After Maastricht: Public Investment, Economic Integration, and International Capital Mobility

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Abstract

This paper studies some interesting implications of economic integration in the context of a neoclassical model of international trade, optimal public investment, and capital mobility. Due the endogeneity of the productive public capital stock, international capital mobility, while equalizing returns to capital, can lead to a divergence in the wages earned by labor. We also demonstrate that international capital mobility can set off an "infrastructure" investment boom. If the benefits of public capital spill over across national borders, governments in the Nash equilibrium spend the "1992" dividend on an excessive provision of public services, attempting to free ride on the public capital of their neighbors.

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1. *Introduction*

Among the many consequences of Europe's post-war movement toward economic and political integration has been the stimulus it has given to the international economic theory of such subjects as free trade zones, customs unions, and optimal currency areas. Many of the important insights in theses fields were anticipated in a characteristically brilliant and prescient article by Hayek (1939) on "The Economic Conditions of Interstate Federalism." Hayek argued that any significant movement toward political integration necessarily entailed adjustments towards economic integration and that such a combined movement would enhance both economic efficiency and political freedom.

Economists have traditionally analyzed European integration by studying the successive relaxation of impediments to the free exchange of goods and factors among the member nations of the community. Thus, the free trade area requires only the removal of trade restrictions among members, the customs union calls for a common external tariff, while a complete economic and monetary union would permit the freedom of factors and firms to locate in any member country within a uniform framework of laws and institutions. This approach is the inheritance from the seminal works of Jacob Viner (1951), James Meade (1953) and Robert Mundell (1958) from the decade of the fifties.

Our approach to the subject of European economic integration draws from a diferent tradition within our discipline, a tradition that emphasizes the role of the state as the provider of public goods, including productive public "infrastructure" capital as well as public services such as clean streets and symphony concerts in public parks. Our interest is not in investigating the removal of barriers to the free flow of goods, capital and workers, but rather in modeling the potential shifts in public investment and the provision of public services that may follow from the extension of the domain of decision over the the provision of public capital and services from the single nation-state through an "association," "commonwealth" or other manifestation of what Hayek calls "interstate federalism," to complete unity in some sort of "supranational" state or "super-state."

Drawing on our previous research (Clarida and Findlay (1991, 1992)) we begin by presenting a model of a small open economy in which public investment in productive infrastructure and final public services are provided at their first-best levels.[1] We show that such an economy will approach a long-run steady state with a unique equilibrium value of public capital and public services, along with production, trade and consumption levels for the two private goods that the economy produces with the given labor force and specific inputs in each sector, as in the Ricardo-Viner model of Jones (1971). If public capital is initially below the steady-state level, we demonstrate that along the transition path, gross public investment falls while the provision of public services rises. That is, along the optimal path, the government shifts from being primarily a builder of public capital to utimately being a provider of

[1] Other relevant work on the role of public sector inputs in growth and trade include Aschauer (1989), Barro (1990), and Casella and Feinstein (1990).

public services.

We next turn to the consequences of integration between small open economies of the type we have just considered. Suppose initially that economic integration simply takes the form of perfecting capital mobility between two economies, economies that face the same world prices for tradables and that have identical factor endowments, technological capabilities, and preferences for tradeables. The economies differ in that policymakers in one of them, say France, have a preference that favors a more generous provision of public services at the expense of lower disposable income as compared with the other country, say Germany. In the absence of capital mobility, this results in a higher rate of public investment and larger stock of public capital in Germany relative to France, and therefore in higher steady-state levels of wages and returns to both specific factors in Germany.

This difference in returns induces capital to move from France to Germany until rentals on capital are equalized. We show that, within the structure of our model, the returns to the other fixed but immobile factor, "land", must also be equalized. Moreover, we show that the optimal public capital stock is higher in a world with capital mobility, and that all of the gains from the additional public capital stock accrue to labor.

