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ENDOGENOUS COMPARATIVE ADVANTAGE, GOVERNMENT, AND THE PATTERN OF TRADE

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ABSTRACT

This paper explores the relationship between government policy and comparative advantage in a neoclassical model of international trade. A specification of the Ricardo-Viner model with public goods and public inputs is presented that is used to study the role that government policy can play in the determination and promotion of comparative advantage and in the maximization of the gains that may be obtained from international trade. The model is also used to study the influence that international trade can exert on the scale and scope of government activity. The paper endeavors to reconcile a positive theory of trade and government with the apparent shift in measured productivity that often follows an opening to trade. The paper concludes by interpreting the model in the context of recent policy discussions of such issues as structural impediments, competitiveness, and the role of trade policy.

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by

Richard H. Clarida and Ronald Findlay

0. Introduction

The theory of comparative advantage, from it Ricardian inception down to the present day, has for the most part excluded consideration of government activity as having any bearing on the pattern of international specialization that would arise under "free trade". Government becomes relevant and significant only in so far as it interferes, through the imposition of tariffs, quotas, and other restrictive measures, with the volume of trade that would arise spontaneously in its absence. Comparative advantage itself is regarded as being determined solely by factor endowments, technology, and preferences for the goods and services produced by the private sector of the "home" and "foreign" countries.

In this regard, the field of international trade can be seen to follow the practice of general equilibrium theory itself, of which it can of course be treated as a branch. Atomistic firms and households in the market are co-ordinated only by the aggregation of their responses to the price quotations of a disembodied "auctioneer". The standard paradigm can of course be augmented to allow for "public" goods, those goods that are non-rival and non-excludable in consumption (Samuelson (1955)). It is only at this point that the state and taxation have to be introduced, and only for the provision of these otherwise underproduced consumption goods.

It does not take much reflection to realize however that, hallowed by tradition though it might be, this practice is flawed - or at minimum potentially

misleading - because it treats *laissez-faire* as anarchy, and not even "anarchy plus the constable" as Thomas Carlysle sneeringly summarized. Competitive markets presuppose contracts and their enforcement as well as the security of life and property of the parties to the transaction. Thus the state, for Hobbesian reasons, must be regarded as endogenous to the market mechanism itself. "Law and order" are not just some specific type of good along with others, but are essential services without which the production of <u>all</u> goods would be drastically reduced to levels prevailing in a "state of nature" or pure anarchy.

Adam Smith, the father of *laissez-faire*, was certainly well aware of this crucial point. He was, of course, opposed to the excessive mercantilistic state intervention of his day, but he did regard as essential that the "duties of the sovereign" be performed so as to provide the framework of "peace, easy taxes, and the tolerable administration of justice" necessary for successful economic development. Contrary to common opinion, he did not regard the "invisible hand" of the price mechanism as operating by some sort of divine providence, but only within the framework of public law and order established by the institution of government.

Recognition of the necessity of government for a productive economy does not however imply that the agents who have effective control of the machinery of the state will behave in a benevolent fashion. From the ancient empires to modern one-party dictatorships, there is a long history "predatory" rule, of resources being diverted to the private benefit of public servants. Nor are pluralistic democracies immune from such practices, as is evident from the over-expansion of public sector bureaucracies or the channeling of public funds to favored groups or industries that is often observed. Over the past several decades, an extensive literature, devoted to the exploration of these issues,

has emerged under the rubrics of "public choice", "rent seeking" or "political economy".

Drawing upon the insights presented in North (1981) and others, Findlay and Wilson (1987) and Findlay (1990) develop a model in which government services represent an "intermediate" input that provides a positive externality in production to the private sector through the provision of a framework of law and order and other components of the "infrastructure" that are needed for the successful functioning of a market economy. Such government activity of course requires real resources, resources that can be withdrawn from private use at a net social benefit so long as their "indirect" marginal productivity in raising private output exceeds their "direct" marginal product in the private sector. The policymaker may choose to provide either more or less than this socially optimal level of the public intermediate input, depending upon the exact specification of his, self-interested, objective function.

Granting that government can augment productivity in the private sector, it does not necessarily follow that the resulting shift in productivity will alter comparative advantage and the pattern of trade. For this to occur, the externality in private production resulting from the provision of government services must have a differential impact across the economy's individual sectors, so that *marginal* rates of transformation, and not just levels of sectoral output, are influenced by the scale and scope of government activity.

The purpose of the present paper is to explore the relationship between government policy and comparative advantage in a world in which the scale and scope of government activity in each country shifts that country's marginal rates of transformation between two tradable goods. Toward this end, we employ a Viner-Ricardo model of international trade that builds on the work of Jones

(1971) but that adds an endogenous government sector. By contrast with the Jones Viner-Ricardo model, comparative advantage cannot be determined simply by specifying endowments, technology, and preferences of each economy's firms and households alone. While we have chosen to work with the Viner-Ricardo model because of its tractability and convenience, our general thesis would hold in any model of comparative advantage - be it Ricardian, Heckscher-Ohlin, or for that matter, the recent models of monopolistic competition with differentiated products and economies of scale. Our key point is that, for the kinds of questions that are of interest in international economics, "government matters if it matters differently for different goods."

Though differing substantially in both motivation and structure from the present paper, there are to be found in the literature a few explorations of the relationship between public goods and trade, most notably Connolly (1972), Ishizawa (1988), and Manning and MacMillan (1979). A recent paper by Casella and Feinstein (1990) is an ambitious attempt to endogenize both the size and scope of political jurisdictions and markets in a one good world, although it is not concerned with the relationship between government and comparative advantage which is the central focus of the present paper.

The plan of the paper, and the key findings are as follows. In Section 1, we present a version the Jones (1971) Ricardo-Viner specific factors model with an endogenous government sector. There are two traded goods, "tech" and "wheat" produced with labor and fixed factor that is specific to each sector. Labor can also be employed to produce a public consumption good or a public intermediate input. The public input contributes to the productivity of labor and capital employed in the tech sector and to the productivity of labor and land employed in the wheat sector. However, we assume that the elasticity of

multifactor productivity with respect to the public input differs across sectors, and that this elasticity is smaller in the wheat sector. It is shown, to no surprise, that the autarky relative price of tech is an increasing function, that the autarky first-best provision of the public input is a decreasing function, and that autarky first-best provision public consumption good is an increasing function of the marginal utility of the public consumption good. It is also established that the share of the labor force employed in the government sector is an increasing function of the marginal utility of the public consumption good.

