The returns on public investment: concepts, evidence and policy challenges

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Concepts, evidence and policy challenges

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Abbreviations

DSF	Debt Sustainability Framework
GDP	Gross Domestic Product
IMF	International Monetary Fund
KfW	Kreditanstalt für Wiederaufbau / German Development Bank
LICs	Low-income Countries
SNI	National Investment System

Summary

Public investment is undoubtedly central for growth and development. In order to make the right decisions on the desirable volume and the most effective allocation of public resources policymakers should know the returns on public investments. Based on this knowledge it would be possible to devise optimal policies, leading to higher growth and poverty reduction. However, in reality, decisions on the volume and allocation of public investments are rarely based on a systematic assessment of their returns. The choice of public investments is rather based on arbitrary decisions in an often intransparent political process. This paper attempts to review the methods of determining the returns of public investment, looks into practical applications of various methods and makes some proposals on how to improve resource allocation in practice, taking into account the difficulties of calculating the returns of public investments ex ante.

Correctly measuring the returns on public investment requires the consideration of all costs of public investment and the full impact of public infrastructure on growth. Public infrastructure affects growth through a variety of channels, and the major growth-enhancing effects include its impacts on productivity, private investment and human capital. At the same time, public investment may crowd out private investment and may cause Dutch disease effects, which both have a negative impact on growth. The cost associated with public investment includes the capital cost, public adjustment cost and the cost of complementary public expenditure.

Effective resource allocation across different public investment projects

Given that the returns on different public investment projects likely vary to a considerable extent, careful resource allocation is critical for the effectiveness of public capital expenditure. However, both theoretical and empirical research give few insights for optimal public resource allocation across different sectors and across different public investment projects, and in view of the high degree of complexity, it is not surprising that approaches at the macro and micro level in general fail to determine the exact return of public investment. Calculating the returns ex ante is complex given the difficulty to quantify benefits. In addition, the economic literature provides little guidance. While it suggests that public investment is beneficial in the long run, the usefulness of theoretical models is limited due to parameter uncertainty, and robust and specific ex-post estimates of the returns on public investment with general validity are hardly available.

The policy implications include:

— A stronger qualitative analysis using a macroeconomic framework

  Due to the shortcomings of the quantitative micro analysis of the returns on public investment projects because of data and methodological limitations, more effort should be made to improve the qualitative analysis in project appraisals. One way is to use the growth diagnostics framework by Hausmann / Rodrik / Velasco (2008). Even though its application is challenging in practice due to difficulties involved in determining the most binding constraint and the best way to remove it, it certainly enriches the quality of project appraisal.

- Further empirical research on the returns on public investment

  The returns on public investment represent essential information for development policy so that further efforts to obtain better estimates are central. Cross-country regressions unlikely yield higher-quality estimates due to methodological problems and country-specific factors. Therefore, the way forward for empirical research is the use of data that is disaggregated at the sub-national level and the estimation of the effects of public investment at the firm level. Increasing availability of relevant data means that this approach is feasible.

- Identification and thorough study of best-practice cases

  Development agencies should lead efforts to identify and study best-practice cases among developing and developed countries alike. Critical questions that should be answered include how project appraisal is organized in practice, what tools are used for ex ante evaluation and, in particular, what types of public investment projects or other types of growth enhancing public services were financed. Suitable candidates for case studies are countries with a strong economic performance and possibly with much space for discretionary public expenditure policy due to large public revenue from external assistance or from natural resource extraction.

Creating fiscal space for public investment

A common argument is to create fiscal space for public investment through borrowing because public investment may pay for itself by possibly generating higher future public revenues. However, it must be taken into account that the impact on growth might be small (possibly even negative) due to crowding-out effects, that complementary public spending (e.g. on maintenance) may be required, and that sufficient tax collection capacity is required to 'capture' the returns on public investment. Thus, given that the exact returns on public investment are unknown, the IMF/World Bank Debt Sustainability Framework (DSF) does not tell how much extra borrowing to finance public investment is possible without threatening debt sustainability. Several policy implications arise:

- The DSF could probably be extended to include more growth scenarios that depend on the way the borrowed funds are used (e.g. a high growth scenario if public investment that targets the most binding constraint is financed).
- There are many countries where the risk that additional borrowing worsens debt sustainability should be avoided. These include countries that are in debt distress according to the DSF, countries where low ex-post returns on public investment can be expected due to a variety of reasons and countries where there are other, 'safer' ways to create fiscal space.

It is strongly recommended to continue research on analytic tools to support a more systematic approach to pro-growth and pro-poor public finances along the lines discussed above. Facing the challenge of decreasing availability of external capital in the aftermath of the financial crisis, it is even more crucial to base the decisions on the allocation of scarce public resources on a more systematic assessment of alternative compositions of public spending.

1 Introduction

Public infrastructure is undoubtedly central for growth and development because it is a complement, rather than a substitute, of private inputs to the production of firms. It is also central for social welfare. Due to market failures, infrastructure is not supplied in sufficient quantities by private providers. Therefore, a long recognized and important role of the government is to undertake public investment. However, exact quantitative measures of the returns both on individual public investment projects and on sectoral public investment programs are very difficult to estimate ex ante (i.e. before the public investment project is implemented) due to complex effects of public investment and methodological problems. Yet, optimal decision making in the context of resource allocation among alternative public investment projects and of public debt policy requires knowledge of the returns on public investment. Therefore, unreliable estimates of the latter create fundamental policy problems. The objective of this paper is therefore to evaluate existing approaches to these policy challenges and to show ways for improvements in situations when the returns on public investment are not known.

Governments can finance a wide range of public investment projects in different sectors that are all likely beneficial especially in low income countries. However, due to the government budget constraint, trade-offs arise so that the government has to choose which projects it wants to implement. This choice is crucial because the magnitude of the returns on public investment projects likely differs significantly, and financing public investment projects with low returns implies waste and adversely impacts on the overall effectiveness of capital expenditure. In principle, the optimal composition of capital expenditure could be determined based on knowledge of the returns on public investment, but even if rough quantitative estimates of the returns are obtained, their comparison across different (sub)sectors is typically not possible.

In addition, public investment requires fiscal space, i.e. the ability of governments to finance public investment without threatening the sustainability of its financial stance. Depending on its effects, public investment leads to economic growth and thereby higher public revenue in the future. In turn, this provides a justification to finance public investment through borrowing based on the assumption that it 'pays for itself'. In principle, the returns on public investment are therefore a crucial parameter for debt sustainability analysis. However, given that the returns on public investment are unknown in practice, there is the risk that additional borrowing worsens debt sustainability, especially if the returns turn out to be smaller than the cost to service debt.

