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EIB **Papers**

Infrastructure investment, growth and cohesion

Public investment: Composition, growth effects and fiscal constraints

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The EIB Papers are published each year by the Economic and Financial Studies Division of the European Investment Bank. The journal is divided into two issues and is aimed at encouraging high-quality economic research and debate on matters of European interest. As such the *Papers* are intended to be accessible to non-specialist readers and emphasise policy dimensions rather than technical issues. They present the results of research carried out by Bank staff together with contributions from external scholars and specialists.

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Preface

Philippe Maystadt
President

This year the European Investment Bank celebrates its 50th anniversary. Since its founding by the Treaty of Rome in 1958, the EIB has become a major financial institution supporting the European Union's public policy objectives. Among such objectives, economic integration, convergence and regional cohesion have featured most prominently over the years in the EIB's operations. In concrete terms, this has meant the EIB providing financial and advisory support to countless infrastructure and other projects connecting European countries, regions and people in all conceivable ways.

It is thus only natural that the 2008 volume of the *EIB Papers* is devoted to infrastructure, growth and regional cohesion, issues at the heart of the EIB's mandate. Drawing on presentations made at the *2008 EIB Conference on Economics and Finance*, the contributions address a variety of themes such as: the composition of government investment and the share of infrastructure in it, changes over time in the productivity of public capital, the cost of funds in government infrastructure investment, the need and fiscal space for government investment, especially in the new Member States (all in Volume 13, Number 1), the role of infrastructure in shaping up economic geography, the determinants and productivity of regional transport infrastructure investment, spillover effects of regional transport investment on other regions, the economics of cross-border infrastructure projects (all in Volume 13, Number 2).

To outline some of the issues addressed, a good starting point is to consider the key facts and figures about government investment in infrastructure and its impact on economic growth. It is quite common to use the terms "government investment" and "infrastructure investment" as synonyms, but it is also well-known that governments invest in a wide range of other things than infrastructure. So how much, then, do governments actually invest in infrastructure? A deceptively simple-looking question, as it will turn out. In addition, it would seem obvious that, in the older Member States, an additional 100 km of motorways had a bigger impact on growth back in the 1960s and 1970s, when large-scale transport networks were still being developed, than today. Thus, an interesting question is whether the productivity of government investment and public capital has actually declined over the decades as infrastructure networks have become more mature.

The composition and productivity of government investment are one side of a coin, its financing another. A government raising funds for a road imposes a cost on the economy that is larger than the cost of the road itself. But the road, once built, may generate economic activity that would not have emerged in its absence, such as service stations or industrial zones along a motorway. How to conceptualise and quantify these kinds of indirect costs and benefits in project appraisal is far from straight-forward. From a more macroeconomic perspective, public financing of infrastructure investment is especially pertinent in the new Member States of the European Union, where the need for additional infrastructure investment often conflicts with the need for fiscal adjustment and reforms. What are the key issues involved in managing this balancing act?

To broaden the perspective further, the companion issue (Volume 13, Number 2) considers the link between infrastructure and regional cohesion in great detail. Suffice it to note here that while the conceptual underpinnings for assessing the impact of infrastructure on economic geography

have evolved significantly in the past decade or two, there are tremendous challenges in designing appropriate empirical analyses to that end. Some of the challenges can be overcome, as illustrated by the contributions to the companion issue.

In sum, the links between infrastructure, growth and regional cohesion are complex and only imperfectly understood. Its support for European integration and regional cohesion in the past five decades has put the EIB in a unique position to reflect on the economic issues involved in disentangling that nexus. I am confident that the research findings presented in this volume of the *EIB Papers* will further enhance our understanding and I am happy we can share them with you.

Infrastructure investment, growth and cohesion

Public investment: Composition, growth effects and fiscal constraints

The *2008 EIB Conference in Economics and Finance* – held at EIB headquarters in Luxembourg on June 12 – examined the role of infrastructure investment in economic growth and cohesion, shedding light on a wide range of policy-relevant issues. These included the composition of government investment; its fiscal implications; the determinants and productivity effects of infrastructure investment; and the effects of infrastructure on the location of economic activities.

Speakers included:

Riccardo CRESCENZI
of the European University Institute, Florence, Italy

Jakob de HAAN
of the University of Groningen, The Netherlands

Somik LALL
of the World Bank, USA

Gianmarco OTTAVIANO
of the University of Bologna, Italy

Diego PUGA
of the Madrid Institute of Advanced Studies, Spain

Armin RIESS
of the EIB

Andrés RODRIGUEZ-POSE
of the London School of Economics, Great Britain

Gerd SCHWARTZ
of the International Monetary Fund, USA

Andreas STEPHAN
of the Jönköping International Business School, Sweden

Timo VÄLILÄ
of the EIB

Editor's introduction

1. Infrastructure, growth and cohesion

It is impossible to imagine a modern economy functioning without transport connections, electricity grids and water networks. Given that infrastructure is so indispensable to our lives, it is tempting to conclude that adding more infrastructure to still-growing economies must be good – if not the best – use of money. As a significant share of infrastructure is owned by the government, higher taxes and government deficits are seemingly easy to justify as long as the proceeds are used for government investment. Yet government investment is a mixed bag that includes many things some of which are not even meant to foster growth or economic efficiency.

So first of all, what does government investment actually consist of? What is the share of (transport) infrastructure in government investment, or in total investment? These questions seem to be simple but the available statistical material is patchy, not disaggregated enough and of heterogeneous quality. As a consequence, disentangling government infrastructure investment from official statistics is not as straightforward as one may think. More specifically, determining the amounts invested in transport infrastructure and the respective shares of the government and the private sectors therein can be a daunting task.

Once some light has been shed on the volume and composition of government investment, a second important issue is whether government investment – or the infrastructure part therein – is really the best use of money. In fact, infrastructure might not escape the powerful law of decreasing marginal productivity that applies to most economic goods and services. In other words: Having a highway network is undoubtedly better than not having one; yet having a bigger one than today may or may not be good. Over the past two decades economic research has made progress in measuring the productivity of government and infrastructure capital. The issue has been looked at from various methodological angles (production-function, cost-function, vector-auto-regression and cross-sectional approaches) each of which has its merits and shortcomings. Following Romp and de Haan (2007),[1] the empirical literature may be summarized as follows. There is now more consensus than in the past on government investment yielding positive long-run effects on output but these effects are much smaller than those reported in the seminal paper by Aschauer (1989).[2] Finally, there remains considerable heterogeneity in the empirical estimates depending on the countries and time periods under study, possibly indicating that asset-quality issues, complementarities with other production factors, non-linearities due to the network character of infrastructure, and larger policy and institutional factors still need to be better understood.

Third – and indirectly related to the productivity discussion, the government is not a profit maximizer. Hence, it is not necessarily realistic to assume that rate-of-return considerations drive government infrastructure investment. But what, then, determines government investment in general and public infrastructure projects in particular? Two different approaches to this question are presented in this volume. One highlights the influence of how decision powers are allocated across different levels of government. Decentralization implies that regions or municipalities compete for (new) firms and the employment and tax revenues they ensure, which should have an effect on the volume and structure of countrywide government investment. The other approach looks beyond the boundary

1 "Public capital and economic growth: A critical survey". *Perspektiven der Wirtschaftspolitik*, (8:Special issue), pp. 6-52. The article is an updated version of the survey the authors contributed to the 2005 EIB Conference (see *EIB Papers*, (10:1), pp. 40-71).

2 "Is public expenditure productive?". *Journal of Monetary Economics*, (23:2), pp. 177-200.

of economics into the political-science literature. This allows generating hypotheses on the political-economy and 'purely political' variables that can be tested with the help of electoral data.

Fourth, government investment has broader public-finance implications. Discussing whether government spending should be on, say, roads or something else implies that the government has raised funds in the first place, be it through taxing today or issuing debt (which means taxing tomorrow). An important fact often neglected in this respect is that raising funds costs society more than the proceeds of taxes. This is because of the excess burden of taxation, that is, the welfare loss brought about by distortionary taxes. The bad news is that the excess burden tends to increase as tax rates increase. A related dimension of public finance is that countries might face a difficult trade-off between government investment and fiscal consolidation. This is especially the case for some of the new member states that have incurred large deficits during their economic transition while at the same time pursuing the ambitious infrastructure investment agenda implied by EU membership.

Finally, infrastructure investment affects the spatial distribution of economic activity. In this respect the new-economic-geography literature holds two main policy lessons. First, infrastructure that facilitates interregional trade increases national economic growth but also tends to increase concentration of economic activity and, hence, production gaps between lagging and leading regions within countries. And second, improved intraregional transport infrastructure can help foster spatially balanced economic development but this could stifle national economic growth if the improvement takes resources away from investing in higher-return infrastructure in or between economically more successful regions. Reflecting this distinction, things are relatively clear conceptually: Society should position itself with respect to the efficiency-equity trade-off and set interregional (or 'global') and intraregional ('local') infrastructure priorities accordingly. However, an economically meaningful distinction between global and local infrastructure can be complicated in practice because the spatial extent of an infrastructure asset can be very different from the geographic scope of its economic effects.

While the knowledge on the issues outlined above is impressive, the organizers and speakers of the 2008 EIB Conference in Economics and Finance are convinced that there is scope for pushing the frontiers of knowledge. This is important for public policy in general and for the EIB that holds two-thirds of its loan portfolio in infrastructure. Advancing on each of the five themes outlined above promises significant policy insights (see Section 4).

Before browsing through the individual contributions to this volume, it is useful to clarify the notions 'government investment', 'public investment' and 'infrastructure investment'. First, only investment directly financed from the budget of the government – be it at the central or lower levels – qualifies as government investment. Second, public investment is a larger concept because it additionally includes investment by entities that can be owned or controlled by the government (*e.g.* a national railway company) but that are commercially run and, hence, classified as corporations in the national accounts. Third, it is true that a significant share of government investment is allocated to infrastructure (such as roads) and that, in turn, the government is an important player in total infrastructure investment. But that does not mean that government investment is identical with infrastructure investment. Examples of infrastructure investment erroneously taken for government investment include investment by energy companies in generation capacity or by rail companies in rail infrastructure.

On our guided tour through this year's *EIB Papers*, the next section discusses the composition and growth effects of government and infrastructure investment as well as their fiscal context, reflecting the content of Issue 1. Section 3 turns to the economics of regional transport infrastructure investment, the theme of Issue 2. Finally, Section 4 summarizes the main economic-policy messages conveyed in the articles and at the EIB Conference in Economics and Finance.

2. Government and infrastructure investment: Composition, growth effects and fiscal constraints

The first article of this volume by **Juan Gonzalez Alegre**, **Andreas Kappeler**, **Atanas Kolev** and **Timo Välilä** sets the scene by analyzing the composition of government investment in Europe, focussing on infrastructure in general and transport infrastructure in particular. They find that traditional infrastructure accounts for about one-third of overall government investment in the EU on average and slightly more than that in the cohesion countries (Greece, Ireland, Portugal and Spain). The share of transport in government infrastructure investment can only be estimated using proxies, each having specific drawbacks. Still, combining their knowledge of what the proxies contain with a number of sensible economic assumptions and official pre-1993 data on government transport investment, the authors conclude that transport accounts for about 80 percent of government infrastructure investment in the EU on average. Transport infrastructure has been fairly stable relative to total government investment and has not carried a disproportionate burden of improving fiscal balances.

Of particular interest is the related analysis of how the distribution of spending powers across levels of government affects the level and composition of government investment. Contrary to the widespread fear of a 'race to the bottom' in tax rates as smaller territorial entities compete for firms and workers, the authors find empirical support for a broader concept of fiscal competition whereby private economic agents also attach value to the public capital that regional and local authorities put in place. Indeed, decentralization is associated with more government investment overall, with a stable share devoted to infrastructure; a higher share to hospitals and schools; and a lower share to investment with a redistributive character.

Looking at all government functions taken together and at the capital stock rather than investment flows, **Richard Jong-A-Pin** and **Jakob de Haan** analyze the long-run impact of government capital on output. They present new empirical results for 21 OECD countries over the period 1960–2001 based on vector auto-regressions (VARs). They show to what extent the impact of government capital on output differs across countries and to what extent it differs over time.

The long-run effect of government capital on output differs considerably across countries. Estimating a VAR for each country and simulating country-specific shocks to government capital, the authors find the long-run effect to be significantly positive in eight countries but insignificant in ten others and even negative in three. Taking the benchmark in this literature[3] as a starting point, the authors change the specification of labour inputs, which they more accurately measure by total hours worked in the economy rather than the number of persons in employment. The estimation results turn out to be sensitive to this improvement. The output effect of government capital tends to be lower the higher the government-capital stock is relative to the private-capital stock. This suggests that beyond a certain point, further additions to the stock of government capital should wait until the business sector has 'grown into the new shoe size' and new bottlenecks appear.

The authors then apply two methods to analyze how the long-run impact of government capital on output has evolved over time. Both suggest that it has declined. One method lumps all countries together (panel VAR), estimates the model for the period 1960–1979 and then gradually carries that 20-year 'time window' forward. While declining, the long-run impact is found to be positive. The other method retains the country-specific focus: The VAR is estimated country by country from 1960 to 1989

3 Kamps, C. (2004) "The dynamic effects of public capital: VAR evidence for 22 OECD countries". Kiel Working Paper No. 1224, Institute for the World Economy.

then the observation period is gradually extended up to 1960–2001. Most of the seven countries with a decreasing GDP impact reduced government investment during the 1990s, possibly reflecting a rational reaction to saturation.

Armin Riess considers the marginal economic cost of public funds, an important aspect on the financing side of government investment. He discusses two approaches and their implications for cost-benefit analysis. The 'conventional' approach suggests that for a project to be economically viable, its direct benefits must be larger than its direct costs to make good for the excess burden of taxation. For example, if the economic cost of raising one euro *via* taxation is EUR 1.2 – consisting of an opportunity cost of one euro and the excess burden of 20 euro cents – the direct benefits of a project must exceed its direct costs by at least 20 percent. However, a government project might boost the economic activity that taxation curbs ('spending effect'), thereby counteracting the excess burden of taxation. The 'modified' approach takes a simultaneous look at raising taxes and spending the money on a government project. As a result, the modified excess burden, which 'nets out' the excess burden and the spending effect could be negative depending on the project. In that case, a project might be welfare enhancing even if its direct benefits fall short of its direct costs.

In principle, both approaches lead to the same project decision. To avoid errors, however, practitioners need to know whether the cost-of-funds estimate they use in appraising a project reflects the conventional or the modified economic cost of public funds. The marginal excess burden of taxation is an economy-wide parameter, specific to the tax that is increased to finance a government project, whereas the spending effect is project specific and can vary even within the same spending ministry. Therefore, using conventional cost-of-funds estimates and assessing spending effects separately for each project at hand is more appropriate than applying the modified approach on the erroneous assumption that it fits all projects. The empirical estimates reviewed by the author suggest that the economic cost of raising one extra euro from labour taxes in Europe ranges from about 1.3 in the United Kingdom and in the southern EU-15 countries to slightly over 2 in Belgium and in the Nordic countries. Therefore, the economic cost of public funds is too important to be disregarded in the appraisal of government investment projects.

The paper concludes with two extensions on user fees and inter-temporal considerations, respectively. If user fees for infrastructure services contribute to covering the direct costs of an infrastructure project, the need for revenues from distortionary taxes decreases and so does the economic cost of public funds relevant to the project. However, full cost recovery is usually not socially optimal – be it due to average costs exceeding marginal costs or due to positive externalities (think of positive network externalities in telephone networks, for instance). This suggests a trade-off between welfare losses from distortionary taxation and those from over-pricing the public service. This trade-off also opens a fresh perspective on the privatization of public services and the contractual design of public-private partnership (PPP). When switching to multi-period analysis, additional parameters enter the scene, such as the social discount rate and the interest rate on government debt. In any case, there is no escape from the excess burden of taxation as servicing the debt will ultimately require additional tax revenues or expenditure cuts.

Such a need for fiscal consolidation continues to prevail in the new member states of the EU to ensure high sustainable growth and, hence, income convergence with the EU-15 according to **Gerd Schwartz**, **Ana Corbacho**, **Qiang Cui**, **Giovanni Ganelli** and **Paolo Manasse**. In their multi-faceted review of macro-fiscal policy challenges, the authors argue that the often-claimed trade-off between fiscal consolidation and infrastructure investment in these countries is not overly severe. First, and foremost, economic growth in the new member states has been driven by total factor productivity (TFP) rather than capital deepening over the past 15 years. This also shows the way ahead: Simulation results

suggest that halving the income gap in a reasonable time frame is possible, without increasing investment-to-GDP ratios further, by maintaining the average TFP growth rate observed for the region in the first half of this decade. By contrast, the same catching-up path would require drastic increases in total investment were TFP growth to converge to the pace seen in the least-performing new member states in the 2000-04 period. Second, countries most successful in terms of fiscal consolidation reined in government consumption rather than investment. Third, private investment increased faster and foreign capital was easier to attract in countries with better fiscal positions than elsewhere. Finally, in surveys businesses do not identify infrastructure networks as a major factor constraining their development.

