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## GLOBALIZATION AND THE INEQUALITY OF NATIONS

by

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## GLOBALIZATION AND THE INEQUALITY OF NATIONS\*

Paul Krugman and Anthony J. Venables

### Abstract.

A monopolistically competitive manufacturing sector produces goods used for final consumption and as intermediates. Intermediate usage creates cost and demand linkages between firms and a tendency for manufacturing agglomeration. How does globalization affect the location of manufacturing and gains from trade? At high transport costs all countries have some manufacturing, but when transport costs fall below a critical value a core-periphery pattern spontaneously forms, and nations that find themselves in the periphery suffer a decline in real income. At still lower transport costs there is convergence of real incomes, in which peripheral nations gain and core nations may lose.

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In recent years there has been growing concern among many observers in the advanced nations over the impact of globalization on their ability to sustain high living standards. As growth has surged in developing countries such as China, these observers fear that Third World growth -- led by an expansion of manufactures exports -- will come at Western expense. The most extreme expression of this fear was Ross Perot's warning that the North American Free Trade Agreement would lead to a "great sucking sound" as American jobs moved to Mexico. Yet more respectable voices raise similar concerns. Indeed, the 1993 White Paper of the European Commission, Growth, Competitiveness, and Employment, in effect asserted that the rise of Third World manufacturing nations has already had serious adverse impacts; it claimed that the single most important reason for the secular upward trend in European unemployment rates was the rise of countries that "compete, even on our own markets, at cost levels that we simply cannot match" -- Eurospeak for low-wage competition from the Third World.

To anyone who remembers the debate over the New International Economic Order during the 1970s, all of this sounds rather surprising. Many of the participants in that debate asserted that globalization, rather than benefitting all nations, tended to produce gains for some at the expense of others -- but the general view was that integration of world markets produced "uneven development", a rise in the living standards of rich nations at the expense of the poor, rather than the other way around. The claim that a global marketplace tends to widen inequality among nations was used to justify demands for aid and commodity price support schemes; more radical theorists argued that the South could develop only if it "de-linked" its economies from the too well-established North.

What accounts for this reversal in the conventional wisdom? In large part, of course, it simply reflects events: the most dramatic feature of the development landscape circa 1974 was the failure of development efforts to narrow the North-South gap, while the most striking feature 20 years later is the contrast between the rapid growth of East Asian economies and the economic troubles of the advanced nations. It is possible, indeed, to dismiss both the old concern about uneven development and the new concern about immiserization of the North as intellectual fads rather than serious analytical propositions; as an empirical matter, one might well argue that divergent growth performance generally reflects internal factors, not the inevitable consequence of national roles in the international economic system.<sup>1</sup>

Nonetheless, in this paper we propose to take seriously concerns about effects of globalization on real national incomes. To do so, we will develop a model in which there are no inherent differences among national economies, yet in which an international division of labor can nonetheless spontaneously arise -- and in which some nations may fare better under this division than others. That is, we offer a model in which the world economy may organize itself into a core-periphery pattern. In the context of this model, we can then ask: how does increased globalization, a closer integration of world markets, affect the real incomes of core and periphery nations? Does globalization, as free-trade enthusiasts might assert, always benefit all nations? Does it hurt the periphery, as so many thought during the 1970s? Or does it hurt the core, as many now believe?

Our somewhat surprising answer is that both concerns about uneven development and worries about maintaining First World living standards in the face of Third World competition have some justification. In particular, they appear to correspond to different stages in the process of globalization. Suppose that transportation and communication

costs fall gradually over time. Then our model predicts an early stage of growing world inequality: when transport costs fall below a critical value, a core-periphery pattern spontaneously forms, and nations that find themselves in the periphery suffer a decline in real income. As transport costs continue to fall, however, there eventually comes a second stage of convergence in real incomes, in which the peripheral nations definitely gain and the core nations may well lose.

It turns out, then, that a relatively simple model predicts a U-shaped pattern of global economic change, of divergence followed by convergence. We are aware that any explanation of such large-scale and long-term economic trends in terms of a single cause must be offered with tongue firmly in cheek (our working title for this paper was "History of the World, Part I"). Moreover, it is highly likely that other factors, such as changing technology of production, have played a more important role than falling transportation costs in driving changes in regional advantage. Nonetheless, we believe that the model is suggestive of some of the forces at work in the real world economy.

It is also interesting that the surprising conclusions of this paper arise from relatively small changes in the assumptions of fairly standard models in international trade -- and that these changes are generally speaking in the direction of greater realism. Indeed, our model may be seen as a sort of hybrid of two well-known models of trade under monopolistic competition. One is the model of costly trade in differentiated final goods introduced in Krugman [1980]. To this we add -- realistically -- trade in intermediate goods, drawing ingredients from the model of costless trade in differentiated intermediate goods introduced by Ethier [1982]. Despite being constructed in this way from off-the-shelf components, our model exhibits behavior different from that of either antecedent: the interaction between transport costs and trade in intermediates creates country-specific

external economies, which may lead to agglomeration of industrial activity. These externalities are similar to those which arise from the interaction between transport costs and labor mobility in recent models of economic geography (e.g. Krugman [1991]). However, our model differs from these in important ways. The mechanism creating the externalities is linkages between firms (through the input-output structure), rather than linkages between firms and worker/customers (as in Krugman [1991]). Since we do not assume labor mobility the model is applicable to international as well as to interregional economics. Immobility of labor also changes results in important ways. Simple geography models like Krugman [1991] respond in a monotone way to declining transport costs: when these costs fall below a critical level, industry concentrates in one region. Here, because labor is immobile (and thus wage differentials between regions emerge), continuing reductions in transportation costs eventually lead to a reindustrialization of the low-wage region. We believe that this is not just an artifact of the model: it represents a real distinction between interregional and international economics, because labor is in fact far less mobile between than within nations.

The remainder of this paper is in six parts. Section I offers an informal exposition of the model's logic. Section II sets out the formal model, while section III shows how equilibrium is determined, and how this equilibrium changes as the world economy becomes increasingly integrated. Section IV then shows how national welfare changes as globalization proceeds. Section V explores the effects of trade policy, and finally, section VI offers some conclusions and suggestions for further research.

## I. The Basic Story

We imagine a world consisting of two regions, North and South. Each region can



produce two kinds of goods: "agricultural" goods that are produced with constant returns to scale, and "manufactured" goods that are subject to increasing returns. The manufacturing sector produces both final goods sold to consumers and intermediate goods used as inputs in production of other manufactures. All countries are equally proficient in both sectors -- neither region has any inherent comparative advantage in manufacturing.

We suppose that initially transportation costs between the two regions are very high. Clearly, in this case each region will be essentially self-sufficient, and each region will produce both manufactured and agricultural goods.

Now imagine gradually reducing transportation costs. There will now be the possibility of trade between the regions; if (as we will assume to be the case) there are many differentiated manufactured products, some two-way trade in manufactures will arise. As long as transport costs are high enough, however, there will be no specialization at the aggregative level.

At some point, however, a circular process arises that leads to regional differentiation. Suppose that one region for some reason has a larger manufacturing sector than the other. This region offers a larger market for intermediate goods, and thus makes the region, other things equal, a more attractive place to locate production of such goods. (This effect corresponds to the traditional development concept of "backward linkages"). But if one region produces a greater variety of intermediate goods than the other, better access to these goods will -- again other things equal -- mean lower costs of production of final goods (an effect corresponding to the concept of "forward linkage"), leading to a further shift of manufacturing to that region, and so on. When transportation costs fall below some critical point, then, the world economy will spontaneously organize itself into an industrialized core and a deindustrialized periphery.

If the manufacturing sector is large enough, this differentiation of roles will be associated with a divergence in real wages as well. The self-reinforcing advantage created by backward and forward linkages will drive up demand for labor in the industrializing region, while the decline of industry in the other region will lead to falling labor demand; thus real wages will typically rise in the region that becomes the core and fall in that which becomes the periphery. Global economic integration leads to uneven development.

But now suppose that transportation costs continue to fall. As they do so, the importance of being close to markets and suppliers -- and thus the importance of forward and backward linkages -- will decline as well. Meanwhile, the peripheral region will offer potential producers the advantage of a lower wage rate. At some point the decline in transportation costs will be sufficient that the lower wage rate in the periphery more than offsets the disadvantage of being remote from markets and suppliers; and at this point manufacturing will have an incentive to move out from the core to the periphery once again, forcing a convergence of wage rates.

This intuitive story suggests, then, that a single cause -- the long-term decline in transportation costs, leading to growing integration of world markets -- can produce first a division of the world into rich and poor regions, then a convergence in incomes and economic structure between those regions.

To study the insights of this intuitive story, however, we must turn next to building a formal model.

## II. A Formal Model

We assume the existence of two economies, North and South, which are identical in endowments, preferences and technology. We describe the Northern economy, simply

noting that analogous conditions hold in South.