This paper makes two contributions. First, by synthesizing and summarizing the literature on public investment, it is shown that quantifying the cost and benefits of public investment is highly complex. This means that in practice, calculating exact measures of the returns is hardly possible ex ante. While there is increasing evidence that public investment matters for long-run growth, it is also shown that existing ex-post estimates of the magnitude of the returns on public investment can typically not be used for ex ante evaluation of public investment. Second, this paper evaluates existing approaches to resources allocation and debt sustainability analysis in the context of debt-financed public investment used in practice and shows how progress in both policy fields can be made.

With regard to determining the optimal resource allocation, this paper argues that policy makers should make more efforts to increase direct comparability of different public investment projects without attempting to calculate absolute returns. This can be achieved through clearer and better founded macroeconomic priorities and through better structured qualitative ex ante evaluation of public investment projects. One way to achieve both is to apply the growth diagnostics framework to identify the most binding constraints. In addition, procedures likely matter in the sense that depending on their design, they can be used to overcome political criteria for project evaluation and they can ensure that public investment projects are chosen from a large pool of proposed projects. With regard to borrowing to finance public investment, the use of alternative scenarios that are based on different assumptions about the impact of public investment seems suitable. In addition, avoidance of unnecessary risk when public investment is financed through borrowing is crucial.

This paper is structured as follows. The second section reviews different measures of the returns on public investment and discusses the cost and the benefits of public investment. The third section reviews relevant theoretical and empirical evidence. The fourth and fifth sections evaluate approaches to resource allocation and debt sustainability with debt-financed public investment in practice. The sixth section concludes.

2 Conceptual framework

2.1 Measuring the returns on public investment

This section reviews different measures of the returns on public investment. In principle, the returns relate the benefits of public investment to its cost. The benefits are derived from the stock of public capital (i.e. public infrastructure in the transport, energy, water, and sanitation sectors) to which public investment projects contribute to, and capital outlays, operating cost and adverse effects on economic activity due to crowding-out represent the cost of public investment. In principle, several measures of the returns on public investment projects exist. The *net present value* is the difference of the sum of discounted benefits and the sum of discounted cost. The *internal rate of return* is the discount rate for which the net present value is zero. The *cost-benefit-ratio* is the ratio of discounted benefits to discounted cost. The *overall rate of return* is defined as the interest rate which compounds the present sum of total outlays to the equivalent future sum of benefits (Au 1983).

These measures reflect the profitability of public investment projects and are used in practice to rank public investment projects. However, as shown by Ley (2006b) and others, only the net present value should be used to evaluate public investment. The reason is that the other indicators can be easily manipulated by changing the time profile of the benefit and cost streams so that rankings of public investment projects become inconsistent. In particular, modifications of the benefit and cost streams that leave the net present value unaltered may still change the ranking of public investment project based on the cost-benefit ratio, the internal rate of return and the overall rate of return. The net present value is therefore the only indicator that delivers a consistent and unambiguous ranking of public investment project in all situations.

However, even the net present value is strongly affected by the choice of the discount rate for which precise estimates may not exist. While frequently, standard values are used, it is likely that the true value of the discount rate depends on the particular setting.

2.2 Net present value of different public investment types

This section shows how the net present value of public investment is calculated for different public investment projects.[1] The net present value is affected by the type of benefits that the public investment project in question entails as well as by perspective taken.

The benefits of public investment differ and can be classified along two dimensions. On the one hand, benefits may be productive, social, or both. Productive effects of public infrastructure enhance the productivity of private inputs to the firms' production and lower their production cost, whereas social benefits enhance the utility of households. On the other hand, the publicness of the benefits differs. Excludable benefits are directly appropriable by the government through user fees, whereas non-excludable benefits are not directly appropriable by the government. Table 1 summarizes the typology of benefits of public investment.

For illustrative purposes, we consider three stylized versions of a project with an infinite lifetime. Each project requires an initial investment of 1, yields a constant flow of benefits b_i and requires a constant operating cost c_i where $i = 1,2,3$. The discount rate is common to all agents in the economy. Finally, it is assumed that the government levies a flat income tax at rate τ_0 on the income of private agents per period, y. Public revenue from taxation is hence $\tau_0 y$.

Project (1) is assumed to entail fully excludable benefits b_1 for which the government levies user fees from firms and households of the amount f. Benefits may be either productive or utility-enhancing. The government enjoys a direct financial return in both cases. Examples include water supply, electricity, ports, airports and tolled roads. From the perspective of the government, the net present value can be written as

$$\sum_{1}^{\infty} \frac{(f - c_1)}{(1+r)^t} - 1$$

Summing yields

$$\frac{(f - c_1)}{r} - 1$$

which implies that the net present value from the perspective of the government is positive if

$$f \geq r + c_1$$

If the benefits are productive, the government also automatically obtains higher tax revenue which increases the returns from the perspective of the government. In this case, taxes can also (partially) finance the public investment project. The net present value from the perspective of private agents can be written as

$$\sum_{1}^{\infty} \frac{(b_1 - f)}{(1+r)^t}$$

1 This section extends and slightly modifies World Bank (2007a).

Since user fees cannot exceed the benefits so that $f \leq b_1$, the net present value from the perspective of private agents is always non-negative. However, this project could in principle be also undertaken by private investors provided that there are no market failures and that the private sector can likewise appropriate the benefits through user fees in the same way.

Project (2) yields non-excludable productive benefits that augment the income of private agents by b_2. The income of private agents per period is therefore $y+b_2$. The government finances project (2) through general income taxation. Even though the benefits are non-excludable, the government receives additional revenue under existing income taxation of $\tau_0 b_2$ and thereby enjoys indirect financial returns. The government undertakes the public investment project if

$$\tau_0 b_2 \geq r + c_2$$

The net present value from the perspective of the private agent is also positive because $\tau_0<1$. If $b_2\tau_0<r+c_2$, the government has to raise the tax rate from τ_0 to τ_2 up to the point where

$$(\tau_2 - \tau_0)y + \tau_2 b_2 = r + c_2$$

$(\tau_2 - \tau_0)y$ represents the additional public revenue derived from taxing income at the higher rate τ_2, and $\tau_2 b_2$ represents public revenue derived from taxing the additional income b_2 of the private sector. In case the government raises the overall income tax rate, the net present value from the perspective of the private agents can be written as

$$\sum_{1}^{\infty} \frac{\left(b_1 - (\tau_2 - \tau_0)y - \tau_2 b_2\right)}{(1+r)^t}$$

which is positive if the additional income of the private sector, b_2, exceeds or equals the all additional tax payments so that

$$b_2 > (\tau_2 - \tau_0)y + \tau_2 b_2$$

Project (3) yields non-excludable social benefits that enhance the utility of the private agents but do not affect their income. Therefore, the government has to raise taxes from τ_0 to τ_2 up to the point where the additional revenue covers capital outlays and operating cost so that the net present value from the perspective of the government becomes positive:

$$(\tau_3 - \tau_0)y \geq r + c_2$$

The net present value of project (3) from the perspective of private agents can be written as

$$\sum_{1}^{\infty} \frac{\left(b_1 - (\tau_2 - \tau_0)y\right)}{(1+r)^t}$$

which is positive if the benefits in monetary terms exceed the additional tax payments. However, the net present value from the perspective of private agents is only positive in social terms but negative in financial terms since project (3) entails utility-enhancing benefits only.