In Section 2, we investigate the role of government in a small open economy. We show that an increase in the world relative price of tech raises the marginal revenue product of labor and the public input in the tech sector. To no surprise, it is shown that the free-trade first-best provision of the public input is an increasing function, the free-trade first-best provision of the public good is a decreasing function, and the trade surplus in tech is an increasing function of the relative price of tech. It is also established that the share of the labor force employed in the government sector is an increasing function of the relative price of tech, so that the resulting decline in government employment in the production of the public good is more than offset by the rise in government employment in the production of the public input. It is shown that a rise in the world price of tech results in a positive Solow residual in the tech sector: the percentage increase in output in the tech sector in response to a rise in the price of tech exceeds the percentage rise in labor input weighted by labor's share.

In Section 3, we combine these findings to obtain all of the paper's key results. We consider a world comprised of a large number economies that share

common technologies, common populations, common endowments of capital and land but that differ in their valuation of the public consumption good. We show that countries that place a high valuation on the public consumption good must be tech importers in equilibrium, and that countries that place a low valuation on the public consumption good must be tech exporters in equilibrium. Low valuation economies devote more resources than do high valuation economies to the production of the public input. The result is that the autarky price of tech in the low valuation economy is lower than the autarky price of tech in the high valuation economy. Thus, the low valuation economy has a comparative advantage in tech in the free-trade equilibrium. Differences in government policy, reflecting differences in private preferences for public consumption goods, are solely responsible for the direction of comparative advantage and completely determine the pattern of trade.

Much more can be said about the free-trade equilibrium. We show that free-trade leads to a convergence in the size of government and to a convergence in real wages. Intuitively, economies that place a high valuation on the public consumption good are economies with large government sectors and high real wages. Real wages are high because the marginal product of labor is greater the smaller is the private sector labor force. In the free trade equilibrium, the relative price of tech faced by producers, households, and the government in the high valuation economy falls. This induces labor to shift out of the production of the public input and the production of tech to the production of wheat and the public consumption good. From the comparative static properties of the first-best allocation, we show that the size of government must shrink, the private sector labor force must rise, and the real wage must fall. Of course, in the low valuation economy free trade leads to a rise in the relative price of tech.

This induces labor to shift out of the production of the public consumption good and the production of wheat to the production of tech and the public input. The size of government expands, the private sector labor force must contract, and the real wage must rise.

While, in the context of our model free trade leads to a convergence in the size of government, it also leads to greater specialization in the employment of government resources. As a result of trade, low valuation economies devote more resources to the production of the public input and fewer to the production of the public consumption good than are allocated in autarky; high valuation economies devote fewer resources to the production of the public input and more to the production of the public consumption good.

One other implication of the model is that the transition from autarky to free trade will be characterized by Solow residuals in the tech sector. That is, the percentage increase in tech output produced by firms in tech exporting countries will exceed the percentage rise in labor input weighted by labor's share, while in tech importing countries, the percentage decrease in tech output produced by firms in tech importing countries will exceed the percentage decline in labor input weighted by labor's share. The Solow residuals are the result of the aforementioned shifts in production of the public input that are induced by trade.

After thoroughly investigating the first-best role for government policy in determining and promoting comparative advantage and in maximizing the gains that may be obtained from international trade in a small open economy, we next examine the influence that the traditional, factor endowments explanation of international trade patterns can exert on the scale and scope of government activity. We consider a world comprised of a large number of economies,

identical in all respects, including their valuation of the public consumption good, save one: the capital-land ratio. Capital rich countries are tech exporters in equilibrium. They devote more resources to the production of the public input and have larger government sectors than do land rich countries. In the context of our specification of the Ricardo-Viner model, trade among countries with different capital-land ratios results in a divergence in the size of government and, if land endowment are equal across countries, a divergence in real wages. The source of comparative advantage matters.

We conclude Section 3 by investigating the possibility that difference in in the valuation of public goods across countries can, in fact, reverse the factor endowments explanation of comparative advantage. We show that if capital rich countries are also high valuation countries, it is possible for the autarky relative price of tech in such countries to be higher than in land rich, low valuation countries. In the resulting free-trade equilibrium, the factor endowments explanation of comparative advantage will be reversed: capital rich economies will be wheat exporters and land rich economies will be tech exporters.

In Section 4, we draw out some additional implications of our model as it relates to recent debates about the relationship between trade and government policy.

1.1. Government in a Ricardo- Viner Closed Economy

Consider a closed economy populated by L workers and endowed with z acres of land and H units of capital. Wheat is produced with land and labor inputs according to:

$$(1) \qquad W = A_W z^{\delta}(L_W)^{1-\delta};$$

while tech is produced with capital and labor according to:

$$(2) \qquad T = A_T H^{\delta}(L_T)^{(1-\delta)}.$$

The restriction that labor's share in wheat and high tech output are equal is not essential for the main results, but simplifies the analysis substantially and helps to highlight the role played by international trade in influencing the scale and scope of government activity.

Each household acts to maximize utility of consuming wheat and tech subject to the constraint that the value of wheat and tech purchases cannot exceed wages *plus* the household's share of the rents earned by capital and land *minus* taxes paid to the government. Labor is supplied inelastically. Thus, in equilibrium the demand for wheat and tech must satisfy:

$$(3) \qquad max\ logu = \theta log(W/L) + (1 - \theta)log(T/L)$$

s.t.

$$(4) \qquad W/L + pT/L = w + R_W/L + R_B/L - TA/L;$$

where p is the price of tech in terms of wheat, w is the wage, R_W is the total rent earned by land in the wheat sector, R_H is the rent earned by capital in the tech sector, and TA is total taxes paid.

Productivity in the private sector can be augmented by a publicly produced input. In particular, assume that A_W and A_T, Hicks-neutral indexes of factor productivity, are increasing, concave functions of employment devoted to the production of the public input and that $A_T = A(L_A)$ and $A_W = (A(L_A))^{\mu}$, where L_A is the number of workers employed in the production of the public input and $\mu < 1$. Thus we assume that, while production of the public input boosts productivity in both sectors, the elasticity of multifactor productivity with respect to the public input in the tech sector exceeds the elasticity of multifactor productivity with respect to the public input in the wheat sector.[1]

In a competitive equilibrium, marginal products are equalized across the tech and wheat sectors. This implies:

$$(5) \qquad p = (z/H)^{(\delta)}(1/(A(L_A))^{1-\mu})((L - L_W - L_A)/L_W)^{(\delta)}.$$

The equilibrium wage satisfies $w = (1 - \delta)A^{\mu}z\,{}^{\delta}L_W^{-\delta}$, while the rent earned by the fixed factor in sector $j = W, T$ is just $R_j = \delta A^{\mu}z\,{}^{\delta}L_W^{-\delta}L_j$. Finally, since public sector workers earn the going wage, total tax collections equal $TA = wL_A$.

The model is easily solved. National income in terms of wheat is just $wL + R_W + R_H - TA$ which simplifies to:

$$(6) \qquad I = (A(L_A))^{\mu}(L - L_A)z\,{}^{\delta}L_W^{-\delta}.$$

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[1] We also assume that, if there is a factor in addition to labor that is required to produce the public input, this factor is specific to the public input sector. It follows that the opportunity cost to society of an extra unit of the public input is just $w\partial L_A/\partial A$.