Thus, when capital mobility increases as a result of economic integration, pressures can be generated to "harmonize" the provision of public services and public capital among member nations. One form that such harmonization can take is in standardizing and otherwise coordinating public investment in each country so that the benefits of public capital in one nation "spill over" to others.

We next suppose that integration takes the form of an "interstate federation" in which the public capital of either country also benefits the

productivity of the other, but in which national sovereignty still reigns over the provision of public capital. We derive a Nash equilibrium for the rate of public investment and provision of public services in each country in the steady state. We show that each nation will to an extent "free ride" on the public capital of the other, reduce its rate of public investment, and increase the provision of public services that are enjoyed exclusively by its own citizens. While each nation provides less public capital, the sum of the two countries' public capital stocks is greater than in a world without such spillovers, and hence each nation has the benefit of a higher aggregate public capital stock than before. Since each nation also enjoys a greater provision of public services, an interstate federation clearly enhances efficiency notwithstanding the tendency of each partner to "free ride" on the other's public investment.

We finally consider the most fundamental type of political and economic integration, the fusion of the partners into a single supra-national entity or "superstate" in shich the decision on the provision of public investment for infrastructure is centralized. A single optimization is done over the entire domain that was formerly divided between interdependent but separate entities that did not internalize all spillovers. There is thus no "free rider" problem at the supra-national level. We show that the super-state emerging out of the fusion of two identical nation-states provides exactly twice as much public investment and steady-state capital as each one of them would have done seperately before integration. The efficiency gains from full political and economic union are therefore even larger than in the case of the interstate federation in which the "free-rider" problem may arise.

2. Public Investment in a Ricardo-Viner Open Economy

We consider a small open economy populated with L workers and endowed with Z acres of land and K units of capital. Wheat is produced with land and labor inputs according to:

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

while tech is produced with capital and labor according to:

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

As we shall see, the restriction that labor's share in wheat and tech output are equal simplifies the analysis substantially, and helps to highlight the role played by international trade in influencing the scale and scope of government activity.

Productivity in the private sector is augmented by the stock of public capital A. A evolves according to

$$(3) \qquad A' = A(1-\gamma) + I(L_A);$$

where γ is the rate of depreciation, I is the gross rate of investment, a concave function of public employment L_A. The government also provides public services S that augment private utility. These are produced with a technology $S(L_S)$ concave in public employment L_S. We assume that government workers are paid the going wage, and that the wage bill is financed by a lump sum tax.

In this small open economy, the share of private sector labor employed in the wheat sector $\phi(p;K/Z)$ is given by:

$$(4) \qquad \phi(p;K/Z) = 1/(1 + p^{1/\delta}K/Z).$$

Using this fact, it is easy to show that disposable national income is given by:

$$(5) \qquad Y = AZ^{\delta}(L-L_A-L_S)^{1-\delta}\phi(p;K/Z)^{-\delta};$$

that is, disposable national income is equal to aggregate private wage income divided by $(1-\delta)$ labor's share.

The policymaker acts to maximize the discounted present value of the log of each period's social welfare function U_t.

$$(6) \qquad max \sum_{t=0}^{t=\infty} \beta^t log U_t$$

where $U_t = \Sigma N_j U_{jt}$ and

$$(7) \qquad U_{jt} = Y_{jt}u(p)v(S).$$

That is, we assume that social welfare is just the sum of individual utilities and that individual utility of each of the N_j households with income Y_{jt} is homothetic in W and T and is weakly separable in S. It follows that:

$$(8) \qquad U_t = Y_t u(p)v(S).$$

Note that we also assume that the policymaker's intertemporal elasticity of substitution is equal to 1.

