Public Economics, Public Projects, and their Funding

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Abstract. *This paper illustrates the contribution of public economics to the analysis of public projects. The illustrations pertain to peak-load pricing (electricity) and to second-best pricing under a budget constraint (subways), also taking into account the pricing of substitutes (rail versus canals, fixed link versus air or ferries). The paper next reviews some difficulties in evaluating costs and benefits (for the Channel tunnel), compares briefly private versus public implementation, then turns to funding. After reviewing the pricing of derivatives in the Capital Asset Pricing Model and the computation of risk premia for public projects, the case for funding public projects on world capital markets is presented and applied to the denomination of Third World debt. The paper ends on a plea to consider the merits of a "World Insurance Agency for Development".*

Introduction

This paper is concerned with public economics, a very suitable topic since public economics is the part of the discipline that is concerned with the activities and policies of public authorities, governments, public agencies, and public institutions like the ADB. Public economics has developed over the last 40 years (see Drèze 1995). The development has been uneven, being very close to microeconomics, one branch of economics, much less close to other branches like macroeconomics and finance. This will be apparent in what follows. I will review some simple examples of applications of public economics, drawing methodological implications, and will be led naturally in this way to take up an unresolved issue closer to macroeconomics and finance, which could be called the globalization of risk bearing.

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Asian Development Review, vol. 15, no. 1, pp. 1-17

As explained for instance in Chapter 10 of Vickrey's *Public Economics* (1994), the logical sequence in considering a public project is the following. First of all, you should define the operating and pricing policies to be followed if the project is carried out; thus when you build the Second Rapid Transit Line in Manila, you would like to know what kind of schedules it will operate on, and what kind of prices will be charged. Then, knowing how it will be operated and priced, you can appraise whether the benefits will outweigh the costs and whether the project should be undertaken. If the test is passed, you undertake the project, then apply the operating and pricing policies as the circumstances command, but according to the blueprint initially defined.

Peak-load Pricing

I will begin by referring to a rather illustrious example, namely the operations and pricing of electricity in France after World War II. A prime concern was that, in rebuilding the country, capital was in short supply. One would like to meet the demand for electricity at the lowest possible overall investment, to leave resources available for other areas. In the process of attacking this problem, a set of economists and engineers, led in particular by Marcel Boiteux who later became president of the French Electricity Company, developed the theory of what is known as peak-load pricing or periodic pricing. Let me, for further reference, remind you very briefly of the principles of peak-load pricing. You want to build a facility for which the total operating cost as a function of output starts with the fixed cost, the investment, followed by a proportional production cost, up to some capacity level at which you cannot produce more from that facility. The marginal cost is constant up to capacity, and then becomes infinite. Let this facility accommodate two levels of demand. In the case of the transit system, it could be the peak hours of commuter traffic and the slack hours of the weekend or midday; in the case of electricity, there is a difference between the seasons of the year. In cold countries, the demand is higher in winter than in summer; in warm countries, the pattern may be reversed, due to the use of air-conditioning. In addition, there will be periodicity during the day. I limit myself to two periods. Figure 1 exhibits the marginal cost curve and the demand at the two levels; the high demand curve corresponds to peak demand, and the lower one to off-peak demand. As verified in the work of Boiteux (1949) and later authors, economic efficiency calls for pricing off-peak at marginal cost and satisfying the demand with slack capacity, while pricing during the peak at whatever price is needed to limit the demand to the existing capacity, thereby avoiding unsatisfied demand. Consequently, during the off-peak period, you just cover the variable cost and your revenue does not contribute anything toward covering the fixed cost. You have to cover the fixed cost from the extra price collected during the peak period. The capacity times the surcharge defines a revenue, to be compared with the level of the fixed cost. In applications of this theory, you have more complex patterns of demand, of equipment, and so on. That is why a general theory was developed. You also have to deal with uncertainty; in particular, in the case of electricity, there are random fluctuations in demand and random failures in the production system that reduce the capacity. In case of hydroelectric production, randomness of rainfall affects the capacity.