North is endowed with  $L$  units of labor, with wage rate  $w$ . It contains two sectors, agriculture and manufacturing. The representative consumer in each country receives only labor income, and has Cobb-Douglas preferences between agriculture and manufacturing. These preferences can be represented by an expenditure function

$Q_A^{(1-\gamma)} Q_M^\gamma V$  in which  $V$  is utility,  $Q_A$  is the price of agriculture, and  $Q_M$  is the price index for manufactures;  $\gamma$  is the share of manufactures in consumer's expenditure. The budget constraint takes the form

$$(1) \quad wL = Q_A^{(1-\gamma)} Q_M^\gamma V.$$

The manufacturing sector produces a number of varieties of differentiated products, which are aggregated by a CES sub-utility function into a composite good. The price index of this manufacturing composite is  $Q_M$ , and takes the form,

$$(2) \quad Q_M = [np^{1-\sigma} + n^*(p^*t)^{1-\sigma}]^{1/(1-\sigma)}.$$

where  $n$  is the number of varieties produced in North; in equilibrium these are all sold at the same price,  $p$ . Similarly,  $n^*$  is the number produced in South and sold at price  $p^*$ . Southern products sold in North incur iceberg transport costs at a rate  $t$ , i.e., a proportion  $1/t$  of the good arrives implying a consumer price  $p^*t$ .  $\sigma > 1$  is the elasticity of demand for a single variety.

Turning to the supply side, we assume that agriculture is perfectly competitive, and uses only labor with constant returns to scale. We let agriculture be the numeraire ( $Q_A = 1$ ), and assume that it can be costlessly traded. Choosing units such that one unit of labor produces one unit of output gives the equilibrium condition:

$$(3) \quad w \geq 1.$$

The wage rate equals 1 if the economy produces agriculture, and exceeds it only if agricultural production is zero.

Firms in manufacturing use labor and a composite manufacturing intermediate good to produce output. We make the major simplifying assumption that the composite intermediate good is the same as the composite consumption good. Thus, the price index of the intermediate is  $Q_M$ , as defined in (2) above. Labor and the intermediate are combined with a Cobb-Douglas technology with intermediate share  $\mu$ . Each firm produces output for domestic sale ( $y$ ) and export ( $x$ ), with production using  $\alpha$  units of the input as a fixed cost and  $\beta$  per unit output thereafter. Each firm's total cost function is therefore

$$(4) \quad TC = w^{1-\mu} Q_M^\mu [\alpha + \beta(y+x)].$$

Given this description of preferences and technology we can now characterize equilibrium as follows. First, define the total value of expenditure on manufactured goods in the Northern economy as  $E$ . Then we have

$$(5) \quad E = \gamma wL + \mu(x+y)pn.$$

The first term on the right hand side is consumers' expenditure on manufactures, and the second intermediate demand, where we have used the fact that proportion  $\mu$  of costs (and since there are no profits, of revenue) is spent on intermediates.

Next, note that firms mark up price over marginal cost by a factor  $\sigma/(\sigma-1)$ , so that prices are set according to the condition,

$$(6) \quad p(1 - 1/\sigma) = w^{1-\mu} Q_M^\mu \beta.$$

Now note that Northern and Southern demand for a single variety take the form

$$(7) \quad y = p^{-\sigma} Q_M^{\sigma-1} E, \quad x = p^{-\sigma} t^{1-\sigma} (Q_M^*)^{\sigma-1} E^*.$$

With free entry and exit of firms, there is a zero profit condition which, as usual in this type of model, establishes a unique size of firm,

$$(8) \quad y + x = (\sigma-1) \alpha/\beta.$$

We choose units of measurement such that the right hand side of this equation is equal to unity, and use (7) in (8) to express the zero profit condition as

$$(9) \quad 1 = p^{-\sigma} [Q_M^{\sigma-1} E + t^{1-\sigma} (Q_M^*)^{\sigma-1} E^*].$$

Equilibrium is now characterised by equations (2), (3), (5), (6) and (9) (and analogous equations for the other region) which can be used to find equilibrium values of variables  $Q_M$ ,  $w$ ,  $p$ ,  $n$  and  $E$ .

Before discussing the solution of the model, it is important to understand the way in which  $n$ , the number of firms in manufacturing, affects firms' profitability. It does this through three channels. The first is the standard one. An increase in  $n$  reduces the price index  $Q_M$ , (equation (2)), this shifting the demand curve for each firm down (equation (7)) and reducing firms' profitability (equation (9)). The second and third channels operate only if  $\mu$  is positive, i.e., manufacturing uses manufacturing as an input. The reduction in  $Q_M$  associated with an increase in  $n$  now reduces total and marginal costs ((4) and (6)), this raising firms' profits. This is a cost, or forward linkage between firms. An increase in  $n$  also increases total expenditure on manufactured products,  $E$ , (equation (5)), this raising demand and profits of each firm (equations (7) and (9)). This is the

demand, or backward linkage between firms. It is the presence of these linkages that generates the effects we describe in this paper.

#### IV. Output and Employment

In order to see how the model works, we first see what determines the allocation of manufacturing between the two countries, and the allocation of labor in each country between activities. Analytical study of the equilibrium is algebraically complex, so our main tool for exposition of the properties of the model is numerical simulation. Analytical results are derived in the appendix.

This is a general equilibrium model, and as in any general equilibrium model of trade each industry must in effect compete on two fronts. On one side, it must compete for markets with foreign firms in the same industry; on the other side it must compete with the other domestic industry for inputs. It is possible to represent the determination of equilibrium in terms of at least two diagrams, each of which focuses attention on one of these competitive fronts.

One such diagram is illustrated in Figure I. On the axes of this figure are the number of manufacturing firms  $n$  and  $n^*$  in North and South respectively. The schedules NN and SS indicate loci along which firms in North and South earn zero profits. On the assumption that firms enter if profits are positive, exit if they are negative, the dynamics are indicated by the arrows. For the parameters used to draw this figure there is a unique stable equilibrium which is symmetric, with each country having the same number of firms. (Values of parameters underlying the figures are given in the appendix).

An alternative representation of the same case, which emphasizes the competition for factors, is the variant of the "scissors" diagram of two sector general equilibrium theory

(especially the specific factors model) shown in Figure II. In that figure the length of the horizontal axis is  $L$ , the total labor force. Northern employment in manufacturing,  $L_M$ , and in agriculture,  $L_A$ , are measured from the left and right hand ends respectively. The vertical axis is the wage,  $w$ .

The broken line,  $L_A L_A$ , is the demand function for agricultural labor; it represents equation (3), and our simple structure ensures that it is horizontal at height unity. The solid line,  $L_M L_M$ , is demand for labor in manufacturing. It gives the maximum wage that Northern firms can pay and break even as a function of Northern manufacturing employment,  $L_M$ , given that Southern manufacturing is in equilibrium with  $w^* = 1$ . (To put it another way, one may think of deriving this schedule by sliding down  $SS$  in Figure 1, and calculating the maximum wage consistent with nonnegative profits in Northern manufacturing at each point). The schedule is computed as follows. Northern employment in manufacturing is related to the value of output by the equation

$$(10) \quad wL_M = (1-\mu)np(y+x).$$

That is, a proportion  $(1-\mu)$  of firms' revenue is devoted to the wage bill. We assume that agriculture is active in the other country, so  $w^* = 1$ , and then use equations (2),(5),(6) and (9) (and their foreign analogues) to trace out manufacturing equilibrium as a function of  $w$ . Using this with equation (10) gives the illustrated relationship between  $w$  and  $L_M$ .

Equilibrium is at the intersection of the two curves, point  $S$ . In the case illustrated in both Figure I and Figure II the equilibrium is symmetric, with both economies having a wage equal to unity and producing both agricultural and manufacturing output. The proportions  $L_M/L$  and  $L_A/L$  are equal to  $\gamma$  and  $1-\gamma$  respectively. There is no net trade (although there is intra-industry trade in manufactures), so employment shares are determined by shares of the two sectors in final consumption.

Figures I and II are constructed with a high level of trade costs, ( $t = 3$ ). Figure III is the analogous diagram with a much lower level of trade costs ( $t = 1.5$ ). The striking point is that the slope of the manufacturing labor demand curve is now positive, so that the equilibrium at U is unstable, and there is another equilibrium at point S. At this point North specializes in manufacturing and has a wage above the value marginal product of labor in agriculture. All agricultural output is produced in South, which may also produce manufactures.<sup>2</sup> The figure is produced with the assumption that South becomes the agricultural exporter, but country labels may of course be reversed. There are therefore three equilibria -- U, S, and a further stable equilibrium with agriculture operating in North and manufacturing concentrated in South. In our discussion this case will be ignored.

The reason for the reversal of slope of the manufacturing labor demand schedule is the presence of linkages between manufacturing firms. Imagine relocating a firm from South to North. This raises demand for Northern firms' output, via the demand linkage, since at positive trade costs firms' demand for intermediates falls disproportionately on firms at the same location. It also reduces Northern firms' costs, via the cost linkage, as another variety of intermediate does not have to bear trade costs. Both these linkages create forces for agglomeration of manufacturing in a single location. At high trade costs (figures I and II) these forces are dominated by the need to be near to final consumer demand. At lower trade costs, they are powerful enough to make the symmetric equilibrium unstable and cause manufacturing agglomeration.

