin, 1986, Interdependence and industrial structure, In: H. Chenery, S. Robinson and M. Syrquin, eds., Industrialization and growth (Oxford University Press, New York).

Lancaster, K., 1979, Variety, equity, and efficiency (Columbia University Press, New York).

Lucas, R.E. Jr., 1990, Why doesn't capital flow from rich to poor countries, American Economic Review, Papers and Proceedings, 80, 92–96.

Markusen, J., 1990, First mover advantages, blockaded entry and the economics of uneven development, Working paper 3284 (NBER, Cambridge, MA).

Marshall, A., 1920, Principles of economics (MacMillan, London).

Murphy, K., A. Shleifer and R. Vishny, 1989, Industrialization and the big-push, Journal of Political Economy 97, 1003–1026.

Okuno-Fujiwara, M., 1988, Interdependence of industries, coordination failure and strategic promotion of an industry, Journal of International Economics 25, 25–43.

Parente, S. and E. Prescott, 1994, Barriers to technology adoption and development, Journal of Political Economy 102, 298–321.

Porter, M., 1992, The competitive advantage of nations (The Free Press, New York).

Rivera-Batiz, F.L., 1988, Increasing returns, monopolistic competition, and agglomeration economies in consumption and production, Regional Science and Urban Economics 18, 125–153.

Rodríguez-Clare, A., 1993, The division of labor, agglomeration economies and economic development, Ph.D. dissertation (Stanford University, Stanford, CA).

Rodríguez-Clare, A., 1995a, Multinationals, linkages and economic development, Manuscript (University of Chicago, Chicago, IL).

Rodríguez-Clare, A., 1995b, The division of labor and economic development, Working paper no. 8, Studies in Theoretical Economics (Graduate School of Business, The University of Chicago, Chicago, IL).

Rodrik, D., 1995, Coordination failures and government policy: A model with applications to East Asia and Eastern Europe, Journal of International Economics, forthcoming.

Romer, P., 1986, Increasing returns and long run growth, Journal of Political Economy 94, 1002–1037.

Romer, P., 1990, Endogenous technological change, Journal of Political Economy 98, S71–S102.

Romer, P., 1991, Increasing returns and new developments in the theory of growth, In: W. Barnett, ed., Equilibrium and its applications: Proceedings of the 6th International Symposium in Economic Theory and Econometrics (Cambridge University Press, Cambridge) 83–110.

Sachs, J. and A. Warner, 1995, Economic convergence and economic policies, Working paper 5039 (NBER, Cambridge, MA).

Scitovsky, T., 1954, Two concepts of external economies, Journal of Political Economy 62, 143–151.

Scott, A.J. and M. Storper, 1987, High technology industry and regional development: A theoretical critique and reconstruction, International Social Science Journal 34, 215–232.

Singlemann, J., 1970, From agriculture to services: The transformation of industrial employment (Sage Publications, Beverly Hills, CA).

Spence, M.E., 1976, Production selection, fixed costs, and monopolistic competition, Review of Economic Studies 43, 217–236.

Stigler, G., 1951, The division of labor is limited by the extent of the market, Journal of Political Economy 61, 185–193

Stiglitz, J., 1988, Economic organization, information, and development, In: H. Chenery and T.N. Srinivasan, eds., Handbook of development economics, Vol. 1 (Elseivier Science Publishers B.V.) 93–160.

Stiglitz, J., 1991, Social absorption capability and innovation, Manuscript (Stanford University, Stanford, CA).

Vernon, R., 1966, International investment and international trade in the product cycle, Quarterly Journal of Economics 80, 190–207.

Wade, R., 1990, Governing the market (World Bank Publications, Washington, DC).

Weitzman, M.L., 1991, Volume, variety, and versality in growth and trade, Manuscript (Harvard University, Cambridge, MA).

Wilson, P., 1992, Exports and local development: Mexico's new maquiladoras (University of Texas Press, Austin, TX).

Young, A., 1928, Increasing returns and economic progress, The Economic Journal 38, 527–542.