RESEARCH SEMINAR IN INTERNATIONAL ECONOMICS

School of Public Policy
University of Michigan
Ann Arbor, Michigan 48109-1220

Discussion Paper No. 405

International Externalities in the Use of Domestic Policies to Redistribute Income

Alan V. Deardorff
University of Michigan

July 19, 1997

Recent RSIE Discussion Papers are available on the World Wide Web
at: http://www.spp.umich.edu/rsie/workingpapers/wp.html

International Externalities in the Use of Domestic Policies to Redistribute Income

Alan V. Deardorff

The University of Michigan

Paper presented at the RIEB International Conference on
"International Economic Links and Policy Formation:
Where Do We Go From Here?"
Kobe University,
June 12-13, 1997

July 19, 1997

ABSTRACT

International Externalities in the Use of Domestic Policies to Redistribute Income

Policies to redistribute income between high- and low-income groups are well known to distort factor supply decisions and thereby to generate deadweight losses incidental to income redistribution. This paper examines the effects that these same distortions may also have on factor supplies themselves, and thus on the implied patterns of production and international trade. The point is not just that redistribution policies may matter for trade, however, but that, through their effects on world market prices and associated factor prices, the distributional effects of redistribution policies spill over into the markets of a country's trading partners. Using a standard two-factor, two-good Heckscher-Ohlin Model with endogenous factor supplies of skilled and unskilled labor, the paper derives the effects of a redistributive tax on factor supplies, production, trade, world goods markets, factor markets, and income distributions at home and abroad. One result is that a redistributive tax by a large country is to some extent undermined in its effects on its own income distribution by changes in world prices, and also that such a policy tends to worsen the income distribution abroad at the same time that it improves it at home. Another result is that a redistributive tax will affect a country's terms of trade in ways that will sometimes reinforce, other times offset, the incentive to redistribute income. Both results have implications for the need for, and desirability of, international coordination of policies for domestic income redistribution. In particular, it is argued that high income countries will tend to go too far in redistributing income, while low income countries will not go far enough. Both could be better off if they coordinated on changes in their distribution policies.

Keywords: Income Redistribution
International Spillovers

JEL Subject Code:
F11 Neoclassical Trade Models
D33 Factor Income Distribution

Alan V. Deardorff

The University of Michigan

Correspondence:

Alan V. Deardorff
Department of Economics
University of Michigan
Ann Arbor, MI 48109-1220

Tel. 313-764-6817
Fax. 313-763-9181
E-mail: alandear@umich.ed

July 19, 1997

International Externalities in the Use of Domestic Policies to Redistribute Income[1]

Alan V. Deardorff
The University of Michigan

I. Introduction

Policies to redistribute income between high- and low-income groups are well known to distort factor supply decisions and thereby to generate deadweight losses incidental to income redistribution. This paper examines the effects that these same distortions may also have on the factor supplies themselves, and thus on the implied patterns of production and international trade. The point is not just that redistribution policies may matter for trade, however, but that, through their effects on world market prices and associated factor prices, the distributional effects of policies to redistribute income will spill over into the markets of a country's trading partners.[2] Using a standard two-factor, two-good Heckscher-Ohlin Model augmented to include endogenous supplies of skilled and unskilled labor, I derive the effects of a redistributive tax on factor supplies, production, trade, world goods markets, factor markets, and income distributions at home and abroad.[3]

One result is that a redistributive tax by a large country is to some extent undermined in its effects on domestic income distribution by changes that it causes in world prices. Also, such a policy tends to worsen the income distribution abroad at the same time that it improves it at home. Another result is that a redistributive tax will

affect a country's terms of trade in ways that will sometimes reinforce, other times offset, the incentive to redistribute income. Both results have implications for the need for, and the desirability of, international coordination of policies for domestic income redistribution.[4]

Section II of the paper lays out the model, focusing primarily on the depiction of endogenous factor supplies and the resulting distribution of income, since these may be somewhat novel.[5] Section III works through the effects of a redistributive tax on the variables of the economy, holding world prices of goods constant, so as to derive the effect on the country's trade and thus its offer curve. Implications for the world market are routine, once this is done, and Section IV therefore explores the effects of resulting changes in international prices on the income distributions at home and abroad. This establishes the first set of results mentioned above. Finally, Section V endogenizes the government incentive to redistribute income and examines the international policy equilibria that obtain when the governments do, and do not, coordinate.

II. The Model

The model builds upon the standard two-factor, two-good Heckscher-Ohlin structure with perfect competition. The two factors are skilled and unskilled labor, which are assumed to be imperfect substitutes in the production of both goods. One of the goods, *X*, uses skilled labor relatively intensively compared to good *Y*. If the endowments of these two factors were fixed, then this model could be analyzed with any of several familiar techniques, of which I will choose the Lerner-Pearce diagram, since it meshes nicely with the way I will model the factor markets.

The number of workers in a country is fixed at a large number, L, but each of these workers can opt to remain unskilled or to acquire skill by giving up their own time and getting a return that varies across the population depending upon a distribution of innate abilities. Each worker lives a fixed working lifetime and is replaced when he or she dies with another worker who must make the same choice. The distribution of births/deaths is constant over time, so that at any moment there is a constant flow of new workers coming on the scene. The distribution of ability across these new workers also remains constant over time.

If a new worker opts to remain unskilled, then he[6] will supply one unit of unskilled labor over his lifetime and be paid the unskilled wage, w_u. To become skilled, an individual i must use some of what would have been his working life in training (indeed, I assume for simplicity that own time is all that goes into acquiring skill), and he then acquires in return an amount of skill, S_i, to supply over the remainder of his life. This amount of skill varies across individuals depending on their innate ability. With a wage per unit of skill of w_s (what I will call the skilled wage, although it is not paid per person and should therefore not be compared to w_u), skilled worker i earns an income of $w_s S_i$ over his lifetime.

Presumably any amount of skill greater than zero will qualify a worker for a higher wage per unit of time worked than the unskilled wage. However, because of time spent in acquiring the skill, the time worked by a skilled worker is less than that of an unskilled worker. Therefore individuals for whom S_i is small may well find that their lifetime income as skilled workers, $w_s S_i$, is less than w_u. These workers will choose to remain unskilled.

The labor market is represented conveniently in the top panel of Figure 1. Unskilled labor is measured along the horizontal axis, with L marking the total population. Units of skilled labor are measured vertically, and the curve *LEM* represents the total skilled labor in the economy as individuals are subtracted from the supply of unskilled labor and become skilled, starting with those most able to acquire skill. The slope of *LEM* as we move from right to left records the amount of skill acquired per individual, S_i. The curve becomes flatter as we move to the left and train less and less able workers.

Now suppose that the wages of skill and unskilled labor are given as w_s and w_u respectively. All individuals for whom $w_s S_i$ is greater than w_u will become skilled, while all those for whom $w_s S_i$ is less than w_u will remain unskilled. The dividing line is therefore where the slope of *LEM*, S_i, is equal to w_u/w_s.. Therefore, by drawing a downward sloping straight line with slope w_u/w_s. we can identify the equilibrium as a tangency with *LEM*.