If the share of manufactures in final consumption ( $\gamma$ ) is less than or equal to  $1/2$ , then all manufacturing agglomerates in a single country, and the equilibrium has  $w = w^* = 1$ . In this case world manufacturing demand is small enough to be met from a single



location. But if  $\gamma > 1/2$ , (as illustrated), then the equilibrium must involve  $w > w^*$ . One country specialises in manufacturing, any further demand for manufacturing is met by the other, and the international wage differential offsets the locational disadvantage suffered by Southern firms distant from their markets and suppliers.

Figure IV illustrates the structure of equilibria at an intermediate level of trade costs ( $t = 2$ ). Four equilibria are illustrated (a fifth in which South has no agriculture is not shown). At this intermediate level of trade barriers linkages are not powerful enough to destabilise the symmetric equilibrium. But if North has all its labor employed in manufacturing; then linkages are sufficient to ensure that this is an equilibrium.

Figures I - IV suggest that as the level of trade costs is reduced, there are two points at which the qualitative character of the set of equilibria changes. At high levels of trade costs, the unique, stable equilibrium is one in which manufacturing is equally divided between the countries. At some point additional, asymmetric equilibria emerge. Finally, when transport costs fall to a critical level the symmetric equilibrium becomes unstable. If we think of a historical sequence in which trade costs gradually fall over time, it is this latter level at which symmetry is broken and the core-periphery pattern emerges. In the appendix we show that the critical level of  $t$  is defined by

$$(11) \quad t^{\sigma-1} = \left( \frac{1+\mu}{1-\mu} \right) \left( \frac{\sigma(1+\mu)-1}{\sigma(1-\mu)-1} \right).$$

What determines this critical level? From inspection of (11), we first notice that asymmetry only arises if there is a significant role of manufactured goods as intermediates. If  $\mu$  were close to zero, there would be few forward and backward linkages; and indeed, we can see from (11) that  $\mu = 0$  would imply a critical  $t$  of unity,

i.e., any  $t > 1$  (any positive trade costs) would imply symmetry between the economies.

At the opposite extreme, if  $\sigma(1-\mu) < 1$  the expression becomes negative. The interpretation of this is that a core-periphery pattern will emerge no matter how high trade costs are. This will occur either if economies of scale are very large -- which will be true in equilibrium if  $\sigma$  is small -- or if the share of intermediates in costs, and thus the importance of backward and forward linkages, is very high. Both factors tend to make the de facto external economies in manufacturing larger.

For values of  $\mu$  in the interval  $[0, (\sigma-1)/\sigma]$ , it is certainly the case that there is a critical value of  $t$  at some number greater than unity. It is messy to derive the effects of changing parameters on the critical level of transport costs, but easy to calculate a table from equation (11). Table I gives the critical value of  $t$  for a range of values of  $\sigma$  and  $\mu$ . The critical value is higher -- and hence the region of multiple equilibria greater -- the lower is  $\sigma$  and the higher is  $\mu$ . In other words, the greater are firms' price cost mark-ups, and the greater is the share of intermediates in production, the more powerful are the forces for agglomeration. (At  $\mu = 0.7$  and  $\sigma = 3$ ,  $\sigma(1-\mu) < 1$ , so the symmetric equilibrium is unstable at all levels of trade costs; even under autarky, adding a further firm reduces price less than it reduces costs).

Table I:  
Critical Values of  $t$ .

$\mu$	$\sigma$	3	5	7
0.3		2.21	1.42	1.25
0.5		4.58	1.90	1.50
0.7		/	3.04	1.96

#### IV. Trade and Welfare.

What are the implications of this structure of equilibria for real income and welfare?

Figure V illustrates the dependence of real wages in each country on trade costs. The curves in the figure are wages divided by the consumer price index in each country (i.e., are utility,  $V$ , as given in equation (1)). The solid line ( $V$ ) gives real wages in North, and the dashed line ( $V^*$ ) real wages in South. Only stable equilibria are illustrated.

The figure illustrates the three stages of development analysed in the preceding section. At high levels of trade costs North and South are symmetric, each operating agriculture and therefore having the same wage relative to agriculture ( $w = 1$ ), and relative to the consumer price index, ( $V$ ).

Reducing  $t$  creates an interval in which there are multiple equilibria (as in figure IV). Beyond some point the symmetric equilibrium becomes unstable, and the world economy develops an asymmetric structure. At this point real wages rise in North while falling in South -- that is, a process of uneven development occurs. Why does this divergence occur? In South the wage in terms of agriculture stays at unity, but real wages fall because a high proportion of manufactures now have to be imported, this incurring transport costs. In North real wages rise for two reasons. Manufacturing labor demand causes an increase in the wage relative to agriculture, (if  $\gamma > 1/2$ ). And a smaller proportion of manufactures are imported and subject to trade costs, this reducing the consumer price index and raising  $V$  further.

The third stage is one of factor price equalization. As trade costs become small enough, the wage differential which holds firms indifferent between locating in core and periphery narrows. Both the relocation of firms to South and the decline in the Northern wage in terms of agriculture reduce the Southern consumer price index, raising real

wages. The movement of Northern real wages is more ambiguous. Relocation of firms reduces wages in terms of agriculture. The consumer price index may, however, move in either direction: on one side, an increasing proportion of manufacturing is being imported and is thus subject to trade costs; on the other hand these trade costs themselves are being reduced, directly tending to reduce the price index. Thus real wages can move either way. In the case illustrated in Figure V, real wages fall as trade costs are brought down to very low levels.

Figure V was constructed for the same parameter values as Figures I - IV. Figures VI and VII indicate the effects of changing two parameters, the share of manufactures in demand and the share of intermediates in manufacturing. In Figure VI the share of manufactures in demand is increased. This increases the amount of manufacturing activity in South, and thereby reduces real wage differences. In this case the 'globalization' phase does not involve falling real wages in North.

Figure VII illustrates the case when the share of intermediates in manufacturing is raised. Agglomeration forces are now stronger, creating a wider real wage differential. Whereas in previous figures there is manufacturing activity in both North and South, there is now a range of transport costs -- the interval  $t \in [1.28, 1.85]$  -- over which all manufacturing is concentrated in North. Northern wages are determined by the condition that the value of manufacturing output equals the value of expenditure; this generates a large North-South wage gap, but not large enough for Southern manufacturing to be profitable. Conditions under which this concentration of manufacturing occur are given in appendix C. Notice that Northern real wages are constant in this range, as trade costs are assumed to affect only manufactures.

These results are, of course, based on numerical examples, that is, on particular

parameter values. Nonetheless, the general picture -- in particular the sequence of phases, with initial separation into core and periphery followed by a return to factor price equalization -- is general given this model. As long as there are some linkages ( $\mu > 0$ ) but these are not too strong ( $\sigma(1-\mu) > 1$ ) there is always a critical level of  $t$  below which the equal-wage equilibrium is unstable. And it is always the case that as  $t \rightarrow 1$  the wage differential between countries must also disappear. Thus while the details depend on parameters, the general picture of a U-shaped response of relative wages to transport costs does not.

#### V. Notes on Trade Policy

The final phase of the process of globalization described by our model, in which the spread of industry to the South reduces relative and perhaps absolute Northern wages, obviously corresponds to the fears of many commentators on the world economy. Among these, some -- such as billionaire-turned-pundit Sir James Goldsmith, whose recent book The Trap [1994] has been a European best-seller -- advocate protectionist policies to prevent global competition from depressing wages.

A Northern tariff affects location of industry in two ways. First, by worsening Southern producers' access to the large Northern market, it tends to draw firms to the North. Against this, Northern firms now pay more for intermediate goods imported from South. The net effect is to attract firms to North from South, widening wage differentials.<sup>3</sup> This is illustrated in Figure VIII, which compares Northern and Southern real wages as  $t$  declines towards unity under two different scenarios: free trade, and a Northern tariff of 33 percent on manufactures imports. Parameters and free trade real wages (the lighter lines) are as in Figure V. The heavy lines give real wages with the

Northern tariff. Northern wages are higher than under free trade; thus the claims of some free traders that protectionism is necessarily a self-defeating policy are not borne out. Additionally, North receives tariff revenue, which is not included in the Figure.

Two crucial cautions should, however, be made about these results. First, in supposing that North as a whole imposes a tariff against South, we have in effect gone beyond regarding North and South as regions and treated them as political units or at least customs unions. A general outbreak of protectionism, in which high-wage nations restricted imports from each other as well as low-wage nations, would clearly produce a very different outcome; by raising the prices of intermediates traded intra-North, Northern industry would suffer. To put it differently, the trade policy experiment described by Figure VIII is one in which trade policy has in effect been taken over by disciples of Goldsmith, who wants free trade in manufactures among high-wage nations while preventing imports from low-wage competitors.