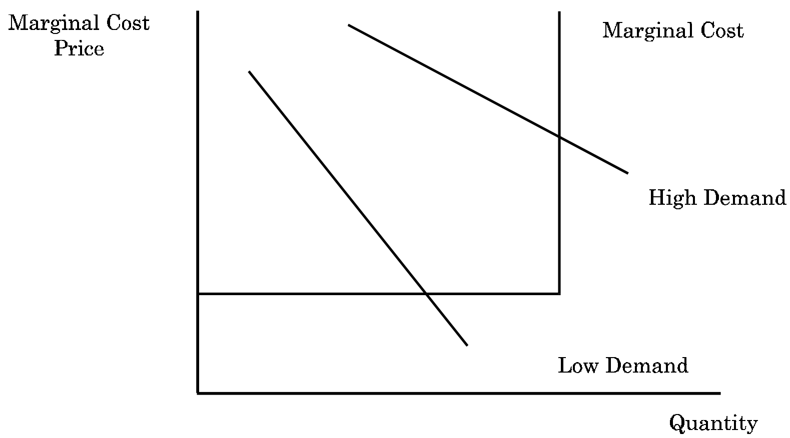

Figure 1

Over the past 40 years, the economists and engineers of the French Electricity Company have been at work to refine this theory. Currently, they have gone very far in the direction of offering to their customers flexible ways of dealing with the uncertainties affecting the supply and demand, hence the marginal cost. This can be contrasted with what has been happening in the United States, where electricity is privately produced, but where the private producers are regulated by special agencies. The practice of a private monopolist is to compute the marginal revenues associated with its two demand curves. The dotted lines in Figure 2 are the marginal revenue schedules. A monopolist would equate marginal cost and marginal revenue. That leads to prices off-peak, and during peak, at higher levels than is warranted for economic efficiency. If you regulate, as in the American tradition, by the rate of return on investment, private monopolists tend to overinvest and to charge a constant price throughout the period (see Wilson 1993). This is doubly inefficient: too much investment, inefficient use of capacity.

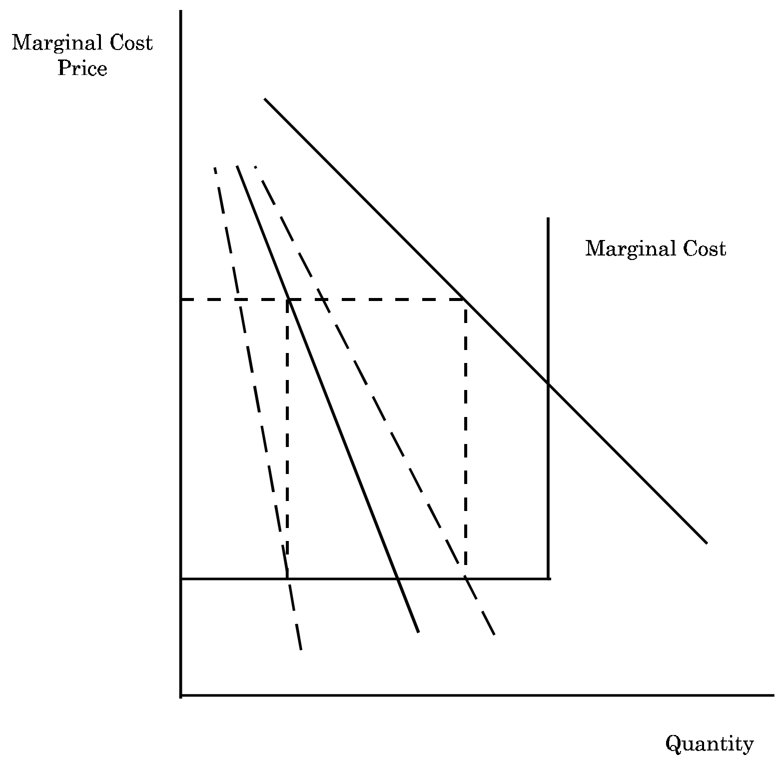

Figure 2

I may mention that more recent research, in particular by Tahar Abdessalem (1997), looks at a third possibility: neither a public service, nor a regulated monopoly, but a sophisticated contract between the regulatory agency and the private monopolist, creating incentives to mimic the behavior of the public service. Abdessalem's work establishes the theoretical feasibility of that third approach. Although it has not yet been implemented, there is a good reason for mentioning it. In the discussion between private and public supply of those services that have traditionally been in the public sector, one has to be concerned about the operating efficiency of the service. It is generally believed that private firms have some advantages in terms of efficiency because they have more experience with governance, and because they are less constrained in their rewards, hiring, and firing policies. But one also has to be concerned with pricing: the correct price signals are just as important as operating efficiency. Both contribute to the overall efficiency of the operation, and one should assess carefully whether the chosen approach offers the best compromise between operating efficiency and correct pricing.