The lower panel of Figure 1 depicts the resulting income distribution. The curve *AEB*, moving from right to left from *B*, measures S_i for the marginal individual becoming trained as we move right to left along *LEM* above. However, this is also multiplied by w_s to give the worker's lifetime income if he becomes skilled. The horizontal line at w_u shows the same for (all) workers if they remain unskilled. Individuals opt for the higher of these two curves, so that their lifetime incomes are given by the heavier curve, *CEB*. This curve therefore shows the complete income distribution of all individuals in the economy, since all of them are arrayed along the horizontal axis. Clearly, under the assumptions of this model, while the marginal skilled worker is no better off than any

unskilled worker, all other skilled workers are better off, by an amount that depends on their ability to acquire skill.

So far, income has been measured in some arbitrary units, the same as wages. In a moment this model of labor supply will be imbedded in a two-good model of international trade, where real wages depend on both prices. As long as those prices are fixed, this poses no problem, but we will not leave them fixed for long. Therefore to avoid complications I will assume that all individuals in a country face the same prices of goods (so that the equilibrium in Figure 1 is valid) and that they share identical homothetic preferences.

Consider, then, the effect of a change in wages on the income distribution. A rise in the relative wage of skill flattens out the wage line in the top panel, moving the tangency with *LEM* up and to the left. The higher relative wage induces more workers to become skilled and thus increases the supply of skill in the economy. At the same time, the wages of all skilled workers in the lower panel increase relative to the unskilled. Some close-to-marginal unskilled workers therefore now become skilled and raise their incomes. Meanwhile, the remaining unskilled workers continue to earn the unskilled wage, which is now lower relative to wages of the rest of the population than it was before. With only a change in the relative wage we cannot of course say who is better off and who is worse off in real terms, if any. But, by any measure, the distribution of income has become more unequal.

To incorporate this model of factor supply into the Heckscher-Ohlin trade model we use the Lerner-Pearce diagram of Figure 2. This depicts a country that takes as given (either because it is small or because we have not yet determined them) the prices of two

goods, X and Y, and the linear homogeneous technologies for producing them from skill and unskilled labor. Together these determine the unit value isoquants shown as $X=1/p_x$ and $Y=1/p_y$. The unique[7] common tangent to these two isoquants defines, by its intercepts $1/w_u$ and $1/w_s$, the only factor prices consistent with producing both goods at these goods prices. Corresponding to these factor prices, cost-minimizing ratios of skill to unskilled labor, s_x and s_y, will be employed in the two sectors, defining the familiar diversification cone, s_xOs_y.

Now suppose that these factor prices do in fact prevail in the factor market. Adding to the diagram the factor supply locus, *LEM*, we can construct a factor price line parallel to the common tangent and find its tangency with *LEM* at *E*. If *E* lies inside the diversification cone, as drawn, then these factor prices do clear the factor market and constitute an equilibrium. I will consider here only such diversified equilibria, leaving it to the reader to examine cases of complete specialization.[8]

The final step is to construct lines from *E* parallel to the rays, s_x and s_y, forming the parallelogram with vertices at *A* and *B*. The isoquants through these points (radial expansions and contractions of the respective unit value isoquants), indicate the outputs of the two industries, X_0 and Y_0, in the equilibrium. All that remains to determine is trade, and this cannot be done with this diagram, since it does not depict demand. However, demand can be handled in the usual way with a production possibility frontier (PPF) and community indifference curves, with the position and any shifts of the PPF identified by Figure 2. Note in particular that with perfect competition and undistorted goods and factor markets, the country will still produce at a point of tangency between a

price line and the PPF, which will still be concave to the origin, although less curved than if factor supplies were fixed.

III. Effects of a Redistributive Tax

Suppose now that the inequality of income across individuals that was shown in the bottom panel of Figure 1 is considered socially undesirable, and that a policy is sought to reduce it. In the present model that can in principle be done without distorting behavior, because the only source of income inequality is innate ability, and that is fully revealed by income. A 100% tax on all income more than a tiny amount epsilon greater than y_u will reduce the after-tax income of every skilled worker to almost the same as that of each unskilled worker, without negating their incentive, epsilon, to acquire skill. Redistributing the tax revenue equally across the population then leaves all of the unskilled, and even some of the skilled, better off. It would be possible to prevent this mechanism from working by complicating the model in some way that prevents this simple identification of workers by ability. For example, one could add a dimension of effort to one or both of the workers' skill acquisition or their employment as skilled and unskilled workers, and also include a tradeoff between effort and leisure, with individuals differing also in their preferences over the two.[9] This would cause workers of identical ability to differ in income as a result of their effort-leisure choice. A simple tax based on observable income would then no longer be able to discriminate among individuals based on their innate differences, and it would therefore fail to redistribute income perfectly. Rather than complicate the model in this way, however, I will simply assume that such a simple policy is not available. Note that with or without this additional dimension of

effort, the model still predicts a positive response of productive labor to a rise in the skilled wage, which is the main thing that I need for my results.

The redistributive policy that I examine is therefore simply a tax on the skilled wage, accompanied by a subsidy on the unskilled wage, the two being calibrated so as to balance the government budget. The effect of the policy is to lower the ratio of the wage received by skilled workers to the wage received by unskilled workers, below the ratio of what their respective employers pay, by some amount, t, while leaving total payments to workers as a group unchanged.[10]

With fixed goods prices and nonspecialization, factor price equalization (FPE) makes the effect of this policy comparatively easy to determine. The wages paid by firms remain at w_u and w_s, while the relative wage received by skilled labor falls below w_s/w_u by t, steepening by this amount the factor price line to which labor supply responds. In the top panel of Figure 3, this is shown by the change from the solid to the broken factor price line. The result is that fewer workers opt to acquire skill, and the factor supply moves from point E to point E'. Directly below in the bottom panel, this change is mirrored in a downward shift of the curve that shows the value of skill each individual can acquire, from $w_s S_i$ to $(w_s - t_s)S_i$, due to the tax on skill. At the same time, the unskilled wage rises by the subsidy, $-t_u$. Together, the two new curves also determine the new marginal skilled worker, now at E'. The new income distribution is shown by the heavy broken line, $C'E'B'$. Compared to CEB, the tax on skilled labor has succeeded in making the income distribution more equal.

Other effects of this redistributive tax are visible in the top panel. The reduced supply of skilled labor and the increased supply of unskilled labor have Rybczynski

effects on outputs of the two sectors, raising the output of the unskill-intensive good, *Y*, and lowering the output of the skill-intensive good, *X*. Consumers face the same relative prices as before, however, and with homothetic preferences the ratio of the two goods they consume is unchanged. Thus if the country is initially an exporter of *X*, then the tax causes it to trade less, exporting less *X* and importing less *Y*. Or if it initially exports *Y*, then the tax causes it to trade more. Levels of consumption of both goods fall slightly, due to the fall of income indicated by the fact that *E'* in the top panel of Figure 3 is inside the original factor price line, ω_0.