Furthermore, it is important to point out that the model does not at all bear out the claims of some modern protectionists that a regime which allows trade only between countries with similar wage rates is somehow in the interests of labor everywhere. On the contrary: in the scenario described by Figure VIII Northern workers are protected from wage decline only by suppressing incipient Southern industrialization, and thereby also keeping Southern real wages low.

#### VI. Summary and Suggestions for Further Research.

The conventional wisdom of economic analysis is that while greater global integration may hurt particular interest groups, it will normally raise the overall real income of just about every nation. There are exceptions to this rule even in the most conventional

model: barriers to trade, natural as well as artificial, may sometimes act as de facto optimal tariffs, and their removal may therefore leave some countries worse off. Nonetheless, standard trade models do seem to suggest a presumption that integration is an all-around good thing.

Critics of this conventional wisdom have long argued that, on the contrary, greater integration usually produces national winners and losers. Traditionally, heterodox critics have argued that integration fosters inequality -- that an integrated world economy divides into a rich core and a poor periphery, and that the wealth of the center comes at the periphery's expense. Only recently has the contrary argument, that globalization benefits the periphery at the core's expense, gained ground.

What we have shown in this paper is that a simple model in which regional differentiation is driven by the interaction between scale economies and transport costs makes sense of both old and new arguments. The world economy must achieve a certain critical level of integration before the forces that cause differentiation into core and periphery can take hold; and when that differentiation occurs, the rise in core income is partly at peripheral expense. As integration proceeds further, however, the advantages of the core are eroded, and the resulting rise in peripheral income may be partly at the core's expense.

There are obviously many ways in which this analysis could be extended. We would, however, emphasize three directions in particular.

First, it would be desirable to get more geography into this model. As it stands, we postulate the existence of two exogenously defined regions, which then take on endogenously derived roles. In practice, the "core" has gradually spread into what was the "periphery", with such areas as the Southern United States, much of Southern Europe,

Japan, and now some of East Asia effectively making a transition from agricultural suppliers to manufacturing exporters. So we would like to extend the analysis to a multi-region setting, perhaps even one with continuous space.

Second, our model excludes capital mobility – indeed, it has no capital. Yet much of the political debate over integration focuses on the alleged impacts of capital movement rather than (or along with) trade flows. Thus a natural step would be to add capital movements.

Finally, it is obviously important to discipline this analysis with some real numbers. We have offered a stark, one-factor explanation of vast global trends. This is in itself worrying. Worse yet, it is an explanation that will appeal to the prejudices of many people. Thus it is crucial to do at least rough empirical work to see whether the kind of story described here is at all likely to be a large part of the explanation of real global economic trends. We suspect that as a practical matter growing integration with the South is at best a minor factor in the economic woes of the North, but the important point is that one should be careful about assuming that something that is possible in principle actually happens in practice.

In spite of these cautions, we regard it as a useful exercise to construct a minimalist model of the kind described here -- and find it remarkable that so simple a structure can give rise to such a sweeping picture of divergence and convergence in the global economy.



## Appendix A: The algebra of symmetry-breaking

Define  $\tau \equiv t^{1-\sigma}$  and the ratios of Northern to Southern values of endogenous variables as follows

$$(A1) \quad \tilde{Q}_M \equiv \frac{Q_M}{Q_M^*}, \quad \tilde{p} \equiv \frac{p}{p^*}, \quad \tilde{E} \equiv \frac{E}{E^*}, \quad \tilde{w} \equiv \frac{w}{w^*}.$$

Using equation (10), we can express the ratios of Northern and Southern expressions (2), (5), (6) and (9) as

$$(A2) \quad \tilde{Q}_M^{1-\sigma} = \frac{L_M \tilde{w} \tilde{p}^{-\sigma} + \tau L_M^*}{\tau L_M \tilde{w} \tilde{p}^{-\sigma} + L_M^*}$$

$$(A3) \quad \tilde{E} = \tilde{w} \left[ \frac{\gamma(1-\mu)L + \mu L_M}{\gamma(1-\mu)L + \mu L_M^*} \right]$$

$$(A4) \quad \tilde{p} = \tilde{w}^{1-\mu} \tilde{Q}_M^\mu$$

$$(A5) \quad \tilde{p}^\sigma = \frac{\tilde{Q}_M^{\sigma-1} \tilde{E} + \tau}{\tau \tilde{Q}_M^{\sigma-1} \tilde{E} + 1}$$

Eliminating  $\tilde{Q}_M$  and  $\tilde{E}$  gives

$$(A6) \quad \tilde{p}^{\frac{1-\sigma}{\mu}} \tilde{w}^{\frac{(\mu-1)(1-\sigma)}{\mu}} = \frac{L_M \tilde{w} \tilde{p}^{-\sigma} + \tau L_M^*}{\tau L_M \tilde{w} \tilde{p}^{-\sigma} + L_M^*}$$

and

$$(A7) \quad \tilde{p}^{\frac{\sigma-1}{\mu}} \tilde{w}^{\frac{(\mu-1)(\sigma-1)}{\mu}} \tilde{w} \left[ \frac{\gamma(1-\mu)L + \mu L_M}{\gamma(1-\mu)L + \mu L_M^*} \right] = \frac{\tau - \tilde{p}^\sigma}{\tau \tilde{p}^\sigma - 1}$$

These two equations express  $\tilde{w}$  and  $\tilde{p}$  as a function of  $L_M$  and  $L_M^*$ . By inspection, if  $L_M = L_M^*$  there is a solution to these equations with  $\tilde{p} = 1$ , and  $\tilde{w} = 1$ . Consider a small

change  $dL_M$  with associated change  $-dL_M^*$  in the neighborhood of these values. Totally differentiating and applying Cremer's rule yields:

$$(A8) \quad \frac{d\tilde{w}}{dL_M} = \left( \frac{\tau-1}{\tau\gamma L} \right) \frac{(\mu-1)[\sigma(\mu-1) + 1] - \tau(\mu+1)[\sigma(\mu+1) - 1]}{2\sigma(\sigma-1)(1-\mu) + (\tau-1)[\sigma(\mu+1) - 1]}$$

This derivative is the slope of the  $L_M L_M$  curve at the symmetric equilibrium. Given that  $\tau \in (0,1)$ , a sufficient condition for the denominator of this expression to be positive is  $\sigma(1-\mu) > 1$ . The numerator is positive or negative according to whether  $t$  is greater or less than the value implied by equation (11) of the text.

#### Appendix B: Parameter values

The simulations of Figures I-V set  $L = L^*$ ,  $\gamma = 0.6$ ,  $\mu = 0.5$ ,  $\sigma = 5$ . In Figure I  $t = 3$ , and in figures II-IV,  $t = 3$ ,  $t = 1.5$ ,  $t = 2$  respectively. In Figure VI  $\gamma$  is increased to 0.7. In Figure VII  $\mu$  is increased to 0.55 and  $\gamma$  is returned to 0.6.

#### Appendix C: The pattern of specialization

As long as the share of manufactures in final demand exceeds 1/2, any asymmetric equilibrium must involve specialization by one "core" country in manufactures. But does the other, "periphery" country also produce some manufactures? It is possible to shed some light on this question algebraically.

Suppose all manufacturing is in North and therefore  $w^* = 1$ . We then have:

$$(A9) \quad E + E^* = \frac{wL}{1-\mu}, \quad E^* = \gamma L^*, \quad E = \gamma wL + \mu \left( \frac{wL}{1-\mu} \right).$$

The first of these says that total expenditure equals the value of output (which is the wage bill divided by the labor share). The second and third give manufacturing expenditure in

each location, with Northern expenditure including intermediate demand. Setting  $L = L^* = 1$  and solving,

$$(A10) \quad w = \frac{\gamma}{1-\gamma}, \quad E^* = \gamma, \quad E = \frac{\gamma}{1-\gamma} \left( \gamma + \frac{\mu}{1-\mu} \right).$$

A necessary condition for this to be an equilibrium is that it is not profitable for any firm to start producing in South. This can be written as a condition imposing an upper bound on the Northern wage,  $w$ . Using (9), together with (2) and (6) and noting that when  $n^* = 0$ , then  $Q_M^* = tQ_M$ , the condition is:

$$(A11) \quad w^{\sigma(\mu-1)} \leq t^{-\mu\sigma} \left[ \frac{E^* t^{\sigma-1} + E t^{1-\sigma}}{E + E^*} \right].$$

This relationship is illustrated as curve  $nn$  in figure IX (for the same values of parameters as used in figure VII, and for constant values of  $E$  and  $E^*$  from (A10)). Above the line  $nn$  the Northern wage is high enough that it would be profitable for a firm to establish in South, and below it this is unprofitable. This maximum wage gap peaks at intermediate values of  $t$ , and is larger the larger is Northern expenditure,  $E$ , relative to Southern,  $E^*$ . The curve  $nn$  is given by industrial location considerations. The actual wage is as given by (A10) and illustrated by the dashed line. Equilibrium is fully specialised in the interval  $SS$ , in which the equilibrium wage in North is low enough that no firm wants to set up in South.

