WHY ARE THERE RICH AND POOR COUNTRIES? SYMMETRY BREAKING IN THE WORLD ECONOMY:

A Note

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SYMMETRY BREAKING: A NOTE

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Abstract

This paper extends Matsuyama (1996) to allow for the presence of a fixed factor such as land. By assuming that agricultural production is more land-intensive than manufacturing production, we generalized Matsuyama's results on symmetry breaking in the world economy. That is, international trade by causing an agglomeration of economic activities in different countries of the world makes inevitable the coexistence of Rich and Poor.

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1 Introduction

This paper extends Matsuyama (1996) to allow for the presence of a fixed factor such as land. By assuming that agricultural production is more land-intensive than manufacturing production, we generalized Matsuyama's results on symmetry breaking in the world economy. We show that under certain conditions when land is present in national production the autarkic organization of the world economy is feasible but unstable. The integrated world economy implies an equilibrium where some of the a priori identical countries will specialize in the agricultural good and the rest will specialize in the manufacturing good. The presence of land, however, causes some the basic results to be weakened.

2 The Model

We follow Matsuyama (1996) and introduce three consumption goods, goods 1 and 2 are tradeable, and good 3 is non tradeable. The world economy consists of a continuum of identical small countries. Each country occupying ℓ units of land and producing its own non tradeable good. We consider first the possibility of autarky and compare with the case where each country specializes in the production of a tradeable good. We modify Matsuyama's basic framework by introducing land as an additional productive factor and return to his question of whether otherwise identical countries would specialize so as one of them would make it possible for its residents to have higher incomes than the other.

We generalize Matsuyama's framework by assuming that raw labor combines with a range of specialized inputs, aggregated by a symmetric CES production function [Dixit and Stiglitz (1977); Matsuyama (1996)], to produce specialized labor with a constant returns to scale Cobb-Douglas production function; specialized labor in turn combines with land to produce consumption goods, again with a constant returns to scale Cobb-Douglas production function. The corresponding unit cost function for goods $i = 1, 2, 3$, is given by:

$$C_i = \left(W^{1-\alpha_i} \left[\int_0^N P(z)^{1-\sigma} dz \right]^{\frac{\alpha_i}{1-\sigma}} \right)^{1-\lambda_i} R^{\lambda_i}, 0 < \alpha_i < 1,\ 0 < \lambda_i < 1, \tag{1}$$

where $W,\ P(z),\ R$ denote the wage rate, the price of intermediate z and the rental rate of land,

and N the range of intermediates. We refer to goods 1 and 2 as the agricultural good, and the manufacturing good, respectively. Accordingly, we assume that good 2, the manufacturing good, requires a greater relative share of specialized skills, $\alpha_2 > \alpha_1$, and that the relative share of land in the production of the agricultural product is larger than that for the manufacturing one, $\lambda_1 > \lambda_2$.

The parameter σ denotes the direct partial elasticity of substitution between any pairs of intermediates, which are interpreted here as specialized skills. It is important that no input is essential: $\sigma > 1$. Specialized skills production uses $\kappa + \zeta n(z),\ 0 < \kappa, 0 < \zeta < 1$, units of labor to produce $n(z)$ units of skills. It follows that each type of skill is produced by a single firm, which prices its output at $P(z) = \frac{\sigma}{\sigma-1}\zeta W$. By choosing units appropriately so as $\zeta = 1 - \frac{1}{\sigma}$, the pricing equation yields: $P(z) = W$. In that case (1) implies: $C_i = W^{1-\lambda_i} N^{\frac{\alpha_i}{1-\sigma}(1-\lambda_i)} R^{\lambda_i}$. Since the direct partial elasticity of substitution across any two pairs of specialized inputs exceeds 1, an increase in the range of specialized skills reduces the unit cost of production of good i. Each of the input- producing firms earns revenue $S = Wn(z)$, incurs a wage bill $W(\zeta n(z) + \kappa) = (1 - \frac{1}{\sigma})S + W\kappa$, and earns profit $\frac{1}{\sigma}S - W\kappa$. At the free entry equilibrium, profit is zero and each of these inputs is produced in quantity $\sigma\kappa$, a constant. The demand for specialized inputs is accommodated by adjusting the number, that is, range of specialized inputs produced. [1]