This is not to deny substantial infrastructure investment needs in the new member states. Infrastructure density is below the EU-15 average, notably in telecommunications and Internet use but also with respect to road networks. As it is impossible to close the gap in the short run, projects should be prioritized using macro-fiscal frameworks and social-returns analyses. Against this background, the authors discuss two additional sources of infrastructure finance – EU funds and PPPs. While EU funds provide welcome supplementary resources, they also imply specific challenges, such as higher fiscal deficits due to co-financing and additionality rules; lacking absorption capacity, *i.e.*, the weak ability of administrations to handle project supervision; and efficient implementation. A new financing opportunity coming with new challenges – this also summarizes the assessment of PPPs in the new member states. Governments should first see if a project is worthwhile and only then decide whether to undertake it as a PPP. They also need to tackle the considerable fiscal risks implied by PPPs, both by strengthening the legal and institutional framework to curb excessive renegotiation and by imposing adequate fiscal reporting.

As manifold as the reasons for the rather mixed evidence on the long-run impact of government capital on output may be – too little private (relative to public) capital; preference for redistributive investment; and political bias towards neglecting maintenance of existing infrastructure and the economic cost of raising public funds – the four contributions to Issue 1 hold one important insight: Having the sticker 'government investment' attached to it does not make a project growth- or welfare-enhancing. Rather, efficient supply of the right infrastructure in the right place is more important for economic growth than the amount of money spent. In other words, project selection and prioritization are paramount.

Identifying the projects with the highest economic value added requires magnifying glasses and a refined toolbox. One way of becoming more specific is to look at regional rather than national economic and infrastructure data. A second way is to model and measure the typical microeconomic reactions to changes in infrastructure endowment and to figure out their implications for national economic growth and regional convergence. Issue 2 of the *EIB Papers* goes down both roads.

3. The economics of regional transport equipment

In his literature review of infrastructure and economic geography, **Gianmarco Ottaviano** sets the tone for the second issue of the volume, arguing that the assessment of new infrastructure projects needs to take into account the microeconomic reactions of economic agents, most notably their (re-)location decisions. He starts by recalling some fundamental economic-geography insights. For one, in the presence of transport costs, firms want to locate close to large markets. For another, when there are increasing returns to scale in an industry, the firms of that industry can cut production costs by locating close to each other. However, the stronger competition resulting from agglomeration lowers firms' profit margins. This gives rise to an anti-agglomeration force that matters more for less

productive firms than for industry leaders and is stronger when transport costs or other trade barriers are relatively high. Relocation of a firm affects both the supply and the demand sides of the regional economy. Indeed, newly arriving firms lower average production costs in the industry while at the same time bringing along workers, generating additional consumption demand. Demand- and cost-linkages make the process of agglomeration endogenous: Relocation can open up differences in market size that trigger further relocations to the same region and thus agglomeration.

Shrinking transport costs lead to agglomeration as long as the supply of production factors and non-tradable goods keeps pace with the increasing demand for them. If this is not the case, for example because labour is not sufficiently mobile or zoning restrictions lead to space shortages, prices for non-tradables might rise to a point where the productivity advantage of the centre is more than undone and production would eventually spread out to the periphery. This, however, has hardly been observed so far in the EU. So long as workers do not move to where job opportunities are and land rents keep climbing in central regions, any given increase in the concentration of production has more severe effects on interregional income inequality than if factors were flexible – a point made by Diego Puga whose paper is summarized below.

To put the most important lesson upfront: Agglomeration of production is economically efficient – at least up to a point. But there may be a trade-off between national or EU-wide economic growth and interregional income convergence. The above economic-geography insights provide for a healthy dose of scepticism against claims that new or improved long-distance transport infrastructures automatically foster interregional income convergence. In all likelihood they do not. But it is necessary to identify the sources of agglomeration economies to determine the strength of infrastructure-related economic effects. Traditional sources include knowledge spillovers, labour-market pooling, more efficient sharing of other inputs (*e.g.* infrastructure capital), and 'urban consumption opportunities' such as public transport. While the empirical literature is supportive of productivity-enhancing spillovers in denser areas, knowledge spillovers fade away quite quickly with distance.

When location decisions are endogenous, how a region fares depends not only on the scale of its production but also on its relative position with respect to other regions. Specifically, the appeal of a region depends on its 'attraction' (*i.e.*, relative size) and its 'accessibility' (*i.e.*, centrality in the network of trading markets). Different types of infrastructure have different agglomeration/dispersion effects: Local infrastructure acts on attraction, global infrastructure on accessibility. Attraction and accessibility combine to 'market potential', a powerful empirical measure to explain actual agglomeration patterns: It expresses the sum of expenditures in all regions, weighted by some measure of relative cost of shipping goods from a given region to each other region. According to the evidence, market potential variations explain 35 percent of cross-country income variations.

Achim Kemmerling and **Andreas Stephan** take a macro-economic approach and look at the determinants and productivity effects of regional transport infrastructure investment in France, Germany, Italy, and Spain. They estimate productivity effects with regional production functions for each country and find elasticites of output with respect to transport-infrastructure capital in the range from 0.05 to 0.20, in line with earlier studies. To control for the potential endogeneity of public infrastructure investment, they specify an equation system that jointly determines regional output and transport-infrastructure investment. The latter is determined both by traditional political-economy variables – the 'normative principles' efficiency, equity, and redistribution – and by factors borrowed from the political-science literature such as electoral competition and electoral rents. Efficiency and redistribution are found as the normative principles driving transport infrastructure investment whereas spatial equity in endowments does not play a significant role.

The results on 'purely' political factors are more scattered, reflecting the diversity of political systems. The traditional claim that left parties increase taxes and the size of the government, thereby also boosting infrastructure investment, is confirmed for France and Italy. In a federalist country like Germany, however, the political congruence between the federal and a regional government (same ruling party) is more relevant; also, a large lead of the biggest party over the second-biggest in a region (incumbency) affects investment expenditure positively. A very small lead does the same, suggesting a U-shaped relationship between investment and the degree of electoral competition. Slightly different from incumbency, the idea that investment should be higher in regions that are strongholds of the central-government party is reflected in the data for Spain and Italy. Finally, a significant influence of regional parties is only found in Italy.

Riccardo Crescenzi and **Andrés Rodríguez-Pose** analyze the effect of road infrastructure on the growth in regional GDP per capita. Unlike Jong-A-Pin/de Haan and Kemmerling/Stephan, they use physical proxies of infrastructure endowment and investment – kilometres of motorways per 1000 inhabitants and the change therein, respectively. They control for other drivers of growth, such as human capital and research and development (R&D), as well as for initial wealth, the size of the regional economy and the national growth rate. The analysis accounts for spatial interactions between different regions in the form of spillovers and network externalities.

The authors find a positive impact of infrastructure endowment on regional economic performance but a weak contribution of additional investment. Regions having good transport infrastructure endowment and being well connected to regions with similar endowments tend to grow faster. However, investment in infrastructure within a region or in neighbouring regions seems to leave especially peripheral regions more vulnerable to competition. The positive impact of the level of infrastructure on growth tends to wane quickly and is weaker than that of human capital. The results for the infrastructure variables are robust to the introduction of additional variables; moving from static to dynamic specifications; and alternative standardizations of the infrastructure variable (motorway kilometres per region area and per GDP, respectively).

Diego Puga looks into the specificities of cross-border infrastructure against the backdrop of theory and evidence on the spatial economic effects of changes in infrastructure. Empirical analyses of international trade have traditionally found large 'border effects'. In the EU, for instance, the border effect makes within-country trade six times larger than international trade for comparable distance and country size. As trade policies, language, legal barriers and differences in doing business cannot fully account for the trade gap, newer explanations rest on firms having the national border in mind already when making their location choices. In other words, sectors do not spread out within countries proportionately to population but firm density declines close to national borders. Transport infrastructure networks, most of which were built mainly with national markets in mind reflect these reduced cross-border flows. Given the path dependency of agglomeration patterns and locational cost advantages, even the best Trans-European Network is unlikely to bring substantial new economic activity to depressed border regions.

Still, there are reasons to believe that cross-border infrastructure links are suboptimal. As production is becoming more international, national infrastructure networks are becoming increasingly inadequate. Furthermore, as the distribution of investment costs of cross-border projects may differ from that of their economic benefits, these projects are prone to under-investment from an international viewpoint. This holds especially if the 'winning' country is not willing to compensate the country incurring the larger cost burden. A variation of this failure is that even with symmetric costs and benefits, long-distance infrastructure projects crossing two and more constituencies typically suffer from coordination failure, providing a role for supra-national institutions such as the European Commission and the EIB to overcome these failures.

Puga also describes the sometimes surprising effects of supposedly local infrastructure on the interregional distribution of economic activity. For example, the M-40 circular road around Madrid has not only alleviated congestion in the Spanish capital. It has also changed travel times and shipment costs throughout the country, thereby leading to substantial redeployment of firms throughout Spain. Conversely, long-distance transport links crossing big cities, such as highways and high-speed railways, are heavily used by commuters and, hence, have significant local effects. To sum up, the defining characteristic of cross-border infrastructure is not what it is but what it does. In other words, what matters is that economic effects are felt across borders, not that the asset itself crosses regional borders.

The final contribution on the 'death of distance' by **David Brown**, **Marianne Fay**, **Somik Lall**, **Hyoung Gun Wang** and **John Felkner** shows new economic geography in action by looking beyond the eastern border of the EU, on Russian regions. Their empirical results on the productivity effects of transport improvements suggest that Russia still has large efficiency gains to reap from stronger agglomeration of economic activities. Simulating the effects on firm productivity of 10-percent decreases in travel times from each district to all others as well as to the Trans-Siberian railway and a port, they find that the strongest gains in productivity (*i.e.*, firm-level TFP) would occur in the Central region (including Moscow) whereas the effect would be only half as strong in the North-western region (including St. Petersburg) and the Far-eastern region and weaker still in the other regions.

History and natural geography go a long way in explaining why Russia has not come anywhere near to optimal – let alone excessive – agglomeration of production. Central planners distributed economic activity relatively evenly across the territory, thereby disregarding the cost of remoteness and leaving many people in very cold places. They also had an incentive to vertically integrate production to increase their political power. While some integration and larger-than-average inventories may be warranted under harsh climatic conditions to avoid disruptions in production, the absence of market mechanisms led to huge multi-product conglomerates that have jeopardized productivity as the authors show. As the descriptive statistics on new *versus* old firms over the past 15 years show, firm entry and survival have been very strong nearby large markets by historical standards, but weak in peripheral areas. That is, entrepreneurs prefer setting up production close to large markets. The empirical results therefore reveal a severe trade-off between boosting national economic growth and promoting spatial equity through major infrastructure projects.

Can these interesting conclusions be transferred to the EU? The speculative answer to this is yes but to a lesser degree than observed in Russia. The results should – at least qualitatively – apply to the new member states in Central and Eastern Europe where production patterns previously determined by central-planning decisions have been and are still being corrected, too. This has led to increasing interregional income differences within countries, strongly favouring capital regions and the regions bordering EU-15 countries. One should not be overly surprised if the gradual completion of modern and reasonably dense infrastructure backbones were to bring about further regional income divergence. Implementing additional infrastructure projects with the primary focus on regional convergence is likely to be at the expense of national and EU-wide economic growth. In this respect one can only reiterate Crescenzi's and Rodríguez-Pose's recommendation of more human-capital based development strategies. It is also worth recalling that fostering labour mobility and removing infrastructure and other bottlenecks in congested areas is a safer cushion against the divergence in regional per-capita incomes than large transport infrastructure projects.

As far as the EU-15 is concerned, it is also true that Trans-European Transport Networks have not reduced regional income inequalities so far. Nonetheless, concentrating infrastructure investment on metropolises is less certain to yield the highest benefits from a countrywide perspective. The reason

for this is the concern of excessive economic dominance by the leading city ('urban primacy') pointed out by Puga. From a short-term perspective, removing congestion around big cities may yield the highest benefit just because society's time-loss from daily congestion is substantial under the *status quo*. The removal of bottlenecks should not, however, come at the expense of connecting big cities with specialized cities of intermediate size. In fact, recent empirical results for the United States and Japan surveyed by Puga suggest that corporations reap substantial efficiency gains by locating research and development, early-stage production, management and administrative services in large diversified cities but large-scale manufacturing in specialized cities of intermediate size. Global transport infrastructure is needed to enable such a balanced urban system to come into existence.

4. The main policy messages

The articles contained in this volume provide a number of policy implications. First of all, the policy debate needs to keep in mind that governments have direct responsibility only for a fraction of infrastructure investment and that, in turn, government investment comprises many things other than infrastructure (*e.g.* schools, police, and social housing). Policymakers may therefore want to differentiate statements about the effects of infrastructure when in fact most of the available information refers to total government investment.

Then take the productivity of investment. The empirical evidence presented in this volume strongly supports the view that 100 kilometres of highway built in the 1960s were more productive than 100 kilometres added today because the investment back then established the most crucial links. Given the path-dependency of economic geography, transport backbones would roughly look the same if they had to be built from scratch today. As a consequence, new investment projects, which tend to be more appealing to politicians, should not come at the expense of proper maintenance of existing infrastructure.

As to the determinants of government investment, the fear that fiscal competition leads to a race to the bottom in tax rates and jeopardizes the supply of government infrastructure and public goods is not confirmed even though the volume does not empirically answer the question to what extent planning at the regional level leads to under-provision of cross-border links – be it between regions or countries.

Looking at investment determinants from the political-economy angle shows that both economic-efficiency and income-redistribution considerations are driving regional investment in transport infrastructure. The volume has merit in making transparent the impact of political factors, enhancing our understanding of the constraints under which politicians operate. While these factors do not necessarily lead to economically optimal investment decisions, they are part of the game in representative democracies. The best economists can do is to inform society about the costs of these decisions.

Keeping in mind the economic costs and benefits is also key regarding the fiscal implications of government investment. Large new infrastructure projects are appealing to decision makers. Indeed, they provide high political visibility as huge amounts are spent in a short time, suggesting activism. They also have strong economic effects – if not always the desired ones – and are relatively easy to manage once the road is up and running. Thus, there is an incentive to neglect or play down the economic cost of raising funds, leading to over-provision of infrastructure from a welfare perspective. As argued in the volume, this cost should not be ignored. Moreover, it would be unwise to let large government investment projects lead to soaring public-debt levels because in that case the macroeconomic benefits from the investment risk being more than undone by less private investment and lower foreign capital inflows.

Finally, the contributions on infrastructure and economic geography show the need for better aligning government interventions (infrastructure *versus* other policies) with the stated economic-policy objectives. In particular, transport infrastructure is a double-edged sword in promoting economic development in that it is unlikely to reduce interregional income inequalities, an insight on which micro-economic and macro-regional analyses agree. Rather, regional convergence requires balanced strategies that combine local infrastructure assets with efforts to boost peripheral regions' human-capital endowment and technological absorption capacity. More fundamentally, policymakers should not undermine national growth strategies over legitimate concerns with regional development. The empirical study on Russia in this volume demonstrates that the productivity effects can be greatly different depending on whether new transport infrastructure connects vibrant markets with high potential or remote regions with low potential.

Trans-European Networks are likely to enhance growth by removing still-acute cross-border infrastructure bottlenecks even though it is probably misleading to advertise them under the heading of regional convergence. International investment efforts should focus more on improving cross-country interconnections in order to reflect the growing internationalization of production; internalize cross-border spillovers; and reduce the risk of excessive urban primacy within countries.

Taken together, this volume combines new empirical results, updates on recent developments in several infrastructure-related fields of economics, and key principles easily forgotten in politics. We do hope that the articles provide valuable inputs for policymakers, policy advisors and project practitioners alike.