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1. For sceptical assessments of the supposed impact of developing country exports on advanced nations, see Krugman and Lawrence [1994] and Krugman [1994].
2. North is specialized in manufactures; but does South specialize in agriculture, or does it produce some manufactures as well? This is a somewhat difficult question to analyze; we discuss it further in Appendix C.
3. To see this, consider a small Northern tariff  $d\tau$  at a point close to  $t=1$ , (at which manufacturing is divided equally between North and South). The tariff raises Southern firms' cost on half their sales by  $d\tau$ . It raises Northern firms costs on all their sales by  $\mu d\tau/2$  (since half of intermediates are imported). The former effect is larger than the latter, so Southern firms are hit harder by the tariff than Northern ones.

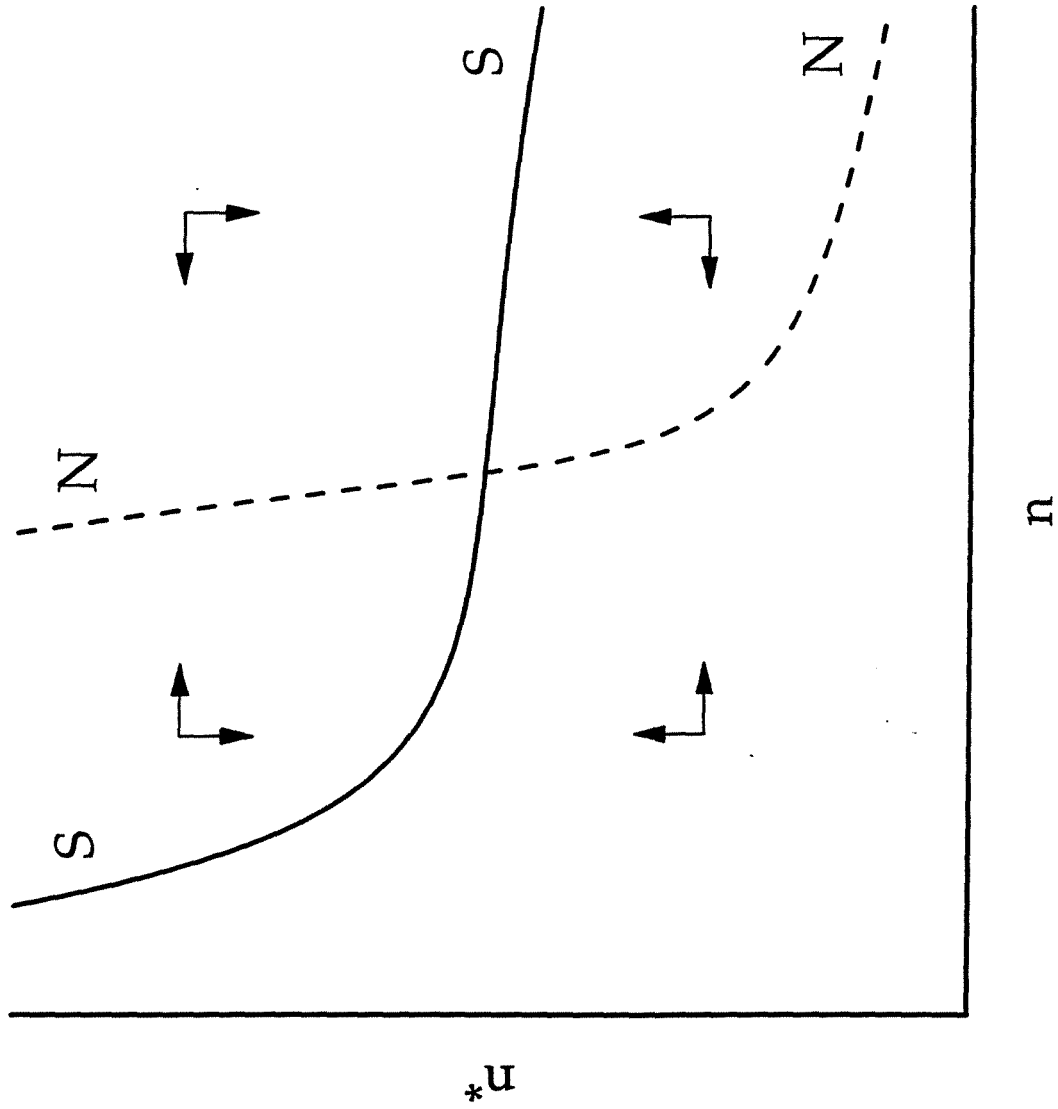


FIGURE I  
Zero Profit Loci in North and South

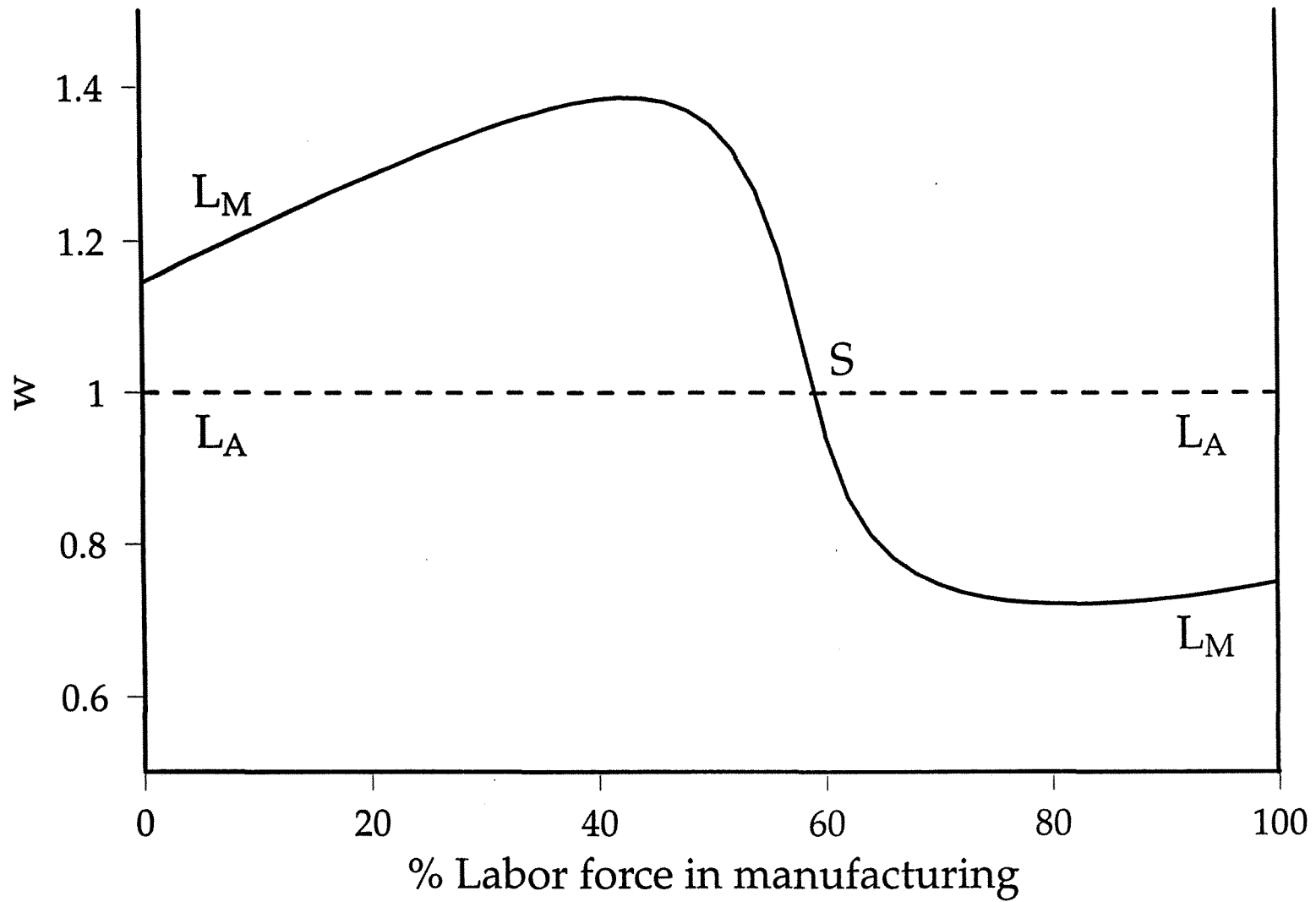


FIGURE II  
Labor Demand: High Trade Costs

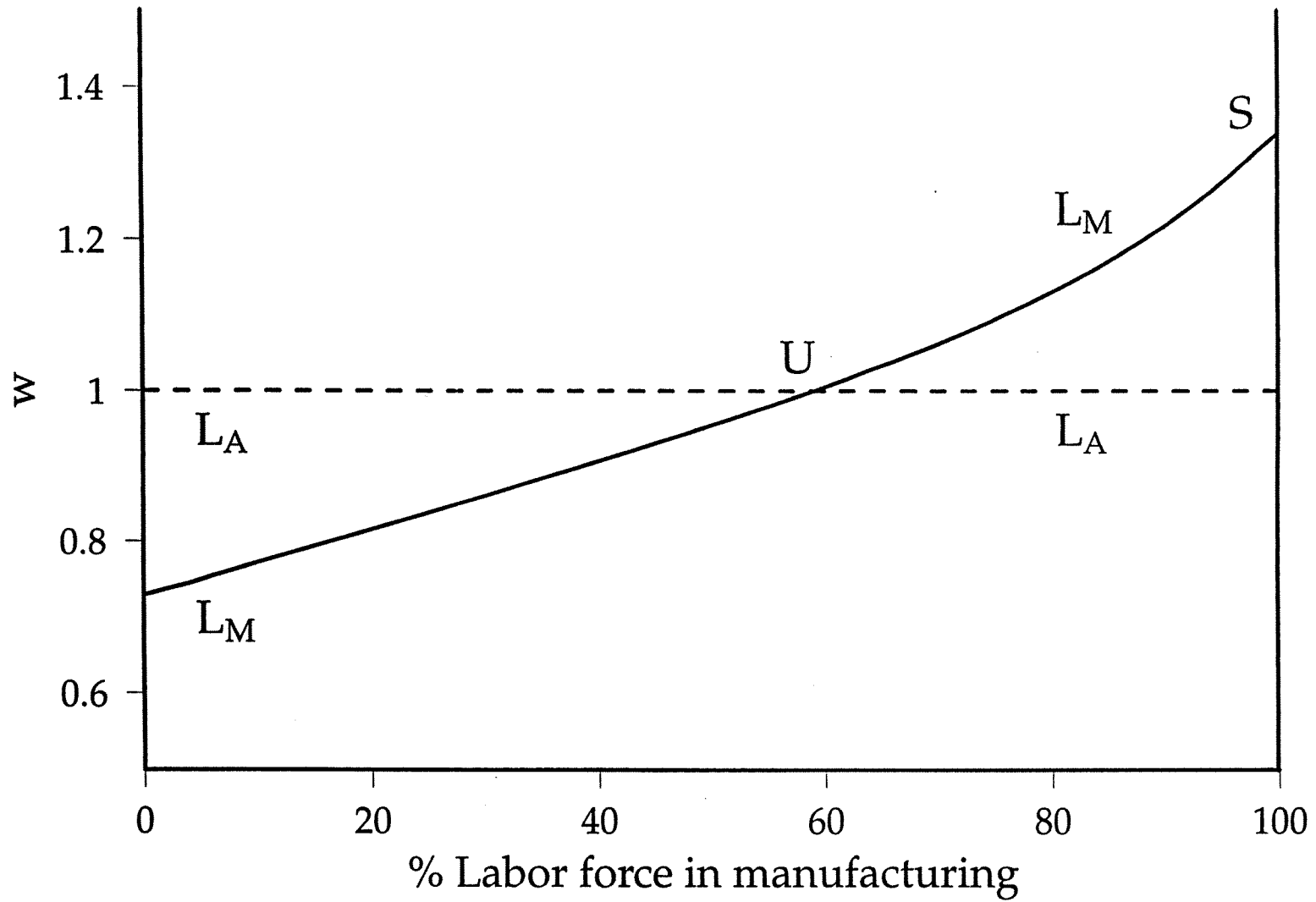


FIGURE III  
Labor Demand: Low Trade Costs



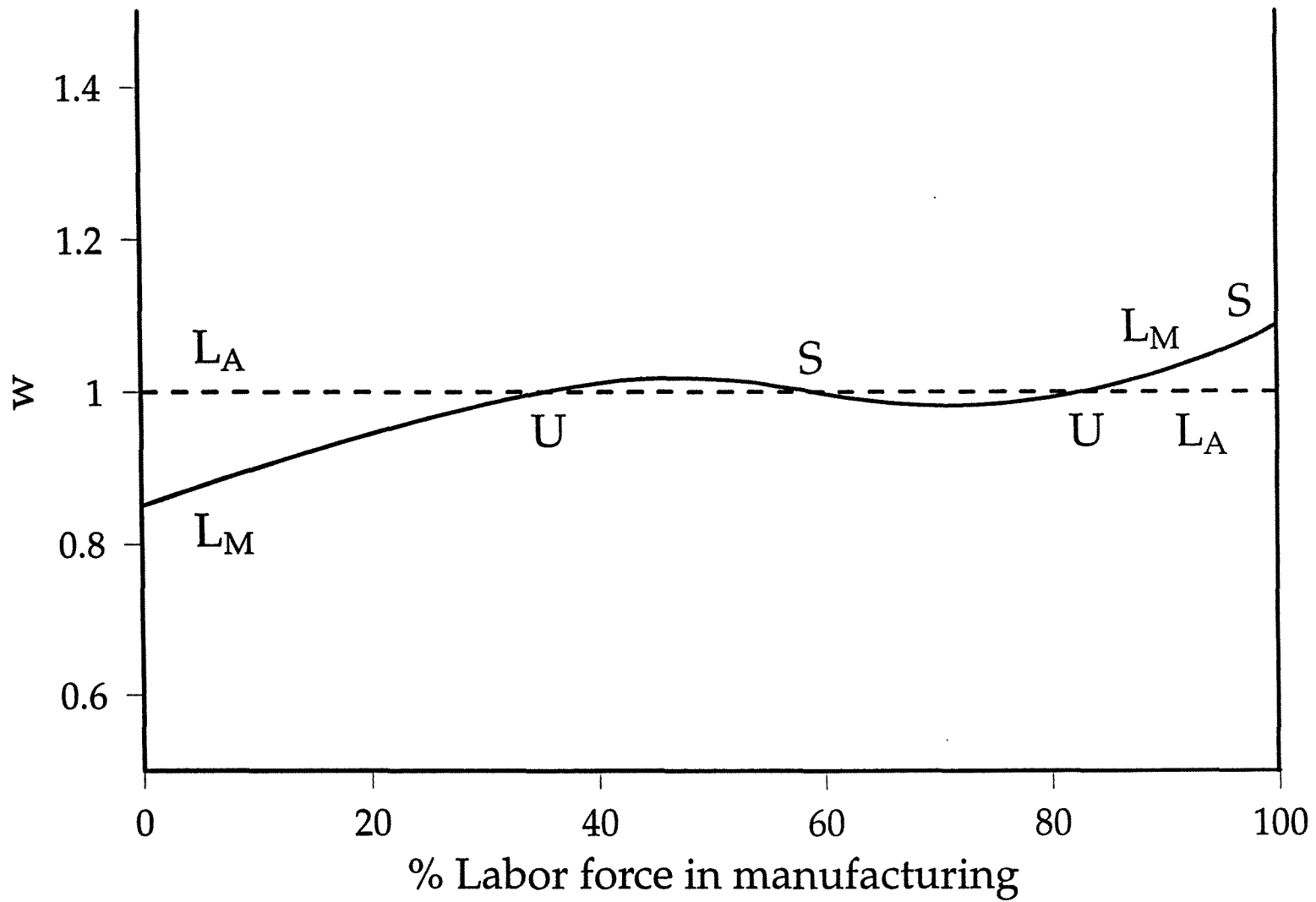


FIGURE IV  
 Labor Demand: Intermediate Trade Costs