Each country is inhabited by individuals with identical preferences, defined in terms of the expenditure function $E = P_1^{\beta_1} P_2^{\beta_2} P_3^{\beta_3} U$, where $\beta_1, \beta_2, \beta_3 > 0$, $\beta_1 + \beta_2 + \beta_3 = 1$.

2.1 Autarky

We consider first a country in isolation. Let Y denote its aggregate income. Expenditure on good i is equal to $\beta_i Y$, which implies that expenditure on intermediates by the $i-$producing sector is equal to $\alpha_i(1-\lambda_i)\beta_i Y$. Therefore, the revenue of the intermediates sector, NS, is equal to $\theta_A Y$, where $\theta_A \equiv \sum_{i=1}^{3} \alpha_i(1-\lambda_i)\beta_i$; θ_A is the share of the intermediates sector in aggregate income in autarky. This parameter also stands for the degree of the aggregate demand externality: it is equal to the increase in revenue of the intermediates sector generated by a unit increase in aggregate income. Total national labor income, WL, where L denotes total labor supply, consists of direct spending

[1] It is possible to modify the model and allow for land to be used in the production of intermediates. Let both fixed and variable inputs be in units of a composite of raw labor and land, whose costs is proportional to $W^{1-\gamma}R^{\gamma}$. The pricing equation becomes $P(z) = W^{1-\gamma}R^{\gamma}$, and (7) implies the resulting model is not qualitatively different.

on labor by all three sectors, which is equal to $\sum_{i=1}^{3}(1-\alpha_i)(1-\lambda_i)\beta_i Y$, plus the wage bill of the intermediates-producing sector. That is: $WL = (1-\lambda_A-\theta_A)Y + N\frac{\sigma-1}{\sigma}S + NW\kappa$, where we have defined $\lambda_A \equiv \sum_{i=1}^{3}\lambda_i\beta_i$, the share of national income that accrues to land.

At the free entry equilibrium, labor income is given by: $WL = NW\kappa + (1-\lambda_A-\theta_A\frac{1}{\sigma})Y$, and real aggregate income is given by:

$$Y = W(L-N\kappa)\frac{\sigma}{(1-\lambda_A)\sigma-\theta_A}. \tag{2}$$

At the free-entry equilibrium under national autarky, each country produces the same range of intermediates. Their number is obtained as follows. By working from the definition of national labor income, we write an expression for real profit gross of fixed cost, $\frac{S}{\sigma W}$, which is simplified after using (2) to become:

$$\frac{S}{\sigma W} = \left(\frac{L}{N}-\kappa\right)\frac{\theta_A}{(1-\lambda_A)\sigma-\theta_A}. \tag{3}$$

We see from (3) that real profit gross of fixed cost decreases in the range of intermediates. When it is greater (less) than fixed costs, firms are likely to enter (leave) and thus make more (less) varieties available in the national economy. At the free entry equilibrium, profit per intermediate-producing firm is zero, $\frac{S}{\sigma W} = \kappa$. Thus:

$$N_A = \frac{\theta_A}{(1-\lambda_A)\sigma}\frac{L}{\kappa}. \tag{4}$$

Each firm produces an amount equal to $\sigma\kappa$.