Hubert Strauss

ABSTRACT

We set out to decompose government investment, seeking especially to estimate how much governments in Europe invest in infrastructure in general and transport infrastructure in particular. *It is concluded that infrastructure accounts for about one-third of overall government investment in the EU on average, with the share of transport investment as high as 80 percent in government infrastructure investment. These shares have remained quite stable in the past decades, so government transport investment has not suffered from excessive swings, slides or sudden stops — at least relative to other types of government investment. Whether that has been economically optimal is an altogether different issue, to be addressed elsewhere.*

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Composition of government investment in Europe: Some forensic evidence

1. Introduction

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Investment activity by governments is a surprisingly tough nut to crack in terms of both concepts and data. To keep things simple, economists habitually use the concepts "public investment", "government investment", "infrastructure investment" and even "transport infrastructure investment" as synonyms. All of them are, presumably, considered as government contributions to the economy's productive capital stock. In empirical work all those concepts are often measured as gross fixed capital formation of the general government.

This paper is all about showing that the cost of such simplicity is significant inaccuracy, both in theory and in practice. There is a world of difference between public investment and transport infrastructure investment, both conceptually and quantitatively. This being the case, an excessively casual attitude to concepts will result in significant measurement errors.

The empirical and policy implications of such measurement errors are obvious. If one wants to guide public policy about the desirability of additional transport investment, one should assess the productivity of investment in roads and the like. Measuring the productivity of transport investment jointly with schools, public running tracks in municipal woods or other government investment would not be very helpful for a policy maker looking for guidance on transport investment only.

Sorting out the concepts is reasonably easy, so we will not devote more than the latter part of this introduction to that task. Having defined the concepts we can set out to measure them in the remainder of the paper. The focus will be on decomposing government investment so that we can isolate the share of infrastructure in general and transport infrastructure in particular. That will allow us to document how big exactly the gaps between those concepts are.

But let us start by getting the terminology straight.

The first task is to get the concept "public investment" out of the way; after all, it is frequently and erroneously used to denote government investment. The public sector comprises the general government and entities in the corporate sector that are owned by the government, such as railway companies or power grid companies. Thus, public investment includes investment by the general government (*i.e.*, government investment) plus investment by government-owned corporations.

Against a commonly held belief, government ownership of an economic unit does not automatically imply that investment undertaken by that unit is government investment. Take publicly owned infrastructure companies, such as many utilities. Is investment by a publicly-owned utility recorded as investment by the government or corporate sector in national accounts statistics? Box 1 addresses this question. In brief, its conclusion is that the principal source of revenues, not ownership structure, dictates the recording. Investment by firms whose revenues from market sales cover more than half of their production costs is recorded as investment by the corporate sector, and all other investment is recorded as investment by the government sector.

Box 1. Government *versus* corporate infrastructure investment: Example of an electricity grid company

Consider investment in additional transmission capacity by a hypothetical electricity grid company. It is often thought that the recording of such investment depends on the ownership structure of the company. In other words, it is postulated that the investment should be classified as investment by the corporate sector if the grid company is (majority) owned by the private sector and as investment by the government sector if the grid company is (majority) owned by the government sector.

As specified in the 1995 version of the European Systems of Accounts (ESA 95), the criterion for classifying the investment relates to the sectoral classification of the grid company, which can be different from its ownership structure. Section 2 of ESA 95 defines as general government:

"*… all institutional units which are other non-market producers whose output is intended for individual and collective consumption, and mainly financed by compulsory payments made by units belonging to other sectors, and/or all institutional units principally engaged in the redistribution of national income and wealth*."

Key here is the distinction between market and non-market producers and production. Chapter 3 of ESA 95 defines non-market output as "output provided for free or at prices that are not economically significant". Economically significant prices, in turn, are by convention defined as prices that allow more than 50 percent of production costs to be covered by sales revenues.

In sum, our grid company is classified as a general government sector unit if and only if most of its production is non-market, with sales revenues accounting for less than one-half of production costs. Specifically, if the transmission fees the grid company collects cover less than half of the costs of producing the transmission service, the company belongs to the government sector in national accounts statistics, and any investment by it is classified as government investment.

Conversely, if the transmission fees cover more than half the costs, the grid company is classified as a corporate sector unit. Note that this is the case even if the grid company is fully owned by the government.

This principle illustrated by the grid company extends to investment undertaken by enterprises in other infrastructure sectors. Thus, the classification of investment by a railway company in rolling stock depends on its main source of revenues, not on its ownership structure.

Government investment is not the same as infrastructure investment.

Second, consider the difference between government investment and infrastructure investment – a key distinction in what is to come. There is a fair amount of infrastructure investment that is not undertaken by the government, such as investment by commercially-run private and government-owned utilities mentioned above. Conversely, governments undertake many different types of investment, some of which can reasonably be called "infrastructure investment" (roads, say) but others not (public running tracks in the woods, already mentioned in passing above).

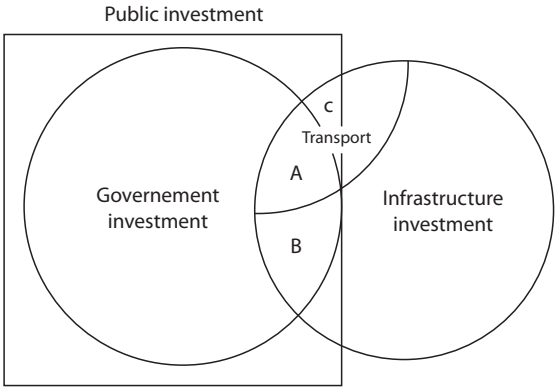
To illustrate, consider the Venn diagram in Figure 1. It shows two sets, government investment and infrastructure investment. (The relative sizes of the sets and sub-sets are not intended to reflect reality.) The rectangular universal set surrounding government investment is public investment, including also investment by government-owned corporations. One part of infrastructure investment is investment in the transport sector. The two sets overlap to some extent, but by no means fully.

The aim is to decompose government investment.

In this paper we are especially interested in the intersection of the two sets. The first task, undertaken in Section 2 below, is indeed to quantify the intersection (A plus B), denoting infrastructure investment by the government. Having started to decompose government investment, one may as well go all the way and figure out what the remainder of it comprises (*i.e.*, government investment not included in A or B).

Next, we seek to split the intersection A + B into A and B; that is, we seek to quantify the share of transport in government infrastructure investment. That is the topic of Section 3. To conclude Section 3, we also give a try at estimating A in relation to overall transport infrastructure investment.

Figure 1. Composition of government and infrastructure investment in a Venn diagram



Sections 2 and 3 both rely on data from the past decade and a half, so Section 4 extends the time perspective backwards and asks how the Venn diagram in Figure 1 has evolved over time. Or to put it more simply, Section 4 considers how the composition of government investment has changed over time.

It will turn out that it is no straightforward task to measure A or A plus B. (If it were, someone else would probably have written this paper a long time ago.)[1] That is why some novel forensic investigation – promised in the title – is necessary. That is also why we stop there and do not proceed to consider intersections such as C, denoting transport infrastructure investment by government owned corporations or, for that matter, to any normative analysis about the optimality of the observed investment levels. We will leave those issues to another Sherlock Holmes to tackle.

1 However, there is improvement in sight as regards the data on especially government transport investment: A current task force organised by Eurostat has as its goal to produce data on government transport investment in the member states of the European Union that are comparable across countries. The publication of such data is some time away in the future, and until then the estimates offered below are among the very few in existence.

2. Composition of government investment[2]

This section presents the key stylised facts about the composition of government investment in the European Union. The underlying data are based on the functional classification of government expenditure in the 1993 UN System of National Accounts and in the 1995 European System of Accounts (ESA 95).[3] The focus is therefore on the past decade or so; longer-term developments are discussed in Section 4. The section starts with a presentation of the functional classification, followed by a description of the stylised facts in EU-15 (old member states of the European Union) and subsequently in the new member states.

To be precise, "government investment" is shorthand for gross capital formation of the general government, which comprises the central and sub-national (regional, local) governments as well as social security funds. It includes changes in inventories, which may create some undesired noise for our analysis; however, the breakdown between gross fixed capital formation and changes in inventories is not available. Also, our variable is measured gross of consumption of fixed capital, but net of sales of fixed assets. The latter implies that government investment below does not exactly measure new investment alone.[4]

The functional breakdown of government investment thus defined is presented in Table 1. The right-hand side column shows the functional classification (Classification of Functions of Government, COFOG for short) in ESA 95 (Eurostat 2007). The left-hand side shows our own aggregation of the ten available "functions" into four types of government investment with economically distinct roles.

Table 1. Functional breakdown of government investment

Aggregation	*ESA 95 COFOG*
1. Infrastructure (INF)	Economic Affairs
2. Hospitals and schools (HS)	Health Education
3. Public Goods (PG)	Defence General Public Services Environment Order and Safety
4. Redistribution (RED)	Housing Recreation Social Protection

Source: Eurostat, own aggregation

Different types of government investment have different economic roles.

The four different types of government investment affect the economy through different channels, with varying degrees of directness, and over different time horizons. Government investment in infrastructure, consisting of just Economic Affairs in the ESA 95 COFOG, seeks to measure government investment in traditional infrastructure, mainly transport. This type of government investment has the most direct economic impact by reducing firms' production and transaction

2 This section draws on Kappeler and Välilä (2007), and Perée and Välilä (2008).

3 The data are available through Eurostat's website at http://epp.eurostat.ec.europa.eu/portal/page?_pageid=1090,30070682,1090_33076576&_dad=portal&_schema=PORTAL.

4 Gross (fixed) capital formation does not include ordinary maintenance of fixed assets, but it includes major improvements of fixed assets, such as rehabilitation of a road.

costs. The economic impact of government investment in health and education sectors is more long-term and less direct in character, as it facilitates the building up and maintenance of the economy's stock of human capital. Investment in public goods affects the economy's allocative efficiency indirectly through framework conditions for productive activity. Finally, redistribution affects the economy's income distribution rather than allocative or productive efficiency *per se*.

Government investment in infrastructure ("Economic Affairs", illustrated by the intersection A plus B in Figure 1) will be the focus of Sections 3 and 4. It comprises a number of different sectors, including Agriculture; Fuel and energy; Mining, Manufacturing and construction; Transport; Communication; R&D; and others. Among these sectors, Transport is likely to be by far the dominant recipient of government investment; exactly how dominant it is will be the topic of Section 3.

In addition to infrastructure investment, some other aggregates shown in Table 1 contain undesirable "noise" as no further breakdowns of the right-hand side "functions" are available. For example, government investment in water supply and wastewater management are not part of infrastructure as one would wish; instead, they are part of redistribution (Housing) and public goods (Environment), respectively. Similarly, one would wish to include street lighting in public goods; now it is included in Housing, and thereby redistribution.

Investment by commercially-run companies, even when state owned, is classified as corporate-sector investment.

It is important to acknowledge that investment by companies owned by the government sector but run on a commercial basis is not included in our data, as explained in Box 1. For example, investment by energy companies owned by the government sector is not included in government investment in infrastructure; rather, it is classified as corporate investment in national accounts statistics as long as such companies are commercially run. Note that government transfers to such companies to finance their infrastructure investment are also not included.

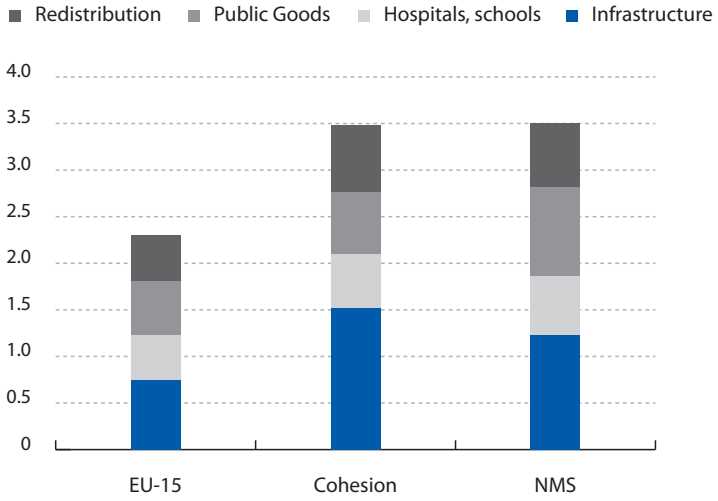
Similarly, when comparing the data across countries, it is important to bear in mind that the institutional framework for providing public services differs between countries. Thus, water or sewage networks may belong to municipalities in one country and to commercially run companies in another country. In the former case they would be included in our data, in the latter case they would be excluded from them.

With these caveats in mind, and following the classification presented in Table 1, Figure 2 shows the breakdown of government investment in EU-15 as a group; separately in the cohesion countries (Greece, Ireland, Portugal and Spain); and also in the new member states (NMS).

Two observations stand out from Figure 2. First, the share of government investment in infrastructure is on average about one-third of aggregate government investment in EU-15 and in NMS, but higher (40 percent) in the cohesion countries. This is striking, especially considering that "government investment" and "infrastructure investment" are often used synonymously in both theoretical and empirical literature. If we include investment in hospitals and schools, which is sometimes considered part of an economy's infrastructure broadly defined, we still only get to one-half of total government investment.

The second, and related, observation from Figure 2 is that infrastructure investment in NMS is somewhat higher than in old EU member states, but below the level in the cohesion countries. While it would be hazardous to draw far-reaching conclusions based on the composition of recent investment flows alone, one can nevertheless take Figure 2 to imply that there has not been any obvious convergence of economically productive government capital stocks between the new member states and especially the cohesion countries.

Figure 2. Composition of government investment in groups of EU countries (in percent of GDP, GDP-weighted average 2000-05)



Source: Eurostat, own classification

Considering the individual countries of EU-15, Figure 3 depicts the composition of government investment as per the aggregation presented above. There are some striking differences between countries; for example, the level of investment in infrastructure in Ireland, Luxembourg and the Netherlands is as much as four times that in Austria, Denmark, France or the United Kingdom (top panel). Government investment in hospitals and schools in Greece is some four times the level in Austria and Belgium. Luxembourg has four times the level of government investment in public goods compared to Austria, Denmark and Germany. Finally, government investment in redistribution in France and Luxembourg is six times that in Austria and the United Kingdom.

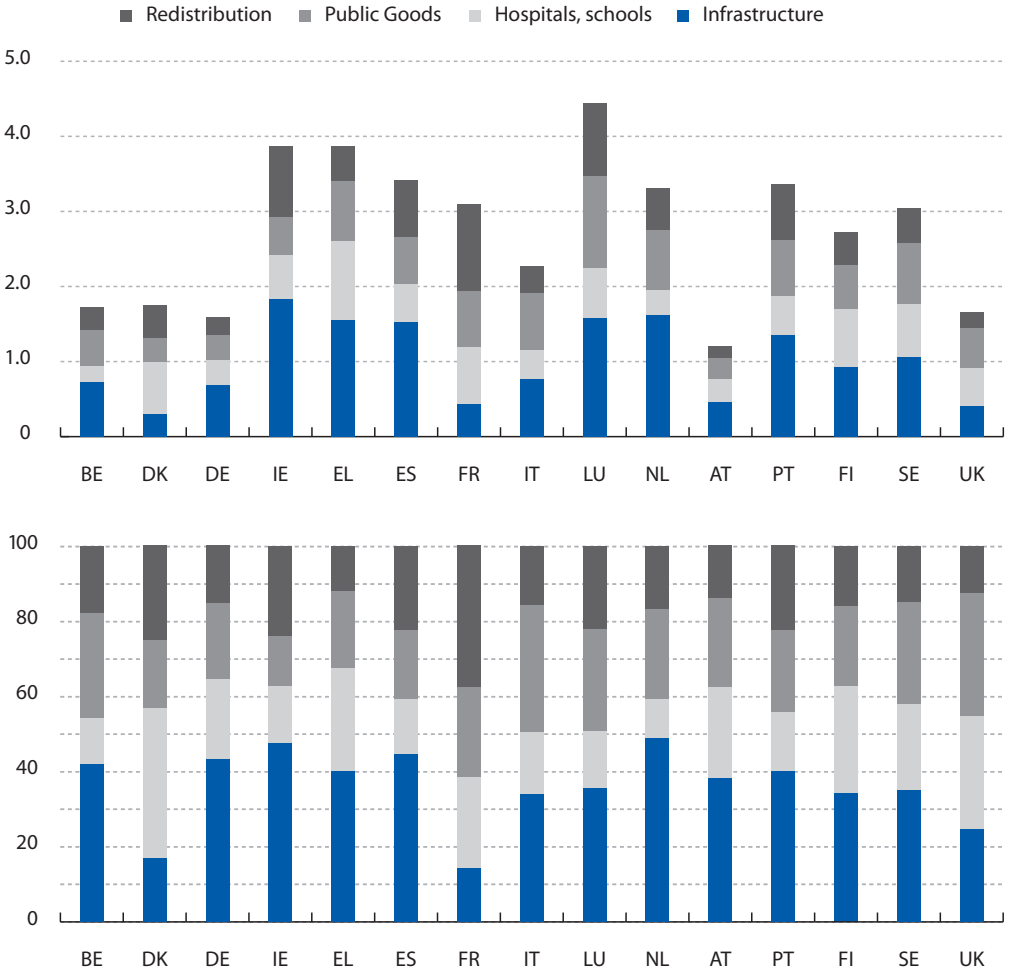
Again, it should be emphasised that some of these cross-country differences reflect differences in the institutional set-ups for providing public services, with similar investment classified in one country as government and in another one as corporate sector investment. Therefore, the cross-country differences should not be interpreted as differences in the level of total investment in the various services; rather, they should be interpreted as differences in the government component of such investment only.