The optimal rate of public investment $I(L_A)$ and the provision of public services are determined as follows. Differentiating (6) using (5) and (8), we obtain the first-order conditions:

$$(9) \qquad (1-\delta)/(L-L_A-L_S) = v'S'(L_S)/v(S(L_S));$$

$$(10) \qquad (1-\delta)/(L-L_A-L_S) = \beta I'(L_A)/(A(1-\gamma) + I(L_A)).$$

Equation (10) defines the AA schedule. For any given public capital stock A and provision of public services S and thus employment L_S, the AA schedule determines the optimal rate of public investment $I(L_A)$. The left-hand-side of (10) is proportional to the marginal social cost of increasing public employment. The right-hand-side of (10) is proportional to the discounted marginal social benefit of using the extra public worker to produce public capital. Equation (9) defines the SS schedule. For any given rate of public investment I and thus employment L_A, the SS schedule determines the optimal provision of public services. The left-hand-side of (9) is proportional to the marginal social cost of increasing public employment. The right-hand-side of (9) is proportional to the marginal social benefit of using the extra public worker to produce public services.

It is easy to verify that there exists a unique steady-state public capital stock and provision of public services and that the optimal public capital accumulation policy is globally stable. In the steady-state, the public capital stock is constant and equal to the optimal rate of public investment divided by the rate of depreciation. Thus, the steady-state is determined by the intersection of the SS schedule with the steady state AA schedule:

$$(11) \qquad (1-\delta)/(L-L_A-L_S) = \beta\gamma I'(L_A)/I(L_A).$$

Figure 1 depicts the determination of the steady-state rate of public investment and provision of public services. The properties of the steady-state are intuitive. In particular, the steady-state public capital stock is decreasing in the rate β at which the policymaker discounts social welfare, while the steady-state provision of public services is rising in the elasticity $\sigma = v'S/v$ of utility with respect to public services.