The rental rate of land is given by: $R_A = \frac{\lambda_A Y}{\ell}$, where ℓ denotes the total supply of land in each country. The price of each good i is equal to its unit cost $P_i = C_i$. Under autarky, aggregate income given by:

$$Y_A = W_A\frac{1}{1-\lambda_A}L. \tag{5}$$

Since income per person is equal to $W_A\frac{1}{1-\lambda_A}$, indirect utility for the typical person is given by:

$$U_A = \Lambda_A L^{\frac{\theta_A}{\sigma-1}-\lambda_A}\ell^{\lambda_A}\left(\frac{\theta_A}{(1-\lambda_A)\sigma\kappa}\right)^{\frac{\theta_A}{\sigma-1}}, \tag{6}$$

where $\Lambda_A \equiv \lambda_A^{-\lambda_A}(1-\lambda_A)^{-(1-\lambda_A)}$. This expression for utility reveals the impact of increasing returns upon welfare within each country in the autarkic case. Indirect utility is more likely to be increasing with a country's population, the more likely it is that $\frac{\theta_A}{\sigma-1}-\lambda_A > 0$, the stronger are increasing returns, as indicated by a smaller σ, relative to the share of land in national income, or *cet. par.*, or the larger the aggregate demand externality, as indicated by θ_A, relative to the share of land in national income.

2.2 International Trade

The relative price of goods 1 and 2, $\varpi = \frac{P_1}{P_2}$, as exogenously given by the international economy. Whether an economy produces good 1 or good 2 depends upon the magnitude of the ratio of the (virtual) production costs in the two sectors producing goods 1 and 2,

$$\frac{C_1}{C_2} = \left(\frac{R}{W}\right)^{\lambda_1-\lambda_2} N^{\frac{\alpha_2(1-\lambda_2)-\alpha_1(1-\lambda_1)}{\sigma-1}}, \tag{7}$$

relative to ϖ. We note that $\frac{C_1}{C_2}$ depends critically upon the range of intermediates produced by the economy. Since $\alpha_2 > \alpha_1$, and $\lambda_1 > \lambda_2$, the larger is the country's N the smaller is the ratio of unit costs $\frac{C_1}{C_2}$ and the greater the cost advantage of the manufacturing good, *cet. par.* This ratio also depends upon the rental rate of land relative to the wage rate: the more expensive labor is relative to land, the greater the cost advantage of the agricultural good. We note that any differences in our results from those of Matsuyama originate entirely in differences in the share of land in the production of the agricultural good from that in the production of the manufacturing good, and not just in the presence of land per se.

In the analysis that follows we need to express $\frac{W}{R}$ in terms of fundamentals. This is quite straightforward, since W and R may be expressed in terms of aggregate national income. Specifically, let λ_{Ij} denote the share of income that accrues to land, the counterpart of λ_A in the case of a international economy, where $j = 1$, if a country specializes in the agricultural good, and $j = 2$, if a country specializes in the manufacturing good. As a function of parameters, the share of land in national income depends upon which of either good 1 or good 2 a country specializes in. If $\frac{C_1}{C_2} < \varpi$, then a country specializes in the production of good 1 and buys good 2 in the international market. In that case, P_1 is equal to the marginal cost of production of good 1 in a country, whereas P_2 is determined by international trade (and is equal to the marginal cost of production of good 2 in a country that specializes in its production.) If $\frac{C_1}{C_2} > \varpi$, then a country specializes in the production of good 2 and buys good 1 in the international market.

2.2.1 Countries Specializing in Agriculture

This is the case when a country produces goods 1 and 3, and imports good 2. Aggregate national income Y is equal to total spending on good 1 and on good 3: $Y = P_1 Q_1 + \beta_3 Y$. It follows that $P_1 Q_1 = (\beta_1 + \beta_2)Y$. The intermediates-producing firms earn revenues equal to $NS = \theta_1 Y$, where $\theta_1 \equiv \alpha_1(1-\lambda_1)(\beta_1+\beta_2) + \alpha_3\beta_3(1-\lambda_3)$. Labor income is given by

$$WL = N(1 - \frac{1}{\sigma})S + NW\kappa + (1 - \lambda_{I1} - \theta_1)Y, \tag{8}$$