Infrastructure accounts for one-third of government investment in Europe.

In terms of shares of total government investment (bottom panel in Figure 3), we note that infrastructure accounts on average for about one-third, and hospitals and schools account for another 20 percent. Public goods and redistribution account for about one-quarter each.

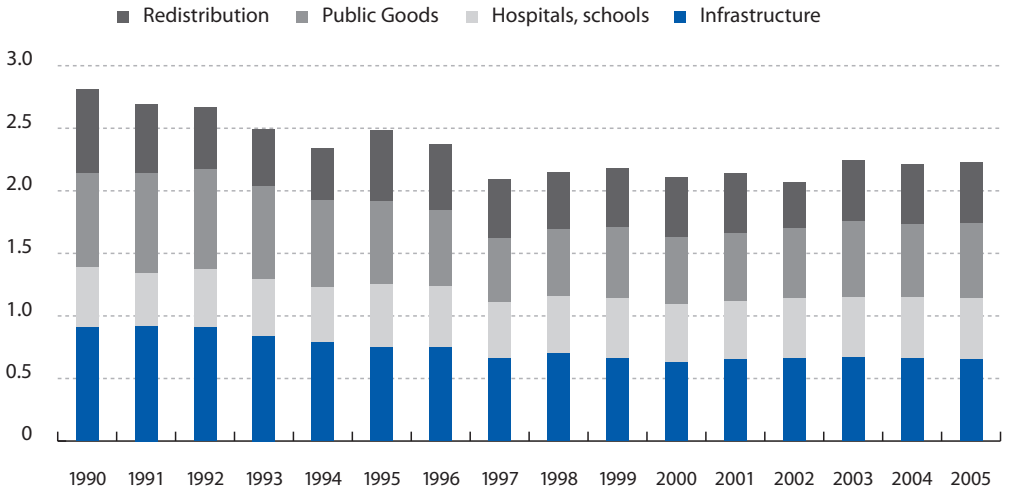
Figure 4 shows the evolution over time of the level and share of the different types of government investment. Overall, government investment in EU-15 has declined from 2.7 percent of GDP to just over 2 percent of GDP since 1990. The shares of the different types of government investment in overall government investment have remained reasonably stable over time. This suggests that both the trend decline in government investment and the cyclical ups and downs have hit the various types of government investment relatively evenly in the past decade and a half.

Figure 3. Composition of government investment in EU-15, average 2000-05 (Top panel: In percent of GDP. Bottom panel: As share of total)



Source: Eurostat, own classification

Figure 4. Evolution of government investment by type, EU-15



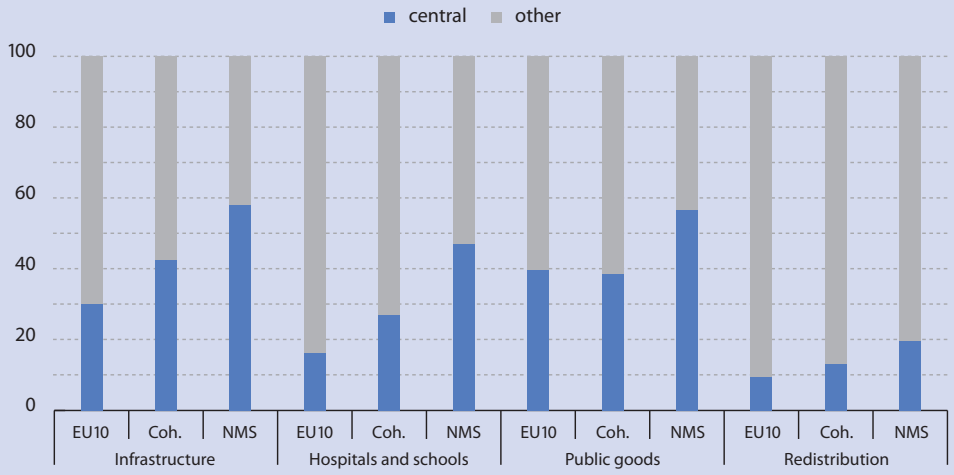
Source: Eurostat, own classification

Having described how the composition of government investment has varied between EU-15 countries and over time in the recent past, it is natural to ask what can explain such differences. Box 2 reports the results of a study into how the composition of government investment depends on the system of fiscal federalism, concluding that fiscal decentralisation tends to boost economically productive government investment, such as infrastructure.

Box 2. Composition of government investment and fiscal federalism

There are significant differences across European countries with regard to the level of government that provides a certain public service. Figure B1 shows the shares of the central and sub-national (regional, municipal) governments in the components of government investment identified in the main text. The figure suggests that the share of the central government is greater in all types of government investment in the new member states than in the old ones. In all three country groups the share of the central government is greatest in government investment in infrastructure and public goods, while it is smallest in redistributive government investment.

Figure B1. Government investment by type and level of government (in percent of total; average 2000-05)



Source: Eurostat, own calculations

A study by Kappeler and Välilä (2007) seeks to disentangle the role of fiscal federalism in explaining the composition of government investment in EU-10 (EU-15 less the cohesion countries and Luxembourg). This box summarises the conceptual underpinnings and the empirical results of that paper.

Starting with the conceptual underpinnings, the traditional economic literature on fiscal relationships between different levels of government emphasised the distinction between local and global benefits from government spending. The benefits of, say, investment in a municipal sports facility accrue chiefly to the local population. In contrast, the benefits of national defence accrue to the population at large. There are also intermediate cases, like motorways, whose benefits can accrue locally, regionally, and also nationally.

If the system of fiscal federalism changes – if for example spending power is decentralised from the central government to lower levels of government – one can easily see how the composition of government investment would change in this framework. Decentralisation would lead to more investment yielding local benefits, possibly at the cost of investment yielding country-wide benefits. Decentralisation would thus lead to more sports facilities and fewer military installations.

More recent literature on fiscal federalism has focussed on the interdependencies in public policy decisions between sub-national units (regions for short, but the analysis applies equally well at municipal level). Consider regional tax competition. Regions compete against one another in order to attract firms and productive capital. If the competition concerns tax rates, such regional tax competition can result in a "race to the bottom". With low tax rates and low tax revenues, regions' ability to provide public services and to undertake investment projects is limited. Thus, in competing for the location of firms, regions may reduce their tax rates to such an extent as to unduly suppress government investment.

But regional competition can also be about government spending. Good regional infrastructure (a "public input") reduces production costs for private firms and may be more important for their location decisions than rock-bottom tax rates. In the extreme, this type of regional competition may induce regions to over-invest in infrastructure serving firms, at the cost of more consumption-oriented government spending such as sports facilities. This can also generate distortions in the composition of government expenditure, with decentralisation leading to an over-supply of government infrastructure and an under-supply of local public goods.

To see how fiscal decentralisation actually affects the composition of government investment in the European context, the study by Kappeler and Välilä conducts two empirical analyses. First, the impact of decentralisation on the level of each type of government investment is estimated. Second, the impact of fiscal decentralisation on the share of each type of government investment in total government investment is estimated.

Decentralisation in these analyses is measured as the share of taxes accruing to sub-national governments in relation to the overall tax intake of the general government. The country sample used in the analysis is EU-10, and the sample period is 1990-2005.

The key results of these analyses are summarised in the table below. It shows the signs of the estimated coefficients for the decentralisation variable (sub-national tax share) in both levels and share analyses. A plus indicates that more decentralisation is associated with higher overall government investment of the type in question. A zero indicates a statistically insignificant relationship between decentralisation and government investment, while a minus indicates that more decentralisation is associated with less government investment.

	INF	HS	PG	RED	TOTAL
Level	+	+	+	0	+
Share	0	+	0	-	

Decentralisation thus increases the level of government investment in total, and of the components it increases investment in infrastructure (INF); hospitals and schools (HS); and public goods (PG). Decentralisation does not affect the level of redistribution investment. In terms of shares in total government investment, decentralisation increases the relative share of investment in hospitals and schools, at the cost of investment in redistribution. Note, however, that although the relative share of redistribution investment declines with decentralisation, its absolute level does not.

The result that decentralisation reduces the share of redistribution investment is difficult to reconcile with the traditional theory of fiscal federalism reviewed earlier. The redistribution variable is meant to capture consumption-oriented local public goods, such as recreational facilities, and the traditional view predicted that decentralisation should lead to an increase, not relative decline, in their provision.

In contrast, the results can be more readily interpreted in view of the newer thinking emphasising broader fiscal competition among sub-national units. Decentralisation increases the level of investment in especially infrastructure as well as hospitals and schools, all providing "public inputs" for private firms. What is more, the increase in investment in hospitals and schools suppresses the share of investment in redistribution, suggesting that decentralisation leads to a relative decline in consumption-oriented government investment.

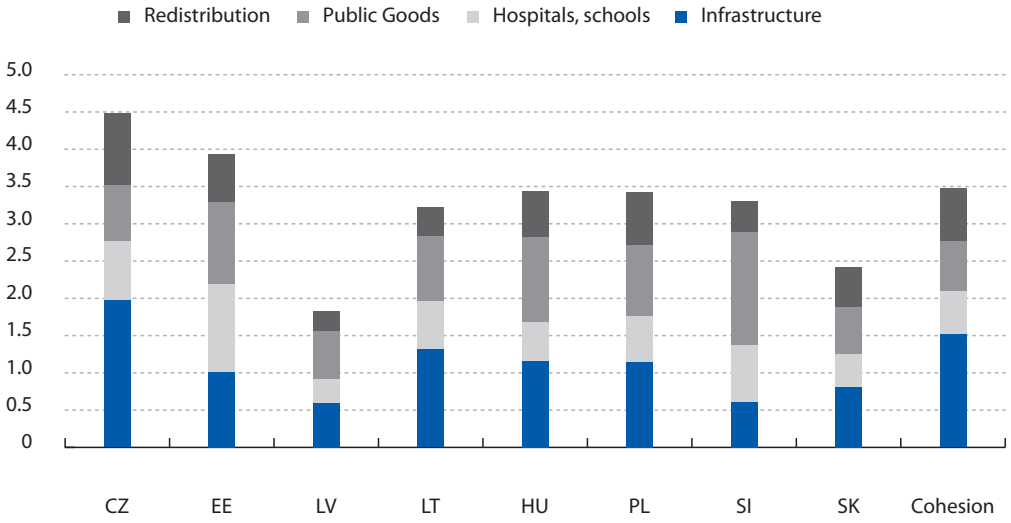
It is noteworthy that decentralisation does not lower the level of any type of government investment. This being the case, there is no evidence of decentralisation being associated with tax competition that would have a detrimental impact on the overall level of government investment.

A common feature for the new member states is the significance of investment in public goods.

We now turn to a description of the composition of government investment in the new member states for which data are available. There are, again, big differences in the composition of government investment between individual NMS, as shown in Figure 5, which also contrasts the composition of government investment in NMS to the cohesion countries. At one end of the spectrum, the Czech Republic invests in government infrastructure even more than the cohesion countries. At the other end of the spectrum, Latvia and the Slovak Republic invest in government infrastructure no more or even less than old EU member states. On the other hand, a common feature for almost all NMS is the significance of investment in public goods, including defence, order and safety, public administration and the environment. Bar in the Czech Republic, the share of public goods is well in excess of one-quarter of aggregate government investment in NMS,[5] compared to one-fifth in the cohesion countries and about one-quarter in other EU-15 countries.

5 In a more detailed breakdown, the shares of defence, order and safety, public administration, and the environment in investment in public goods are, on average, roughly speaking equal in the eight new member states shown in Figure 5. The share of public administration is slightly higher than the others, and to the extent that such investment is linked to the development of institutions necessary for a well-functioning market economy, such investment enhances long-term growth potential.

Figure 5. Composition of government investment in new member states (in percent of GDP, average 2000-05)



Source: Eurostat, own classification

To conclude this section, let us summarise some key stylised facts of the composition of government investment in Europe. On average, a third is infrastructure investment and another 20 percent investment in hospitals and schools. These two types of government investment, accounting for half the total, are productive from an economic perspective, reducing firms' costs and boosting human capital. The other half of government investment is roughly evenly split between public goods and redistribution, as defined in this section.

Half of government investment is directly economically productive.

As regards differences across country groups, the share of government investment in hospitals and schools as well as redistribution is higher in the old member states (EU-15) than in the new ones. NMS have the biggest share of investment in public goods. In turn, the cohesion countries have – at 40 percent – by far the highest share of infrastructure investment.

3. Government infrastructure investment

Having broken down government investment into four economically different categories above, this section zooms in on one of them – government infrastructure investment ("Economic Affairs", or the intersection A plus B in Figure 1) – seeking to decompose it further. We saw that infrastructure is the single biggest component of government investment in Europe; however, we also saw that it comprises a bewildering array of investment, ranging from roads to government agricultural investment. Our prior was that transportation investment dominates government infrastructure investment; in this section we set to test that prior.

Before assessing the share of transport in government infrastructure investment (that is, to figure out the share of A), Box 3 takes a detour around the globe and compares government infrastructure investment in Europe to that in Japan and the United States. In sum, government infrastructure investment remains relatively much more dominant in Japan than in Europe or the United States.

Box 3. Government investment in "Economic Affairs" in the EU, Japan and the United States

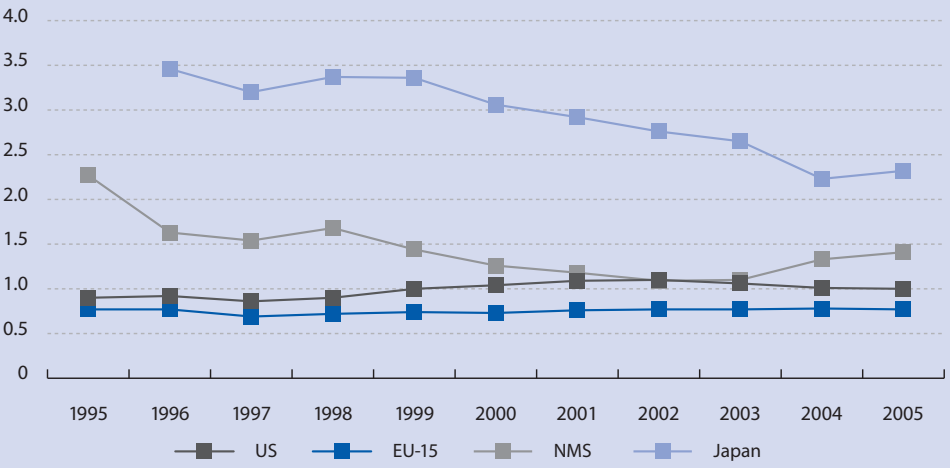
The classification of government expenditure by functions (COFOG) in the European System of Accounts (1995) discussed in Section 2 is based on the United Nations' System of National Accounts (1993); consequently, a similar breakdown as presented for European countries is also used in countries outside Europe. That allows us to compare the level and evolution of government investment in "Economic Affairs" (infrastructure for short) in Europe with Japan and the United States.

The Figure B2 shows that the current level of government infrastructure investment is lowest in EU-15 at about 0.8 percent of GDP, a third of the level in Japan. In the United States the government sector invests some 1 percent of GDP in infrastructure, while in the new member states of the EU the figure is 1.5 percent of GDP.

As mentioned in the main text, some of the cross-country differences reflect simply different institutional set-ups for providing infrastructure services. In addition, it is important not to confuse quantity with quality: These figures tell us something about the relative size of annual investment flows from public sources, but how productive that investment is is an altogether different matter.

Further on Figure B2, we see that government infrastructure investment has remained remarkably stable over the past decade or so in EU-15 and the United States, while there has been a marked downtrend in Japan, related to the winding down of the drawn-out fiscal stimulus of the 1990s. In the NMS, government infrastructure investment was on a downtrend until a few years ago, halving in magnitude relative to GDP. However, the past few years have seen a reversal of that downtrend.