Figure 1

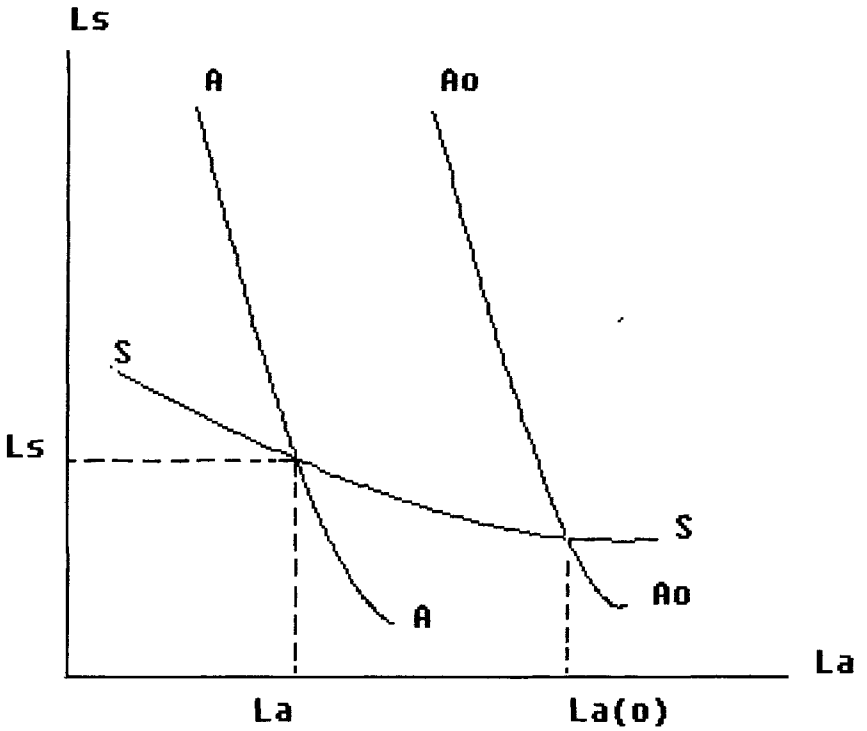


Figure 2

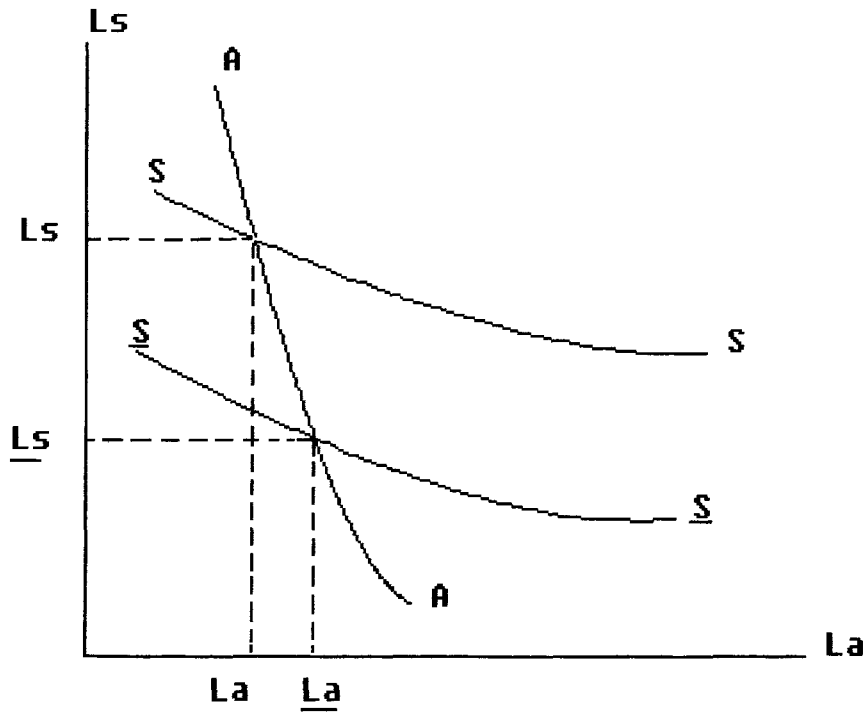
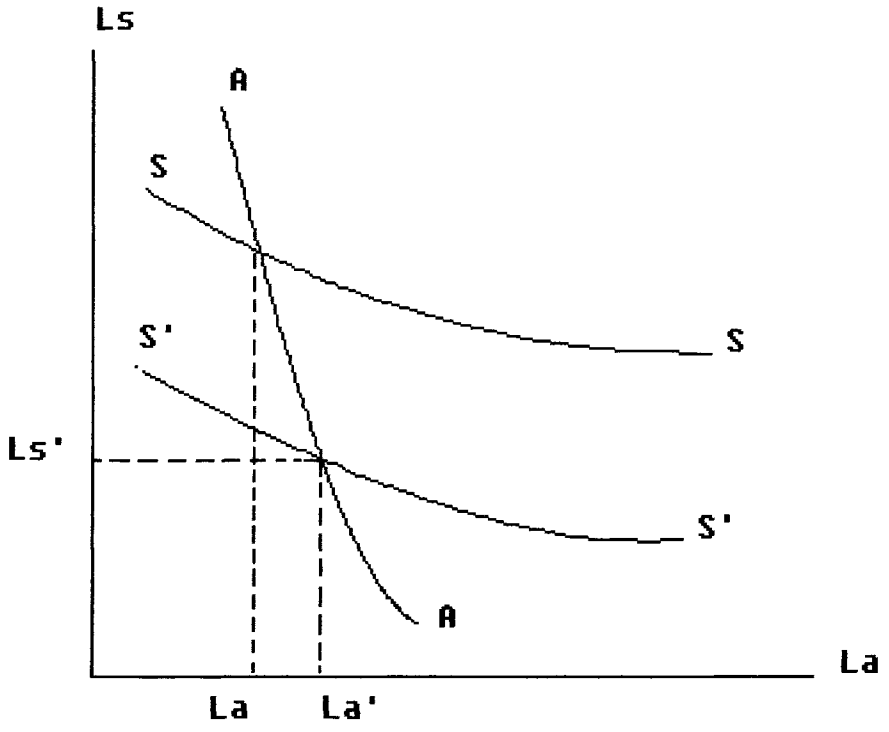


Figure 3



An interesting feature of the public capital accumulation process is that, during the transition to the steady state, the public capital stock, the provision of public services, and the level of national income all rise together. When the initial stock of public capital, A_0, is low relative to steady-state, the marginal social product of public investment $I'(L_A(0))$ is high. Few public services are provided, and the government finds it optimal to hire labor away from the private sector to build up the public capital stock. As public capital is accumulated and labor is released to the private sector, income rises, reducing the opportunity cost, and thus encouraging the provision, of public services $S(L_S)$.