It is relatively easy to do that in a public service like the French Electricity Company where a staff of economists and engineers study the issue. In India, where power shortages are still a daily occurrence and where the supply systems of the different states are not fully interconnected and not managed as a global unit, priorities are different. In Cambodia, where electricity is sold to retailers who then draw the lines to the individual households and collect prices that are uncontrolled, the situation is again different. Who could perform there the services that the economists and engineers of the French Electricity Company supplied? One possible answer is: an institution like the ADB can have on its staff a group of economists, technicians, and engineers who, on a variety of public projects, be it in electricity, water supply or transportation, provide the services of professional advice to which every project authority in the different countries lacks access.

Budget Constraints and Second-best Pricing

One question has not been raised so far: when will you cover the fixed cost, and when will you not? There are fortunate cases where, by applying the simple model of efficient peak-load pricing, you cover fixed costs. But there are also circumstances where fixed costs are too high for that. Then, you face two possibilities; either subsidies fill the losses associated with efficient pricing, or you have to accept departures from efficient pricing. This leads me to mention another early application, due to William Vickrey (1952, 1955) advising the New York Transit Authority on managing, operating, and pricing the New York subway system. He too was applying the principles of peak-load pricing. He considered replacing the existing single flat fare, applicable at all times and to all types of trips, by a system of marginal cost pricing which took into account the particular legs that were being travelled and the time of day. This unfortunately implied additional losses. So he looked for a compromise between the goal of avoiding deficits and the goal of using the facilities efficiently through appropriate pricing. He concluded that the best compromise emerged where the inefficiencies coming from charging too high prices relative to marginal cost would just offset the inefficiencies connected with running a deficit. The latter were due to the dead-weight economic losses associated with taxation. The city of New York, if it was to cover the deficit of the subway, had to raise the revenue: by sales taxes that are known to introduce a wedge between the price received by the seller and the price paid by the buyer; by property taxes that influence building projects; or by income taxes that affect labor supply. He summed it up by evaluating that a dollar of revenue allocated by the city to the subway was, ultimately, costing the community \$1.30. He called the extra 30 cents the "marginal cost of public funds". Although he was not first to use this term, introduced earlier by Meade and Fleming

(1944), he was first to produce a figure, the 30 cents, and to apply it to a concrete problem.

This prefigured the tradition of using what is known as “shadow prices” in project appraisal and cost benefit analysis, whereby one recognizes that certain items are not costing society what the price tag suggests but something different. In this instance, a dollar coming from the public budget is costing society $1.30. Vickrey made sure that one would not incur inefficiencies in the use of the subway exceeding these 30 cents. He found an equilibrium where there was exact balance between the inefficiencies from taxation and from operation, at the margin. This was also a premonition of the theory of the “second-best”. Knowing that some objective reasons prevent you from achieving a fully efficient allocation, you try to do as best as you can under the circumstances, i.e., you try to achieve a second-best. It was left for Marcel Boiteux (1956) again, and then for Peter Diamond and James Mirrlees (1971), to write out the full theory. That theory has sometimes been summarized by the “inverse elasticity rule”: when you are forced by circumstances to depart from efficient pricing, you will typically minimize the loss and reach the second-best through departures from the efficient pricing proportional to the elasticities of demand, or the combined elasticities of supply and demand, as the case maybe.

The formulas are developed with great generality in the theoretical work. In applications, you might find that in the case of the subway, commuters’ demand is less price-sensitive than off-peak demand. The airlines are applying this principle today on a large scale by charging different prices, depending upon whether or not a Saturday night is spent at destination. This separates the private travellers from the business travellers. The assumption is that business travellers have a demand that is less responsive to prices than the families or tourists. Accordingly, they are charged higher fares. But there is an important proviso: airlines operate as private monopolists at the point of maximal profits. Public services operate at the point where they balance off the marginal cost of public funds with the receipts from operation. Accordingly, they work with “reflated” elasticities that do not take as much advantage of the demand features as the private monopolist would (Drèze 1964, 32).