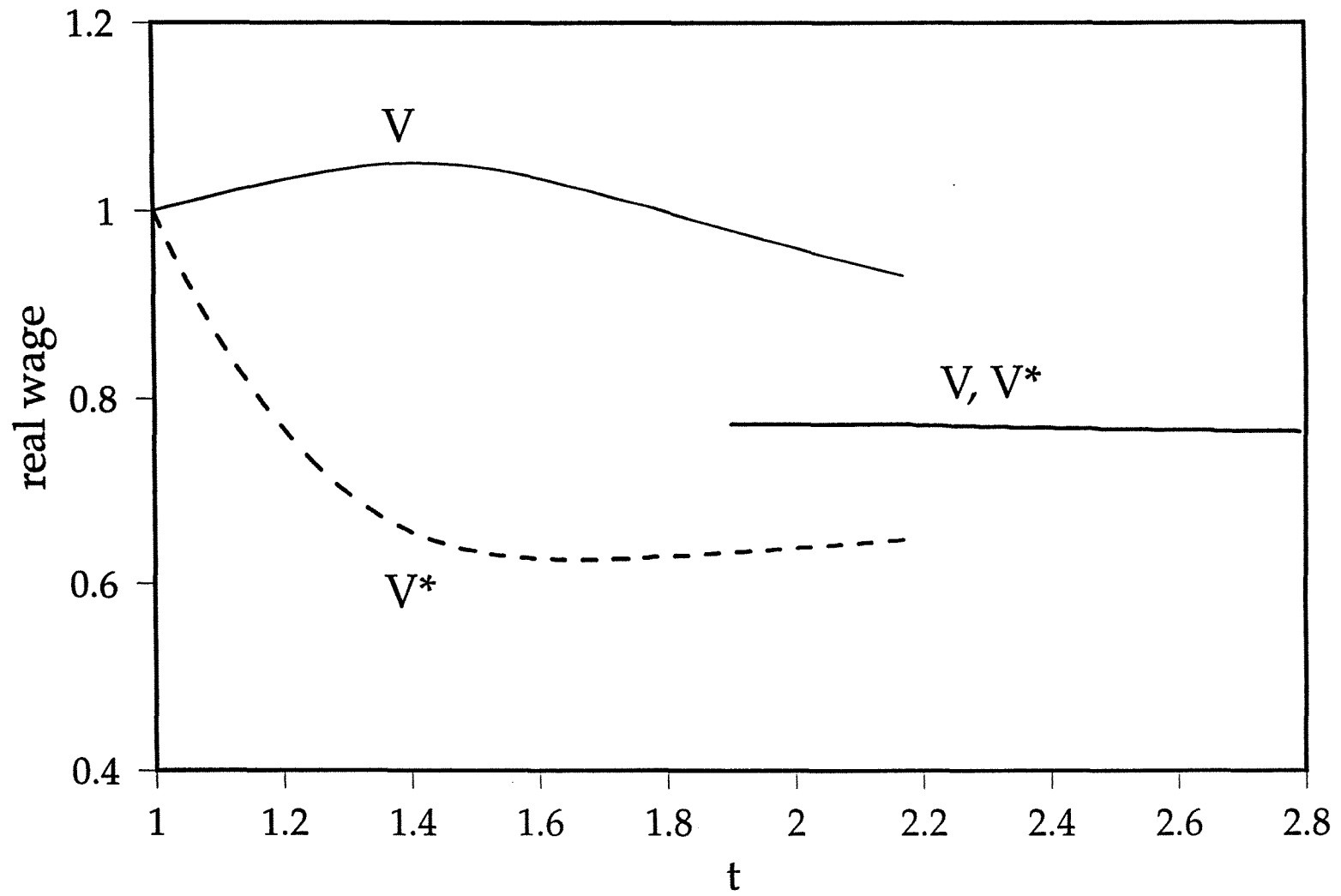


FIGURE V  
Trade Costs and Real Wages

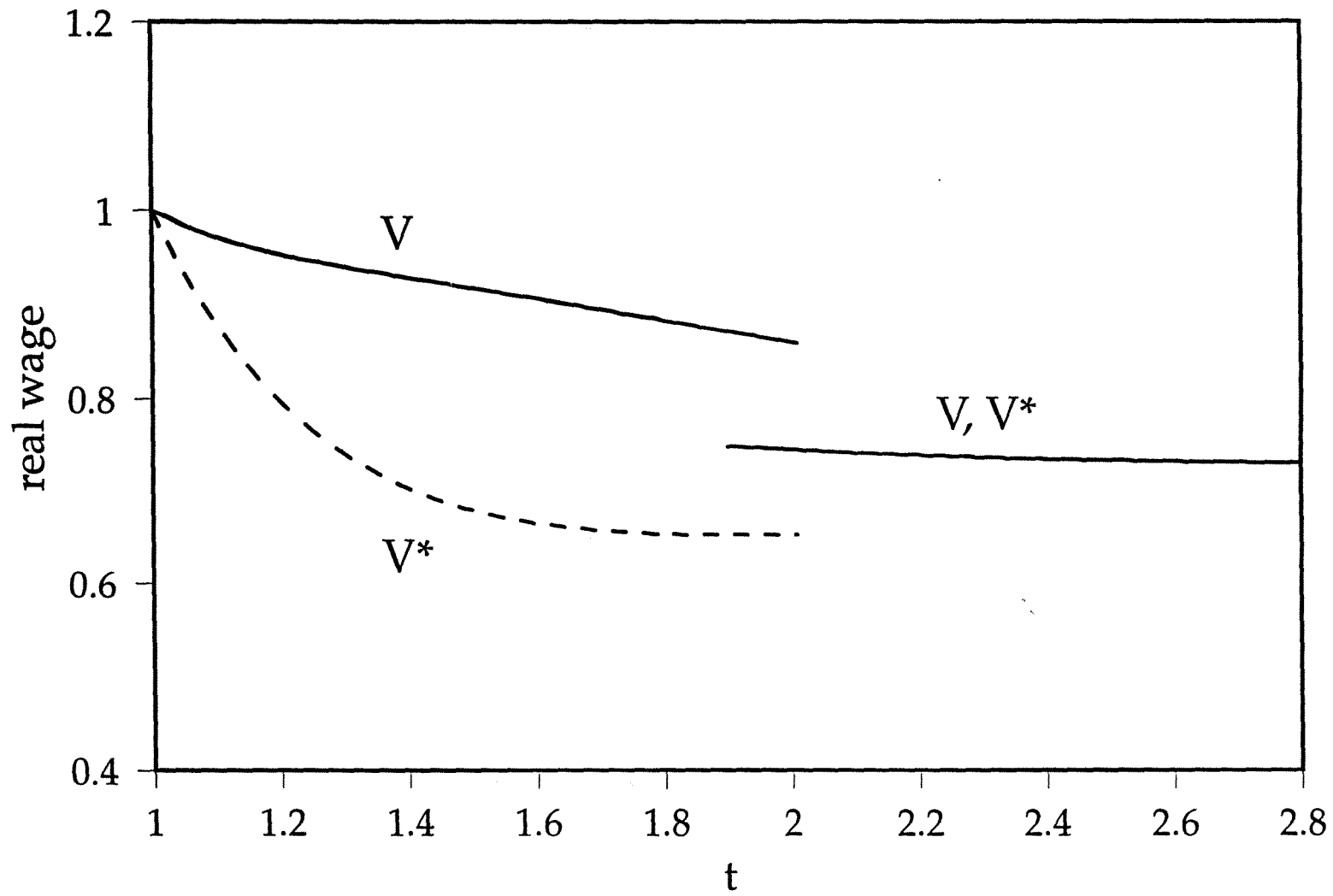


FIGURE VI  
Real Wages: High  $\gamma$

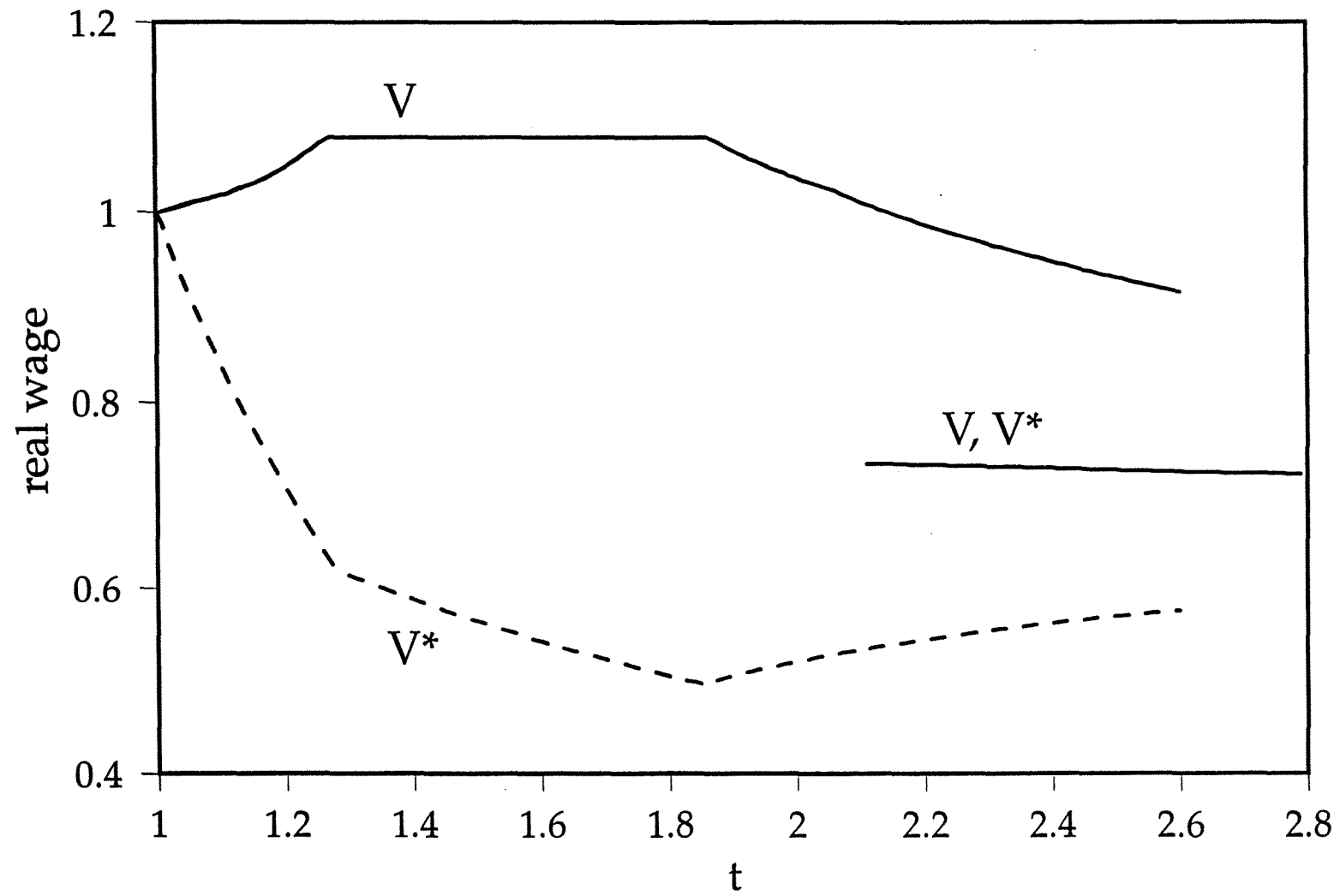


FIGURE VII  
Real Wages: High  $\mu$

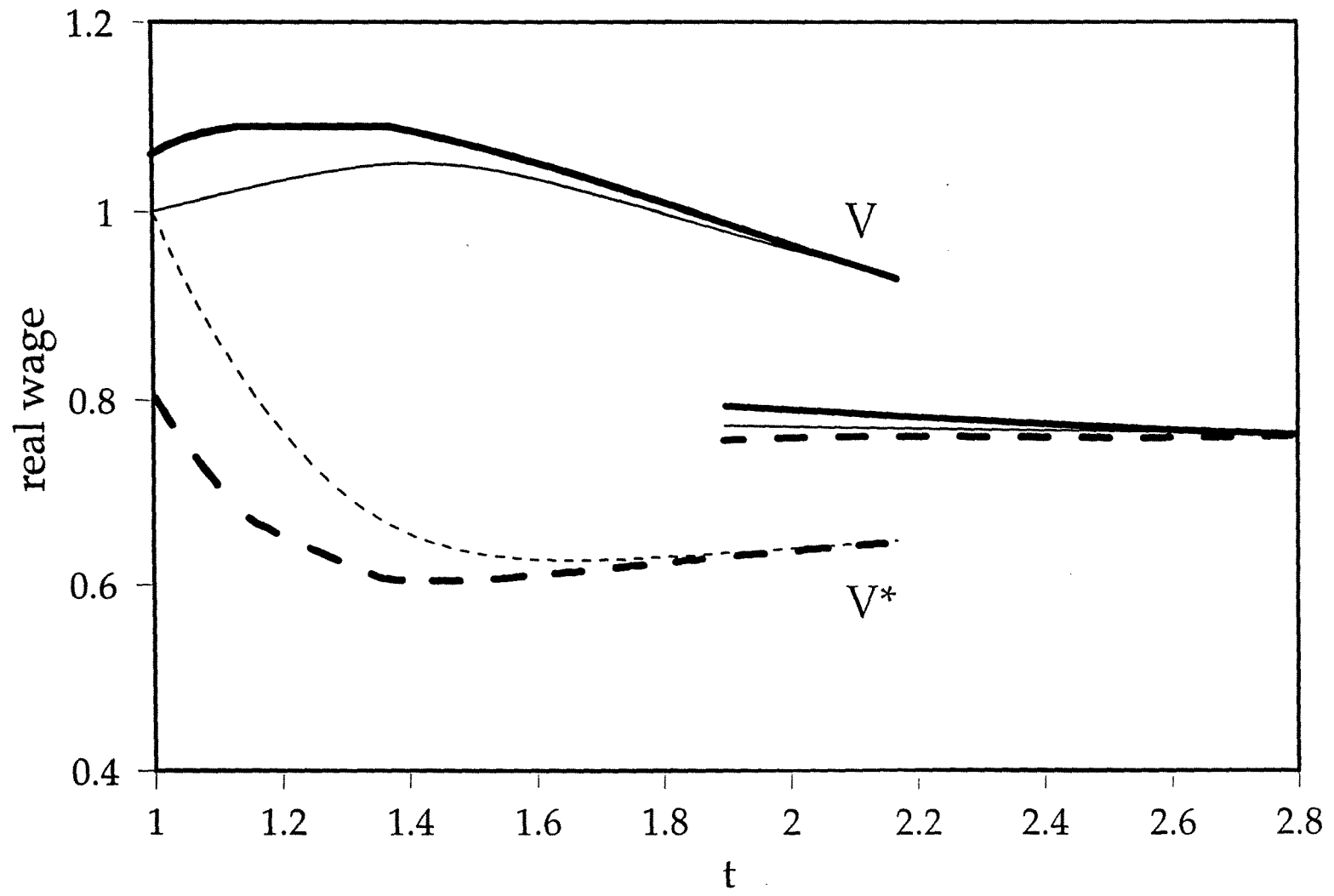


FIGURE VIII  
Real Wages with a Northern Tariff

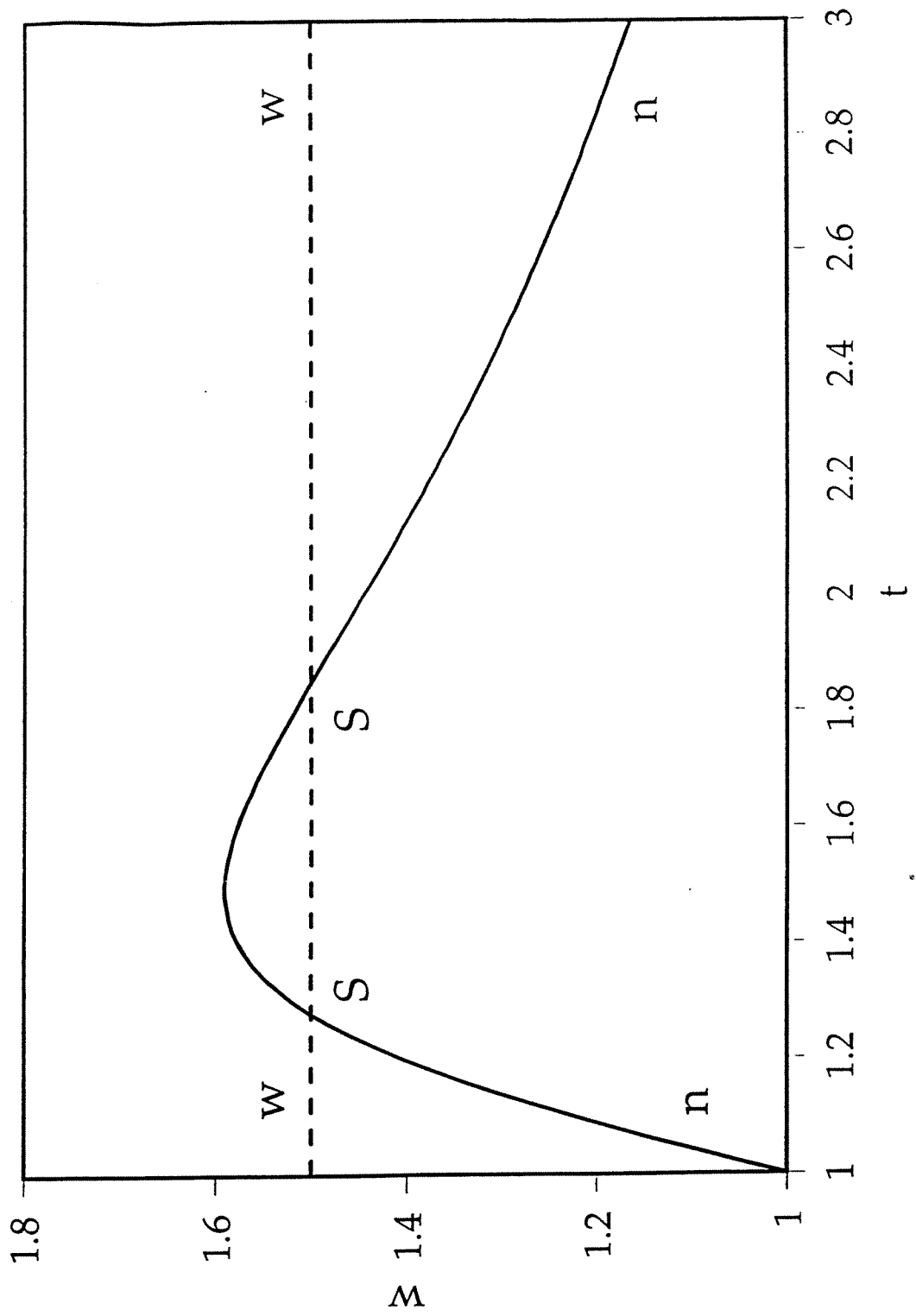


FIGURE IX  
Southern Specialization