In practice, calculating the net present value is likely more complex than these simple calculations suggest. First, benefits are often of mixed nature in the sense that they are partially excludable, and public investment projects often entail a range of productive and social benefits that are difficult to quantify as shown in the next section. Therefore many public investment projects entail direct financial, indirect financial and indirect social returns from the perspective of the government. Second, for simplicity, the calculations above assumed that taxes have no distortionary effects. However, distortionary effects may be sizeable, but they are likewise difficult to quantify in practice.

Table 1: Typology of the benefits of public investment

	Excludable / Direct	**Non-Excludable / Indirect**
Productive (firm as beneficiary)	Direct financial returns	Indirect financial returns
Social (HH as beneficiary)		Indirect social returns

Adapted from Easterly / Irwin / Servén (2007)

2.3 Productive benefits of public investment in a simple model

For simplicity, this section assumes that public capital is non-excludable and non-rival and that it is an input to private production which is the only transmission channel through which public investment affects the economy. In this case, public investment only indirectly affects welfare, and from the perspective of the government, there are indirect financial returns. The production function of the representative firm can be written as

$$y = Ak_G^{\alpha}k^{\beta}$$

where y denotes output, A denotes total factor productivity, k_G represents public capital and k represents the stock of private capital. $\alpha>0$, $\beta>0$ and $\delta>0$ are share parameters, and $\alpha+\beta+\delta\leq 1$.

Now consider the productive benefits of a one unit increase of public investment which increases the stock of public capital by the same amount. A higher stock of public capital obviously increases output. Due to decreasing marginal returns, this effect depends not only on the technology parameters but also on the initial stock of public capital. Even in this simple setting a higher stock of public capital also results in larger returns to private capital accumulation so that firms increase their stock of private capital. In turn, this results in an additional increase of output. Since higher output translates into higher consumption levels, social welfare also increases.

In turn, the magnitude of these productive benefits also depends on the lifetime of public capital and private capital which is determined by their depreciation rates. The latter can vary considerably depending on various factors including the type of public or private capital (machines may depreciate considerably faster than physical structures), and on the

specific context (the depreciation rate of roads may well depend on climatic factors). Low (high) depreciation rates increase (decrease) the magnitude of the benefits.

In addition, network externalities are important. Infrastructure is generally provided through networks. This interconnectedness means that the benefits of investments at one point in the network generally depend on the network quality and capacity at other points in the network (Romp / de Haan 2007).

Finally, the benefits of public investment depend on whether in the long run public capital has only level effects or also growth effects. In this simple model, there are only level effects if there are decreasing returns to scale $\alpha+\beta+\delta<1$. Alternatively, public capital affects long-run growth if there are constant returns to scale $\alpha+\beta+\delta=1$ as demonstrated below.

Therefore, in practice, the ex ante estimation of the returns on public investment is problematic even if highly restrictive assumptions with regard to the types of benefits of public capital are made. The reason is fundamental parameter uncertainty with regard to functional forms, the effectiveness of public investment and the lifetime of capital.

2.4 Transmission channels of public investment

This section reviews additional effects of public investment.[2] In reality, the transmission channels of public investment on the economy are much more complex than suggested by the simple model presented in the previous section. Public investment affects private production and investment as well as social welfare in a variety of ways through different transmission channels.

First, public infrastructure likely exhibits additional, but less visible productive effects:

- Independently of its effect on the marginal product of factor inputs in the production process, it is likely that public infrastructure has a distinct impact on labour productivity. The underlying rationale is that with better access to roads and other means of public transportation, workers can get to their job more easily or farmers can get to the market more easily, thereby spending less time moving between different locations.

- Public infrastructure may also lower adjustment cost. Adjustment costs occur if firms cannot increase or decrease private capital costlessly. They include therefore costs associated with the sale, purchase or productive implementation of capital goods in addition to the price of these goods. By lowering adjustment costs related to investment, public infrastructure will tend to raise expected rates of return on private investment.

- Public infrastructure may lower the rate of depreciation of private capital thereby extending its durability. For instance, the smoothness of roads affects the longevity of vehicles. With a more reliable power grid, electrical equipment may last longer.

2 This section is based on Agénor / Moreno-Dodson (2006).

Second, public infrastructure likely enhances human capital which is an input to private production and which augments social welfare.[3]

- Public infrastructure may have a positive impact on educational attainment. Transport infrastructure increases accessibility to schools for both students and teachers. Typically, after roads are built, enrolment and attendance rates increase in developing countries. Access to safe water and sanitation at schools raises attendance rates (particularly among girls). Access to electricity may improve educational achievement by allowing children to spend more time studying as well as allowing them to use electronic equipment for learning.

- Public infrastructure may have a sizable impact on health outcomes in developing countries. Access to safe water and sanitation helps to directly improve health, and access to electricity helps to improve hygiene, by for instance facilitating the boiling of water. Access to electricity is also crucial to replace traditional fuels used for cooking and heating, which reduces the incidence of respiratory illnesses. In addition, the availability of electricity is essential for the delivery of health services, and better transportation networks facilitate access to health facilities in rural areas. Health is crucial for human capital accumulation. Healthier children tend to show better school performance, and healthier workers are more productive. Improved health also increases life expectancy which in turn tends to raise the incentive to invest in education (in addition to increasing the propensity to save), because the returns on investments are expected to accrue over longer periods

Finally, public infrastructure may facilitate the provision of other productive public services, which in turn also affect private production and investment. For instance, access to the electricity grid lowers the energy cost of public administration which is necessary to provide essential public services.

In addition, public investment may also have additional adverse effects by crowding-out private investment. There are several potential reasons:

- The way in which public investment is financed matters. If public investment is financed by distortionary taxation, private investment may decrease. In addition, complementary spending (e.g. for operation and maintenance) financed by taxation causes additional crowding-out.