The wheat market clears when $\theta I = W$ which happens only when:

$$(7) \qquad L_W = \theta(L - L_A).$$

Since L_A is chosen by the policymaker (more on this below), employment in tech is just $(1 - \theta)(L - L_A)$. The equilibrium price of tech is seen to be:

$$(8) \qquad p = (z/H)^{\delta}(1/(A(L_A))^{1-\mu})((1 - \theta)/\theta)^{\delta};$$

while the wage rate is

$$(9) \qquad w = (1 - \delta)A^{\mu}z^{\delta}(\theta(L - L_A))^{-\delta}.$$

In choosing L_A the policymaker faces an obvious trade off: the more workers employed in the production of the public input - and thus the higher the productivity in the private sector, the fewer workers available to produce either wheat or tech. If the policymaker seeks to maximize the welfare of the representative household - there are no distribution effects since "workers" own the fixed factors - the first-best choice of L_A is easily characterized.

The representative household's utility is, up to a constant, just

$$(10) \qquad u = (I/L)p^{(\theta-1)}.$$

Substituting (6), (7), and (8) into (10), taking logs, and differentiating with respect to L_A, we obtain the first order condition:

$$(11) \qquad (1 - \theta + \mu\theta)A'/A - (1 - \delta)(L - L_A)^{-1} = 0.$$

If either $A'(0) = \infty$ or $A(0) = 0$ is satisfied, there exists a unique, positive allocation of labor to the production of the public input that is decreasing in $(1 - \delta)$, the elasticity of private sector output with respect to labor, increasing in L, the private sector labor supply, and that is increasing in $\alpha(L_A) = A'L_A/A$, the elasticity of the output of the public input with respect to labor input. Note that with a common elasticity of output with respect to labor input across the wheat and tech sectors, the optimal provision of the public input is independent of the capital-land ratio. If $A(L_A) = (L_A)^{\alpha}$ so that $A'L_A/A$ is constant, we obtain the following closed-form expression for L_A:

$$L_A = L\alpha(1 - \theta + \mu\theta)/((1 - \delta) + \alpha(1 - \theta + \mu\theta)). \tag{12}$$

Substituting, the optimal choice of total factor productivity in the tech sector is given by:

$$A_T = [L\alpha(1 - \theta + \mu\theta)/((1 - \delta) + \alpha(1 - \theta + \mu\theta))]^{\alpha}; \tag{13}$$

while the optimal choice of total factor productivity in the wheat sector is

$$A_W = [L\alpha(1 - \theta + \mu\theta)/((1 - \delta) + \alpha(1 - \theta + \mu\theta))]^{\alpha\mu} \tag{13'}$$

1.2 Public Consumption Goods

Suppose now that the government has access to a technology for producing a non-excludable consumption good, S, that yields utility to each household. We assume that the household utility function is given by:

$$V = u^{1-\lambda}S^{\lambda} \tag{3'}$$

where u is the subutility function for private goods defined in (3).

The technology for producing the public consumption good is concave in the labor input so that $S = S(L_S)$. The first-best allocation is the solution to:

(14) $\max \lambda \log S + (1 - \lambda)\log u(I,p)$

s.t. (8) *and*

(15) $I = (A(L_A))^{\mu}(L - L_A - S)z^{\delta}(\theta(L - L_A - L_S))^{-\delta}$.

The first order conditions for this problem are:

(16) $\lambda S'/S - (1 - \lambda)(1 - \delta)/(L - L_A - L_S) = 0$;

(17) $(1 - \theta + \theta\mu)A'/A - (1 - \delta)/(L - L_A - L_S) = 0$.

If either $S'(0) = \infty$ or $S(0) = 0$ is satisfied, there exists a unique, strictly positive allocation of labor to the production of the public input and to the production of the public consumption good. Equation (17) defines the II schedule in the closed economy. As depicted in Figure 1, for any given level of employment in the production of the public consumption good, the II schedule gives the level of employment in the production of the public input that maximizes the utility of the representative household. Equation (16) defines the SS schedule in the closed economy. For any given level of employment in production of the public input, the SS schedule determines the level of employment in the production of the public good at which the marginal utility of an extra public good equals the marginal utility of the foregone consumption of wheat and tech required to produce the public good. As shown in Figure 2, the production of the public good is increasing in λ, the elasticity of utility with respect to the public good, the production of the public input is decreasing in λ, and aggregate government employment is increasing in λ. If $S(L_S) = (L_S)^{\Gamma}$, and letting $m = \lambda/(1 - \lambda)$, we can obtain:

(18) $L_A = L\alpha(1 - \theta + \mu\theta)/((1 - \delta) + \alpha(1 - \theta + \mu\theta) + m\Gamma)$;

(19) $L_S = Lm\Gamma/(((1 - \delta) + \alpha(1 - \theta + \mu\theta) + m\Gamma)$.

Substituting, the optimal choices of total factor productivity in the tech and wheat sectors are given by:

(20) $A_T = [L\alpha(1 - \theta + \mu\theta)/((1 - \delta) + \alpha(1 - \theta + \mu\theta) + m\Gamma)]^{\alpha}$;

(21) $A_W = [L\alpha(1 - \theta + \mu\theta)/((1 - \delta) + \alpha(1 - \theta + \mu\theta) + m\Gamma)]^{\alpha\mu}$;

1.3 A Re-interpretation:

In the Leviathan model of Findlay and Wilson (1982), the policymaker is willing to trade off private utility for surplus, defined as the difference between tax collections and wage payments to government workers that produce the public input. In the context of our model, suppose that private utility is a function of only wheat and tech and is defined by u in (3). Let $S = L_S$ denote the size of the government employment in excess of that required to produce the public input, and let V given by (3') define the policymaker's utility function. All of the results in Section 1.2 and in the rest of the paper may be re-interpreted as follows: λ represents the elasticity of the policymaker's value function with respect to the size of the bureaucracy S. We shall, to avoid unnecessary repetition, describe the results in the context of the Samuelson public good model of Section 1.2.

2. A Small Open Economy

In the small open economy, the world price of tech and relative factor endowments determine the allocation of labor between wheat and tech as well as the optimal provision of the public input and the optimal production of the public good. We now investigate the effect of a change in the world price of tech or a change in relative factor endowments on the production of the public input, the production of the public good, and government employment.

Given L_A and L_S and the world price of tech, wheat employment must satisfy:

(22) $p = (z/H)^{\delta}(1/(A(L_A))^{1-\mu})(L - L_A - L_S - L_W)/L_W)^{\delta}$.