The Prices of Substitutes

Interestingly Vickrey, though being a specialist of urban transportation pricing, missed an important point, brought out later by the French engineer Hubert Lévy-Lambert (1969): when you look at efficient pricing of a facility like a subway, you should ask yourself whether the substitutes are priced correctly. If they are not, you should take this into account when designing the prices for your own facility. In the case of the subway, the alternative is very clear. It is ground transportation in the form of either public transportation by buses or private transportation by car. The question “is ground transportation priced correctly?” almost always deserves the same answer: emphatically no, because use of streets at peak times is very seldom priced in urban transportation. So there is a gross distortion in New York, or again in Manila: drivers of private cars do not pay for their contribution to congestion. Whether somebody drives in at 8:00 in the morning or at 11:00, the tax on the car is the same, the tax on the gasoline is the same, but the effect on congestion is not the same. At 8:00 peak time, each driver imposes a cost on others through congestion. This externality should be priced if you want to operate efficiently. The fact that it is not has implications for how you should price the subway at that time. This point was made by Lévy-Lambert. It is a bit ironic that Vickrey missed it. His thinking had gone in a different direction, namely how to price the roads. His book *Public Economics* reprints several papers on road pricing, which are really important and which will receive attention as we learn to cope with the problems of transportation in megacities.

I may say parenthetically that the importance of looking at the pricing of substitutes impressed me when I was first invited to comment on a public project, in 1960. The project concerned a canal connecting the main harbor of Belgium, Antwerp, and an area that in those days had an important steel industry. There existed a canal that only small barges could use, barges ill-suited to transport iron ore. The project called for enlarging this canal so that big efficient barges could use it. When I started interviewing people from the steel industry, I realized that they did not care about the wider canal. They cared about the railroad fares. They were getting their ore by railroad. But in Belgium at that time, the fare on the railroad was a function of the size of the canal on the same leg. To keep the competition between waterways and rail balanced in the eyes of the regulator, it was imposed that railroad fares should be adjusted to what it would cost by barges. So fares were high when the canal was small. The conclusion I reached was clear: do not build this canal, instead change the structure of railroad fares. The canal was difficult to build due to a long hill. The engineers of the Belgium Waterways had devised a marvelous scheme: do not build a battery of locks along the hill; build instead a single lock like a big bathtub, put the barges in the bathtub, and move the bathtub up the hill on wheels and rail. They were enamored with this technological achievement. They did build this huge bathtub. Today it is a tourist attraction. I mention this because you should always look at your own country for negative examples. The world is full of white elephants like this. Belgium is no exception. It is very sad that the public debt of Belgium, which is the highest in the world in relation to GDP, has been inflated by this huge bathtub instead of using the correct prices for substitutes.

Evaluating Costs and Benefits

The relevance of prices for substitutes stands out clearly in my next example, namely the tunnel under the channel between France and the United Kingdom (UK), locally nicknamed “the chunnel”. There is a long history of projects to build a fixed link between the UK and the continent. Eventually, a decision was reached by Mrs. Tatcher and President Mitterrand to establish such a link. But it would be entirely in private hands. These were two important political decisions.

Although I could not gain access to the cost-benefit study underpinning the decision, I have no doubt that the long-run benefits of the fixed link will outweigh its costs—especially if proper shadow prices are put on energy and use of air facilities. (Putting a shadow price on the immaterial benefits of UK-continent proximity is less easy.) One might however ask whether the time was ripe. Why do it now, rather than 5 or 10 years hence? That is a more difficult question, calling for more refined calculations. In particular, it calls for evaluating and discounting time profiles of benefits, as well as for comparing present and future costs. Quantification of benefits from faster and more comfortable transportation is not easy, especially when a new mode is at stake. One saving grace, in this case, is that a major source of benefits to users comes in the form of cheaper prices for air and ferry transportation—the prices of substitutes! Well before the opening of the chunnel, air and ferry fares were reduced substantially, as these competing carriers attempted to solidify their market positions.[1] Could such fare adjustments have been triggered otherwise, through some form of regulation, or incentives a la Abdessalem? Perhaps political scientists should be invited to investigate that question.

I shall not dwell on the difficulty of choosing the proper discount rate. It should of course be a real rate. The inflation component is not a real cost to society when considering the advancement of a public project. More active markets for indexed bonds would help on this score. There is an additional hurdle: should one take into account the possible influence of the project on the level of world interest rates? The overall investment eventually totalled around US$17 billion, which is neither overwhelming nor negligible. It corresponds to some 2 percent of annual fixed capital formation in the EU. The unknown is the elasticity of interest rates to investment demand. When I last looked at the empirical literature on that topic, I encountered grossly different estimates, none of which was really convincing.