where $\lambda_{I1} \equiv \lambda_1(\beta_1+\beta_2) + \lambda_3\beta_3$. Parameter λ_{I1} stands for the share of national income that accrues to land. We note that specialization changes the share of income that accrues to land. Since national income is equal to spending on all factors of production, a share of spending equal to $1-\beta_3$ goes to purchases of inputs for the production of good 1, of which a share λ_1 goes to land. This yields, in turn, that $Y = W(L - N\kappa)\frac{\sigma}{(1-\lambda_{I1})\sigma - \theta_1}$, and $\frac{S}{W\sigma} = (\frac{L}{N} - \kappa)\frac{\theta_1}{(1-\lambda_{I1})\sigma - \theta_1}$. At the free-entry equilibrium, the range of intermediates is obtained by setting $\frac{S}{W\sigma}$ equal to κ, in the previous equation, and solving for N_1:

$$N_1 = \frac{L}{\kappa\sigma}\frac{\theta_1}{1-\lambda_{I1}}. \tag{9}$$

Each firm produces an amount equal to $\sigma\kappa$. The corresponding value for national income readily follows:

$$Y_1 = W_1 L \frac{1}{1-\lambda_{I1}}. \tag{10}$$

Since the rental rate of land is given by $R_1 = \lambda_{I1}\frac{Y_1}{\ell}$, it follows that $\frac{R_1}{W_1} = \frac{Y}{\ell}\frac{\lambda_{I1}}{1-\lambda_{I1}}$. The larger the fraction of national income that accrues to land, the higher the rental rate of land relative to the wage rate.

The price P_2 of the imported good is determined in the international economy. Since the country is specializing in the production of good 1, $P_1 = C_1$, and demand in the international economy adjusts accordingly. This condition relates the national wage rate W_1 to P_1, the latter being determined nationally:

$$W_1 = P_1\left(\frac{L}{\kappa\sigma}\frac{\theta_1}{1-\lambda_{I1}}\right)^{\frac{\alpha_1}{\sigma-1}(1-\lambda_1)}\left(\frac{L}{\ell}\frac{\lambda_{I1}}{1-\lambda_{I1}}\right)^{-\lambda_1}. \tag{11}$$

Similarly, $P_3 = C_3$, that is,

$$P_3 = P_1\left(\frac{L}{\kappa\sigma}\frac{\theta_1}{1-\lambda_{I1}}\right)^{\frac{\alpha_1}{\sigma-1}(1-\lambda_1) - \frac{\alpha_3}{\sigma-1}(1-\lambda_3)}\left(\frac{L}{\ell}\frac{\lambda_{I1}}{1-\lambda_{I1}}\right)^{\lambda_3-\lambda_1}.$$

With prices P_1, P_2 given, the value of indirect utility for each of the residents of a country specializing in the production of good 1 is:

$$U_{I1} = \left(\frac{P_1}{P_2}\right)^{\beta_2} \Lambda_{I1} L^{\frac{\theta_1}{\sigma-1} - \lambda_{I1}} \ell^{\lambda_{I1}} \left(\frac{\theta_1}{(1-\lambda_{I1})\kappa\sigma}\right)^{\frac{\theta_1}{\sigma-1}}, \tag{12}$$

where $\Lambda_{I1} \equiv \lambda_{I1}^{-\lambda_{I1}}(1-\lambda_{I1})^{-(1-\lambda_{I1})}$. The above expression is identical with that of (6), with all auxiliary variables having been adapted in terms of θ_1 and λ_{I1}. in For countries that specialize in the production of the agricultural good, indirect utility is an increasing function of the terms of trade, which agrees with intuition. The interpretation of the expression for U_{I1} is otherwise similar to that of U_A, in the end of section 2.1.