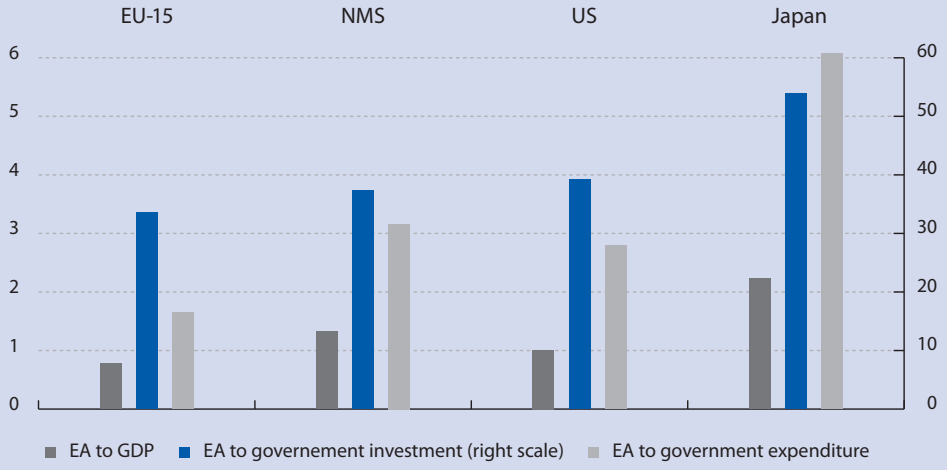
Figure B2. Government investment in "Economic Affairs" (in percent of GDP; GDP-weighted average for EU-15 and NMS)



Source: Eurostat, OECD, own calculations

To broaden the perspective, Figure B3 compares government infrastructure investment not only to GDP but also to total government investment and total government expenditure. Infrastructure investment is the dominant component of overall government investment in Japan, with a share of some 55 percent. In Europe and in the United States that share is lower at between 30 and 40 percent. In relation to total government spending infrastructure investment accounts for 6 percent in Japan, roughly half of that ratio in NMS and the United States, and one-quarter in EU-15.

Figure B3. Government investment in "Economic Affairs" (2004, in percent)



Source: Eurostat, OECD, own calculations

In sum, while on a downtrend, government infrastructure investment remains relatively much more dominant in Japan than in Europe or the United States. Especially in the old member states of the EU infrastructure investment is at a relatively modest level. That is, however, not necessarily bad; to assess the economic (sub-) optimality of the current levels of government infrastructure investment one would need to know how productive such investment is.

It is not straightforward to decompose government infrastructure investment.

The decomposition of government investment in "Economic Affairs" is no straightforward matter. In principle, there exists a further breakdown of aggregate government investment by function of government. The first-level breakdown presented in Section 2 is supplemented by a second-level breakdown, comprising more narrowly defined "functions" such as transport. However, submission of data according to the second-level breakdown by national statistical agencies to Eurostat is voluntary, and only a few countries have so far provided such data.[6]

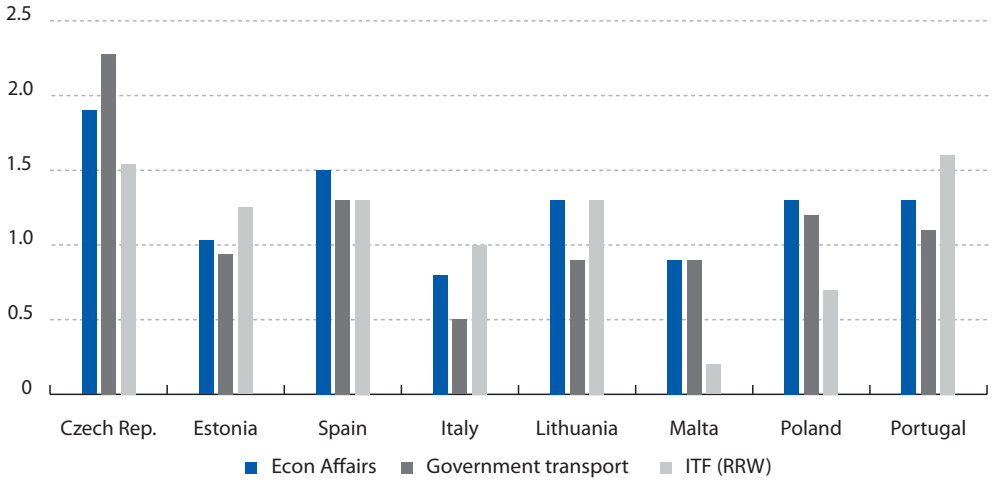
To decompose government investment in "Economic Affairs" we therefore have to rely on proxies. This will obviously limit the comparability of data across countries and over time which, in turn, means that the results below should be interpreted with some caution. Details about the data sources for constructing proxies and the caveats involved in that exercise are given in the Annex.

6 In addition, some transport-related public investment may not be reported under Transport in Economic Affairs but, instead, under individual government ministries unrelated to transport activities, such as ministries for a certain geographical area. Such investment is excluded from our data.

The share of transport in government infrastructure investment has to be estimated using proxies.

Alongside government investment in "Economic Affairs" as a benchmark, Figure 6 shows the existing "hard data" on government transport investment (level-two breakdown of government investment by function) for the few countries where such data are directly available.[7] Figure 6 also presents our first proxy for government transport investment, based on data from the International Transport Forum (ITF). Those data cover transport investment in road, rail and inland waterways (RRW). A comparison of the ITF data on these three sub-sectors with the "hard data" gives an indication of how good a proxy it is. In principle, we would expect government investment in "Economic Affairs" to be higher than both the ITF-based proxy and the hard data on government transport investment.

Figure 6. Government investment in Economic Affairs; of which transport; and comparison with International Transport Forum data (in percent of GDP, average 2000-05)



Sources: Eurostat, International Transport Forum (ITF)

Two conclusions can be drawn from Figure 6. First, transport accounts for well over 80 percent of government investment in "Economic Affairs" on average. Second, the ITF data on investment in road, rail and inland waterway infrastructure is close to government transport investment on average, with some exceptions. In the case of Portugal the ITF data appear to include a great deal of corporate transport investment (presumably PPP roads) as well, while in Poland and, especially, Malta the ITF data only capture part of government transport investment.

A possibly important discrepancy between the government transport investment and ITF data concerns the railway sector. In many countries railway companies cover the bulk of their operating costs from market sales (passenger and cargo charges), so they are considered corporations and not government-sector units. However, governments frequently extend transfers to railway companies to finance their infrastructure investment. In such cases the ITF data would capture railway infrastructure investment, while our data on government transport investment – which excludes transfers – would not. As a result, the ITF figures would be higher, *ceteris paribus*. We cannot, however, quantify the importance of this source of discrepancy using aggregate data sources.

The second comparison, shown in Figure 7, involves mixing data from two different classifications of functions of government. Government investment in "Economic Affairs" (ESA 95) is compared with a proxy for government transport investment obtained from the classification used in ESA 79,

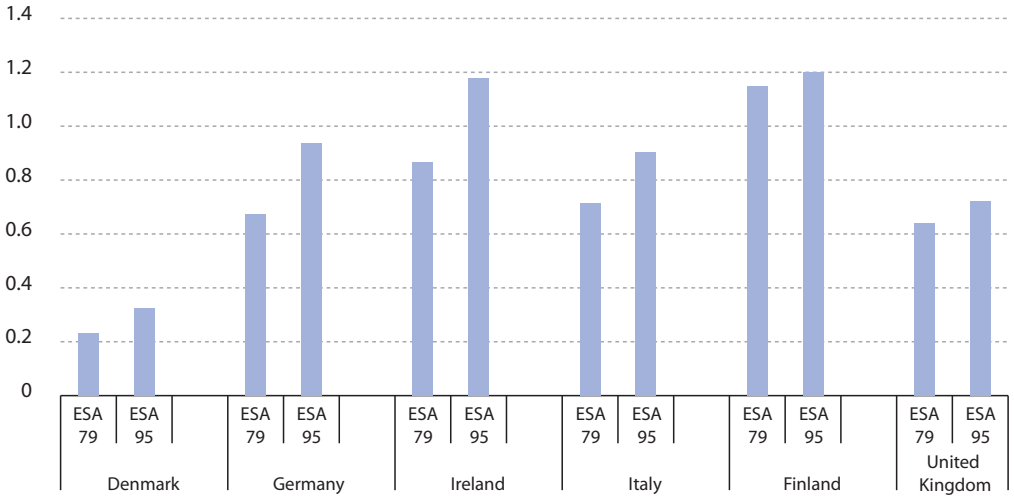
7 As noted earlier, these data exclude infrastructure investment by government-owned corporations financed through government transfers. This is especially relevant in the railway sector.

the predecessor of ESA 95. The functional classification in ESA 79 is described in detail in Section 4; suffice it to say here that it included Transportation and communication as a function in its own right. Given that most investment in communication has even historically been undertaken by the corporate sector, we consider government investment in Transportation and communication from the ESA 79 as a reasonable proxy for government transport investment.

Transport accounts for some 80 percent of government infrastructure investment.

Figure 7 shows a comparison of government investment in Economic Affairs (ESA 95) and government investment in Transportation and communication (ESA 79) for those countries and time periods where both are available for at least three overlapping years. It is, in general, not advisable to mix data based on different accounting standards. Rather than drawing any far-reaching conclusions, we therefore just note, based on Figure 7, that government investment in Transportation and communication in ESA 79 has been for the sampled countries some 70 to 90 percent of government investment in "Economic Affairs" in ESA 95.

Figure 7. Government investment in Transportation and communication (ESA 79) *versus* government investment in Economic Affairs (ESA 95) (in percent of GDP, average 1990-95)



Source: Eurostat, own calculations

Note: Only countries with at least three overlapping observations are included. The observation period is 1991-95 for Germany and 1993-95 for Finland.

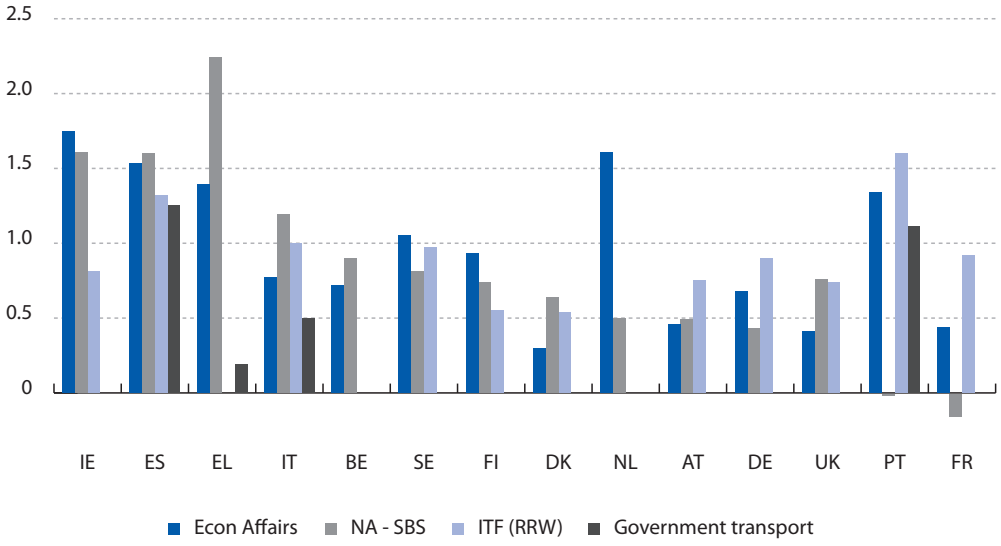
Figures 8 and 9 present a third proxy for government transport investment, as well as a summary comparison of all variables based on ESA 95. Again, government investment in "Economic Affairs" is shown as a benchmark for these proxies. The new proxy – which is available for most EU countries – is obtained by subtracting Transport, storage and communication investment as recorded in the Structural Business Statistics from total economy investment in Transport, storage and communication, as recorded in the national accounts. The former proxies corporate investment in Transport, storage and communication, and if we subtract it from total economy investment, we obtain a proxy for government investment in Transport, storage and communication. Given that most of storage and communication investment is undertaken by the corporate sector, the subtraction described above leaves us with a proxy of government transport investment.

In principle, we would expect that this proxy for government transport investment should be close to the ITF-based proxy as well as hard data on government transport investment for those countries where they are available. All these figures should be smaller than government investment in "Economic Affairs".

In practice, there are only a few countries where these relationships hold exactly. Lithuania comes closest, and there is a reasonable match in Sweden and Finland. There are some striking mismatches for a number of countries – *e.g.*, government investment in "Economic Affairs" falling well short of our proxies for government transport investment in some cases. In addition, the last proxy derived by subtracting Structural Business Statistics data from national accounts data varies much more between countries than any of the other indicators considered, sometimes even turning negative, suggesting that the *caveats* listed in the Annex about the coverage and comparability of these datasets need to be taken seriously.

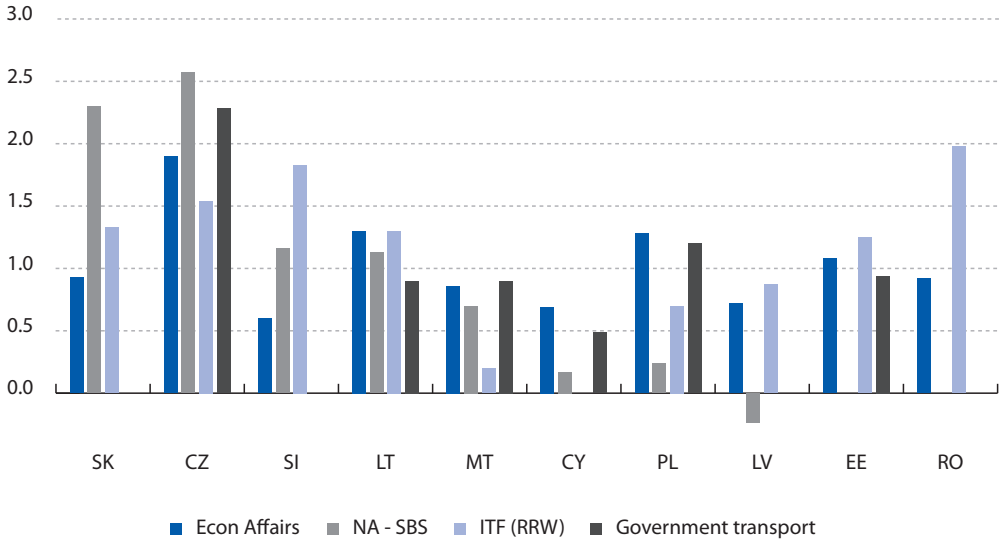
The proxies are subject to caveats.

Figure 8. Proxies for government transport investment, old member states (in percent of GDP, average 2000-05)



Source: Eurostat, ITF, own calculations

Figure 9. Proxies for government transport investment, new member states (in percent of GDP, average 2000-05)



Source: Eurostat, ITF, own calculations

Nevertheless, Figures 8 and 9 suggest some reasonably uncontroversial conclusions. First, transport accounts for roughly 80 percent of government investment in "Economic Affairs". In the countries with hard data on government transport investment, that share is 88 percent. In both old and new member states, the ITF-based proxy is on average higher than government investment in "Economic Affairs" – suggesting the presence of corporate sector transport investment in the ITF data (notably in the railway sector). In countries where the ITF-based proxy is below government investment in "Economic Affairs", it amounts to good 70 percent of the latter. The proxy derived by subtracting Structural Business Statistics data from national accounts data is on average quite close to government investment in "Economic Affairs" in both old and new member states. Considering only countries with this proxy below government investment in "Economic Affairs", their average share is about 60 percent.

Second, the level of government transport investment varies by country groups, with individual cohesion countries in the range 1 – 1.5 percent of GDP; other old member states at 0.5 – 1 percent of GDP, and new member states at 0.5 – 2 percent of GDP.

In other words, the share of transport in overall government investment is on average and roughly speaking one-quarter in the old member states of the EU; one-third in the cohesion countries; and between one-quarter and one-third in the new member states.

Transport accounts for one-quarter to one-third of overall government investment.

In a way to conclude this section, Box 4 seeks to put the estimated government transport investment into perspective and relate it to overall transport infrastructure investment in Europe. Linking back to the Venn diagram in Figure 1, Box 4 seeks to relate the intersection A to overall transport infrastructure investment.

Box 4. Government investment in overall transport infrastructure investment

A key conclusion of Section 3 is that transport accounts on average for some 80 percent of government investment in "Economic Affairs". The aim of this box is to put that finding in a broader perspective by relating government transport investment to overall transport investment in EU member states.