- If public investment is financed by borrowing on domestic financial markets, domestic interest rates may increase. By raising the cost of borrowing and by negatively affecting expected after-tax rates of return on private capital, private investment may decrease as well.

- If public investment is financed through external assistance, Dutch Disease effects may occur which threatens the country's competitiveness.

3 It is also obvious that public infrastructure directly enhances utility apart from its impact on human capital accumulation by making life more comfortable.

3 Returns on public investment: theoretical and empirical evidence

3.1 Theoretical evidence from endogenous growth models

Since the 1990s, a number of endogenous growth models have been proposed in which public investment affects the long-run growth rate. In general, these models demonstrate that public investment may have sizeable benefits by affecting long-run growth, and these models allow identifying the determinants of policy rules (i.e. the level of public investment in relation to output or the allocation of capital expenditure among alternative public investment projects) that maximize welfare or growth.

In the seminal paper presented by Futagami / Morita / Shibata (1993), output is produced in a similar way as above except that they impose constant returns to scale:

$$y_i = A_i k_{Gi}^{\alpha} k_i^{1-\alpha}$$

It is assumed that the government levies a distortionary tax on output to finance public investment (I_G):

$$I_G = \tau y$$

The representative household allocates output net of taxation between consumption and private investment to maximize lifetime utility. With instantaneous household utility given by

$$u = \ln c$$

(where c denotes consumption), the long-run growth rate of the economy corresponds to

$$\gamma = (1-\tau)(1-\alpha)A\left(\frac{k_G}{k}\right)^{\alpha} - \rho$$

It can be seen that public infrastructure generally raises the growth rate, and that income taxation generally lowers the growth rate (by crowding out private investment). Increasing the rate of public investment has therefore ambiguous effects on the growth rate. Futagami / Morita / Shibata (1993) then show that the share of public investment in output that maximizes the growth rate corresponds to the output elasticity of public capital (α).

More recent models take into account additional transmission channels. Agénor / Neanidis (2006) for instance present a model in which the level of output depends on the stock of private capital, the stock of public infrastructure and effective labour which depends on the availability of health services. The production of health services requires among other inputs public infrastructure. The policy rules are shown to become more complex than in simpler models.

However, in these models, the net present value or other measures of the returns on public investment are usually not calculated. One reason is that rules for the optimal share of public investment in output and optimal allocation rules between different types of public investment can be derived without knowledge of the net present value. Optimal policies are a function of the model parameters, notably of the technology parameters. However, due to parameter uncertainty, these policy rules are of little use for practice.

3.2 Long-run impact of public investment: empirical evidence

This section summarizes relevant empirical evidence and shows why ex-post estimates are of little use for ex ante project evaluation. There are numerous empirical papers that estimate the effects of public capital ex-post. Recent and exhaustive reviews of the literature include Romp / de Haan (2007) and Straub (2008). The empirical papers can be categorized along various dimensions.

First, papers estimate production functions, cost functions, growth models and vector autoregression models, or they estimate the impact of infrastructure on specific aspects of human development or on firm-level performance. Second, the data sets used vary. The level of aggregation of the data is different, and data used includes national, regional, sectoral, firm and household data. In addition, studies consider developed and developing countries. Third, public capital is measured in different ways. Papers apply the perpetual inventory method to calculate the stock of public capital or they use physical measures of infrastructure (e.g. km of roads). In addition, some papers estimate the impact of the flow of public investment.

Despite the use of different methodologies, data sets and public investment measures, there seems to be increasing evidence that public capital and thus public investment has beneficial effects. 63 % of the specifications that Straub (2008) reviews find a positive link between public capital and some development outcomes, while 31 % find no significant link and only 6 % find a negative relationship. Romp / de Haan (2007) also note that in the recent literature, there is more of a consensus that public capital enhances growth than in the older literature.

However, there are two reasons why ex-post estimates are mostly of little use for ex ante evaluation of public investment projects in practice. The first reason is heterogeneity in terms of the estimates of the returns on public investment: There remains a considerable variety with regard to the magnitude of the effects of public investment (Estache / Fay 2007). This is not surprising because it is likely that – as some studies suggest – the effects of public investment are context specific and differ across countries, regions and sectors. Two identical stocks of public capital may have different effects if they are in different locations with respect to economic activity. In addition, the reasons for heterogeneity include the fact that the composition of public investment differs but is often not controlled for, that network effects cause non-linearities, and that the quality of public capital and public investment spending matters. Further, the rationale of public investment differs but is likewise mostly not controlled for either. It is likely that public investment that is undertaken for political reasons has lower returns than public investment that is undertaken for economic reasons. Finally, heterogeneity may also be related to methodological problems.

The latter cause is the second major reason why ex-post estimates can typically not be used for ex ante evaluation of public investment projects. First, not all studies take into account the possibility of endogeneity of public capital. One reason for endogeneity is that rich countries can typically afford larger stocks of public capital. Second, it is difficult to correctly measure public capital. The use of the perpetual inventory method requires assumptions about the initial level of the capital stock and about depreciation rates. Typically, the stock of public capital is not disaggregated even though the depreciation rates of different types of public capital might vary significantly (Romp / de Haan 2007). In addi-

tion, long time series of public investment spending are necessary, but they are often not available for developing countries. The use of physical measures avoids some of the problems with public capital measures constructed by the perpetual inventory method, but they do not correct for quality either, and some of them may only poorly reflect public spending. Estimating directly the effects of public investment is problematic as well because public investment is only beneficial in the long-run because its benefits arise only due to its contribution to the stock of public capital.

Further and more robust empirical research on the returns on public investment seems essential. Cross-country regressions unlikely yield higher-quality estimates due to methodological problems and country-specific factors. Therefore, the way forward for empirical research is the use of data that is disaggregated at the sub-national level and the estimation of the effects of public investment at the firm level. Increasing availability of relevant data means that this approach is feasible.

4 Public resource allocation in practice

4.1 The policy challenge

Given that there is a large range of alternative public investment projects with widely differing returns, public resource allocation is of fundamental importance for policy. In practice, it has two dimensions: Resources must be allocated across different public investment projects within sectors (intrasectoral allocation or allocation at the microeconomic level) and across different sectors (intersectoral allocation or allocation at the macroeconomic level).[4] The importance of careful resource allocation to minimize resource waste when returns greatly differ is only slowly recognized in practice.

The first best solution would be to calculate the returns on all possible public investment projects ex ante and then to allocate public resources based on returns. This would ensure that public investment projects with the highest returns are prioritized and that the effectiveness of public capital expenditure would be maximized.