3. International Capital Mobility

A principle objective of the 1992 project is to eliminate barriers to the movement of capital across national borders. In the absence of such barriers, capital will relocate until returns are equalized throughout Europe. Even with free trade in goods, returns to capital will diverge if factor prices are not equalized. In the context of our three factor-two tradeable good model, the equilibrium rental on machines is given by:

$$(12) \qquad r = pA\delta K^{\delta-1}(L-L_A-L_S)^{1-\delta}(1 - \phi(p;K/Z))^{1-\delta}.$$

We will now show that differences across countries in σ, the elasticity of household utility with respect to public services, will require differences across countries in the return to capital in the absence of capital mobility. σ has an especially interesting interpretation when household utility is homothetic. It is the rate at which households are willing to reduce disposable income in exchange for a 1 percent rise in the provision of public services. Thus if $\sigma = 2$, the representative household is willing to reduce its disposable income by 2 percent in order to finance a 1 percent increase in the provision of public services.

From the steady-state first order conditions (9) and (11), we know that the SS schedule in a high σ country lies above the $\underline{SS}$ schedule in a low $\underline{\sigma}$ country so that the σ country has a smaller stock of public capital and provides more public services than does the $\underline{\sigma}$ country. As shown in Figure 2, it is also the case that the government of a high σ country employs a larger fraction of its labor force than does a low $\underline{\sigma}$ country. Indeed, since GNP is proportional to wage income, it is easy to show that the share of government spending in GNP is simply:

$$(13) \qquad G/Y = (1-\delta)(L_A + L_S)/(L - \delta(L_A + L_S)).$$

Because a high σ country has a smaller steady-state stock of public capital and a smaller private sector labor force, we see from (12) that the return on private capital in a high σ country must also be lower. Simply put, in a country that is willing to accept a large reduction in disposable income to finance a generous provision of public services, there will be fewer workers and less public capital to be combined with private capital. For all these same reasons, the rental on the other specific factor land,

$$(14) \qquad \upsilon = A\delta Z^{\delta-1}(L-L_A-L_S)^{1-\delta}\phi(p;K/Z)^{1-\delta};$$

will also be lower in the high σ country, as will be the private sector wage bill $w(L - L_A - L_S)$. Moreover, it can be shown that, for plausible parameters, wages must also be lower in the high σ country.

After barriers to international capital movements have been eliminated, free trade in machines will equalize the rental on machines across countries. Moreover, using (12), (14), and the condition (4) that wages are equalized across the tech and wheat sectors, we see that:

$$(15) \qquad r/\upsilon = p^{1/\delta}.$$

This implies that free trade in machines and final goods is sufficient to equalize returns on the internationally immobile factor. This result is well known for the case in which A is exogenous and common across countries. A Cobb-Douglas production structure with common labor and public capital output elasticities across the tradeables sectors delivers the additional implication that υ is equalized regardless of cross-country differences in the public capital stock. Notice that this has the interesting implication that owners of internationally mobile capital and immobile land have no economic interest in

maintaining the public capital stock at the level that prevailed before the integration of capital markets! Machines can always be shipped abroad and, so long as the public capital stock is not allowed to decline "too" much, outflows of labor from the tech sector to the wheat sector will maintain v at the worl level.