This implies that $L_W = \varphi(p;L_A;H/z)(L - L_A - L_S)$; where:

$$(23) \qquad \varphi(p;L_A;H/z) = 1/[1 + (A^{1-\mu}p)^{1/\delta}H/z].$$

Of course, given L_A and thus A, the higher is the price of tech or the larger is the endowment of capital relative to land, the smaller is the share of private sector labor devoted to wheat. National income in terms of wheat is given by:

$$(24) \qquad I = (A(L_A))^{\mu}(L - L_A - S)z^{\delta}(\varphi(p;L_A;H/z)(L - L_A - L_S))^{-\delta};$$

while the output of wheat is just:

$$(25) \qquad W = A^{\mu}z^{\delta}(\varphi(p;L_A;H/z)(L - L_A - L_S))^{1-\delta}.$$

We begin with the special case in which $\lambda = 0$. Recalling that the representative household's utility is, up to a constant $u = (I/L)p^{\theta-1}$, the first-order condition for the policymaker who wishes to maximize u subject to (24) is given by:

$$(26) \qquad (1 - \varphi(p;L_A;H/z) + \mu\varphi(p;L_A;H/z))A'/A - (1 - \delta)/(1 - L_A) = 0;$$

(c.f. equation (11)) or more conveniently:

$$(26') \qquad (1 - \delta)/(L - L_A) = \mu A'/A + (1 - \mu)(1 - \varphi(p;L_A;H/z))A'/A.$$

So long as the conditions on $A(L_A)$ are satisfied, there exists an interior solution to (27). If in addition,

$$(27) \qquad \delta > \varphi(p;L_A;H/z)(1 - \mu);$$

a condition we shall impose throughout, the optimal L_A is unique and is strictly increasing in p and H/z. Intuitively, the higher the price of tech or the larger the capital-land ratio, the greater will be the share of private sector labor devoted to tech. Together, these forces push up the marginal social product of the public input, resulting in an increase in its first-best provision. Thus a rise in the world price of tech or an increase in the capital-land ratio generates positive Solow residuals in the tech sector, $\partial A_T/\partial p>0$, $\partial A_T/\partial(H/z)>0$, and if $\mu > 0$, in the wheat sector, $\partial A_W/\partial p > 0$, $\partial A_W/\partial(H/z) > 0$.

In response to a rise in p or the capital-land ratio, national income in terms of wheat must rise. To see this, note that given L_A, I is increasing in p and H/z. Since $L_A(p;H/z)$ is chosen optimally, I must rise. From (24) and (25) it is seen that:

(25') $\qquad W = \varphi(p;L_A;H/z)I.$

Since the demand for wheat is just θI, starting from balanced trade, a rise in p or H/z must produce a trade deficit in wheat and a trade surplus in tech.

Result 2.1: *Starting from balanced trade, a rise in the world price of tech - or increase in the supply of capital relative to land - must result in an expansion in the production of the public input, a positive Solow residual in the tech sector, an expansion in public employment, a trade deficit in wheat, and a trade surplus in tech.*

Consider now the general case in which both public consumption goods and public inputs are produced. To maximize (14) subject to (23), (24) and the world price of p, L_S and L_A must be chosen to satisfy:

(28) $\qquad (1 - \delta)/(L - L_A - L_S) = \mu A'/A + (1 - \mu)(1 - \varphi(p;L_A;H/z))A'/A;$

(29) $\qquad \lambda S'/(1 - \lambda)S = (1 - \delta)/(L - L_A - L_S).$

So long as (27) and the aforementioned conditions on $A(L_A)$ and $S(L_S)$ are satisfied, there exist unique, strictly positive first-best choices for L_A and L_S in the small open economy.

Equation (28) defines the II schedule in the open economy. For any given level of employment in the production of the public consumption good, the II schedule gives the level of employment in the production of the public input that maximizes national income. Equation (29) defines the SS schedule in the open economy. For any given level of employment in production of the public input, and thus given world prices the allocation of private sector labor, the SS schedule determines the level of employment in the production of the public good at which the marginal utility of an extra public good equals the reduction in national income required to produce the public good. As depicted in Figure 3 a rise in the world price of tech shifts the II locus out and to the right and leaves the SS locus unchanged. It follows that

(31) $\partial L_A/\partial p > 0$ *and* $\partial L_S/\partial p < 0$;

So long as (27) is satisfied, production of the public input is strictly increasing in the price of tech and the optimal provision of the final public good S is decreasing in the world price of tech. The intuition for this result is evident from (29). An increase in L_A raises the marginal cost of the final public good S (in terms of lost national income), $(1 - \lambda)(1 - \delta)/(L - L_A - L_S)$, but does not change the marginal utility of S, λ/S. Thus, since a rise in p raises the optimal provision of the public input given L_S, it must reduce the optimal production of the public good. What happens to total public employment when the world price of tech rises? From (31) and (29) we see that total public employment, $L_A + L_S$, must increase.

In response to a rise in p, national income in terms of wheat must rise. To see this, note from (24) that if L_A and L_S were to remain unchanged in response to the rise in p, income in terms of wheat, I, would rise. Since optimal L_S falls, so that the policymaker is willing to trade off public consumption goods for public input production, the policymaker must be able to achieve higher utility and thus income by cutting L_S and raising L_A. Since the $W = \varphi(p;L_A;H/z)I$ and the demand for wheat is just θI, starting from balanced trade, a rise in the price of tech must produce a trade deficit in wheat and a trade surplus in tech.

Note that all of the above arguments go through for the case in which we compare two economies with different capital - land ratios. Again, a rise in the world price of tech or an increase in the capital-land ratio generates positive Solow residuals in the tech sector, $\partial A_T/\partial p > 0$, $\partial A_T/\partial(H/z) > 0$, and if $\mu > 0$, in the wheat sector, $\partial A_W/\partial p > 0$, $\partial A_W/\partial(H/z) > 0$. Thus, for a policymaker who maximizes the utility of a representative household that consumes traded goods as well as a nontraded public good we have:

Result 2.2: *Starting from balanced trade, a rise in the world price of tech - or increase in the supply of capital relative to land - must result in an expansion in the production of the public input, a positive Solow residual in the tech sector, an expansion in total public employment, a contraction in the production of the public good, a trade deficit in wheat, and a trade surplus in tech.*

Before moving on, we consider the impact of differences in λ, the weight placed by the public on the public final good, in the small open economy. Recall that in the closed economy, the provision of the public final good and the size of the government are increasing in λ, while the provision of the public input is decreasing in λ. From the definition of the open economy SS schedule, we see that, as in the closed economy a rise in λ shifts the SS schedule up and to the right and leaves the II schedule unchanged. L_S must rise, L_A must fall, and, from (28), government employment must rise:

$$(33) \qquad \partial S/\partial\lambda > 0 \text{ and } \partial L_A/\partial\lambda < 0 \text{ and } \partial(S + L_A)/\partial\lambda > 0;$$

if

$$(34) \qquad \delta \geq \varphi(p;L_A;H/z)(1 - \mu).$$

In economies with larger λ, tech output is lower. This follows from the fact that employment in the tech sector must be lower and that the production of the public input must be lower. Employment in the tech sector is lower because total private employment is lower and the share of private employment in the tech sector is reduced - $\varphi(p;L_A;H/z)$ rises. Of course, the greater is λ, the smaller is national income at any given world price p. We have:

Result 2.3: *The larger is λ - the marginal utility of the public final good - the smaller the production of the public input, the greater is the production of the public good, and the larger is public employment.*

3. Comparative Advantage, Government, and the Pattern of Trade

We now establish the connection between the provision of the public input, the production of the public good, and the pattern of trade that will emerge when the economies described in Section 1 open to trade.