However, returns-based resource allocation is challenging in practice. First, calculating the returns ex ante is complex given the difficulty to quantify benefits as shown above. In addition, the economic literature provides little guidance. While it suggests that public investment is beneficial in the long-run, the usefulness of theoretical models is limited due to parameter uncertainty, and robust and specific ex-post estimates of the returns on public investment with general validity are hardly available. Second, procedures must be put in place that allow public investment projects to be chosen based on their returns and not based on political interests.

4 Strictly speaking, the allocation of public resources across time or sequencing of public investment represents an additional dimension. We assume that spatial allocation of public resources is part of intrasectoral allocation.

4.2 Approaches at the microeconomic level

4.2.1 Overview of methods

This section reviews different approaches used in practice to evaluate the cost and benefits of public investment projects. Implicitly, they aim at increasing the efficiency of public resource allocation. Ex ante, returns on public investment projects can either be estimated or inferred from existing ex-post estimates of different projects. There exist different methods:

- Within **cost-benefit analysis**, the costs and benefits that are associated with a public investment project are quantified which then allows the calculation of the net present value. The major difficulty is that calculating the full range of the benefits of public investment is almost impossible. Therefore, in practice, benefits are quantified in a simplistic way which does not reflect their 'true' value, or benefits are only partially considered (Table 3 in the appendix provides an example of partial cost-benefit analysis at the German Federal Ministry of Transport, Building and Urban Affairs because many productive benefits, such as the impact of transport infrastructure on private investment, are excluded).
- **Cost-effectiveness analysis**, which is especially used in the health sector, relates public expenditures for a specific project or intervention to the achievement of a particular outcome or output level. From the perspective of cost-effectiveness, the project or public intervention that achieves the outcome at least costs is most desirable. While this technique circumvents the problem of the quantification of benefits, it also has major weaknesses. First, it does not tell anything about the desirability of the outcome or output. Second, the principle of cost effectiveness does not allow comparisons of projects and interventions that are geared towards different objectives (Fozzard 2001). Third, cost effectiveness does not consider effects that contribute towards achieving other objectives. Finally, in other sectors and in the context of public investment, there may often be few alternatives to achieve a specific objective. This implies that in some instances, cost-effectiveness analysis only allows to choose from a narrow set of alternatives.
- **Qualitative analysis** is an alternative to quantitative measures of the returns on public investment when quantification of benefits is too demanding. It simply consists of a description and possibly of the rough weighting of the benefits that can be expected from a particular public investment project. While this method facilitates the consideration of benefits that are difficult to quantify, the obvious disadvantage is the loose structure and the lack of measures for unambiguous comparisons between alternatives.
- Techniques for improved **ex-post evaluation** of the returns on public investment might help to infer the returns ex ante. **Impact evaluation**[5] generally assesses the economic outcomes that can be attributed to a particular project, programme or policy, and the effects are estimated using microeconomic data as briefly reviewed above using various econometric techniques. The special feature of impact evaluation is that it compares the group that benefited from a particular intervention to the counterfactual – that is, a group which is as similar as possible to those benefiting from the intervention. While impact evaluation often yields powerful and robust results, it also has a number of disadvantages and cannot be applied to every public

5 This section is partially based on http://www.worldbank.org/impactevaluation.

investment project. First, it is resource and time intensive because it requires a systematic collection of data throughout the implementation period and possibly beyond if there are time lags. Second, the results may be highly context-specific so that their validity in other situations may be questionable. Third, it may often be difficult to identify a control group due to externalities or general equilibrium effects. For instance, whereas the beneficiaries and the non-beneficiaries of school vouchers can be easily distinguished within a community, infrastructure typically yields community-wide benefits with wide spatial spillovers to other districts or regions. Finally, the results of impact evaluations of different projects are difficult to compare, so that they can often not be used to calculate benefits in relative terms. In addition to impact evaluation, a range of **indicators** is often used for ex-post evaluation. Indicators for instance include the number of new businesses after the completion of an infrastructure project. While indicators may be useful to reduce complexity when the quantification of benefits is too difficult, there is no guarantee that they adequately reflect causality, and they are often highly context specific so that ex-post results cannot be used for ex ante evaluation.

Given the complexity of the benefits, the scope for ex ante evaluation of the returns of public investment to ensure effective resource allocation is limited in practice. Robust and returns-based rankings of a wide range of alternative public investment projects that contribute to different objectives in different subsectors can generally not be obtained ex ante.

4.2.2 Practices and procedures at different institutions

Using the KfW, the World Bank and the National Investment System in Chile as examples, this section describes and assesses how different organizations and institutions evaluate the returns on public investment projects ex ante in practice using the methods described above.

Project Evaluation at the KfW[6]

Project appraisal reports (*Projektprüfungsberichte*) which evaluate projects ex ante and project completion reports (*Schlussprüfungsberichte*) which evaluate projects ex-post typically include a section on the evaluation of the project impacts, both from the implementing agency's perspective (project perspective), and from an economy-wide perspective.

The evaluation of the project impact from the agency perspective is a conventional cost-benefit analysis that calculates the internal rate of return by quantifying the direct revenue (especially user fees) and direct costs associated with the project.

The evaluation of the project impact from an economy-wide perspective aims at analyzing and identifying the wider economic benefits and costs of the project. Sometimes, time and expenditure savings as measures for the benefits are calculated. However, in the reports reviewed, more emphasis seems to be put on the qualitative analysis of the benefits. First, the wider productive benefits are described. For instance, in the case of road construction,

6 This section is based on interviews at the Kreditanstalt für Wiederaufbau / German Development Bank (KfW) and on the review of selected project reports.

the implications of lower transport costs for the local economy are analyzed, and the impact on school attendance or on public administration is considered. Second, the main beneficiaries in terms of socio-economic groups are identified. Third, the relevance of the sector for the attainment of strategic development objectives is considered.

Project Evaluation at the World Bank[7]

Project appraisal and project completion reports of the World Bank include a financial analysis and an economic analysis. The financial analysis assesses the financial sustainability of the projects. In the case of projects with direct benefits (such as water supply infrastructure), the direct financial return is calculated using standard cost-benefit analysis.[8] In the case of projects that do not entail direct benefits, the likelihood that maintenance requirements can be met is assessed. The economic analysis aims at assessing the wider benefits of the project from the perspective of the beneficiaries. First, another cost-benefit analysis is carried out with explicit consideration of the wider benefits. For instance, in the case of water supply infrastructure, the time savings are quantified and multiplied with the minimum wage and then discounted which are used as a measure of wider benefits. In the case of major roads, a similar analysis is undertaken in which the time saved and the expenditure saved on vehicle maintenance are quantified and discounted. Sensitivity tests are performed to ensure that the internal rate of return remains positive if assumptions are changed. In both cases, emphasis is put on the requirement that the internal rate of return exceeds 12 %. Second, indicators are used to evaluate the benefits. For instance, in the case of local access roads, ex-post indicators used include the number of people that live in proximity, new business openings and changes in market prices. Third, social indirect benefits are described. Fourth, the economic analysis evaluates the importance of the sector for the attainment of strategic development objectives.