Comparing costs over time raises a further issue, namely macroeconomic impact. The building of the chunnel started in the late eighties, at a time characterized by substantial unemployment and underutilization of capacities. Accordingly, the social cost of the resources going into the project was inferior to the private cost,

[1] I have not found any quantitative assessment of these reductions that are difficult to measure in view of the complexity of tariffs, prevalence of discounts, and multiplicity of package sales (holidays, duty free shopping trips); but reference to reductions as high as 40 percent or more is common (Vickerman 1995).

substantially so for unskilled labor. In a cost-benefit analysis, shadow prices should again be used, following the guidelines of the Little and Mirrlees (1969) manual and related sources. But standard cost-benefit analysis does not include multiplier effects through aggregate demand. Such effects are not negligible, for a major project like this. It is regrettable that public economics, including project evaluation, has not achieved an integration with macroeconomics comparable to its integration with microeconomics—an integration that led to second-best analysis and to all the work referred to above. The blame lies mostly with macroeconomics, which does not offer today the rigor and solidity needed for the foundations of a bridge to public economics. This is a major lacuna.

In summary, evaluating properly the costs and benefits of a complex project like the chunnel still raises several insufficiently understood issues, confirming the need to delegate their study to competent and diversified research groups.

Private versus Public Implementation

The decision to put the chunnel in private hands was political, and the reasons for that option are easy to guess. The nature of the contract is revealing of the extent to which it is private. The building syndicate (hereafter the syndicate) is granted a 50 years concession[2] to operate a tunnel, which it commits itself to build, in conformity with the approved blueprint. There are no other strings; in particular, there are no guarantees, and no constraints on tolls.

It is interesting to note that, at roughly the same time, the Danish government decided that the fixed link connecting the islands of Fun and Sjaeland (hence connecting Copenhagen to Jutland and the continent) should be a public project, because the government wished to retain control over the tolls. Without freedom to price, a private syndicate could not be asked to bear the risks of the project.

Here too, there exists a middle road between a private and a public monopoly, namely a concession of variable duration with pricing constraints, labeled “Least Present Value of Revenue” auction by Engel, Fischer, and Galetovic (1997). The principle is to stipulate in the contract a global amount to be recovered by the syndicate and a discount rate. The government may regulate prices. The concession ends when total receipts, discounted back to the initial date, become equal to the stipulated amount. This is irrespective of building and operating costs, for which the syndicate is responsible. The contract goes to the bidder requiring the “Least Present Value of

[2]The concession was extended to 60 years when safety authorities required modifications at a late stage (late 1990).

Revenue”.[3] (Interestingly, the painful financial restructuring of the chunnel, currently under way, includes a plea for lengthening the concession.)

It is unusual for a project so big and hazardous as the chunnel to be undertaken privately without any public guarantee. That feature is the counterpart of complete freedom on pricing. Apparently, it was felt that competition from airlines and ferries (the substitutes again) would prevent monopolistic exploitation by the chunnel syndicate. The record seems broadly consistent with that view, even though increasing concentration among ferry operators invites the European Commission to enforce vigilantly its competition policy.

Another dimension of the public versus private decision has received too little attention from public economists, namely funding. Does it make a difference that the project be financed publicly or privately? The question arises, because a project like the chunnel is surrounded by sizeable uncertainties. There are, in the literature, conflicting answers to the question whether public authorities should value risks differently from private investors. In order to select the proper answers, it helps to start from finance theory.

Pricing Assets and Derivatives

A basic simple formula captures in one line the essentials of efficient funding. It comes from a celebrated model called the Capital Asset Pricing Model (CAPM), which provides a first approximation to equilibrium in capital markets. For some purposes, it is a very good approximation; for other purposes, not; both remarks apply here. From the CAPM, I want to extract a formula for derivative pricing. There is a large-scale activity now of calculating the prices of some fancy security on the basis of the market prices that exist for other securities. What should be the price of a security issued to finance the Channel tunnel?