Consider first a world comprised of a large number economies that share a common capital-land ratio but that differ in their valuation of the public good. For concreteness let a fraction b of the world economies place a large valuation, λ', on the public good and let the remaining fraction (1 - b) place a lower valuation $\lambda < \lambda'$ on the public final good. From (16) and (17), the provision of the public input in the λ' economies falls short of the public input provision in λ economies since $L_A(\lambda') < L_A(\lambda)$. Thus, from (8), the autarky price of tech in the high valuation λ' economies, $p^A(\lambda')$, must exceed the autarky price of tech in the low valuation λ economies $p^A(\lambda) < p^A(\lambda')$. This is because the rate at which the economy, in autarky, can transform wheat into tech is increasing in the provision of the public input so long as the elasticity of A_W with respect to the public input, μ, falls short of the elasticity of A_T with respect to the public input.

When the world is open to trade, the equilibrium price of tech, P, is bounded below by the autarky price of tech in the low valuation economies, and is bounded above by the autarky price of tech in the high valuation economies:

$$p^A(\lambda) < P < p^A(\lambda'). \tag{35}$$

It follows that, when each high valuation λ' economy is open to trade, the price of tech facing its households and producers must fall, while when each low valuation λ economy is open to trade, the price of tech facing its households and producers must rise. From **Result 2.2**, it follows that each high valuation λ' economy must run a trade deficit in tech and that each low valuation λ economy

must run a trade deficit in wheat in the free trade equilibrium. We now state a central proposition that follows directly from the results of Section 2:

Proposition 3.1: *Consider a world economy comprised of a large number of countries that share a common capital-land ratio, common expenditure shares, but that differ in their valuations of the public final good. In the free trade equilibrium, each high valuation λ' economy must run a trade deficit in tech and a trade surplus in wheat, while each low valuation $\lambda < \lambda'$ economy must run a trade surplus in tech and a trade deficit in wheat. That is, the pattern of trade is completely determined by differences in public choice and the resulting differences in the provision of public inputs.*[2]

In autarky, each high valuation λ' economy provides fewer public inputs, accepts lower absolute productivity in the tech sector and wheat sectors, produces more public goods, and has a larger government than does each low valuation $\lambda < \lambda'$ economy. Since the free-trade equilibrium price is bounded by the autarky prices, **Result** 2.2 implies that free-trade shrinks the size of government in the high valuation economies and expands the size of government in the low valuation $\lambda < \lambda'$ economies. However, by **Result** 2.3, in the free-trade equilibrium each high valuation λ' economy continues to have a larger government than does each low valuation $\lambda < \lambda'$ economy. Thus we have:

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[2] In the context of our Cobb-Douglas specification of the Ricardo-Viner model, differences in λ across countries are not sufficient to generate gains from trade. If $A'(L_A)=0$, so that $A(L_A) = A$, the optimal choice of L_S is defined by $\lambda S'/(1 - \lambda)S = (1 - \delta)/(L - L_A - L_S)$ under both autarky and free-trade (c.f. equations (16) and (29)). From equation (8), we see that the autarky price of tech, $p = (z/H)^{\delta}(1/A^{1-\mu})((1 - \theta)/\theta)^{\delta}$ is independent of λ. Thus, differences in λ will not result in trade unless $A'(L_A) > 0$.

Corollary 3.2: In *a world economy comprised of a large number of countries that share a common capital-land ratio, common expenditure shares, but that differ in their valuations of the public final good, free trade leads to a convergence in the size of government.*

Notwithstanding the fact that free trade can lead to a convergence in the size of government, it is evident that free-trade can lead to a divergence in the allocation of government resources between public input provision and the production of the public good. To see this, note that since $P < p^A(\lambda')$, in each high valuation λ' economy free trade will lead to the provision fewer public inputs and the production of more public goods than in autarky. This follows from **Result 2.2**. Of course, since $P > p^A(\lambda)$, in each low valuation λ economy free trade will lead to the provision more public inputs and the production of fewer public goods than in autarky. Recalling that the autarky provision of public inputs (public goods) in each high valuation λ' economy falls short of (exceeds) said provision in each low valuation economy, it must be the case that:

Corollary 3.3: *In a world economy comprised of a large number of countries that share a common capital-land ratio, common expenditure shares, but that differ in their valuations of the public final good, free trade leads to a divergence in the allocation of government resources. In particular, trade leads to an increase in the production of the public good and a decrease in the production of the public input in each high valuation economy, and to a decrease in the production of the public good and an increase in the production of the public input in each low valuation economy.*

Proposition 3.1 and Corollaries 3.2 and 3.3 have an interesting interpretation in the context of the Findlay-Wilson Leviathan model. If we interpret S as the size of the bureaucracy, Proposition 3.1 states that differences across countries in the public's willingness to tolerate - or differences in policymakers' ability to maintain - a large bureauacry as indexed by λ can lead to gains from trade. Corollaries 3.2 and 3.3 imply that if such institutional differences are the source of gains from trade, free-trade leads to convergence in the size of government but a divergence in the size of bureaucracy.

Returning to our "Samuelson" interpretation of S, differences across countries in their valuation of the non-traded public good have implications for factor returns. For concreteness, consider the special case in which $\mu = 0$, so that the public input contributes to productivity in the tech sector but not the wheat sector.[3] In autarky, the wage in terms of wheat in each high valuation λ' economy is higher than the wage in each low valuation λ economy. To see this, recall that the private labor supply is decreasing in λ, but that the share of private sector labor devoted to wheat is constant and equal to θ in autarky. What happens when low and high λ economies trade? The price received by tech producers in each low valuation $\lambda < \lambda'$ economy rises. Regardless of μ, this induces labor to shift out of wheat and public goods provision into tech and public input provision. The wage in terms of wheat in each low valuation economy must rise in the free trade equilibrium since A_w is non-decreasing in p. Of course, the same reasoning implies that wage in each high valuation economy must fall in the free trade equilibrium. We have just shown:

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[3] It is straightforward to show that, for μ positive but sufficiently small, $w(\lambda';\mu) > w(\lambda;\mu)$ in autarky.