In addition, the World Bank increasingly uses impact evaluation for the ex-post evaluation of projects. There are around 130 impact evaluation studies of World Bank projects at a design state or completed. However, only a small fraction of them (14) analyzes infrastructure projects (Goldstein 2007)[9] and as argued above, their value for ex ante evaluation of returns is limited.

Project Evaluation within the National Investment System in Chile[10]

In Chile, the appraisal of public investment projects is organized within the National Investment System (SNI) which is a set of methods and procedures. The objective of the SNI is to select the projects with the largest return.

The process of project appraisal is clearly defined. It starts out with a 'policy idea' by a government unit which is entered in a national database. This idea then needs to be developed into a project profile that is subsequently subjected to a pre-assessment study. The Ministry of Planning analyzes legal issues, the alignment of the project with policy priori-

7 This section is based on interviews at the World Bank and on the review of selected project reports.

8 Frequently, the internal rate of return instead of the net present value as a measure of the direct returns is used.

9 One of the few impact evaluations in the transport sector is Mu and van de Walle (2007).

10 This section is based on Ley (2006a).

ties (e.g. the impact on gender equality), environmental issues, stakeholder participation, etc. It may then reject or accept the project, or it may ask for partial reformulation.

In case of acceptance, a cost-benefit analysis is performed on what can be measured reasonably. In case the net present value is negative, positive recommendations are still possible if the qualitative analysis reveals that there are important positive effects. If benefits cannot be quantified at all, cost effectiveness analysis is used. The project then either gets the final acceptance, or it is rejected.

Assessment and Comparison of the Approaches

The KfW, the World Bank, and the SNI in Chile each use a combination of different methods for ex ante evaluation of public investment projects, and they all rely on quantitative and qualitative criteria. This approach makes sense since all methods have weaknesses. If several methods favour a particular project, chances are lower that the conclusions of ex ante project evaluation are misleading.

However, there seem to be differences with regard to the weights put on particular methods for project evaluation. Implicitly, the KfW and the SNI recognize to a greater extent the limited usefulness of partially quantified benefits used within cost-benefit analysis compared to the World Bank. Especially the KfW seems to put more weight on qualitative criteria which is reasonable if there is no suitable data to properly quantify the benefits of public investment. In contrast, at the World Bank, quantitative measures of the returns and the use of indicators seem to dominate other qualitative criteria. In addition, the World Bank increasingly carries out impact evaluations, which is desirable despite their limitations. However, it is unclear how and if the results of impact evaluations are used to complement more traditional methods. Compared to the World Bank and the KfW, the SNI seems to be more flexible in terms of which methodologies (or which combinations) are chosen.

At the KfW and at the World Bank, many ex ante project evaluations include an assessment of the sector importance. While the latter is in principle desirable, it may be more useful to assess sector importance in one strategic document to avoid contradictions or the impression that all sectors are important.

Finally, the procedures for project appraisal certainly matter because they determine to what extent political preferences override objective project selection criteria. In this respect, the SNI method seems superior because it ensures that only the most effective public investment projects (at least according to the evaluation methods used) are chosen. Project rejection is not a hypothetical option but occurs frequently. The reason is that within the SNI, rejection of the project is feasible at several stages. This option is especially important before projects reach the feasibility stage at which they often have too many beneficiaries who may oppose rejection which then becomes considerably harder. In 2005, only 28 % of proposed projects were actually implemented. In other words, within the SNI, projects to be implemented are chosen from a large pool of proposed projects. This increases the likelihood that the ones implemented have relatively high returns if proper methods for evaluation are used. At the same time, rejection is not tied to a single quantitative measure so that manipulation of the ex ante evaluation is considerably harder (Ley 2006a).

4.3 Approaches at the macroeconomic level

This section reviews different approaches at the macroeconomic level to guide intersectoral resource allocation. These are especially important if the quality and the coverage of ex ante evaluation at the project level is insufficient, and if resource allocation is institutionally divided between the project and sector level (e.g. line ministries vs. the ministry of finance).

If ex ante evaluation of the returns is incomplete, then the overall efficiency may still be low even if some projects with high returns are implemented. The reason is that the government also finances projects with low returns that were not chosen based on an ex ante evaluation. Imperfect ex ante project evaluation means that typically, project returns cannot be compared across sectors. Finally, institutional arrangements also often imply that public investment project returns are not compared across sectors even if this would be feasible. Improving intersectoral allocation helps in these cases to improve overall allocative efficiency. Yet, suitable criteria are scarce and often not developed in practice.

Elimination of Wasteful Public Investment

One approach to improve the overall effectiveness of public spending that is sometimes advocated by the International Monetary Fund (IMF) consists of identifying particularly ineffective public expenditure programmes or of identifying public waste. This helps to improve the overall effectiveness of public expenditure.

However, this approach cannot be easily applied to public investment. While public programmes involving recurrent expenditure can be stopped or reformulated, public investment creates a lasting capital stock, and interrupting ongoing public investment projects may not be desirable. In addition, it may be difficult to identify the least effective public investment project in countries where overall public investment effectiveness is very low, especially when specific criteria are missing. Finally, in the context of reallocation, there is no guidance for what the 'saved' public resources should be used for.

Setting Macroeconomic Priorities

Setting overall macroeconomic priorities for public spending can be used to increase the effectiveness of public spending in general and to guide public investment decisions. However, economic research provides little guidance for setting detailed and well justified priorities in practice. Therefore, it is not surprising that frequently, priorities within development policy often correspond to biases towards certain sectors (e.g. infrastructure bias or social sector bias), or contain a wide range of issues.

Table 2 provides examples of public spending priorities in EU countries. However, it is unclear how these criteria were derived and to what extent public expenditure policy is based on these priorities. In addition, they tend to be broad and in part unspecific, and the underlying economic rationale differs. For instance, the Czech Republic prioritizes public expenditure programmes that are co-financed by the EU. Given that the impact of productive public spending is difficult to quantify, it is rational to simply increase the total amount of productive public spending by choosing public spending programmes for which supplementary external financing is available.