The approach of the CAPM is to relate returns to the aggregate wealth of the equity holders. One must admit that this aggregate wealth is not known with certainty; it will depend in particular upon how this particular project turns out, but it will depend on many other things because this wealth is invested in other stocks and bonds of different currencies, the market value of which fluctuates. Much of it is human capital. Try to imagine that you can aggregate it all; and call W_s the aggregate wealth of the equity holders, in a state of the environment labeled s, which might, for instance, stipulate a total cost of the investment amounting to so many billions, a growth rate of national income in the UK and France of 2.3 and 2.1 respectively, etc. It is a hypothetical calculation. Then, put a price Qs on a dollar of return to

[3] In principle, a “second price” auction (Vickrey 1961) would be recommended. Engel et al. (1997) argue that this is unnecessary when building and operating costs are known and common to all bidders.

investment (in the chunnel or in anything else) if the state of the environment is *s*. The formula from the CAPM is

$$Q_s = P_s\left[1 + R_R \frac{(W_s - \overline{W})}{\overline{W}}\right] \tag{1}$$

P_s is the probability of this occurrence *s*. R_R is a measure of relative risk aversion, which is the characterization of the ability and willingness to bear risk of the investors operating on this capital market. In the formula, this measure is applied to (multiplies) the deviation of wealth from expectation (from average) in relative terms. Then, when you compute the value of your investment,

$$\Sigma_s y_s Q_s = \overline{y} + R_r \frac{\mathrm{Cov}\left(y_s, W_s\right)}{\overline{W}} \tag{2}$$

where y_s is the net return on the investment under the same circumstances that I have labeled *s*; it is multiplied by Q_s and the products are summed over *s*. This brings in the covariance between *y* and *W*. This closed analytical formula will, under the assumptions of the CAPM (which, in this case, would give a satisfactory approximation) permit calculating the risk premium that must be appended to the expected cost of the project. It is equal to the covariance divided by $\overline{W}$ and multiplied by R_R.

The fact that we are not looking at the variance, that is, the variability of the returns on the investment, but only at how these returns correlate with the aggregate wealth, means that we can benefit from pooling risks. In particular, there are cases where the risks associated with a particular project are negatively correlated with other risks, so that the covariance washes out. The best example is price uncertainty. If both the buyer and the seller are covered by the formula, because they operate on the same capital market, then the price uncertainty for both of them washes out in calculating risk premia. This gives you an indication of the advantages of *pooling risks*.

$\overline{W}$ is the aggregate expected wealth of those who participate in the financial operation. The greater the $\overline{W}$, which comes in the denominator, the less will be the risk premium. This is a measure of the gains from *spreading* risks. The logical distinction between risk pooling and risk spreading is interesting. Risk pooling takes the form of replacing a variance by a covariance. A single individual holding two negatively correlated assets can capture the full benefit of risk pooling. Risk spreading takes the form of replacing an individual risk tolerance by a market risk tolerance. At identical levels of relative risk aversion (a scale-free concept), the market risk tolerance is proportional, and the risk premium inversely proportional, to the aggregate wealth of market participants, for a given covariance between y_s and W_s.

Risk Premia for Public Projects

These two features—risk pooling and risk spreading—are applied to the distinction between private and public funding in a classic paper by Kenneth Arrow and Robert Lind (1970). That paper is sometimes interpreted as suggesting that public investments should be appraised on the basis of expected returns, without regard for risks. A careful interpretation does not quite validate that conclusion, however.

The risk-pooling argument says that, if the new project has returns y_s uncorrelated with aggregate wealth *including* the new project itself W_s, the covariance in formula (2) is zero and no risk premium is needed. Now, the covariance of y_s with W_s, $\mathrm{Cov}\,(y_s, W_s)$ can be decomposed as

$$\mathrm{Cov}\,(y_s, W_s) = \mathrm{Var}\,(y_s) + \mathrm{Cov}\,(y_s, W_s - y_s)\ . \tag{3}$$

The last term in (3) is the covariance of y_s with aggregate wealth *excluding* the new project itself, i.e., it is the covariance of the returns to the new investment with the returns to all previous investments combined. Often, there exist grounds to argue that this last covariance is zero. For instance, uncertainty about the cost of building a chunnel (due to geological and technological uncertainties) may well be independent of returns to previous investments. In that case,

$$\mathrm{Cov}\,(y_s, W_s - y_s) = 0 \text{ and } \mathrm{Cov}\,(y_s, W_s) = \mathrm{Var}(y_s)\ .$$

The risk premium will thus be $R_R \dfrac{Var(y_s)}{W}$, a positive amount. In order for the risk premium to vanish, it would have been required that

$$\mathrm{Cov}\,(y_s, W_s - y_s) = -\mathrm{Var}(y_s) < 0\ .$$

Seldom are there grounds to validate this last equality.