The offer curve of this country is conventionally shaped under the assumptions here,[11] and in Figure 4 it is shown without any tax as the curve *AOA*. The effect of the redistributive tax is to rotate the curve counterclockwise to *A'OA'*, pulling its northeast portion in toward the origin (exporting less *X*) and pulling its southwest portion away from the origin (exporting more *Y*). The initial pattern of trade depends on the foreign offer curve, and both cases are shown in Figure 4. For the steep foreign offer curve *BOB*, the home country exports *X*, and the effect of the tax is to move equilibrium from *E* to *E'*, reducing trade. For the flatter foreign offer curve *B*OB**, the home country exports *Y*, and the effect of the tax is to move equilibrium from *E** to *E*'*, expanding trade. However, in both cases, the relative price of good *X* on the world market rises, regardless of the pattern of trade. This is not surprising, since the country has taxed the factor used intensively in the production of good *X*, making it in some sense both more costly and more scarce.

Note also that while in both cases the world price moves in the same direction, the resulting effects on the taxing country's terms of trade are quite different. If the country

exports the skill intensive good, *X*, then taxing skill improves its terms of trade, as in the move from *E* to *E'*. But if the taxing country exports the unskill-intensive good, *Y*, then the tax on skill worsens its terms of trade. This is just a reflection of the "factor endowments" as they determine comparative advantage and trade. To export the skill intensive good, the country must have, if not an abundance of skilled labor, then an abundant willingness or ability to acquire it, and taxing skilled labor is a way for such a country to exert its monopoly power over the world market for the products of skill and the acquisition of skill.

IV. Effect of World Prices on Income Distributions

Consider now the effect of the rise in the world price of the skill-intensive good *X* that we found for both patterns of trade in Figure 4, as it now feeds back onto the income distribution in either country. Figure 5 shows what happens to the original country, the one that imposed the tax on skill. Having started from equilibrium at *E* in both panels, the redistributive tax moved equilibrium to *E'* (the movement has been exaggerated here, compared to Figure 3, in order to make more room for subsequent changes). Recall that while the ratio of the unskilled to the skilled wage received by workers has increased from ω_0 to ω_0', the wage ratio paid by firms has so far remained at ω_0, since we haven't yet allowed goods prices to change.

An increase on the price of good *X*, however, from p_x^0 to p_x^1, shifts the unit value isoquant for good *X* inward, as shown. The common tangent rotates counter-clockwise, causing the familiar Stolper-Samuelson magnified increase in the skilled wage, from w_s^0 to w_s^1, and a decrease in the unskilled wage from w_u^0 to w_u^1. These are the wages paid by

firms, but if we hold the size of the redistributive tax constant,[12] then there will be comparable changes in wages received by workers, lowering the ratio of the unskilled to skilled after-tax wage from ω_0' to ω_1'. This in turn causes the supply of skilled labor to increase, moving the equilibrium from E' to E''. The induced change in the terms of trade has therefore undone some of the labor market supply response that would have occurred due to the redistributive tax if prices had remained constant.

Of course the same offsetting effect can be seen also in the lower panel for the income distribution. With constant prices, the redistributive tax would have changed the income distribution from *CEB* to $C'E'B'$, the latter being a more equal income distribution than the former, with higher low incomes and lower high incomes. The rise in the world price of the skill-intensive good, however, raises the skilled wage paid by firms and lowers the unskilled wage in a manifestation of the Stolper-Samuelson Theorem. This reverses the move toward equality, with a higher skilled wage for high-income workers and a lower unskilled wage for low-income workers. The new income distribution is now shown by $C''E''B''$ in Figure 5. Thus we conclude that an attempt to redistribute income by a country that is large enough to influence world prices will cause changes in those prices in a direction that partially offsets the effect that it was trying to achieve.[13]

The effect on the rest of the world is similar, although it did not initiate the policy. If the rest of the world has no redistributive tax itself, then its initial position in something like Figure 5 will be at E, not E', but the world price change will still move it northwest and cause greater inequality in the bottom panel.[14] Alternatively, if the rest of world already had a redistributive tax in place (the effect of which on world prices was already

included in the initial prices here), then Figure 5 in its equilibria E' and E'' gives us the correct depiction of what happens there. In either case, then, the attempt by one country to make its income distribution more equal by using a redistributive tax has caused greater income inequality abroad. In a sense, a portion of the inequality has been exported.

V. Policy Coordination

Having established that redistributive policies can have spillover effects on income distributions abroad, the question arises whether it is necessary for governments to coordinate their use of such policies in order to avoid undermining each other's efforts with their own. For that purpose, we need to be a little bit more formal about what is motivating governments in the use of these policies. Fortunately, under the assumptions of the model we do not need to be too elaborate.

As long as the distribution of abilities within a country remains fixed, as will be assumed, then the curve representing the tradeoff between U and S is fixed, as is the shape (but not the height) of the AEB curves in the bottom panels of Figures 3 and 5 representing the relative nominal income distribution if all workers were skilled. I will also assume, as mentioned earlier, that all workers share identical homothetic preferences for the two goods, so that differences in nominal income across individuals are also differences in real income. Therefore the relative distribution of income across individuals is affected only by the ratio of wages, ω, and we can use it as our indicator the income distribution.[15]

Suppose then that governments seek to maximize a social objective function $W(Y,\omega)$, whose arguments are real national income, Y, and the income distribution as represented by the relative wage of unskilled labor, ω. Social welfare is an increasing function of both Y and ω. This is not quite enough structure to give us clear results, since as usual in problems of this sort the results can depend ambiguously on the interaction of income and substitution effects. To avoid such ambiguities I make the following assumption:

> **Assumption:** For the changes considered here, policy makers will always choose to accompany a rise in real income with an increase in equality, and a fall in real income with a decrease in equality.

A sufficient condition for this to happen would be that the indifference curves of W be L-shaped, so that income effects always dominate substitution effects. The assumption itself is somewhat weaker than this, since it only applies to certain so-far-unspecified changes. I prefer it though, not for that reason, but because it may make clearer what is really being assumed, and it might therefore suggest to some readers that the opposite is more plausible in some circumstances. For example, while additional equality may well be desirable and a good use for additional real income, if that increase in real income can only be obtained at the cost of increased inequality, surely some would opt to accept it. However, let us see where the assumption leads.

I will start with the effects of a change in international prices on the optimal redistributive tax. A rise in the relative price of the skill-intensive good, X, holding constant any tax, makes the income distribution more unequal, as we saw in Figure 5. Its effect on real income, however, depends on the country's pattern of trade. If it is an

exporter of *X*, then the price change constitutes an improvement in its terms of trade and real income rises. If it is an importer of *X*, income falls. More importantly, this would remain true even if the change in prices were accompanied by a change in a redistributive tax that would leave the relative after-tax wages of workers unchanged. This is true because under such a tax the factor supplies would remain unchanged and the countries would be just like those of the conventional H-O Model with fixed factor endowments.

This means that an *X*-exporting country, when confronted with an improvement in its terms of trade, has the option of holding its distribution of income (indexed by ω) constant while still getting an increase in real national income. Under the Assumption above, the optimal policy will therefore be to increase the redistributive tax even above this level, so as to improve the distribution of income along with the (now smaller) increase in income.

A similar conclusion can be argued for a country that imports good *X*, so long as the price change is not too large. Such a country, at a constant tax, will experience a worsening of its income distribution along with a fall in real national income.[16] It could, if it chose to, increase its tax to hold the income distribution constant, but if it were to do so, it would still suffer a fall in real income (again, like an *X*-importer in the H-O Model). Therefore, under the above Assumption, it will not do that. Whether the tax will actually rise or fall relative to the initial situation we cannot say, but we can be sure that ω will fall.