2.2.2 Countries Specializing in Manufacturing

In the case when a country produces goods 2 and 3, the manufacturing and the non tradeable goods and imports good 1, the agricultural good, aggregate national income Y is equal to total spending on goods 2 and 3: $Y = P_2Q_2 + \beta_3 Y$. It follows that $P_2Q_2 = (\beta_1+\beta_2)Y$. The intermediates-producing firms earn revenues equal to $NS = \theta_2 Y$, where $\theta_2 \equiv \alpha_2(1-\lambda_2)(\beta_1+\beta_2) + \alpha_3\beta_3(1-\lambda_3)$. Labor income is given by

$$WL = N(1-\frac{1}{\sigma})S + NW\kappa + (1-\lambda_{I2}-\theta_2)Y, \tag{13}$$

where $\lambda_{I2} \equiv \lambda_2(\beta_1+\beta_2) + \lambda_3\beta_3$, which is equal to the share of national income that goes to land. This yields, in turn, that $Y = W(L-N\kappa)\frac{\sigma}{(1-\lambda_{I2})\sigma-\theta_2}$, and $\frac{S}{W\sigma} = (\frac{L}{N}-\kappa)\frac{\theta_2}{(1-\lambda_{I2})\sigma-\theta_2}$. At the free-entry equilibrium, the range of intermediates is obtained by setting $\frac{S}{W\sigma}$ equal to κ, in the previous equation, and solving for N_2. This is given by an expression for N_2, which is like (9), but with 2 in the place of 1 in all subscripts. The counterparts of equations for Y_2, W_2, and U_{I2}, (10), (11), and (12), respectively, and all other associated auxiliary expressions are obtained in like manner.

2.2.3 Conditions for International Specialization

From the definitions of the auxiliary variables λ_{I1}, λ_A, and λ_{I2} in the previous sections and the assumption that $\lambda_1 > \lambda_2$, it follows that $\lambda_{I1} > \lambda_A > \lambda_{I2}$. Similarly, from the definitions of the auxiliary variables θ_1, θ_A, and θ_2 in the previous sections and in addition, the assumption that $\alpha_1 < \alpha_2$, it follows that $\theta_1 < \theta_A < \theta_2$.

If $\lambda_i = 0$, which is the case examined by Matsuyama, the range of intermediates under free entry can be ranked unambiguously for the cases of autarky, specialization in the agricultural good and in the manufacturing good. A country that specializes in the agricultural (manufacturing) good would have to "deindustrialize" ("overindustrialize") relative to autarky. It should not come as a surprise, however, that when $\lambda_i \neq 0$, such unambiguous ranking is no longer possible.

By working with conditions (4), (9), and its counterpart for countries specializing in manufacturing we derive that conditions

$$\frac{\theta_1}{1-\lambda_{I1}} < [>] \frac{\theta_A}{1-\lambda_A} < [>] \frac{\theta_2}{1-\lambda_{I2}}, \tag{14}$$

hold iff,

$$(1-\lambda_1)(1-\lambda_2)(\alpha_2-\alpha_1)(1-\beta_3)+\beta_3(1-\lambda_3)[(1-\lambda_2)\alpha_2-(1-\lambda_1)\alpha_1] > [<] (\lambda_1-\lambda_2)\alpha_3\beta_3(1-\lambda_3). \tag{15}$$

This condition may be interpreted readily as follows. In order for the international economy to imply specialization, the elasticity of the manufacturing intermediates in the production of the manufacturing good must be sufficiently greater than in the production of the agricultural good, after weighting by the share of land in the production of those two goods. We note that if the share of land in the production of the three goods is equal across all goods, then (15) reduces to $\alpha_2 > \alpha_1$, and we revert back to Matsuyama's case. Therefore, it is the *differential* role of land in the production of the three goods and distinguishes our results from those of Matsuyama's.