The risk-spreading argument says that, for a given value of $\mathrm{Cov}(y_s, W_s)$, the risk premium is inversely proportional to $\overline{W}$ and goes to zero as $\overline{W}$ tends to infinity. Under independence, i.e., $\mathrm{Cov}(y_s, W_s) = \mathrm{Var}\,(y_s)$, that argument is valid. More generally, however,

$$\frac{\mathrm{Cov}\,(y_s, W_s)}{\overline{W}} = \frac{\mathrm{Var}(y_s)}{\overline{W}} + \frac{\mathrm{Cov}(y_s, W_s - y_s)}{\overline{y} + (\overline{W} - \overline{y})}.$$

If we expand the size of the original economy, say by multiplying $W_s - y_s$ by λ and letting λ grow, then

$$\frac{\text{Cov}\left(y_s,\lambda\left(W_s-y_s\right)\right)}{\overline{y}+\lambda\left(\overline{W}-\overline{y}\right)}=\frac{\text{Cov}\left(y_s,W_s-y_s\right)}{\left(\overline{y}/\lambda\right)+\left(\overline{W}-\overline{y}\right)}\underset{\lambda\to\infty}{\to}\frac{\text{Cov}\left(y_s,W_s-y_s\right)}{\overline{W}-\overline{y}}\;; \tag{4}$$

accordingly,

$$\frac{\text{Cov}\left(y_s,\lambda\left(W_s-y_s\right)\right)}{\overline{y}+\lambda\left(\overline{W}-\overline{y}\right)}=\frac{\text{V}ar\left(y_s\right)}{\overline{y}+\lambda\left(\overline{W}-\overline{y}\right)}+\frac{\text{Cov}\left(y_s,W_s-y_s\right)}{\left(\overline{y}/\lambda\right)+\left(\overline{W}-\overline{y}\right)}$$
$$\underset{\lambda\to\infty}{\to}\frac{\text{Cov}\left(y_s,W_s-y_s\right)}{\overline{W}-\overline{y}}\,. \tag{5}$$

Thus, the variance component still washes out.

The benefits from risk spreading are maximal when the increase in W is not accompanied with a proportional increase in $\text{Cov}(y_s, W_s - y_s)$.

From a pure efficiency viewpoint, the gains from pooling and spreading are maximal when all the risks in the world are pooled and all investors in the world carry efficient portfolios. This is known as the Borch Theorem, after Borch (1962). It is the counterpart for insurance markets of the standard argument for free trade. Note however that it is an efficiency argument, silent on the distribution of benefits over individuals. Some may lose, even though in principle they could have been compensated.

Funding Public Projects

Applying these results to the chunnel situation, I conclude that an optimal funding calls for equity funding on world capital markets. In particular, letting the governments of France and the UK bear the risks would not have been efficient, since risk spreading would have been limited to citizens of France and the UK. Although in a world of complete asset markets these citizens could have hedged their risks by selling short securities corresponding to either the chunnel project or the French-UK budget deficits, such securities do not exist. The point is developed systematically in a recent book by Robert Shiller (1993). Besides, carrying short sales over long periods requires costly transactions. Thus floating equity on world markets was in principle a better approach.[4] I doubt that this consideration was part of the political decision to go private.[5]

On the other hand, real-world capital markets may fall well short of achieving efficient risk sharing. The March 1997 issue of the *American Economic Review* contains three papers pointing successively to the following: (i) the levels and volatility of prices for closed-end mutual funds are at variance with those of the portfolios held by the funds;[6] (ii) individual investors do not take advantage of international diversification, thereby reducing worldwide the extent of risk pooling and risk spreading (Baxter and Jermann 1997); and (iii) investment counselors do not mix stocks and bonds efficiently (Canner et al. 1997). It has also been observed that stock returns reveal risk premia exceeding those justified by reasonable estimates of the risk aversion of investors (Siegel and Thaler 1997). There are accordingly serious doubts about the ability of capital markets to allocate risks efficiently.

There remains one source of public funding potentially well suited for large projects. It is exemplified by the ADB. Indeed, the shareholders of the ADB are the governments of industrialized countries and of Asia. Together, these countries account for a very large share of the world's wealth, like 85 percent. Much of the (huge) subscribed capital of the ADB is not paid in, but can be called in as needed.[7] Risks borne by the ADB are thus ultimately spread over owners of most of the world's wealth. This would seem to define a funding basis superior to that offered by asset markets. To the extent that one questions the efficiency of private markets, the risk premia applicable to funding by an institution like the ADB should however be recalculated. How precisely to do this is an intriguing question that cannot be covered here.