Now consider how redistributive policies might be set in an equilibrium among governments. Several alternatives are possible, depending on what policy makers view themselves as controlling and, more important, what they take as given in the behavior of

others. I will consider a two-country world in which a home and foreign (with a *) country are both large enough to influence world prices. In that context, I will look at a Nash equilibrium in the redistributive taxes of the two countries, t and t^*. This is illustrated in Figure 6, the bottom panel of which shows reaction curves that have been loosely derived with the aid of the offer curves in the top panel.

Let OA and OA^* be the two countries' offer curves with taxes set at zero. Trade indifference curves labeled Y_0 and Y_0^* show the levels of real income that each attain in a free trade equilibrium with no tax. $\tilde{Y}_0$ and $\tilde{Y}_0^*$ show what they each might attain using optimal tariffs in the absence of retaliation, although there are no tariffs in the current analysis. Consider first the redistributive taxes, t, that the home country might choose to levy. As we saw in Figure 4, use of such a tax will rotate the offer curve counterclockwise, pulling it in toward the origin in the northeast quadrant. With the right tax, call it $\tilde{t}$, it could move the international equilibrium to point $\tilde{E}$, where it would attain the real income $\tilde{Y}$. This would also improve the income distribution, although as we saw above, the more the terms of trade has improved to raise real income, the less has been the increase in ω. The optimal tax, $\hat{t}$, may be on either side of $\tilde{t}$, although I assume in the figure that it is larger. That is, the optimal tax in the home country given a zero tax abroad is $\hat{t} > \tilde{t}$, and it moves the home offer curve to $O\hat{A}$. This is one point on the domestic reaction curve, $\hat{t}(t^*)$, shown in the bottom panel.

Now suppose that the foreign tax increases above zero. This rotates the foreign offer curve also counterclockwise (not shown), and without any change in the domestic tax causes the world price of good X to rise. This is an improvement in the home

country's terms of trade and raises its real income. But by also raising the price of the skill-intensive good, it worsens the domestic distribution of income. By raising its tax, the home country could neutralize the adverse effect on its distribution of income while still enjoying some of the improvement in its terms of trade.[17] By the above Assumption, then, it will in fact raise the tax even more, so as to combine the increase in real income with an improvement in income distribution. Thus, $\hat{t}(t^*)$ is drawn as upward sloping in the bottom panel. Note too that the increase in t^* improves welfare in the home country, while any change in t away from $\hat{t}$ lowers welfare. Therefore the iso-welfare contours for the home country are convex downward, and they are horizontal where they cross $\hat{t}(t^*)$, as shown by the curve labeled W_0.

Turning to the foreign country, it is in the opposite situation as far as its trade is concerned. To cause an improvement in its terms of trade, it would have to restrict its imports, not its exports, of good X, and a redistributive subsidy to skill, not a tax, would be required to do that. That is, to move its offer curve to $\tilde{E}^*$, and get income $\tilde{Y}^*$, would require a negative redistributive tax, $\tilde{t}^* < 0$, and this would make the income distribution worse, not better. Indeed, any tax less than zero will leave the foreign country with a worsened income distribution but a high income, while any tax greater than zero will do just the opposite. Taking literally the above Assumption, it will keep its tax at zero.

As we next consider what the foreign country will do if the domestic country levies positive taxes, things do not become much clearer. The domestic tax contracts the domestic offer curve to $O\hat{A}$ as seen above, and if the foreign government does nothing, its income distribution and real income will both worsen. It may therefore either raise or

lower its own tax, depending on the balance that it wants to strike between these two objectives, but whatever it does it will surely leave both objectives inferior to what they were before, according to the Assumption. In the bottom panel of Figure 6, the foreign reaction curve, $\hat{t}^*(t)$, is therefore drawn as non-monotonic because of this ambiguity. What is not ambiguous, however, is the shape of the foreign iso-welfare contour. Since the foreign country benefits only from a decrease in the domestic tax, t, and loses from any rise or fall of t^* around its own reaction curve, this contour is convex to the right and vertical where it crosses $\hat{t}^*(t)$.

Nash equilibrium is where the two reaction curves intersect, E_N, and it need not be unique. The levels of social welfare reached by both countries are W_0 and W_0^*, and they are clearly not optimal. Both countries could benefit by agreeing to reduce the redistributive tax in the domestic country below $\hat{t}_N$ and raising the tax in the foreign country above $\hat{t}_N^*$.

Thus, the model does suggest some scope for international coordination in domestic policies for income redistribution. Both countries can do better in terms of their own objectives if they agree to cooperate by using policies that neither would find individually optimal given the policy of the other. Pareto superior policies (for the governments, not necessarily for all citizens) are to be found in the shaded lens-shaped area between the two iso-welfare contours, W_0 and W_0^*. Exactly what point in that area will be chosen will depend on how effectively the two governments can coordinate and on their respective bargaining strengths.

Still, the outlines of an agreement are clear. We can think of the country that exports the skill-intensive good as the high-income country, since its comparative advantage results from an abundance of skilled and therefore highly paid labor, a result of a corresponding abundance of ability to acquire skill.[18] The other country, the importer of the skill-intensive good, has more low-paid unskilled workers and a lower income overall. We have found that the high-income country will tend to use too-large a redistributive tax, since it internalizes the effect of that tax in improving its terms of trade, and it does not internalize the effect of the tax in worsening the income distribution abroad. The low-income country will do the opposite, although to a lesser extent, since only the terms of trade effect induces it to set its redistributive tax too low. When they coordinate, then, the high-income country should agree to reduce its tax and the low-income country to increase its. The overall levels of both, however, will be determined by the two countries' social preferences for equality as well as by the countries' relative bargaining strengths. Other things being equal, the high-income country will prefer both countries to have high taxes and the low income country will prefer both to have low taxes, since both want to turn the terms of trade in their own favor.

VI. Conclusion

This paper has argued that attempts to redistribute income, to the extent that they must be implemented with policies that alter behavior, will have international effects due to these changes in behavior. In addition to the domestic distortions that make them desirable in only a second-best sense, these changes in behavior cause effects on income distribution to be transmitted abroad. Once these effects are taken into account in an

analysis of equilibrium policy utilization, there is scope for countries to improve on the policy outcomes that they could achieve individually by coordinating their policies.

Specifically, in a model where both trade and income distribution are driven by the distinction between skill and unskilled labor, a country with an abundance of skill and hence high wages will tend to go too far in redistributing income, while its poorer trading partner will not go far enough. Both could benefit by the high income country relaxing its redistributive tax, while the low income country raises its tax.

Bibliography

Brown, Drusilla K., Alan V. Deardorff, and Robert M. Stern 1996 "International Labor Standards and Trade: A Theoretical Analysis," in Jagdish Bhagwati and Robert Hudec, eds., *Fair Trade and Harmonization: Prerequisites for Free Trade?*, Cambridge, MA: MIT Press.

Davis, Donald R. 1996 "Does European Unemployment Prop Up American Wages?" National Bureau of Economic Research Working Paper No. 5620, June.