The task is obviously not straightforward and involves a few courageous assumptions and cutting some corners. The first assumption is that transport does indeed account for 80 percent of government investment in "Economic Affairs" in all EU countries. This assumption allows us to calculate country-specific estimates for government transport investment.

Estimating overall transport investment in each country is more complicated. As mentioned in the main text, the national accounts statistics lump investment by the transport sector together with storage and communication investment. While the ITF data are well-focused on transport investment, they are for many countries a better proxy for government than overall transport investment. And the investment data in the Structural Business Statistics has the same drawback as all data that are based on a sectoral classification: They measure all investment, not just investment in transport infrastructure assets, by all companies who report transport sector as their main activity.

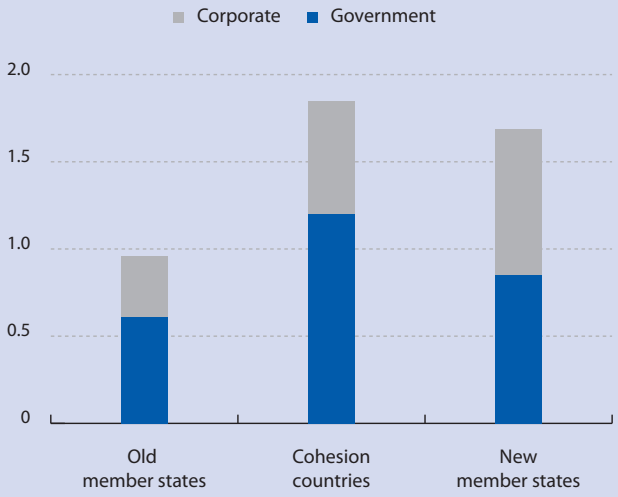
To get an estimate of total economy investment in transport infrastructure, we adopt a different perspective and consider the production of, rather than investment in, transport infrastructure. The Structural Business Statistics report for each country the annual "production value" of a sample of companies whose main activity is in the construction of transport

infrastructure. This production value serves as a proxy for gross capital formation in transport infrastructure assets.

This estimate is, of course, subject to major *caveats*. First, we cannot know how well the reported production value of, *e.g.*, road construction companies, proxies the formation of road assets. Second, the data cover the construction and, to some extent, maintenance of highways, roads, railways, airfields, waterways, ports as well as sports facilities but not, *e.g.*, bridges and tunnels. So the difference between sports facilities (which we would wish to exclude) and bridges and tunnels (which we would wish to include) introduces an error to the estimate.

Bearing these caveats in mind, Figure B4 shows our best estimate of government transport investment in relation to the construction value of transport infrastructure.

Figure B4. Construction value of transport infrastructure assets and estimated government sector share therein (GDP-weighted averages 2000-05, in percent of GDP)



Source: Eurostat, own calculations
Note: Old member states include Austria, Belgium, Finland, France, Italy, Luxembourg, the Netherlands, Portugal, Spain and the United Kingdom. Cohesion countries include Portugal and Spain. New member states include Cyprus, Estonia, Latvia, Lithuania, Malta, Poland, Romania, the Slovak Republic and Slovenia.

As regards the construction value of transport infrastructure, we see that at some 1 percent of GDP on average, the old member states are well below the cohesion countries (1.8 percent of GDP) and the new member states (1.7 percent of GDP).

The share of the government sector is above 60 percent in the old member states and cohesion countries, while it is at 50 percent in the new member states. These differences reflect differences in assets built (railways tend to be government while airports or ports are more often private), and also differences in the institutional set-up for providing infrastructure assets. Take Austria, where the government share is lowest among the old member states (30 percent). The Austrian network of motor- and expressways is controlled by ASFINAG, which is state owned but classified outside the government sector. Investment by ASFINAG would therefore be recorded as corporate sector investment and not part of government transport investment, explaining the seemingly low share of government in overall transport infrastructure investment.

4. Composition of government investment and government infrastructure investment pre-1990s

Comparisons over time are complicated by changes in national accounting standards.

This section presents developments in the composition of government investment in a longer time perspective, again with a special focus on transport. As explained in Section 2, the system of national accounting changed in 1995, so we need to resort to the previous version of the European System of Accounts, ESA 79, to discuss pre-1995 developments. To maximise the comparability of the discussion in this section with Sections 2 and 3, we start by replicating our aggregation in Section 2 using ESA 79 data. The functional breakdown in ESA 79 includes a separate category labelled Transportation and communication, which facilitates our analysis of government transport investment. In describing the evolution of the composition of government investment and the share of transport in it, we focus on the four biggest EU member states (France, Germany, Italy and the United Kingdom) and the period 1977-1993. To conclude this section, we consider observed changes in government (transport) investment in view of broader fiscal policy developments.

4.1 Composition of government investment

The functional classification of government expenditure in ESA 79 was slightly different from that presented in Section 2. Table 2 below augments Table 1 by adding the classification of functions of government in ESA 79.

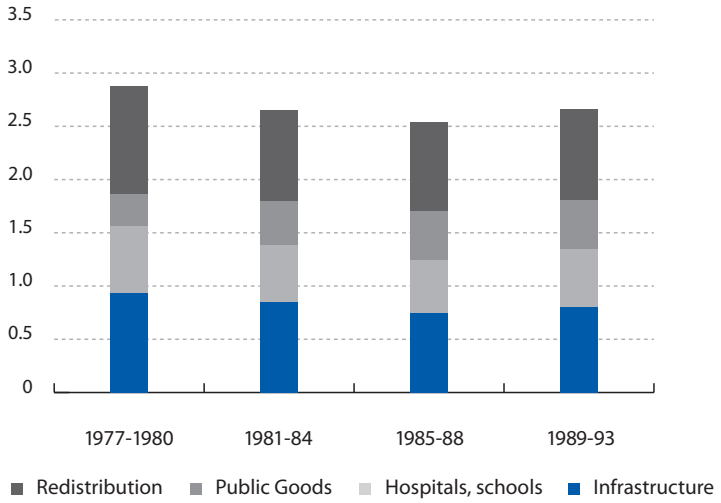
Table 2. Functional breakdown of government investment, ESA 95 and ESA 79

Aggregation	ESA 95 COFOG	ESA 79 COFOG
1. Infrastructure	Economic Affairs	Agriculture, forestry, hunting and fishing Fuel and energy affairs and services Mining and mineral resource Transportation and communication Other economic affairs and services
2. Hospitals and schools	Health Education	Health affairs and services Education affairs and services
3. Public Goods	Defence General Public Services Environment Order and Safety	General public services Public order and safety affairs Defence affairs and services Expenditures not classified by major group
4. Redistribution	Housing Recreation Social Protection	Housing and community amenity services Recreational Social security and welfare services

Source: Eurostat, own aggregation

Following this classification, Figure 10 depicts the level and composition of government investment in the four biggest EU member states for the period 1977-1993. The bars represent four-year averages of the components of government investment, expressed as percentage shares of GDP.

Figure 10. Composition of government investment in France, Germany, Italy and the United Kingdom (in percent of GDP)



Source: Eurostat, own calculations

The level of government investment, measured relative to GDP, was consistently above 2.5 percent during this sample period. It decreased slightly over the twelve years till 1988 from 2.9 percent to 2.5 percent, but nearly half of this decrease was recovered later on. At a first glance, what declined most was government investment in infrastructure and hospitals and schools. Their combined share first declined from 1.56 to 1.24 percent, only to increase to 1.35 percent by 1993.

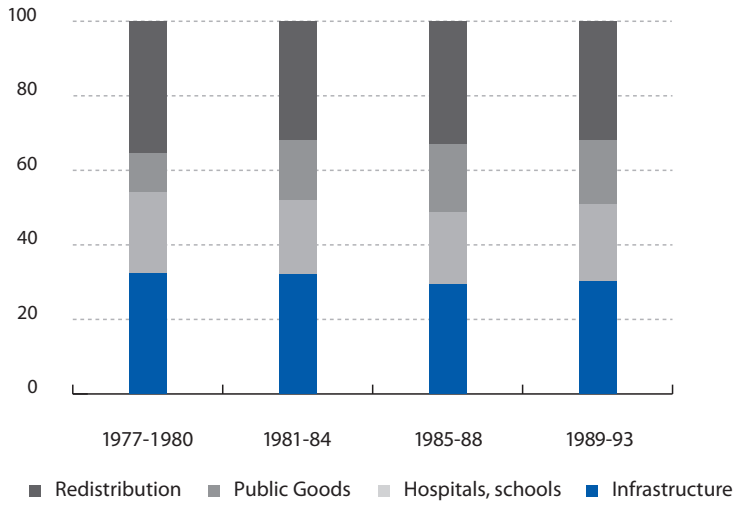
The other two categories of government investment moved consistently in one direction over the sample period. Government investment in redistribution declined from 1 percent of GDP in the first four years to 0.8 percent thereafter, while investment in public goods expanded throughout the sample period from 0.3 to 0.45 percent of GDP.

The shares of infrastructure and hospitals and schools have remained stable.

Figure 11 shows the shares of the four types of government investment in total government investment. The shares of infrastructure and hospitals and schools have remained stable at about 30 and 20 percent, respectively, ever since the late 1970s. This implies that changes in both these components have followed those in overall government investment. The shares of the other two types of government investment, however, have undergone larger changes. While the share of investment in public goods rose steadily from 10 to 17 percent between the late 1970s and early 1990s, the share of government investment in redistribution registered a decrease of 4 percentage points – the largest among the four categories.

Government investment in redistribution decreased largely due to developments in the United Kingdom, while investment in public goods rose mainly in France and Italy. Box 5 provides further details on the contributions of each of the four countries to the aggregate developments shown in Figures 10 and 11.

Figure 11. Composition of government investment in France, Germany, Italy, and the United Kingdom (in percent of total government investment)

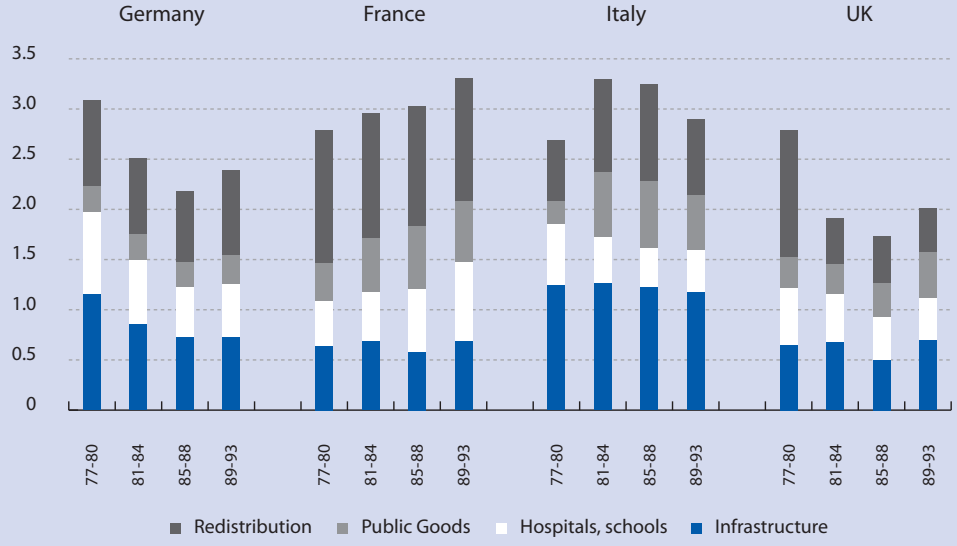


Source: Eurostat, own calculations

Box 5. Country-by-country developments in the composition of government investment

This Box considers differences between the four countries in terms of the composition of government investment. Figure B5 replicates Figure 10 but disaggregated by country.

Figure B5. Composition of government investment (in percent of GDP)



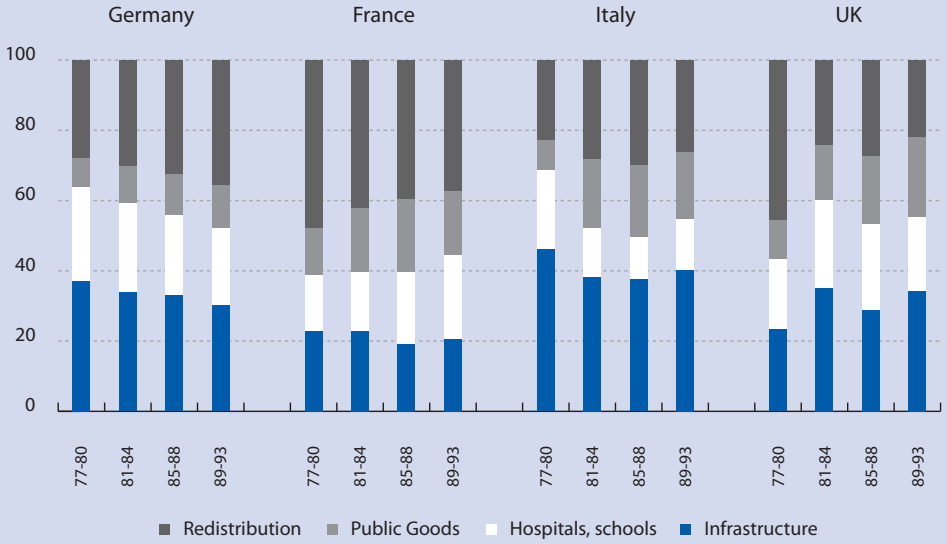
Source: Eurostat, own calculations

Overall government investment declined in Germany and the United Kingdom but increased in France and Italy. Government investment in infrastructure and hospitals and schools combined declined markedly in Germany and slightly in the United Kingdom, thanks to a rebound in the early 1990s. In France and Italy infrastructure investment stayed stable, while investment in hospitals and schools boomed in France but shrank in Italy.

The share of public goods investment in GDP was stable in Germany, while it increased especially in France and Italy. Government investment in redistribution came down dramatically in the United Kingdom during the early 1980s. In the other three countries developments were more mixed.

Figure B6 below replicates Figure 11, showing the shares of the components of government investment in overall government investment.

Figure B6. Composition of government investment (in percent of total government investment)



Source: Eurostat, own calculations

Notably, the share of infrastructure investment dropped from almost 40 to 30 percent in Germany, while increasing from 25 to 35 percent in the United Kingdom, thanks to the rebound in the early 1990s. There were significant changes in the share of hospitals and schools in France (up) and Italy (down). The share of investment in public goods increased in all countries apart from Germany. In France and the United Kingdom, this happened at the expense of government investment in redistribution, while in Italy the share of investment in hospitals and schools bore the adjustment.

4.2 Government investment in transportation and communication

This subsection zooms in on government transportation investment, seeking to provide a longer time perspective to the discussion in Section 3. As noted earlier, the ESA 79 accounts documented government investment in Transportation and communication as a separate item. As the bulk of communication investment (especially telecommunications) is recorded as corporate sector

investment in national accounts and not as government-sector investment, we regard government investment in Transportation and communication as a good proxy for government transport investment.

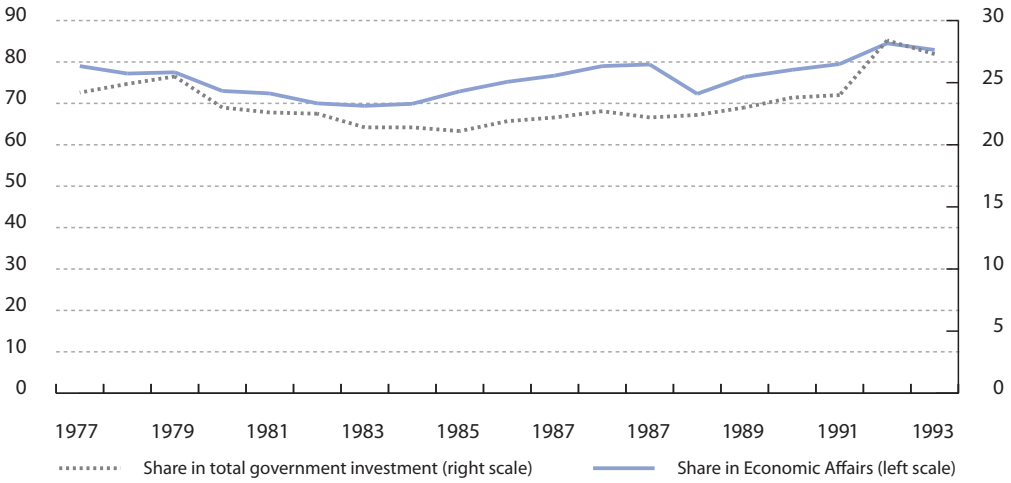
Recall that Section 3 found, based on proxy variables, that government transport investment accounted for some 80 percent of government investment in "Economic Affairs" (infrastructure). We now wish to ascertain whether that share has been stable over a longer time horizon or whether there have been some longer term trends or structural breaks.