4. It is an amusing anecdote that the floating took place during the week of the New York Stock Exchange crash in October 1987. The floating, which had been previously subscribed, was successful anyhow.

5. The financial history of the chunnel syndicate has not been a happy one. Investment costs added up to roughly twice the ex ante appraisal, including intercalary interests. (Unexpectedly, the main difficulties arose not from the excavation but from the railroading part of the investment.) Price competition from substitutes was fiercer than expected. A fire broke out inside the tunnel in November 1996, resulting in damage (covered by insurance) but also loss of revenue over nearly a year. The syndicate was forced to stop interest payments on debt and to dilute the initial share ownership by issuing new shares allocated to lenders. The shares, initially issued at £3.50, reached a speculative high at £6 but are now down to £.70, at a total loss to the shareholders of 80 percent of their initial investment. From this, financial analysts seem to conclude that such big and hazardous projects call for public funding, in contradiction to the conclusion reached in the previous paragraph. The view of the financial analysts may impede further private funding of public projects in Europe for some time, I am sorry to say.

6. Lower levels, higher volatility, see Pontiff (1997).

7. That approach is not available to private firms, because unpaid capital is not easy to collect from anonymous dispersed shareholders. The chunnel syndicate resorted instead to a high degree of leverage (debt financing), which increased the risk borne by equity holders.

Globalization of Risk-Bearing

I conclude on this funding theme, by connecting it to public investment projects in developing countries. In the Little-Mirrlees (1969) manual, and in much of the literature on this problem, the discussion runs in terms of risks borne by individual countries. Formula (2) is in Little-Mirrlees, but W is the national income of a particular country. I thus raise the question: when an investment project is carried out, be it in Bangladesh or in Indonesia, why should the risks automatically be borne by Bangladesh or by Indonesia, instead of being pooled and spread on a worldwide basis as required for overall economic efficiency? I ask this question in earnest, and I make it even more specific by asking: in the experience of the ADB, would it have made a difference if projects had been funded more on an equity basis than on a lending basis? My reasoning above suggests that the ADB could transfer the risks to its shareholders, which come close to being the whole world. So the ADB, in principle, could bear lots of risks. From a viewpoint of economic efficiency, this would be much better than any stock market can do, much better than what the private financial markets can do today. But to take over the risk of a project means, basically, that you are providing equity financing instead of loan financing.

So a first question is: would it have made a difference? Could one find out, by going back to the files? I would be tremendously interested to know, from posterior analysis of the record, what difference it would have made if this or that project 20 years ago had been funded through equity rather than on a loan basis.

A second question is: should one check this about individual projects, or should one look at whole countries? Indeed, with public lending, the risks are eventually borne by the countries. One could identify the global risks which each individual country faces and ask: could one introduce a form of insurance on the risks borne by the countries? This subject is broached in the book by Robert Shiller (1993) mentioned above. It raises, of course, a host of questions, in particular of agency and moral hazard. If you start insuring a whole country on its global risks, are you not reducing the incentives for correct management of the country and correct policies? This is the counterpart of the moral hazard and agency problem that exists in private insurance.

Third question: so much for yesterday, what about today? We start by looking at yesterday to see whether it makes a difference. If it makes no difference, we forget about the issue. But, suppose it makes a difference. Is there something that we should correct today? Probably, this is not a crucial question in Asia, where country debts are moderate; but it is a crucial question in Africa and Latin America. There exist more efficient debt structures for developing countries than the kind of instruments in which the debt of African and Latin American countries is denominated. It should, in principle, be possible to restructure the debt in a way that exploits negative covariances with their natural returns, that indexes on some prices of exported commodities or services. Such restructuring could improve the current risk situation.

I conclude with these questions, hoping seriously that there may come some answers, maybe not immediately but at some point in the future. These questions go beyond the normal statutory goal of an institution like the ADB, and I am not suggesting that the practice of the ADB should be changed. I am suggesting that the experience of the ADB could tell us whether these issues are important or not, so that we can think about designing new institutions that would be geared to them. Specifically, should we think about setting up a "World Insurance Agency for Development", designed to organize insurance of country risks on behalf of developing countries? The question lies at the frontier of research, because the distinction between banking and insurance is being questioned in the field of private finance. The same question should be raised about public banking and public insurance. There is scope here for intellectual discussion and collaboration between those in the fields of finance and insurance, and those in public economics. It is in the spirit of the ADB lectures to stimulate such discussion and collaboration.

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