Corollary 3.4: *In a world economy comprised of a large number of countries that share a common capital-land ratio, common expenditure shares, but that differ in their valuations of the public final good, free trade leads to a convergence in real wages if* $\mu = 0$. *Regardless of* μ, *wages fall in wheat exporting countries and rise in tech exporting countries.*

As is well known, and as we shall shortly verify, real wage convergence is not a general property of the Ricardo-Viner model (Dixit and Norman (1980)). We now summarize by stating the potentially observable implications of these findings:

Corollary 3.5: *Consider a world economy comprised of a large number of countries that share a common capital-land ratio and common expenditure shares but that differ in their (unobservable) valuations of the public final good. In the free trade equilibrium, tech exporting countries devote more resources to the provision of the public input than do tech importing countries. Opening to trade results in positive Solow residuals in the tech sector of tech exporting countries, and in negative Solow residuals in the tech sectors of tech importing countries. In fact, producers in tech exporting countries enjoy an absolute advantage over producers in tech importing countries, despite the fact that endowments of technology and factors are common in both countries.*

Of course, in the world of this paper, governments do not pursue trade policy per se. Rather, differences in the valuation of non-traded public final goods induce differences in the autarky allocation of resources, and thus generate differences in autarky relative prices and create comparative advantage. Trade re-enforces these differences in autarky resource allocation. Relative to countries that place a high valuation on public goods, countries that place

a low valuation on public goods devote more resources in autarky to the provision of public inputs and fewer resources to the production of public goods. In a free-trade equilibrium, low (high) valuation countries devote even more (fewer) resources to the provision of public inputs and fewer (more) resources to the production of public goods. In effect, countries that place a high valuation on non-traded public goods use the gain in national income arising from trade to "purchase" even more public goods. This requires shifting resources away from the provision of public inputs and tech toward the production of wheat and public goods. However, since absolute productivity in the tech sector is endogenous in this world, a Pareto improving policy of boosting the production of public goods is achieved at the cost creating an absolute disadvantage in the production of tech.

Consider next a world comprised of a large number economies that share a common land endowment and common preferences, but that differ in their endowment of capital. For concreteness let a fraction b of the world economies be endowed with H' units of capital and let the remaining fraction (1 - b) be endowed with H units of capital. From (8), the autarky price of tech in capital rich H' economies, $p^A(H')$, must fall short of the autarky price of tech in the H economies $p^A(H') < p^A(H)$. Note that under our hypotheses about preferences and technology, the results of Section 1 imply that tech sector productivity, the production of public goods, the size of government, and wages in terms of wheat are equal in capital rich and (relatively) land rich countries in autarky.

When the world is open to trade, the equilibrium price of tech, P, is bounded below by the autarky price of tech in each capital rich economy and is bounded above by the autarky price of tech in each land rich economy:

$$p^A(H') < P < p^A(H). \tag{36}$$

From **Result 2.2**, it follows that each capital rich economy must run a trade surplus in tech and that each land rich economy must run a trade surplus in wheat in the free trade equilibrium. **Result 2.2** also implies that free-trade expands the size of government in the capital rich economy and shrinks the size of government in the land rich country. In particular, the rise in the price of tech facing producers in the capital rich country leads the policymaker to increase the provision of the public input, reduce the production of the public good, but increase the size of government in the free-trade equilibrium. Of course, exactly the same reasoning implies that exactly the opposite occurs in the land rich economies. It follows that free trade will lead to a divergence in wages regardless of the values of μ. This is because the labor employed in the wheat sector must contract (expand) in a capital (land) rich economy engaged in trade. Pulling all this together, we have the following:

Proposition 3.6: Consider economy comprised of a large number countries that share a common land endowment and common preferences, *but that differ in their endowment of capital. In the free-trade equilibrium, each capital rich country runs a trade surplus in tech, while each (relatively) land rich country runs a trade surplus in wheat. Free trade leads to a divergence in the size of government and to a divergence in the real wage. Free trade also results in a divergence in Solow residuals in the tech sector and a divergence in the production of the public good.*

We now investigate the possibility that differences in the valuation of the public good across countries can reverse the factor endowments explanation of comparative advantage. Consider a world comprised of a large number economies

that share a common land endowment and common expenditure shares, but that differ in their endowment of capital as well as in their valuation of the public good. For concreteness let a fraction b of the world economies be endowed with H' units of capital and place a valuation of λ' on the public good, and let the remaining fraction (1 - b) be endowed with H units of capital and place a valuation of $\lambda < \lambda'$ on the public good.

Since $L_A(\lambda') < L_A(\lambda)$, it is possible that the autarky price of tech in the (H',λ') economy can exceed the autarky price of tech in the (H, λ) economy. To see this, note that $p^A(H',\lambda') > p^A(H, \lambda)$ if

$$(37) \qquad (z/H')^{\delta}/(A(L_A'))^{1-\mu}) > (z/H)^{\delta}/(A(L_A))^{1-\mu}).$$

From (37) and (8), it is easily seen that $p^A(H',\lambda') > p^A(H, \lambda)$ if

$$(38) \qquad A(L_A)/A(L_A') > (H'/H)^{\delta}$$

From (16) and (17), and as illustrated in Figure 2, L_A - and thus $A(L_A)$ - is a monotonically decreasing function of $m = \lambda/(1 - \lambda)$. If $A(0) = 0$, there exists a sufficiently large value $\underline{\lambda}$ such that, if $\lambda > \underline{\lambda}$, (38) must be satisfied and $p^A(H',\lambda') > p^A(H, \lambda)$. For example, if $A(L_A) = L_A^{\alpha}$ and $S(L_S) = L_S^{\Gamma}$, (20) and (38) imply that if $m' = \lambda'/(1 - \lambda')$ satisfies:

$$(38') \qquad [((1-\delta)+\alpha(1-\theta+\mu\theta)+m'\Gamma)/((1-\delta)+\alpha(1-\theta+\mu\theta)+m\Gamma)]^{\alpha} > (H'/H)^{\delta};$$

$p^A(H',\lambda') > p^A(H, \lambda)$.

Thus, there can exist a sufficiently great weight λ' such that the autarky price of tech in the capital rich country will exceed the autarky price of tech in the capital poor country. In such a capital rich economy, preference for the public good induces the policymaker to divert sufficient resources to the production of the public good away from the provision of the public input so that the autarky price of tech in the capital rich country must be above the price of tech in the capital poor country.