Deardorff, Alan V. 1997a "International Conflict and Coordination in Environmental Policies," in Jagdeep Bhandari, ed., *Economic Analysis of International Law*, forthcoming.

Deardorff, Alan V. 1997b "International Externalities in the Use of Pollution Policies," *International Review of Law and Economics* 16, forthcoming.

Deardorff, Alan V. and John H. Jackson 1993 "Problems of Regulating Economic Activity in a World of Increasing Interdependence," in process, October 17.

Leamer, Edward E. 1996 "Effort, Wages and the International Division of Labor," in process, October 16.

Martin, John P. 1976 "Variable Factor Supplies and the Heckscher-Ohlin-Samuelson Model," *Economic Journal* 86, (December), pp. 820-831.

Naito, Hisahiro 1996 "Tariffs and Production Subsidies as Devices to Relax the Incentive Problem of a Progressive Income Tax System," Research Seminar in International Economics Discussion Paper No. 391, University of Michigan, November 13.

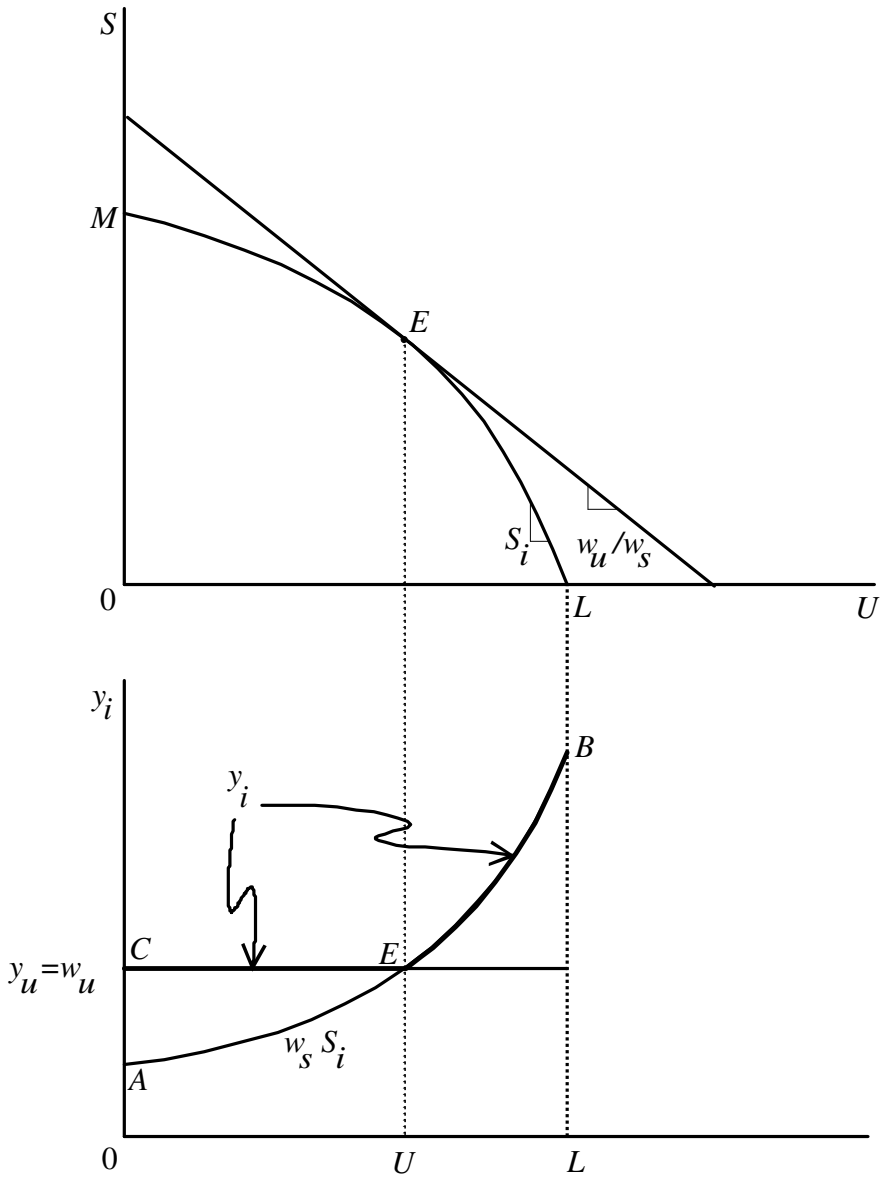


Figure 1

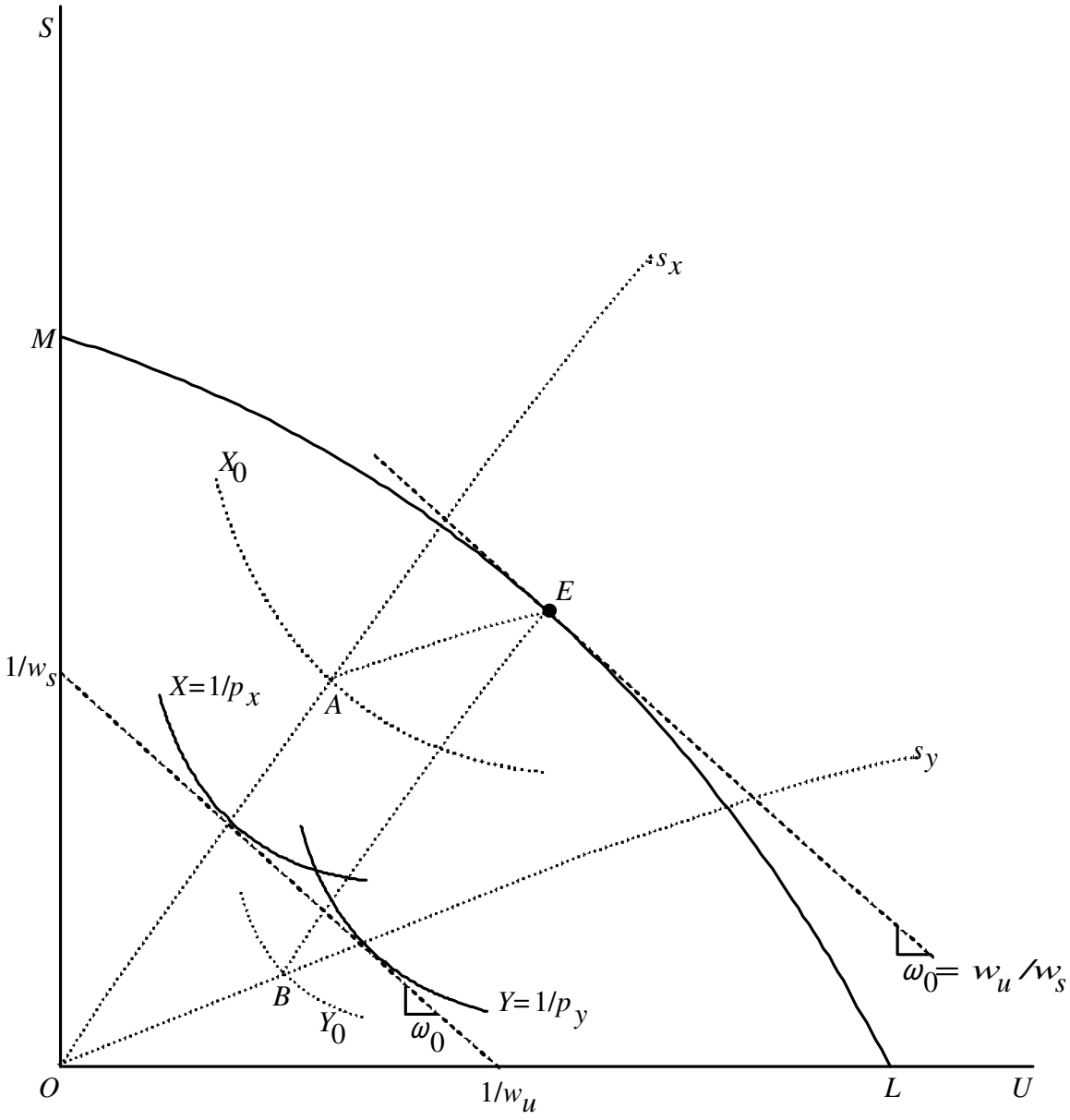


Figure 2

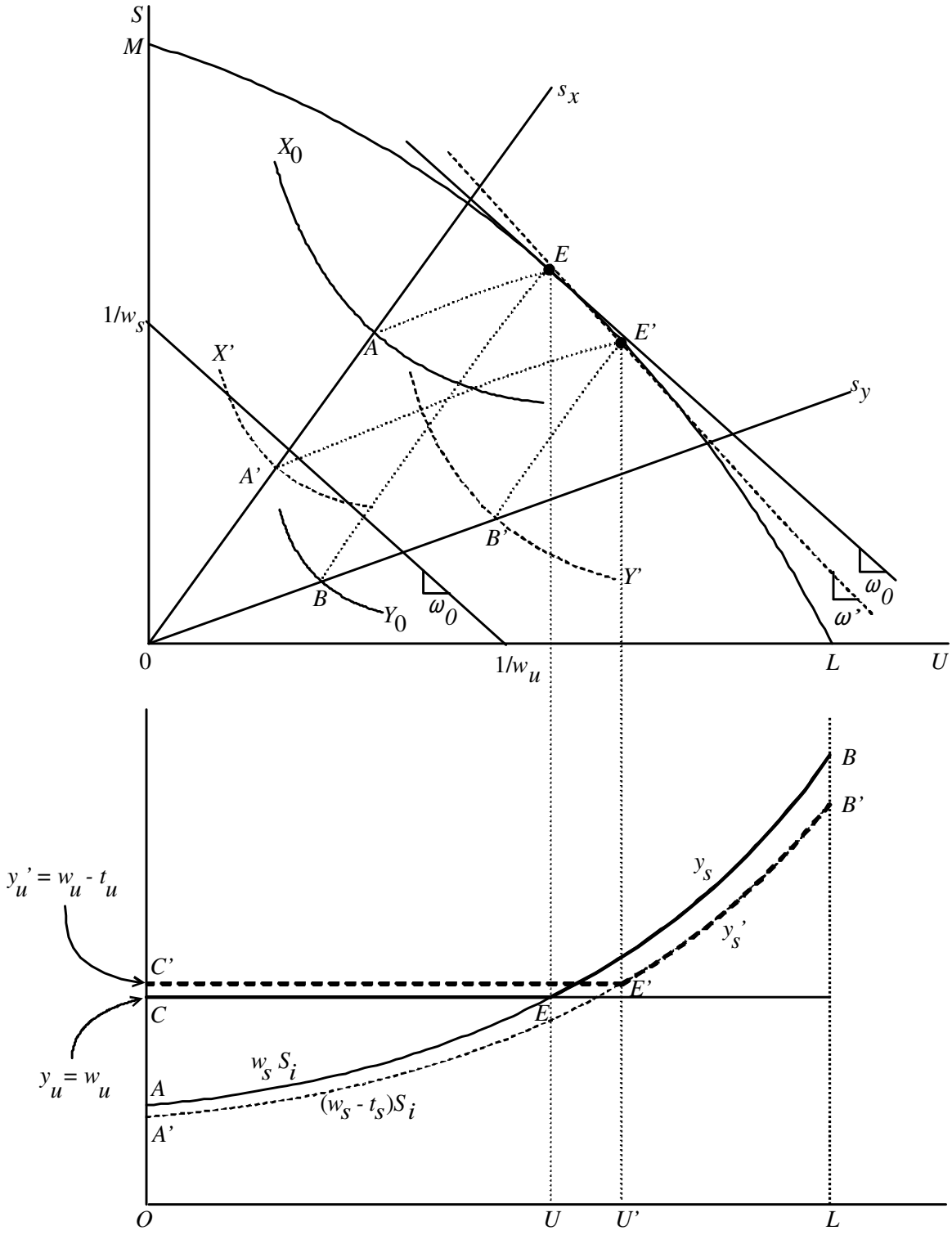

S
M
s_x
X_0
E
$1/w_s$
A
E'
X'
s_y
A'
B'
Y'
B
Y_0
ω_0
ω_0
ω'
0
$1/w_u$
L
U
B
B'
$y_u' = w_u - t_u$
y_s
y_s'
C'
E'
C
E
$w_s S_i$
$y_u = w_u$
A
$(w_s - t_s)S_i$
A'
O
U
U'
L