As a result, there are three possible equilibria of the economy with national specialization. First, countries may maintain autarky, in which case the range of intermediates is given by (4). Second, countries with a range of intermediates less than N_A would find it advantageous to specialize in the production of the agricultural good, in which case the equilibrium range of intermediates is given by (9) and is equal to N_1. Third, countries with a range of intermediates greater than M_A would find it advantageous to specialize in the production of the manufacturing good, in which case the equilibrium range of intermediates is equal to N_2.

Figure 2, in Matsuyama (1996), which shows the revenue of the typical firm as a function of the range of intermediates, still applies (suitably adjusted). When the possibility of specialization arises "the revenue of a firm, and hence its profit, no longer declines monotonically with the number of firms. This is because, entry of firms, when it pushes over the threshold causes a shift in comparative advantage, which increases aggregate demand for intermediate inputs"[*ibid*]. Consequently, the autarky equilibrium is unstable, where the two alternative equilibria with specialization are stable. Here, the autarky equilibrium is, in effect, a symmetric equilibrium. [2]

2.2.4 International Equilibrium with National Specialization

From (7) by substituting in for the ratio of the wage rate to the rental rate of land, which were to prevail in each region, we obtain expressions that bound the terms of trade that are compatible with national specialization. We define the quantities $\varpi_j,\ j = 1, 2,$

$$\varpi_j = \left(\frac{\lambda_{Ij}}{1-\lambda_{Ij}}\frac{L}{\ell}\right)^{\lambda_1-\lambda_2}\left(\frac{L}{\kappa\sigma}\frac{\theta_j}{1-\lambda_{Ij}}\right)^{\frac{\alpha_2(1-\lambda_2)-\alpha_1(1-\lambda_1)}{\sigma-1}}. \tag{16}$$

Since in our case, it may not always be the case that $\varpi_1 < \varpi_2$, we shall introduce the following notation: $\varpi_- = \min\{\varpi_1, \varpi_2\},\ \varpi_+ = \max\{\varpi_1, \varpi_2\}$.

Under the condition that $\varpi_1 < \varpi_2$, national specialization occurs if:

$$\varpi_- \leq \frac{P_1}{P_2} \leq \varpi_+. \tag{17}$$

Our next objective is to establish the existence of a national equilibrium with national specialization.

Let ϕ be the fraction of all countries which find it advantageous to specialize in the production of good 2, the manufacturing good. Each of the countries that specialize in good j produces output equal to $Q_j = \frac{(1-\beta_3)Y}{P_j}$, where Y denotes national income. By using (10), (11), and their counterparts for countries specializing in manufacturing, the national outputs of goods 1 and 2 are:

$$Q_1 = (1-\phi)(1-\beta_3)L\frac{1}{1-\lambda_{I1}}\left(\frac{L}{\kappa\sigma}\frac{\theta_1}{1-\lambda_{I1}}\right)^{\frac{\alpha_1}{\sigma-1}(1-\lambda_1)}\left(\frac{L}{\ell}\frac{\lambda_{I1}}{1-\lambda_{I1}}\right)^{-\lambda_1}; \tag{18}$$

$$Q_2 = \phi(1-\beta_3)L\frac{1}{1-\lambda_{I2}}\left(\frac{L}{\kappa\sigma}\frac{\theta_2}{1-\lambda_{I2}}\right)^{\frac{\alpha_2}{\sigma-1}(1-\lambda_2)}\left(\frac{L}{\ell}\frac{\lambda_{I2}}{1-\lambda_{I2}}\right)^{-\lambda_2}. \tag{19}$$