In the free trade equilibrium of a world economy comprised of (H',λ') and (H, λ) economies that satisfy (37), each capital rich country will be a tech importer and a wheat exporter. Free trade will lead to a convergence in the size of government and in the real wage. Free trade will also lead to a divergence in the allocation of government resources and to a divergence in measured Solow residuals. Thus, it is in fact possible and not at all pathological for differences in the valuation of the public good to reverse the factor endowments explanation of comparative advantage. More formally we have:

Proposition 3.7 : *Consider a world comprised of a large number economies that share a common land endowment and common expenditure shares, but that differ in their endowment of capital as well as in their valuation of the public good. If* $\lambda' > \lambda$ *is such that*

$$(39) \qquad [((1-\delta)+\alpha(1-\theta+\mu\theta)+m'\Gamma)/((1-\delta)+\alpha(1-\theta+\mu\theta)+m\Gamma)]^{\alpha} > (H'/H)^{\delta};$$

is satisfied, each high valuation, capital rich country must run a trade deficit in tech and a trade surplus in wheat, while each low valuation, capital poor country must run a trade surplus in tech and a trade deficit in wheat. While free trade must lead to a convergence in the size of government and the real wage, it must also result in a divergence in Solow residuals.

4. Conclusions and Implications

Our purpose in this final section is to bring out some of the implications of the model as they pertain to the relationship between trade and government, a topic that has received a great deal of popular attention of late. Perhaps the most striking property of our model is that, in contrast with the traditional literature, technological efficiency in the traded goods sector varies with the terms and pattern of trade, rather than remaining immutable as in Ricardo, Heckscher-Ohlin, and the newer monopolistic competition framework. The link, of course, is provided by the impact of trade on government which in turn influences total factor productivity in the tradables sectors via the provision of a public input. Thus, upon the opening to free trade, tech exporters experience productivity gains in both tradables sectors since the provision of the public input - and government employment - expands, while wheat exporters experience productivity declines in both sectors and in the size of government. Note that neither country pursues trade policy per se. Differences across countries in factor endowments or the relative valuation of public goods are sufficient.

The US-Japan trade relationship has received a great deal of popular attention in recent years. The "revisionist" or "Japan is different" school has maintained that the Japanese government intervenes extensively in promoting the production and export of high-technology goods, while opponents of this view have pointed out that there is little or no evidence that Japanese trade policy is more interventionist, by any of the conventional measures, than is the policy of the US or Europe. While we take no position on the empirical facts of the matter, it is interesting to note that our model explicitly provides a channel, distinct from the conventional import tariff or export subsidy, through which

government activity can favorably influence productivity in the tradables sector in Japan and unfavorably in the US.

The recent structural impediments initiative adopted by the US and Japan focuses precisely on the differences in valuation of public goods between the two countries. It is argued that the Japanese have tended to skimp on direct services to the public (such as the much publicized inadequacy of Tokyo sewage facilities), while the US has tended toward the lavish in its expansion of the public sector bureaucracy. On the other hand it is argued that Japan, through MITI and other agencies, appears more successful than the US in its effort to channel government resources to public uses that will augment private productivity, notwithstanding past successes in the US with the agricultural extension services and other natural-resource related activities as emphasized in an interesting recent article by Gavin Wright (1990).

The structural impediments initiative can be interpreted in the context of our model, with the US aiming to reduce its relatively high valuation of the public good - and thus expand the resources committed to productivity enhancing public expenditure, and Japan pledging to raise its relative low valuation of the public good - and thus expand the resources committed to utility enhancing public expenditure. Although our framework is simple, such policy issues cannot even be discussed within the context of conventional models since the activities to which these discussion refer are not incorporated in t the formal structure of traditional models.

Recent policy debates have also focused on the concept of "competitiveness" in international trade. It has been alleged that the US is losing its international competitiveness, while at the same time Japan and the East Asian NICS have been gaining competitiveness. "Competitiveness" is a concept that

has no meaning within the context of traditional trade models, at least with regards to the economy as whole. While certain sectors of an economy may not be able to compete with imports, some other sector of the economy must be able to export competitively: a country must always possess a comparative advantage in something. In the context of our model, however, the concept of the international competitiveness of the economy as a whole can be given a natural and operational meaning.

Thus, consider within our framework two economies that posses identical factor endowments, technologies, and valuations of public goods. Under autarky, relative prices will be identical, so that there will be no trade in equilibrium. We now perturb the valuation of the public good, so that it is $\lambda' = \lambda + \epsilon$ in the high valuation economy, and $\lambda = \lambda - \epsilon$ in the low valuation economy. As we have shown, because the low valuation λ economy devotes more resources to the production of the public input, it will in autarky enjoy superior technological efficiency in both the wheat in tech sectors compared with the high valuation λ' economy. Furthermore, for sufficiently small μ, wages in the high valuation economy will be lower than in the λ' economy in autarky. It thus makes perfect sense to say that the low valuation economy is more internationally competitive than is the high valuation economy, even though the λ' economy will have a comparative advantage in wheat. Furthermore, free trade will actually enhance the technological superiority of the λ' economy in both sectors as measured by the productivity indexes A_T and A_W. Comparative advantage is equalized while absolute advantage diverges as a result of trade.

While we have refrained from an explicit analysis of trade policy per se, it should be noted that the endogeneity of technological efficiency has significant implications for impact of tariffs and other trade restrictions on

the world trading equilibrium. Consider a two country world comprised of a low, λ, and high, λ', valuation economy and let a tariff be imposed by the wheat exporting, high valuation λ'. The tariff will turn the terms of trade in favor of the wheat exporter: the world price of tech imports will fall while the domestic, tariff inclusive price will rise. If the tech exporter does not retaliate, the effect of the tariff will be to shrink, relative to free trade, the technological efficiency in producing both wheat and tech that is enjoyed by the tech exporter. The tariff, by depressing the world price of tech relative to free trade, will induce the policymaker in the tech exporting country to shift resources away from the provision of the public input toward the provision of the public good. Thus, a tariff imposed by the wheat exporter has the effect of making the tech exporter less efficient, less internationally competitive.[4]

Consider now what happens if the tech exporting country imposes a tariff, without retaliation from the wheat exporter. The tech exporter's terms of trade must improve, and thus the world price of tech in terms of wheat must rise. A tariff imposed by the tech exporter will improve the technological efficiency of producing both wheat and tech in the wheat exporter. The tariff, by raising the world price of tech relative to free trade, will induce the policymaker in the wheat exporting country to shift resources away from the provision of the public good toward the provision of the public input, benefiting both sectors. Thus, a tariff imposed by the tech exporter has the effect of making the wheat exporter more efficient, more internationally competitive. These results follow

[4] The tariff imposed by the wheat exporter also depresses the wage in terms of wheat in the tech exporting country. The fall in the world price of tech shrinks government employment in the tech sector, and boosts the share of private sector labor employed in the production of wheat.

from the fact that a tariff imposed by either country induces a shift in resources away from a free-trade toward an autarky allocation, reversing the forces at work, and outlined in Result 2.2, as the world economy opens to trade. In any event, the adverse welfare consequences of tariffs resulting from the reduction in the gains from trade remain. The "optimum" tariff argument that trades off the gains in the terms of trade against the value of lost trade foregone still applies.