Given the stocks of public capital and levels of government employment prevailing before integration, it is clear that machines will flow into the low $\underline{\sigma}$ country and out of the high σ country until the rental on machines is equalized. The inflow of machines to the low $\underline{\sigma}$ country will boost the output of tech, raise the marginal product of labor and thus the wage, and induce workers to shift out of the wheat sector to the tech sector. In the high σ country, the outflow of machines will lower the marginal product of labor and the level of wages, inducing labor to shift into the wheat sector and thus lowering the output of tech and boosting the output of wheat. It follows that, given the stocks of public capital and levels of government employment, free trade in machines, while leading to convergence in the returns on capital and land, results in a divergence in wages.

We now examine this sectoral reallocation of labor more closely. Capital flows occur until the marginal product of capital is equal to the global equilibrium rate r. From the sectoral mobility of labor and equation (4) we know that, in low $\underline{\sigma}$ countries receiving machines, a larger share of the private sector labor force is attracted to the tech sector. Solving (14) for K/Z as a function $\kappa(A,L-L_A-L_S,Z,p,r)$, we can obtain an expression for the allocation of private employment in a world with capital mobility:

$$(16) \qquad \phi(p;\kappa(A,L-L_A-L_S,Z,p,r)) = (Z/(L-L_A-L_S))(r/\delta A p^{1/\delta})^{1/(1-\delta)}.$$

Since workers are paid their marginal product, the equilibrium wage in a world with capital mobility is given by:

$$(17) \qquad w = (1-\delta)A^{1/(1-\delta)}p^{1/(1-\delta)}(\delta/r)^{\delta/(1-\delta)}.$$

Comparing with (15) we see that, while capital mobility equalizies returns on capital and land regardless of national endowments of land and stocks of public capital, wages differ across countries to the extent that the stocks of public capital differ. Indeed, we see that in a world of capital mobility, workers reap the entire value of the contribution of public capital to GDP.

In a world without capital mobility, wages and the returns earned by the fixed factors are proportional to private domestic product. Thus in such a world workers, capitalists, and landholders all aggree that, given the provision of public services S, the policymaker should maximize the present value of the utility derived by consuming private domestic product. In a world of capital mobility, workers have objectives that differ from those of capitalists and landholders. Given the provision of public services, workers still wish to select public investment to maximize utility derived by consuming private domestic product. We now demonstrate that, in a world of mobile private capital, a policymaker that maximizes the utility of workers will want to <u>increase</u> the rate of public investment and to raise the steady-state stock of public capital. As we have argued above, owners of capital and land have no economic interest in maintaining the public capital stock at the level that prevails before private capital becomes mobile.

To see this result, we note that aggregate worker utility is $(1-\delta)Yu(p)v(S)$ where Y is private domestic product. Maximizing (6) subject to (5) and (16), we obtain the first-order conditions:

$$(17) \qquad (1-\delta)/(L-L_A-L_S) + \delta/(L-L_A-L_S) = v'S'(L_S)/v(S(L_S));$$

$$(18) \qquad (1-\delta)/(L-L_A-L_S) + \delta/(L-L_A-L_S) = \beta I'(L_A)/(1-\delta)(A(1-\gamma)+I(L_A)).$$

Comparing (18) with (10), we see that in a world of capital mobility, there is both an extra cost and an extra benefit to hiring a worker away from the private sector to produce public capital. The extra cost is that, by shrinking the private sector labor force today, fewer machines will be attracted to the home country today, lowering private domestic product. The extra benefit is that public investment today augments the public capital stock tomorrow, attracting addition machines and boosting private domestic product. These influences seem quite general. In the context of our Cobb-Douglas specification, these two effects balance out: both the cost and the benefit of an extra worker producing public capital increase by a factor $1/(1-\delta)$, the reciprocal of labor's share. Comparing (17) with (9), we see that in a world of capital mobility, there is an extra cost to hiring a worker away from the private sector to produce public services, but no extra benefit. Again, the extra cost is that, by shrinking the private sector labor force today, fewer machines will be attracted to the home country today, lowering private domestic product.