4.4 The way forward

The first best approach to resource allocation, i.e. the return-based ranking of a large range of public investment projects and the implementation of the ones with the highest return is clearly not feasible in practice. However, improvements in resource allocation still seem feasible.

Table 2: Priorities for public expenditure

Country	Priorities
Denmark	Education, human capital and knowledge
Estonia	n/a (priority given to fiscal consolidation)
Spain	Technological investment, development and innovation, infrastructure, education
Austria	Expand future-related spending (public infrastructure, R&D, education)
Czech Republic	Research and development, education, transport infrastructure, programmes co-financed from the EU budget
Poland	Public investment, development of technical infrastructure
Slovenia	Investment in science and technological development; education and training

Source: German Federal Ministry of Finance

Generally speaking, a second-best approach should be taken in terms of the methodology. Governments face budget rigidities (e.g. due to political interests, past promises, commitments or legal requirements) so that they are therefore not able to freely allocate public resources among different public investment projects in different sectors. Therefore, instead of attempting to estimate ex ante the absolute returns on a range of public investment projects, more efforts should be made to obtain the returns on public investment projects in relation to each other. In addition, if the scope for reallocation is limited due to budget rigidities, identifying the most and the least effective public investment projects might be sufficient.[11]

Methodologically, this objective can be achieved in three ways. First, clearer, better founded and consistent criteria for intersectoral resource allocation are needed which can then be used to support ex ante evaluation at the project level. Second, at the project level, the qualitative analysis should be better structured given that quantitative measures are insufficient. Third, results from impact evaluations should be used to a greater extent in a more systematic way. While exact values of the ex ante project returns cannot be inferred from ex-post estimates, impact evaluations might still be used to identify projects that are likely highly ineffective.

Macroeconomic criteria for intersectoral resource allocation and qualitative criteria for intrasectoral resource allocation can be improved using the growth diagnostics framework to identify the most binding constraints. The growth diagnostics framework which was

11 In a similar way, the UN Millennium Project implicitly set priorities for specific public spending categories by defining so called ‘quick win interventions’. They are the interventions that have ‘high impact in the very short run’ and that can be implemented using existing capacity (Millennium Project 2005).

introduced by Hausmann / Rodrik / Velasco (2008) is based on the notion that different countries require different growth strategies, and that administrative and political limitations likely prevent the government from implementing all desirable policies so that the government should alleviate the most binding constraint to economic activity. This seems to be the case in the context of public resource allocation: Governments face budget rigidities and the budget constraint so that they are no able to finance all productive public investment projects.

Hausmann / Rodrik / Velasco (2008) propose three proximate determinants of the levels of private investment and entrepreneurship which in turn determine the rate of economic growth: returns to economic activity, their private appropriability and the cost of finance. A decision tree conceptualizes the methodology to identify the most binding constraint. The first step of the diagnostic analysis aims to uncover which of these three factors represents the greatest impediment to private investment. The second step is to uncover the specific distortions that lie behind the most severe impediment. The list of distortions is derived from a standard endogenous growth model. Moving down the branches of the decision tree automatically discards the candidates for the most binding constraint (Hausmann et al. 2008). Therefore, provided that gaps in infrastructure are the underlying causes of the most severe impediment, those public investment projects or sectors of public investment that likely remove the most binding constraint can be assumed to have the highest returns and could therefore be prioritized.

However, while the growth diagnostics approach may have intuitive appeal, it says little about how to remove the most binding constraint. One difficulty is that there are often many alternative interventions in different sectors. Suppose that high transport costs represent the most binding constraint. Remedies may include diverse measures such as road construction, improved road maintenance, more efficient port handling, reduction of road blocks by the police or more efficient customs clearance. Thus, in order to choose among alternative public investment projects that all seem suitable to remove the most binding constraint, existing tools at the microeconomic level such as cost-effectiveness analysis could be used to identify the least cost solution.

In terms of the procedure of public investment appraisal, much can be learnt from Chile. One aspect that seems desirable is to encourage project proposals. This increases the pool of projects to choose from and therefore also the likelihood that the most effective projects are included in the pool. Even if methods and approaches to calculate and compare the returns on public investment projects are not perfect, the most or least effective projects can possibly be spotted by comparing a large number of projects. In addition, the procedures should be changed so that rejection is the norm and not the exception. Rejection can be facilitated by opening this possibility at an early stage of the proposal, by defining clear budget ceilings for particular sectors and by ensuring that there is no institutional overlap between the proposing and accepting government unit (Ley 2006a).

5 Financing public investment through borrowing

5.1 The policy challenge

Financing public investment with productive effects is desirable. However, there needs to be sufficient fiscal space which, in this context, can be defined as the availability of budgetary room that allows the government to finance additional public investment without threatening the sustainability of the government's financial position.[12]

In principle, there are a number of different ways to create fiscal space for public investment without threatening macroeconomic stability. They include increased taxation, improved tax collection, cutting wasteful spending and stronger reliance on external grants. However, in developing countries, the scope of these measures to increase fiscal space is limited in the short-run. Due to enforcement problems and a limited tax base, governments often face difficulties to increase domestic revenue. Budget rigidities may limit the possibility to cut wasteful expenditure, and the amount of grants is limited and beyond the control of the recipient country.

In addition, governments may also borrow to finance public investment. However, the central challenge is to determine if additional borrowing threatens the sustainability of government debt. Debt is sustainable when future primary surpluses will be large enough to pay back the debt and the interest without a major correction in the balance of income and expenditure, given the costs of financing it faces in the market (Wyplosz 2007). In turn, future primary surpluses depend on the financial returns on public investment. In other words, precise debt sustainability analysis requires knowledge about the magnitude of the returns on public investment which are uncertain ex ante.

5.2 Debt sustainability analysis in practice

Description[13]

In recent years, the external debt of low-income countries (LICs) has been reduced, in part due to debt relief initiatives. However, given the large financing requirements to achieve development objectives including the Millennium Development Goals (MDGs), chances of a renewed excessive build-up of debt in the future may persist in some countries. The joint World Bank-IMF Debt Sustainability Framework (DSF) was introduced in 2005 to provide a framework for debt sustainability analysis in practice. The objective is to support LICs to achieve development goals without building up unsustainable debt.

The debt sustainability analysis under the DSF consists of

— a projection of macro variables that affect the evolution of external debt including the primary account, Gross Domestic Product (GDP), interest rate, exchange rates and inflation. Several scenarios are used for projection including a baseline scenario based on standard forecasting models, the 10-year historical average of these vari-

12 This section is based on Heller (2005a).

13 This section is based on IMF (2002) and on Wyplosz (2007).

ables as a scenario and worst-case scenarios in which the variables in the baseline scenario are exposed to adverse shocks.