Since with Cobb-Douglas preferences, the relative demand for goods 1 and 2 is equal to $\frac{\beta_1}{P_1}/\frac{\beta_2}{P_2}$. Therefore, at equilibrium, (18 – 19) imply that the terms of trade must satisfy:

$$\frac{P_1}{P_2} = \frac{\beta_1}{\beta_2}\frac{\phi}{1-\phi}\frac{1-\lambda_{I1}}{1-\lambda_{I2}}\frac{\left(\frac{L}{\kappa\sigma}\frac{\theta_2}{1-\lambda_{I2}}\right)^{\frac{\alpha_2}{\sigma-1}(1-\lambda_2)}\left(\frac{L}{\ell}\frac{\lambda_{I2}}{1-\lambda_{I2}}\right)^{-\lambda_2}}{\left(\frac{L}{\kappa\sigma}\frac{\theta_1}{1-\lambda_{I1}}\right)^{\frac{\alpha_1}{\sigma-1}(1-\lambda_1)}\left(\frac{L}{\ell}\frac{\lambda_{I1}}{1-\lambda_{I1}}\right)^{-\lambda_1}}. \tag{20}$$

[2] Papageorgiou and Smith (1983) were the first to demonstrate that spatial agglomeration emerges as a locally stable equilibrium when the spatially uniform equilibrium is unstable. In their model, the interactions are due to real externalities. In our model, they are due to pecuniary externalities. See also Matsuyama (1995).

We shall use $\Phi(\phi)$ to denote the rhs of (20). It is an increasing function of ϕ, with $\Phi(0) = 0$, and $\Phi(\phi)$ tends to ∞ as ϕ tends to 1, as in Matsuyama.

The model of the international equilibrium with national specialization admits a multiplicity of equilibria exactly as does Matsuyama's model. There exist two quantities ϕ_- and ϕ_+, such that any value $\phi \in (\phi_-, \phi_+)$ satisfies the equilibrium conditions for national specialization. Specifically, let parameter values be such that $\varpi_1 < \varpi_2$. By working from (16) and (20) we have:

$$\frac{\tilde{\Lambda}_1 \frac{\beta_2}{\beta_1} \left(\frac{\frac{\theta_1}{1-\lambda_{I1}}}{\frac{\theta_2}{1-\lambda_{I2}}} \right)^{\frac{\alpha_2}{\sigma-1}(1-\lambda_2)}}{1 + \tilde{\Lambda}_1 \frac{\beta_2}{\beta_1} \left(\frac{\frac{\theta_1}{1-\lambda_{I1}}}{\frac{\theta_2}{1-\lambda_{I2}}} \right)^{\frac{\alpha_2}{\sigma-1}(1-\lambda_2)}} \equiv \phi_- < \phi < \phi_+ \equiv \frac{\tilde{\Lambda}_2 \frac{\beta_2}{\beta_1} \left(\frac{\frac{\theta_1}{1-\lambda_{I1}}}{\frac{\theta_2}{1-\lambda_{I2}}} \right)^{\frac{\alpha_1}{\sigma-1}(1-\lambda_1)}}{1 + \tilde{\Lambda}_2 \frac{\beta_2}{\beta_1} \left(\frac{\frac{\theta_1}{1-\lambda_{I1}}}{\frac{\theta_2}{1-\lambda_{I2}}} \right)^{\frac{\alpha_1}{\sigma-1}(1-\lambda_1)}}, \tag{21}$$

where $\tilde{\Lambda}_1 \equiv \left(\frac{\lambda_{I2}}{\lambda_{I1}}\right)^{\lambda_2} \left(\frac{1-\lambda_{I2}}{1-\lambda_{I1}}\right)^{1-\lambda_2}$, and $\tilde{\Lambda}_2 \equiv \left(\frac{\lambda_{I2}}{\lambda_{I1}}\right)^{\lambda_1} \left(1 - \frac{\lambda_{I2}}{1-\lambda_{I1}}\right)^{1-\lambda_1}$. The definitions of ϕ_- and ϕ_+ can be modified in the obvious way if $\varpi_- = \varpi_2$ and $\varpi_+ = \varpi_1$.

3 Conclusions

Consideration of an immobile factor of production such as land, generalizes Matsuyama's results regarding specialization. Broadly speaking, the more important are increasing returns and the aggregate demand externality, the more likely it is that economies will specialize. The presence of land matters, only if it has a *differential* impact upon the production of all goods.

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