We conclude that, in a world of international capital mobility, a policymaker that maximizes the utility of workers will want to <u>increase</u> the rate of public investment and to raise the steady-state stock of public capital. Geometrically, capital mobility increases the opportunity cost of providing public services and thus shifts down to SS' the schedule defined by (17). We have just seen that capital mobility leaves the steady-state AA schedule

$$(18) \qquad 1/(L-L_A-L_S) = \beta\gamma I'(L_A)/(1-\delta)I(L_A);$$

unchanged. Figure 3 depicts the new steady-state.

This analysis highlights a potentially important mechansim by which economic integration can boost the level of productivity: the mobility of capital that follows from economic integration can encourage public investment and thus raise the steady-state public capital stock. We also note that, in the new steady-state, the provivion of public services and the share of government in GNP is lower since the marginal social product of an extra private sector worker, a worker who can attract extra machines from abroad, is higher.

4. Public Capital Spillovers

We now consider the implication of spillovers across national borders in public capital productivity. In particular, we suppose that technologies at home benefit from a larger public capital stock abroad. Letting underscores denote foreign variables, with public capital spillovers we have:

$$(19) \qquad T = (A + \underline{A})K^{\delta}((1-\phi(p;K/Z))(L-L_A-L_S))^{1-\delta};$$

$$(20) \qquad W = (A + \underline{A})Z^{\delta}(\phi(p;K/Z)(L-L_A-L_S))^{1-\delta};$$

and similarly for the "foreign" country. How do pulbic capital spillovers influence the rate of public investment at home? Given the level of foreign public capital stock $\underline{A} = I(\underline{L_A})/\gamma$, public investment at home must satisify:

$$(21) \qquad (1-\delta)/(L-L_A-L_S) = \beta I'(L_A)/(A(1-\gamma) + I(L_A) + \underline{A});$$

which is just a modified AA schedule, as well as (9), the SS equation. Thus public capital spillovers, by boosting the level of future output for any given path of public investment, lower the marginal utility of an extra unit of public capital, but leave the marginal cost unchanged. The AA schedule rotates to the left, reducing public investment and freeing up resources that can be shifted to the provision of public services.

In the steady-state with public capital spillovers, public investment must satisfy the steady-state AA condition:

$$(22) \qquad (1-\delta)/(L-L_A-L_S) = \beta\gamma I'(L_A)/(I(L_A) + I(\underline{L_A}));$$

The steady-state public capital stock at home falls, and the provision of public services rises. From the SS schedule, we see that $L_G = L_A + L_S$ must fall. Since I is concave, we know that $I(L_A)/\gamma + I(\underline{L_A})/\gamma$ must rise. Thus given the foreign

public capital stock $\underline{A} = I(\underline{L}_A)$, public capital spillovers reduce the home public capital stock but increase total productivity as the home country "free rides" of the foreign public capital stock. Because the home policymaker can benefit from a higher level of steady-state productivity with a lower rate of public investment, more resources are devoted to the provision of public services and private production. That is, the share of government spending in GNP shrinks.

Of course, the foreign country faces these same opportunities and constraints given the level of home country public capital stock. It is easy to show that there exist a unique Nash equilibrium in this game between home and foreign countries and that this equilibrium is symmetric. In this Nash equilibrium, the aggregate public capital stock and thus the level of productivity rises even though each country's public capital stock falls. Governments spend the "1992 dividend" on a more generous provision of public services, and the share of government spending in GNP falls in both countries.

This is not the first best outcome. If the "Brussels" social welfare function is given by the sum of home and foreign utilities:

$$(23) \qquad U_t + \underline{U}_t = (Y_t + \underline{Y}_t)u(p)v(S);$$

it is easy to verify that at the "Brussels" optimum, public investment, the provision of public services, and the share of government spending in GNP are unchanged in a world with public capital spillovers. Thus, relative to the first-best Brussels optimum, the Nash equilibrium public capital stock in each country is too small, the Nash equilibrium provision of public services too generous, the Nash equilibrium share of government spending in GNP is too small, and the Nash equilibrium level of productivity in each country - while higher than in a world without public capital spillovers - is too low.

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