Transport has maintained its relative share in government investment.

Figure 12 depicts the percentage share of government investment in Transportation and communication in government infrastructure investment for the four biggest European economies (solid line). During the whole period this share fluctuated between 70 and 80 percent. There are no obvious long term trends or structural breaks.

The aggregate share shown in Figure 12 hides some differences between the individual countries (not illustrated). The share of Transportation and communication in government infrastructure investment trended down in Italy and up in the United Kingdom. In Germany the share was flat with little volatility, while in France there was considerable volatility without a discernable trend.

Figure 12. Government investment in Transportation and communication in France, Germany, Italy and the United Kingdom (shares in percent)



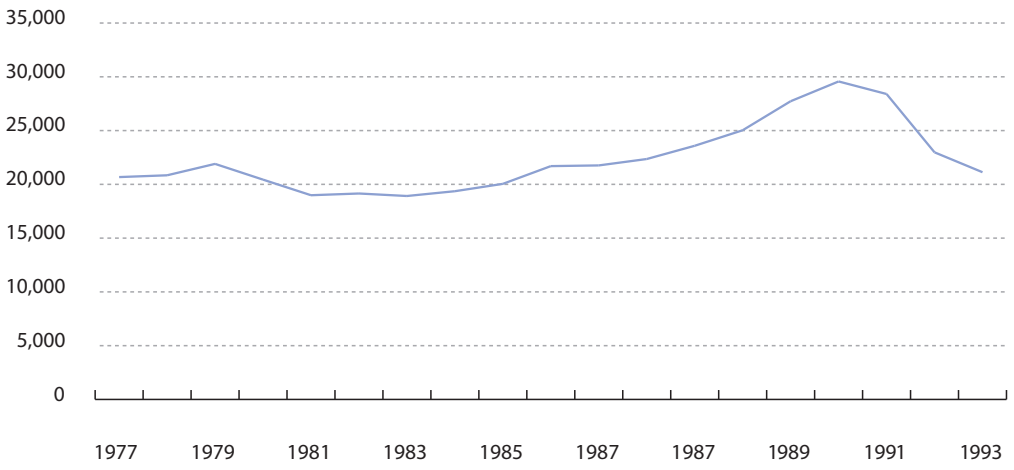
Source: Eurostat, own calculations

Figure 12 also depicts the percentage share of government investment in transportation and communication in total government investment (dotted line). It has moved in the band of 21-26 percent, again with no obvious long term trend or structural break.

Again, developments differ across individual countries. Consistent with Box 5 (showing the share of infrastructure in overall government investment) and the description of the share of Transportation and communication in government infrastructure investment, the following can be concluded about the share of Transportation and communication in overall government investment. In Germany, Transportation and communication steadily lost ground in overall investment. There was a downtrend in Italy, too, albeit shallower. In France the share of Transportation and communication in overall government investment was stable, while it was on an uptrend in the United Kingdom.

Finally, let us consider the evolution of government investment in Transportation and communication in real terms, abstracting from fluctuations in other comparator variables. Figure 13 plots aggregate government investment in transportation and communication in the four countries in constant 1995 prices. The figure shows that real government transportation investment remained reasonably stable throughout most of the 1980s. In the late 1980s, it started to grow strongly, increasing by 40-50 percent in real terms in just a few years. The main reason for this increase was German reunification, which both caused a level shift in the series (by adding government investment in the former GDR) and contributed to the uptrend (by inducing growth in government investment). Note, however, that this structural break does not show up in the ratios discussed earlier, which implies that the level shift and uptrend were of at least similar relative magnitudes in infrastructure and overall government investment.

Figure 13. Government investment in Transportation and communication in France, Germany, Italy, and the United Kingdom (millions of 1995 euros)



Source: Eurostat, own calculations
Note: Deflator for aggregate gross fixed capital formation has been used.

To sum up, the key findings concerning the relative shares of government infrastructure and transport investment in a longer time perspective are as follows:

At the aggregate level both infrastructure in general and transport in particular have retained their shares in the past decades, moving alongside overall government investment without any clear time trends or structural breaks. To put it differently, transport and infrastructure investment have not grown much faster or more slowly than other types of government investment taken together.

There have been marked differences between individual countries.

Developments in individual countries have, however, differed. Most importantly, transport investment and infrastructure investment have both lost ground in Italy. In contrast, both have been on an uptrend in the United Kingdom. In Germany, transport has retained a stable share in infrastructure investment; however, the share of infrastructure in overall government investment has declined. In France, there have been no clear trends.

4.3 Changes in fiscal position and government transport investment

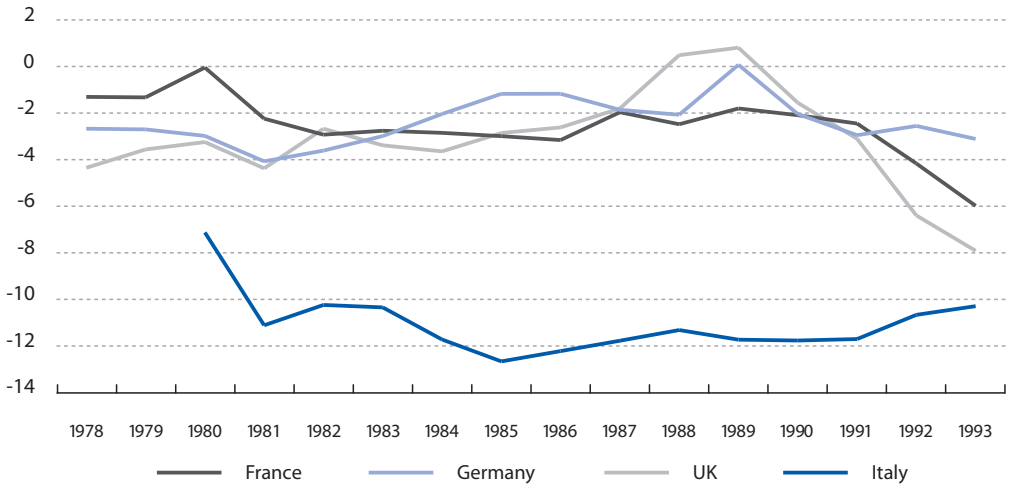
Has transport investment reacted to fiscal-policy swings differently from other government investment?

To conclude this section, we broaden the perspective and link the movements in government investment in general and transport in particular to changes in overall fiscal positions. This serves to asses whether government transport investment played a role in fiscal policy swings that is somehow different from the rest of government investment.

The scope of this analysis is quite modest. We do not attempt to decompose changes in overall fiscal positions into their discretionary or cyclical components, so we cannot draw any conclusions about the contributions of government (transport) investment to different types of fiscal swings.[8] In other words, we cannot say, based on what is to come, whether government (transport) investment swung more during episodes of discretionary consolidation or in cyclical fluctuations. Rather, we simply consider ups and downs in the overall fiscal position and compare the magnitude of such changes to the magnitude of simultaneous changes in government investment. We zoom in on government transport investment in order to see whether it has behaved somehow differently from overall government investment.

To start with, let us depict the evolution of overall fiscal positions in the four biggest EU member states during 1978-93 (Figure 14). The fiscal position improved in Germany and the United Kingdom throughout the 1980s, while worsening in France and Italy.

Figure 14. Net borrowing (-)/ Net lending (+) (in percent of GDP)



Source: Eurostat, own calculations

Based on the data underlying Figure 14, we can calculate annual changes in the overall fiscal position in each of the four countries. We then calculate the annual changes in government (transport) investment and relate them to the changes in the overall fiscal position. This gives us a measure of the contribution of government (transport) investment to changes in the overall fiscal position.

8 There have been attempts to consider the link between fiscal consolidations and public investment; as surveyed by Serven (2007), it is something like conventional wisdom to consider that fiscal consolidations affect public investment disproportionately.

Table 3 shows such contributions of both government transport investment and of overall government investment. The signs in the table show whether a change in government (transport) investment supported or counteracted the change in the fiscal balance. A positive sign signals support, that is, a decrease in investment when the fiscal balance improves or an increase in investment when the fiscal balance deteriorates. A negative sign denotes the opposite: Investment increases (decreases) while the fiscal balance improves (worsens).

Take Germany as an example. Government transport investment contributed on average 5 percent to a change in fiscal balance (column 2), with transport investment increasing at times of fiscal improvement and contributing -9 percent to the improvement (column 3). During episodes of fiscal worsening, government transport investment grew as well, contributing on average 17 percent to the worsening (column 4). As regards total government investment, its contributions were -27 percent to fiscal improvements (that is, government investment increased) and 64 percent to worsening (again, government investment increased).

Table 3. Contribution of government (transport) investment to changes in fiscal balance (in percent of the change in fiscal balance, 1973-95)

	Government investment in Transportation and communication			Total government investment		
	Average	Fiscal improvement	Fiscal worsening	Average	Fiscal improvement	Fiscal worsening
Germany	**5**	**-9**	**17**	**23**	**-27**	**64**
Observations	*23*	*11*	*12*	*23*	*11*	*12*
France	**6**	**10**	**4**	**-41**	**-221**	**32**
Observations	*16*	*5*	*11*	*16*	*5*	*11*
Italy	**9**	**9**	**9**	**30**	**28**	**31**
Observations	*16*	*4*	*12*	*16*	*4*	*12*
United Kingdom	**-14**	**-31**	**3**	**-38**	**-96**	**17**
Observations	*18*	*9*	*9*	*18*	*9*	*9*

Source: Eurostat
Note: Contributions are expressed in percent of change in the overall fiscal position. Data for Germany include ex-GDR from 1991.

Government transport investment has not consistently followed the ups and downs of fiscal balances.

With this interpretation of Table 3 in mind, we conclude that government transport investment followed the ups and downs of the fiscal balances only in France and Italy. It increased in Germany and the United Kingdom regardless of the direction of change in the fiscal balance. However, the magnitude of increase (relative to the change in the fiscal position) in Germany was greater whenever the fiscal position worsened, while in the United Kingdom, government transport investment increased much more strongly whenever the fiscal balance improved.

We must be careful in not interpreting these co-movements as pro- /counter-cyclical or as supporting/counteracting fiscal consolidation or relaxation efforts. In the absence of any knowledge about the source of changes in the fiscal balance (structural, cyclical, one-off, random) we cannot assess the specific role of government (transport) investment.

The magnitudes of the contributions, mostly around 10 percent, seem small at the outset – but are they really? To make a judgement we consider the contributions of transport in relation to the contributions of total government investment, also shown in Table 3.

In considering the relative contributions of transport and total government investment to changes in the fiscal balance, we focus on episodes where the fiscal balance has improved. We know from Figure 12 that transport accounted, on average, for about one-quarter of total government investment. That share varied a little from country to country, with France at 15 percent and the other three countries at or above 25 percent.

Take first Germany and the United Kingdom, where government transport investment increased even at times of fiscal improvement. In both countries also overall government investment increased when their fiscal positions improved. The increase in transport, relative to the improvement in the fiscal position, was in both cases exactly one-third of the increase in overall government investment. As the share of transport in overall government investment was smaller (around one-quarter), we can conclude that transport was not disadvantaged relative to other government investment at times of fiscal improvement.

Then consider France and Italy, where transport declined when the overall fiscal position improved. In France, government transport investment contributed some 10 percent to the fiscal improvement, while other government investment actually increased. In Italy, both transport and other government investment contributed to the improvement, with transport accounting for one-third of the contribution of total government investment.

To sum up, we can consider the behaviour of government transport investment in a broader fiscal perspective by two measures: First, did it move up and down with the fiscal balance and, second, were its movements "small" or "large" compared to other government investment at times of improving fiscal positions. In Germany and the United Kingdom, transport kept growing throughout, keeping pace with other government investment even at times of fiscal improvement. In France and Italy transport investment followed the ups and downs of the fiscal balance; however, in France transport contributed to fiscal improvements more than other government investment, while in Italy the contribution of transport investment was broadly in line with its weight in total government investment.

All in all, government transport investment has not consistently followed the ups and downs of fiscal balances. Also, it has not been the case that government transport investment has consistently carried a disproportionate burden at times of improving fiscal balances. Whether the reaction of government transport investment in times of especially structural improvement in fiscal balances (discretionary fiscal tightening) is somehow different from other types of public investment cannot be assessed based on the analysis above; that we leave to future research to tackle.

Government transport investment has not carried a disproportionate burden at times of fiscal improvement.

5. Conclusions

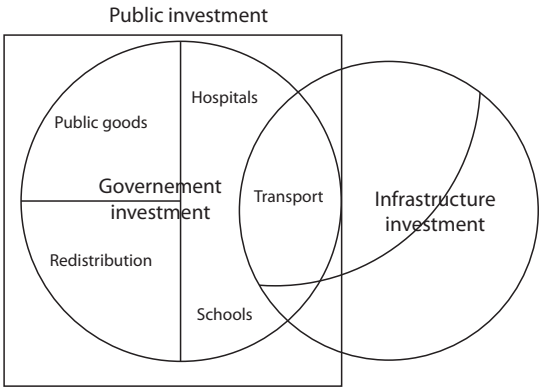
To clarify misconceptions about what government investment is and what it is not, this paper has sought to decompose it by economic function; specifically, it has sought to depict the share of infrastructure in general and transport infrastructure in particular in overall government investment and to describe changes over time in those shares.

The key findings of our forensic investigation are as follows. In rough terms infrastructure accounts for one-third of government investment in the EU; in the cohesion countries that share is higher at 40 percent. Add to that government investment in hospitals and schools and half of overall government investment is accounted for. The other half comprises investment in public goods (such as military installations) and redistribution (social housing, municipal swimming pools and the like).

Within government infrastructure investment, as much as 80 percent represents transport, chiefly road. In other words, the share of transport in overall government investment is on average and roughly speaking about one-quarter in the old member states of the EU; one-third in the cohesion countries; and between one-quarter and one-third in the new member states.

Based on these results, we can reproduce the Venn diagram in Figure 1 with additional detail and more precision. The relative sizes of the subsets of government investment in Figure 15 are indicative of EU average.

Figure 15. Composition of government and infrastructure investment in a Venn diagram



Transport and other infrastructure investment did not grow much faster or more slowly than other types of government investment.

Considering government transport investment in a longer time perspective, there have not been any major trends or structural breaks, at least at the aggregate level. Both infrastructure in general and transport in particular retained their shares throughout the 1980s, moving alongside overall government investment without any clear time trends or structural breaks. To put it differently, transport and infrastructure investment did not grow much faster or more slowly than other types of government investment taken together.

In a broader fiscal perspective, government transport investment has not consistently followed the ups and downs of fiscal balances, nor has it consistently carried a disproportionate burden at times of generally improving fiscal balances. Whether especially discretionary fiscal tightening has affected government transport investment differently from other government investment remains to be examined in future research.

In conclusion, government transport investment has not, over the past decades, suffered from excessive swings, slides or sudden stops – at least relative to other types of government investment. Whether that has been economically optimal or not is an altogether different issue, to be addressed elsewhere.

Government transport investment has remained stable – which may or may not have been optimal.

Annex: Data sources and *caveats*

To construct proxies for government transport investment in Section 3, we use the following sets of data:

Data on transport infrastructure investment from the International Transport Forum (ITF).[9] ITF compiles and publishes data broken down by transport mode (road, rail, inland waterways, ports, airports). The data originate from relevant government ministries and vary from country to country in terms of coverage (*e.g.*, to what extent corporate investment or local government investment is included).

Historical data on government investment through 1995, based on the European System of Accounts, version 1979 (ESA 79). In ESA 79 the breakdown of government investment included Transportation and communication as a separate category.

National accounts data (as reported by Eurostat in its New Cronos database[10]) broken down by NACE sector of economic activity. These data provide us with total economy investment, without making a distinction between the government and corporate sectors. Moreover, the lowest level of aggregation lumps together the transportation sector with communication and storage, with no further breakdown available. Also, the data cover all investment by the sector, not only investment in infrastructure assets and their maintenance.

Structural Business Statistics, also available through New Cronos, reporting investment[11] by a sample of surveyed enterprises whose main sector of activity is Transport, storage or communication – including infrastructure. In other words, the sectoral breakdown of Structural Business Statistics follows the same NACE classification as national accounts statistics, and the same *caveats* apply to both sets of data.