Figure 3

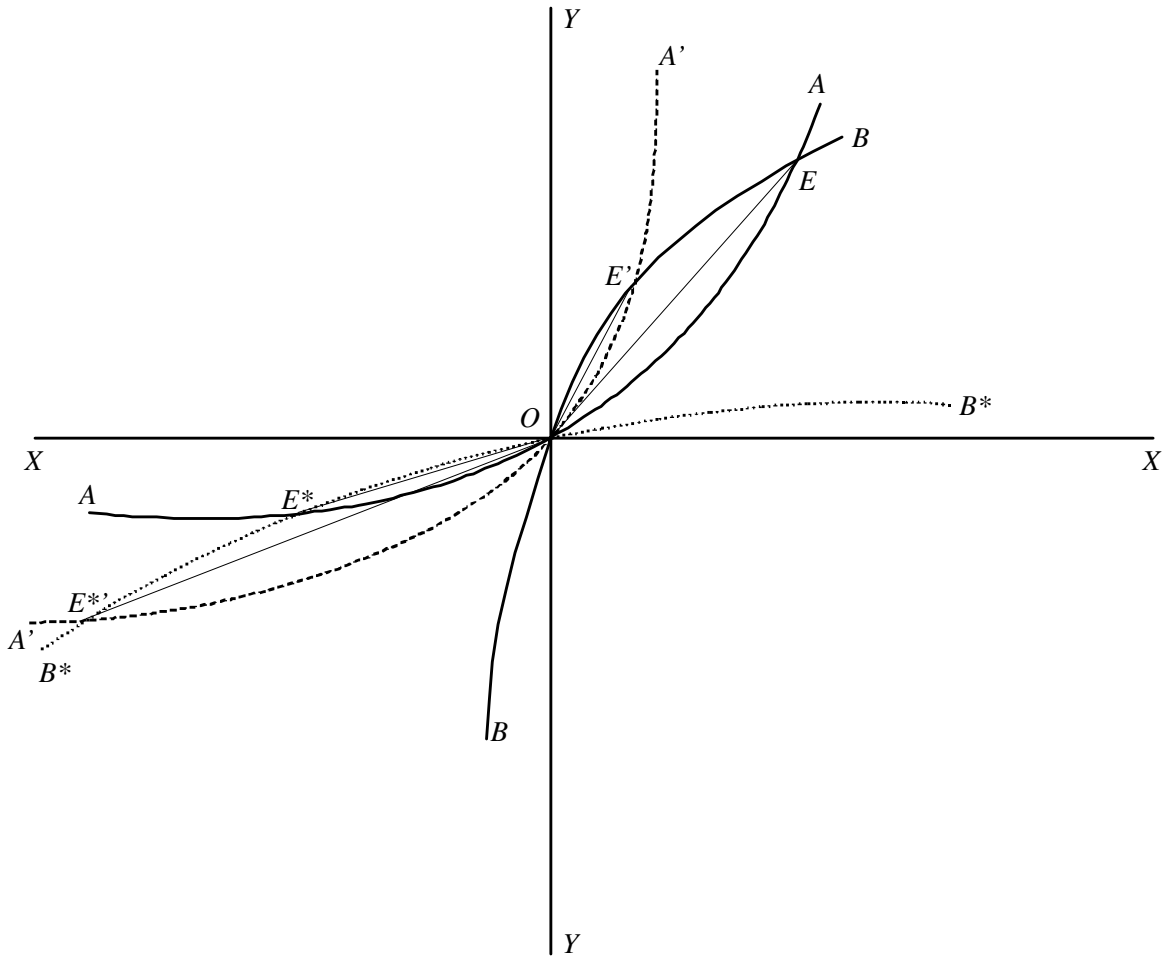


Figure 4

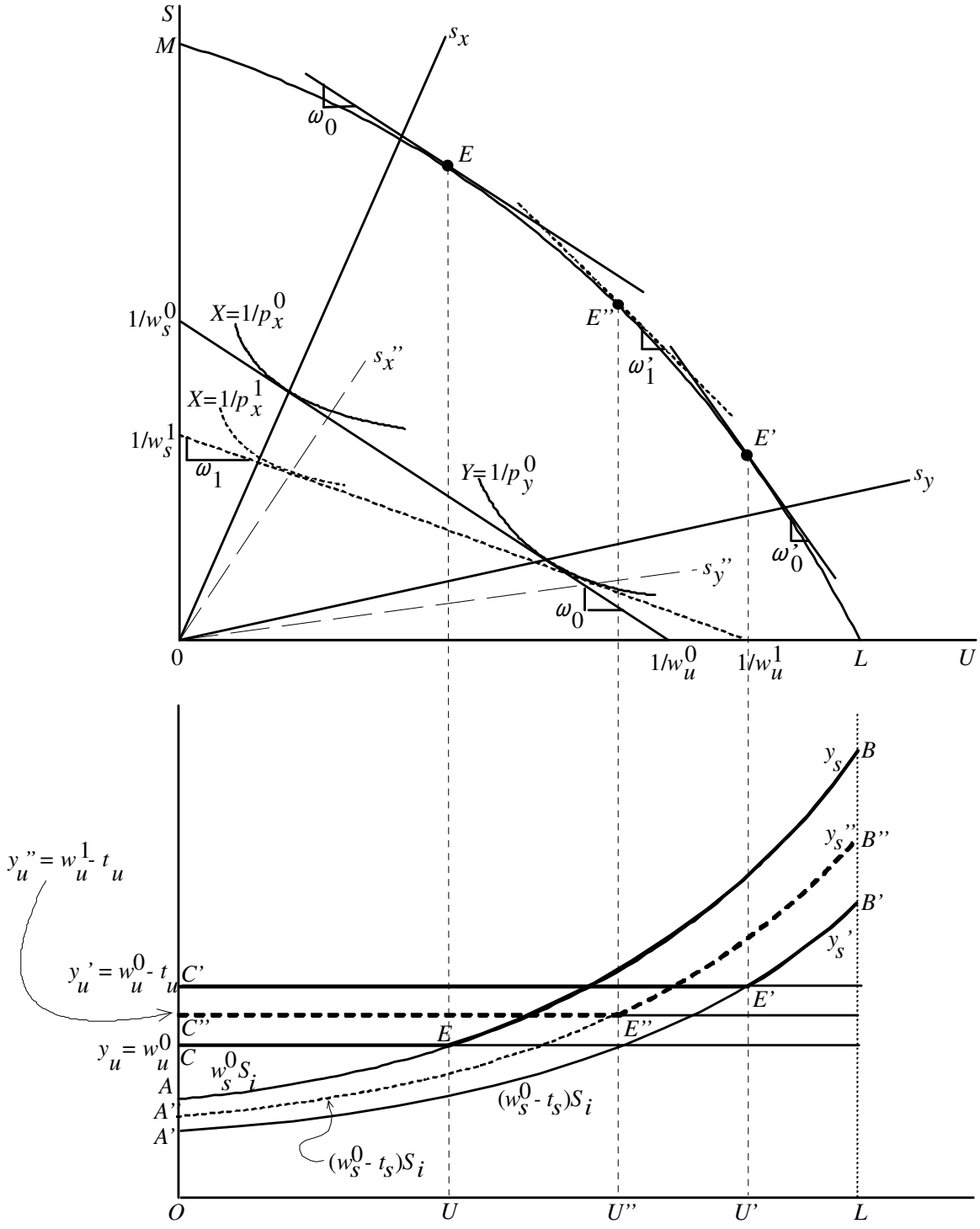

S
M
s_x
ω_0
E
$1/w_s^0$
$X=1/p_x^0$
E''
s_x''
ω'_1
$X=1/p_x^1$
$1/w_s^1$
ω_1
E'
$Y=1/p_y^0$
s_y
ω'_0
s_y''
ω_0
0
$1/w_u^0$
$1/w_u^1$
L
U
y_s
B
y_s''
B''
B'
y_s'
y_u'' = w_u^1 - t_u
y_u' = w_u^0 - t_u
C'
E'
C''
E
E''
y_u = w_u^0
C
$w_s^0 S_i$
A
A'
$(w_s^0 - t_s)S_i$
A'
$(w_s^0 - t_s)S_i$
O
U
U''
U'
L