We have in this paper also neglected to consider role played by "political economy" factors in shaping the scale and scope of government activity. In particular, we have, for the most part, interpreted our model in such a way that the λ valuations of the public good reveal the preferences of households who are also the "principals" of the government. Thus, all our results can be understood as first-best outcomes achieved by governments that faithfully act in the best interest of the representative household. As we have suggested, the model can also be given a more sinister "Leviathan" interpretation in which the λ valuation is that of a self-interested policymaker.

Suppose that the policymaker in our low valuation λ economy is a power-seeking mercantilist bureaucracy that deliberately acts to enhance productivity in the tradables sector, and in particular the tech sector, while the policymaker in our high valuation λ' economy is captured by the interest of labor, and in particular the Association of Federal, State, and Municipal Employees. The true preferences of the households in both economies could well be the same, say λ^{hh}. Nonetheless, if the scale and allocation of public employment is driven by the policymaker's λ's and not the public's, there will be gains from trade and the free trade equilibrium will be that described in Section 3 for the λ and λ' economies. Note that in contrast to the recent "political economy of trade"

literature, it is not necessarily through trade restrictions alone that politics can shape the terms and pattern of trade. The provision and allocation of government resources, to the extent that these decisions alter both absolute and relative sectoral productivity, is another, perhaps more important channel through which politics can shape the terms and pattern of trade.

It is hoped that our analysis, and its implications, have made it clear that government and trade can be, and should be studied together. The interaction between government and trade that we have outlined in this paper shows that it is possible and profitable to go far beyond that which is contained in the traditional literature of comparative advantage, and even that strand of the literature that has until now concerned itself with the political economy of protection and trade policy.

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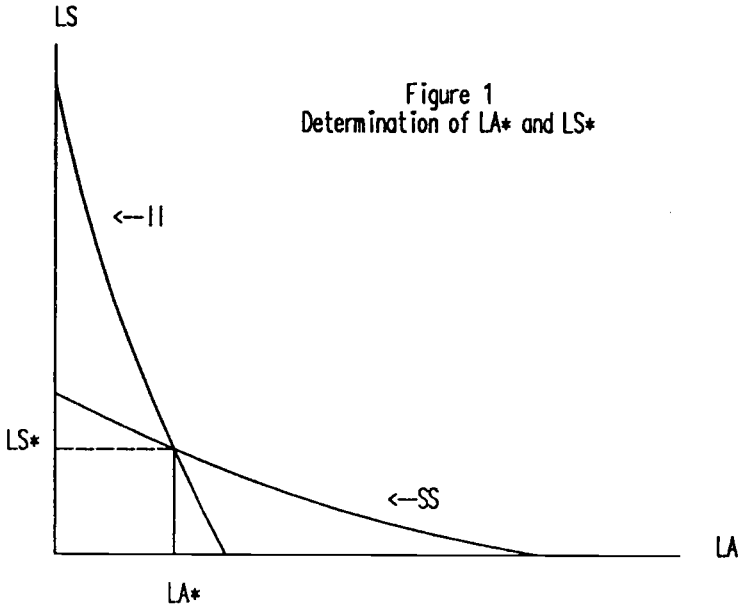

Figure 1
Determination of LA* and LS*

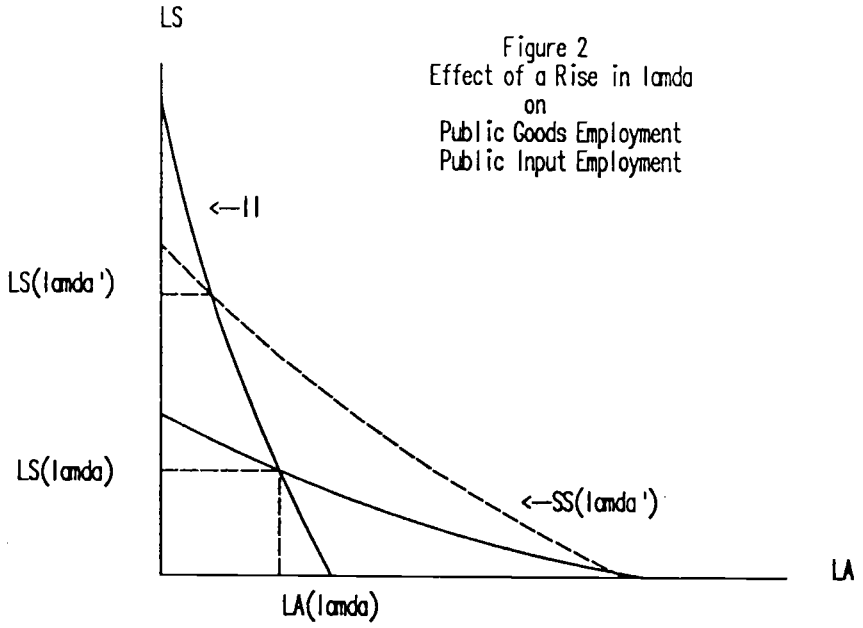

Figure 2
Effect of a Rise in lamda
on
Public Goods Employment
Public Input Employment

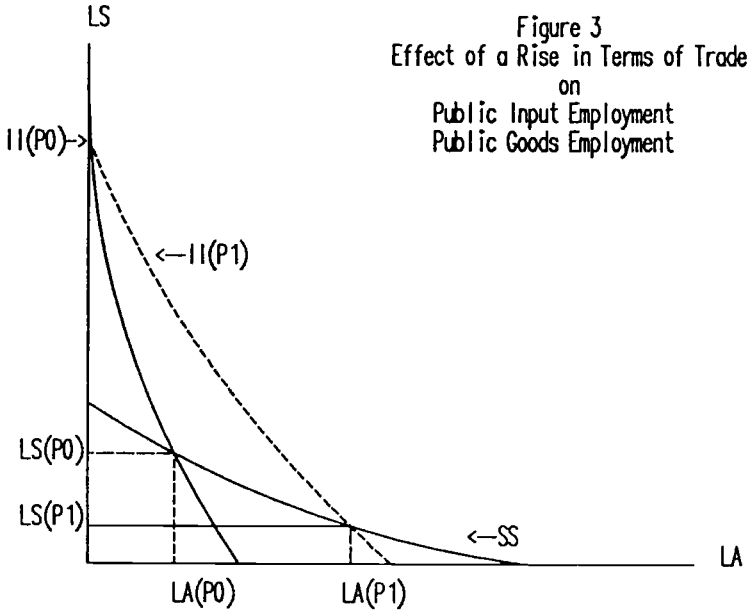

Figure 3
Effect of a Rise in Terms of Trade
on
Public Input Employment
Public Goods Employment