— Indicators of debt sustainability under all scenarios using debt and debt service relative to measures of repayment capacity which is measured by GDP, exports, or government revenue. While debt-related indicators provide a measure of the total future debt-service burden, debt-service indicators provide a measure of the immediate burden.

— Thresholds to assess if the debt stock is sustainable according to the indicators. The countries are classified according to the quality of their policies. The reason is that policies impact on the debt levels that LICs can sustain.[14] Thresholds for each indicator and each category are then chosen.

— An assessment of the country's risk to accumulate unsustainable debt based on how the indicators compare with the thresholds under all scenarios. Countries are classified as low risk, moderate risk, high risk and in debt distress depending on how many indicators breach thresholds under which scenarios. This classification is complemented by subjective judgments.

5.3 Including public investment in the DSF?

All approaches to debt sustainability analysis have to rely on assumptions about the future evolution of various macroeconomic variables so that the usefulness of the conclusions is directly related to the validity of these assumptions (Wyplosz 2007). Given the complexity of debt sustainability analysis and the fundamental underlying uncertainty about the future values of the variables that drive the debt evolution, the current approach to debt sustainability analysis seems adequate, and uncertainty is dealt with by analyzing several alternative scenarios.

However, the present approach does not overcome the central difficulty of assessing debt sustainability of unknown financial returns on debt-financed public investment. Ideally, thresholds of the indicators should therefore also explicitly depend on the use of the borrowed funds and not only the overall quality of public policies. Proposals along these lines have been made. The World Bank (2007a) argues that scenarios with higher assumed growth rates could be included if the borrowed funds are used for public investment. According to the proposals, the benefits of public investment could be assessed using country-specific indicators, and ex-post estimates from microeconomic studies could be taken into account. However, it is recognized that the relevance of these indicators is limited, and that inference of ex ante returns from ex-post estimates is often not feasible, especially in the context of public investment as argued above.

While in theory, borrowing to finance productive public investment and using the financial returns to service the debt is justified, in practice, it is difficult to determine sustainable debt levels due to missing information on financial returns on public investment. One way to enrich debt sustainability analysis would be to consider additional scenarios depending on what type of public investment is financed. For instance, based on the methods discussed above, public investment projects with high returns (e.g. inexpensive public

14 Policy performance is measured by the Country Policy and Institutional Assessment Index.

investment projects that target the most binding constraint) and public investment projects with low returns (e.g. resource intensive public investment projects that do not target the most binding constraint) could be distinguished. Scenarios that assume that the former are implemented could assume higher growth rates.

In the absence of more detailed information on the returns on public investment, one feasible approach is to avoid the risk of unsustainable debt accumulation due to overestimation of the returns on public investment in situations when

- the economic consequences of a higher unsustainable stock of debt are especially dire. This is the case in countries that are classified as in debt distress or as in high risk of debt distress. If financial returns on public investment are not sufficient to enhance growth and to generate additional public revenue, the debt burden even increases.
- The actual ex-post returns on public investment are relatively low compared to other countries or compared to ex ante expectations (for instance due to low project completion rates) so that financial returns are likely insufficient to service the debt.
- Tax collection and tax enforcement is weak which is reflected by a large and expanding informal economy. In this case, the government might not be able to 'capture' indirect financial returns on public investment and generate additional public revenue needed for debt servicing.
- When procedures for project appraisal are weak and project rejection rates are low which may likely result in low average returns on public investment.
- Alternative options to create fiscal space for public investment exist.

6 Conclusions

This paper shows that quantitative measures of the returns on public investment are very difficult or even impossible to calculate ex ante in practice. The reasons are far-ranging benefits and costs that are difficult to trace and to estimate ex ante. Ex-post estimates are often not robust or available, or they are context specific so that it is difficult to use them to infer ex ante returns on planned projects.

Policy challenges that arise due to missing information on returns on public investment are only slowly recognized in practice even though they affect central areas of development policy. While the increasing availability of impact evaluations of public investment projects might facilitate ex ante estimation of returns in the future, meanwhile, second-best approaches are necessary that take into account limited knowledge of governments. In contrast, current policy approaches to resource allocation calculate quantitative measures of the returns on public investment only partially which may lead to suboptimal policy choices. In the case of borrowing to finance public investment, the current approach ignores to some extent that returns on public investment may greatly differ.

This paper has also made some simple proposals about how to improve resource allocation and debt sustainability analysis that could be implemented in practice. However, policy recommendations could be further improved through the study of best-practice cases where public investment has been highly efficient. Critical questions that could be answered include how project appraisal is organized in practice, what tools are used for ex

ante evaluation and if there are particular types of public investment projects which are predominantly financed. Suitable case studies may include Chile (with a more in-depth analysis than in this paper), Ireland (of which is assumed that part of the strong growth performance can be attributed to public investment financed by EU grants) or Botswana (which receives large public revenue flows from natural resource extraction and which has had strong economic performance which likely implies that public investment has been efficient).

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Appendix

Example of transport infrastructure planning

The process of transport infrastructure planning at the German Federal Ministry of Transport, Building and Urban Affairs is based on an ex ante evaluation of the proposed public investment or maintenance in the transport sector. A cost-benefit analysis is cornerstone of the analysis. The following shows which benefits are taken into account depending on the project in question.

Table 3: Transport infrastructure planning by the German Federal Ministry of Transport, Building and Urban Affairs

Benefit component	Transport mode		
	Road	Rail	Water-way
Price reduction of transportation 1) Lowering of vehicle maintenance costs 2) Lowering of vehicle operation costs 3) Change in transport cost due to displacement of traffic volume	×	×	×
Preservation of transport routes 1) Renewal of transport routes 2) Maintenance of transport routes	×	only 2)	×
Increase in traffic safety	×	-	×
Improvement of accessibility of journey destinations	×	×	×
Spatial advantages 1) Employment effects from the construction of transport routes 2) Employment effects from the operation of transport routes 3) Contributions to the promotion of international relations	×	×	×
Relief of the environment 1) Abatement of noise 2) Abatement of vehicle exhaust emissions 3) Abatement of inner city cut-effects	×	only 1) and 2)	×
Effects of the induced traffic	×	-	-
Improved accessibility of sea- and airports	-	×	-
Fulfilment of functions not associated with traffic	-	-	×
Capital cost	×	×	×

Source: Bertenrath / Thöne / Walther (2006)

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