Figure 5

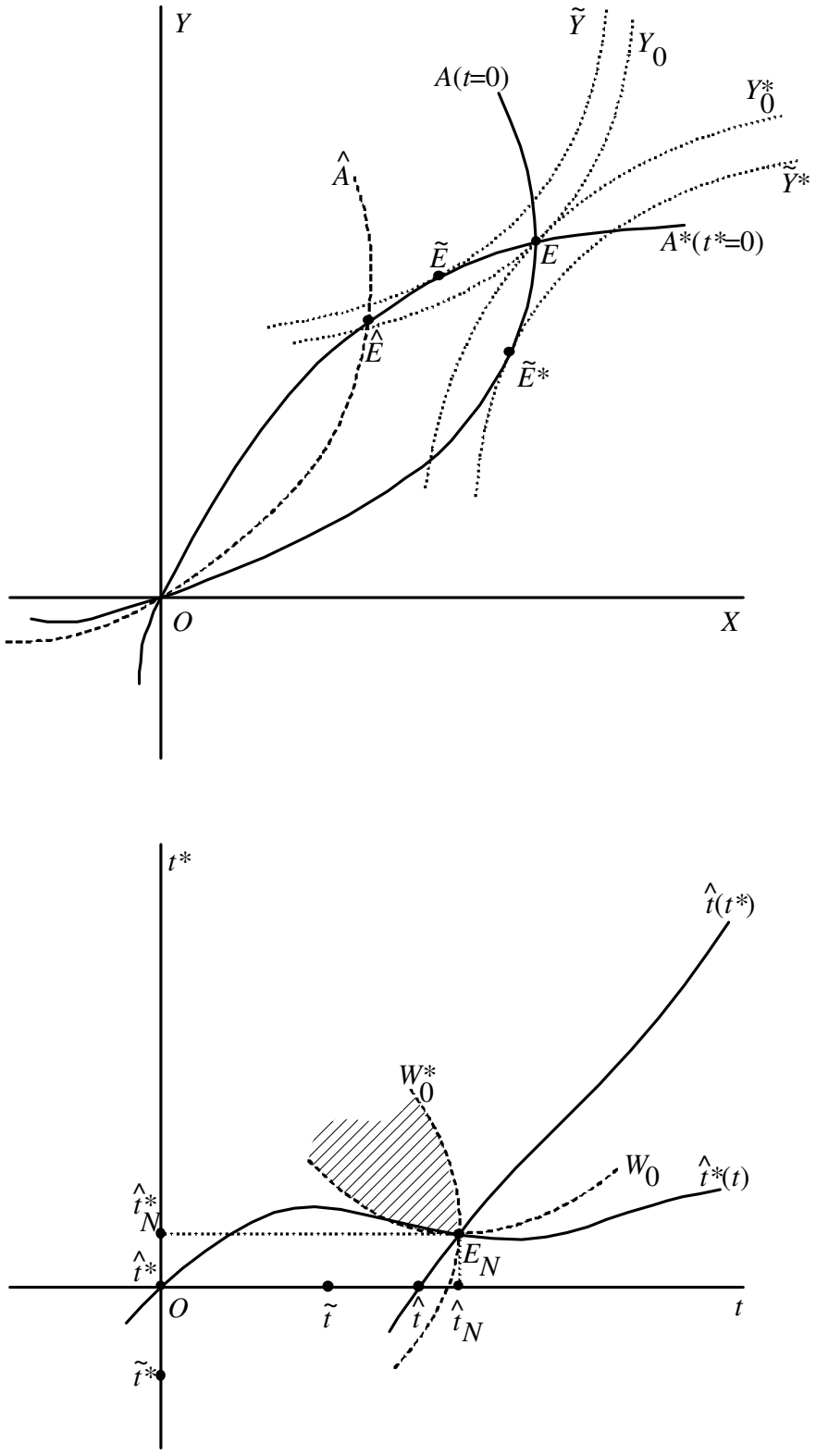

Y
$\tilde{Y}$
Y_0
$A(t=0)$
Y_0^*
$\hat{A}$
$\tilde{Y}^*$
$\tilde{E}$
E
$A^*(t^*=0)$
$\hat{E}$
$\tilde{E}^*$
O
X
t^*
$\hat{t}(t^*)$
W_0^*
W_0
$\hat{t}^*(t)$
$\hat{t}_N^*$
$\hat{t}^*$
E_N
O
$\tilde{t}$
$\hat{t}$
$\hat{t}_N$
t
$\tilde{t}^*$

Figure 6

Endnotes

[1] I have benefited from discussion of this topic with Bob Stern and John Jackson, and from comments on the paper at the Kobe conference by my discussant, Tetsuya Kishimoto, as well as Peter Lloyd, Rachel McCulloch, Martin Richardson, and Gary Saxonhouse.

[2] Davis (1996) has explored a similar linkage across countries, showing how a minimum wage policy in one country can affect trade patterns and economic performance in another.

[3] I do not attempt to improve on the distorting redistributive tax itself, even though in the context of the Heckscher-Ohlin model that may be possible. Naito (1996) has shown that the Stolper-Samuelson property of the Heckscher-Ohlin model can be exploited so that a tax/subsidy on production, and even on trade, can do a better job of redistributing income than an income tax.

[4] Income distribution is only one of many domestic policy areas where international linkages exist and where international policy coordination may be desirable. See Deardorff and Jackson (1993). In Deardorff (1996, 1997) I examined similar issues arising from environmental policies, using partial equilibrium analysis. Brown et al. (1996) have also dealt with issues of labor standards in a similar way, using both partial and general equilibrium models.

[5] Martin (1976) seems to have been the first, and still the primary, contributor to the Heckscher -Ohlin literature to allow for variable factor supplies. His was a much more general form of variability than here, and it had nothing to do with converting unskilled labor to skilled. Most recently, Leamer (1996) has explored a model in which workers could vary their supply of effort, but this too was rather different from what is done here.

[6] These workers are sufficiently drab and uninteresting that I will refer to them from here on as male. My apologies to equally uninteresting women.

[7] I assume the absence of factor intensity reversal in the technologies.

[8] These would appear as tangencies of one or the other isoquant with *LEM* outside the cone.

[9] Again, see Leamer (1996).

[10] There are certainly other policies that might be preferable to a factor tax, even if a totally nondistorting mechanism is unavailable. Peter Lloyd has suggested that an income tax would cause less distortion and thus have less of the effect explored here, and a value added tax would have even less. Rachel McCulloch points out that a subsidy to the acquisition of skill would not only work better, but would distort factor choice in the opposite direction. All of these policies, however, would cause some distortion of factor choice and therefore raise some of the issues considered here.

[11] Although because the PPF will be straighter than if factor supplies had been fixed, the offer curve will approximate more closely that of a Ricardian model than we are accustomed to in a Heckscher-Ohlin context.

[12] The individual *ad valorem* tax on skilled labor and subsidy to unskilled labor will have to change somewhat, so as to continue to yield zero net revenue and add up to the same original *ad valorem* total.

[13] The offset is only partial, since if world prices were to change by the full amount of the tax, this would return factor supplies to what they were before and leave the country supplying more, not less, of good *X* to the world market.

[14] Of course, if it really started at *E* in Figure 5, then the price change might push it into specialization, but the effect on the income distribution would be the same.

[15] In general, this wage ratio would not be nearly enough, since governments would also care about how many people are rich and how many are poor, as well as the variation of income within both groups. Were one to extend this model to allow for other policy or exogenous changes that might alter any of this (all of which is completely described by the income distribution curves in the bottom panels of Figures 3 and 5), one would also have to confront society's attitudes toward these dimensions of the income distribution.

[16] Unless the price change is large enough to reverse its pattern of trade, which will be impossible in the two-country cases considered below.

[17] Since, again, this would put it back in the situation of a country with fixed factor endowments.

[18] One could think of this abundance of ability as itself the result of previous social investment in educational infrastructure, if one wished, although this is outside the current model. It need not reflect differences that are truly innate in the population in any fundamental sense.