There are different sources of *caveats* involved in constructing proxies based on these data sets. There are issues related to changes in accounting standards over time (ESA 79 *versus* ESA 95); breakdowns by institutional sector (government *versus* corporate); and breakdowns by sector of economic activity (transport alone *versus* an aggregate of transport, storage and communication). In addition, some of the datasets report investment by economic sector (*e.g.*, all investment by enterprises in the transport sector), while others, notably ITF report investment in infrastructure assets and their maintenance in the transport sector (roads, rail tracks, inland waterways, seaports, airports).

What is the significance of these *caveats* for estimating the share of transport in government investment in "Economic Affairs" in Section 3? First, although the change in accounting standards from ESA 79 to ESA 95 created the aggregate "Economic Affairs" that we try to disentangle, the fact that a few countries reported a breakdown of their government investment according to both standards for a number of years in the early 1990s is actually helpful for us. Second, the lack of a breakdown by institutional sector can be circumvented by assuming that the Structural Business Statistics represent investment that in the national accounts would be classified as investment by the corporate sector. This assumption seems justified, as the Structural Business Statistics are based on enterprise surveys, and as the bulk of state-owned enterprises in the transport sector, such as

9 The ITF data are available through: http://www.internationaltransportforum.org/.

10 Available through: http://epp.eurostat.ec.europa.eu/portal/page?_pageid=1090,30070682,1090_33076576&_dad=portal&_schema=PORTAL.

11 The reported variable is "investment in tangible goods", as opposed to gross (fixed) capital formation in the national accounts statistics.

railway companies, cover most of their costs through market sales and are therefore considered corporations, not government sector entities.

Furthermore, it is plausible to assume that most investment in storage and communication is corporate rather than government; hence, the lumping together of transport, storage and communication in the NACE sectoral breakdown need not introduce an insurmountable obstacle. Under this assumption, most economy-wide investment in storage and communication would be captured by the Structural Business Statistics, so simply subtracting the Transport, storage and communication investment in Structural Business Statistics from that in the national accounts should in principle give us a reasonable approximation of government transport investment.

Finally, consider the *caveat* concerning the mixing of investment by sector and by asset type. Take road: The government sector is dominant in investing in road infrastructure, while most other investment (transport equipment) would be recorded in the corporate sector. In other words, the bulk of government transport investment comprises infrastructure assets, while corporate transport investment is much more a mixture of equipment and, for some modes of transport, also infrastructure assets (seaports, airports). This means that data focussing on infrastructure assets (such as the ITF data) should be a reasonable match for government investment data, while the mixture of infrastructure and other assets in the national accounts and Structural Business Statistics should not pose a major problem, as most of such mixture would be netted out when subtracting the latter from the former.

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ABSTRACT

This paper presents new estimates for 21 OECD countries covering the period 1960-2001, focusing on two questions: To what extent does the impact of public capital on output differ across countries? And to what extent does it differ over time? *Using vector autoregressions (VARs), we find that in some countries a shock to public capital has a positive long-run impact on GDP while in others the long-run impact is zero or even negative. We also find that variability of public capital and its long-run impact on output are negatively correlated. Furthermore, when the public capital stock is large relative to the private capital stock the long-run impact of public capital is lower. Our results on 'recursive' VARs suggest that in the majority of countries the effect of a public-capital shock on output has decreased over time. Countries where the impact of public capital decreased during the 1990s have a declining public-capital-to-GDP ratio, and vice versa. Estimates based on a panel VAR for the OECD area confirm the declining long-run impact of public capital.*

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Time-varying impact of public capital on output: New evidence based on VARs for OECD countries

1. Introduction

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It is hard to imagine a well-functioning economy without public capital. While public capital is necessary for modern economies to function, it may not be the case that more public capital causes more growth at all stages of development. Indeed, in their survey Romp and De Haan (2005) report that even though the findings of recent studies on the impact of public capital on output are less dispersed than those of older studies, there is still quite some variety in the findings, particularly as to the magnitude of the effect. In other words, the literature supports the notion that public capital matters but it cannot serve to unequivocally argue in favour of more or less public investment (Estache and Fay 2007).

The variety of findings is, in fact, unsurprising. There is no reason to expect the effect of public capital to be constant (or even systematically positive) over time or across countries. Furthermore, estimating the impact of public capital on output is a complicated endeavour, and papers vary in how carefully they deal with pitfalls, like endogeneity and lack of sufficiently long time series of high-quality data (Estache and Fay 2007).

Various authors have tried to determine the productivity effects of public capital by estimating a Cobb-Douglas production function that includes public capital as an input. Aschauer (1989) was one of the first to use this approach for the United States in an attempt to explain the productivity slowdown of the 1970s. He found that a one-percent increase in the public capital stock increases private capital productivity by 0.39 percent, suggesting that public capital is an important determinant of production. Since then, many authors have employed this approach (see Romp and De Haan 2005). However, while public capital may affect productivity and output, economic growth can also shape the demand and supply of public capital services, which is likely to cause an upward bias in the estimated returns to public capital.

To deal with the interaction between output, public capital, and private capital, Vector Auto Regression (VAR) models have been proposed. The VAR approach sidesteps the need to specify a structural model by modelling every endogenous variable as a function of its own lagged values and the lagged values of the other variables in the system. VAR models have a number of advantages over structural approaches such as the production function approach (Kamps 2004). First, VAR models do not impose any causal links between the variables *a priori* but allow testing whether the causal relationship implied by the production function approach is valid or whether there are feedback effects from output to inputs. Second, the VAR approach allows for indirect links between the variables in the model. In the VAR approach, the long-run output effect of a change in public capital results from the interaction of all the variables in the model. For example, public capital may not only directly affect output but may also have an indirect impact on output *via* its effects on the private factors of production. Third, the VAR approach does not assume that there is at most one long-run relationship among the variables in the model.

This paper first offers a survey of recent research on the impact of public capital on output in which VAR models are used. After identifying the major steps that have to be taken in deciding on the specification of a VAR, we come up with new estimates for 21 OECD countries covering the period 1960-2001. We focus on two important questions. First, to what extent does the impact of public capital differ across countries? Second, to what extent does it differ over time?

In some countries a shock to public capital has a positive long-run impact on GDP, in others the impact is zero or even negative.

We apply two approaches in this paper. The first approach is based on the work by Kamps (2004) who estimates VAR models for individual OECD countries. Our analysis differs from Kamps (2004) as we do not use employment as our measure for labour input but the number of hours worked. It turns out that this choice leads to rather different results than those reported by Kamps (2004). While in some countries a shock to public capital has a positive long-run impact on GDP, in others the long-run impact is zero or even negative. We find no evidence of a systematic relationship between the size of the capital stock (relative to GDP) and the long-run impact of public capital in a cross-section of OECD countries. However, we do find a negative relationship between the ratio of public capital to private capital and the estimated long-run impact of public capital. Moreover, we find that the variability of the public capital stock and the estimated long-run impact of public capital on output are negatively correlated.

Using so-called 'recursive VARs', in which the period of estimation is increased by one year in every new regression, we examine whether the impact of public capital on output has changed over time. It turns out that for many countries the relationship is not constant. Three groups can be distinguished: In some countries the effect of public capital has increased, in some others it has been relatively stable, but in the majority of countries the effect of a public-capital shock on output has decreased over time. We find that these trends depend on the change in the public capital stock. That is, countries where the impact of public capital on output increased during the 1990s have an increasing public-capital-to-GDP ratio, while countries with a negative trend in the long-run impact of public capital on output saw this ratio decline.

The second approach that we apply is a panel VAR model. An important motivation is the relatively short time span covered by the data for individual countries. The outcomes of VARs are known to be less reliable if based on short time series. Although we use the most comprehensive data set currently available, the period covered by these data may still be too short. The results of the VAR models estimated at the country level should therefore be treated carefully. As an alternative, we also estimate a panel VAR model, which better allows addressing our second research question, *i.e.*, whether there is a time-varying effect of public capital on output. For this purpose we estimate a 'rolling' panel VAR and find that the long-run impact of public capital on output has clearly declined over time.

The remainder of the paper is structured as follows. Section 2 summarizes recent VAR studies on the relationship between public capital (or public investment) and economic growth. Section 3 presents our estimates of a similar model as that of Kamps (2004), while Section 4 contains the 'recursive VARs' and the estimation results for the panel VAR. Section 5 offers some concluding comments.

2. Using VARs to examine the impact of public capital on economic growth

A vector autoregression is modelled as:[1]

$$z_t = A(L)z_t + u_t \tag{1}$$

where z_t is a vector of endogenous variables, $A(L)$ is a matrix of polynomial order p, and u_t is a vector of reduced form errors. Before one is able to estimate a VAR model to analyse the impact of public capital on output, various choices need to be made. First, what is the sample period under consideration? Second, which variable will be used for public capital? Third, which other variables

1 For simplicity of exposition we only show endogenous variables in the equations.

will be included? Fourth, how should the model be estimated? Fifth, how many lags should be included? Sixth, how should the model be identified? And finally, how to calculate the impact of public capital on output?

With respect to the choice of the sample period, there is a trade-off: The longer the sample period is, the more degrees of freedom are available for estimation, but the larger the probability that the parameters will not be constant. More degrees of freedom can be gained by employing higher frequency data, but many series – notably government capital – are only available at an annual frequency.

Infrastructure assets' lifespan and depreciation vary a great deal.

Many studies use the stock of public capital. In calculating the stock of public capital on the basis of investment flow data, researchers typically use the sum of the monetary value of past investment, adjusted for depreciation. In applying the so-called perpetual inventory method, the researcher has to make certain assumptions about the assets' lifespan and depreciation. Furthermore, one needs an initial level for the capital stock. Especially with infrastructure these assumptions are far from trivial. There is huge variation in the economic lifespan of different types of infrastructure; the lifespan of a railroad bridge cannot be compared with the lifespan of an electricity line. Usually, the initial stock is calculated by assuming that real investment prior to the sample period was constant at the level for the first observation and that the capital stock was at its steady state at the start of the sample period. With low depreciation rates, the rate of convergence towards the steady state level is low, which requires a long time of constant investment.

As to the number of variables in a VAR model there is a limit: The larger and more complicated a VAR model becomes, the more parameters in the *A(L)* matrices need to be estimated and the more degrees of freedom are used. Hence, there is a trade-off between rich information set for modelling the impact of public capital on economic growth and over-parameterisation of the econometric model.

Estimation of the unrestricted VAR model is easy. The equations of the VAR can be estimated separately by ordinary least squares (OLS). Under general conditions, the OLS estimator of *A* is consistent and asymptotically normally distributed. This result not only holds in the case of stationary variables but also when some variables are integrated and possibly cointegrated (Sims *et al*. 1990). As pointed out by Kamps (2004), various older studies have ignored non-stationarity issues and estimated unrestricted VAR models in levels based on this result. However, Phillips (1998) showed that impulse responses and forecast error variance decompositions based on the estimation of unrestricted VAR models are inconsistent at long horizons in the presence of non-stationary variables. As impulse response analysis is one of the main tools for policy analysis based on VAR models, a careful investigation of the integration and cointegration properties of the VAR system is warranted. Hence, one has to test for the existence, and number, of cointegrating vectors. Many authors have used the Engle-Granger cointegration test for this purpose. However, this test assumes that there is only one cointegrating vector. Furthermore, as it is a Dickey-Fuller test on the residuals of the estimated equation, the low power of this test in small samples is also problematic. As a consequence, the Engle-Granger test may be unable to detect cointegration when it is present in the data (see Kremers *et al*. 1992). Therefore, the approach suggested by Johansen (1988) has often been used.[2]

2 This approach is more vulnerable than the Engle-Granger procedure to the small sample bias toward finding cointegration when it does not exist. This holds especially when variables have long term memory and trending behaviour (Gonzalo and Lee 1998).

This consists of estimating:

$$\Delta z_t = c + \Gamma(L)\Delta z_t + \Pi z_{t-1} + \varepsilon_t \quad (2)$$

and using the trace test and/or the maximum eigenvalue test to determine the number of cointegrating vectors. The cointegration rank, *i.e.*, the rank (Π) = r, determines whether or not cointegration is present. In case of four variables, there is cointegration if $0 < r < 4$. Johansen (1988; 1991) suggests two possibilities to determine the number of cointegrating vectors: The trace test tests the null hypothesis of *r* cointegrating relations against the alternative of more than *r* cointegrating relations, while in the maximum eigenvalue test the null hypothesis of *r* cointegrating relations is tested against the alternative of *r*+1 cointegrating relations.

The analysis accounts for long-run relationships and short-run dynamics.

A vector error correction model (VECM) is a restricted VAR model that can capture restrictions implied by theory. The VECM has cointegration relations built into the specification so that it restricts the long-run behaviour of the endogenous variables to converge to their cointegrating relationships, while allowing for short-run adjustment dynamics. The cointegration term is known as the error correction term since the deviation from the long-run equilibrium is corrected gradually through a series of partial short-run adjustments. To take the simplest possible example, consider two variables *x* and *y* with one cointegrating equation, *i.e.*, $y_t = \beta x_t$, and no lagged difference terms. The corresponding VECM is:

$$\begin{aligned} \Delta x_t &= \alpha_1 (y_{t-1} - \beta x_t) + \varepsilon_{1,t} \\ \Delta y_t &= \alpha_2 (y_{t-1} - \beta x_t) + \varepsilon_{2,t} \end{aligned} \quad (3)$$

In this simple model, the only right-hand side variable is the error correction term. In long-run equilibrium, this term is zero. However, if *x* and *y* deviate from this long-run equilibrium, the error correction term will be nonzero and each variable adjusts to partially restore the equilibrium relation. The α-coefficients measure the speed of adjustment towards the equilibrium.

After estimating a VAR model (or VECM) we would like to be able to discuss the impact of changes in one variable on another. A shock to the *i*-th variable not only directly affects the *i*-th variable, but is also transmitted to all other endogenous variables through the dynamic (lag) structure of the VAR. An impulse response function traces the effect of a one-time shock to one of the variables on current and future values of the endogenous variables. We cannot, however, simply change one of the elements of u_t in equation (1) and see what happens because the errors in u_t are correlated with each other. In order to interpret the impulses, it is common to apply a transformation to the innovations so that they become uncorrelated, thereby enabling identification of the model. One of the most commonly used identification strategies is the Cholesky decomposition. The Cholesky decomposition is a simple algorithm for splitting a positive-definite matrix into a triangular matrix times its transpose.[3] The ease of implementation explains why it is so widely used. However, the impulse response functions based on the Cholesky decomposition are known to be sensitive to the ordering of variables. The method of Generalized Impulses as described by Pesaran and Shin (1998) constructs an orthogonal set of innovations that does not depend on the VAR ordering. The generalized impulse responses from an innovation to the *i*-th variable are derived by applying a variable-specific Cholesky factor computed with the *i*-th variable at the top of the Cholesky ordering.

3 The Cholesky decomposition may appear to be a-theoretical, but it implies a strict causal ordering of the variables in the VAR: The variable positioned last responds contemporaneously to all of the others but has no contemporaneous effect on them; the next to last variable responds contemporaneously to all variables except the last, whilst affecting only the last variable contemporaneously, and so on. The first variable contemporaneously affects all the other variables while not responding contemporaneously to any of them.

Some recent empirical studies that use the VAR methodology to examine the relationship between public capital and economic growth are summarized in Table 1 (see Kamps 2004 for a survey of older studies).

As pointed out by Kamps (2004), only few studies analyse a group of OECD countries. Also, most studies rely on annual data, as capital stock data are often not available at higher frequency. The majority of studies use a model with four variables, namely public capital, private capital, employment and output. In some studies investment has been substituted for capital or additional variables have been included in the model. Apart from theoretical reasons (for instance, the production function approach *versus* a growth model), the order of integration of the series can be a reason to use either the (log of) the capital stock or the (log of) investment.

The results of unit root tests point in different directions. Whereas many studies suggest that all variables usually included – *i.e.*, the log of output, employment, private capital, and public capital – are non-stationary I(1) series (*i.e.*, series integrated of order one), some studies (for instance, Pereira 2000) report that the log of private and public investment are non-stationary I(1) series. In view of the low power of the Dickey-Fuller test for relatively short time series, it is quite remarkable that almost all papers do not use other tests for stationarity.

Some other studies have found no long-run relationship between output, employment, and private and public capital.

In various papers, notably in the work by Pereira, it is found that output, employment, and private and public capital stocks (or investment) are not cointegrated. Pereira and his co-authors therefore employ the growth rates of the variables included in the VAR. For the case of Portugal, Pereira and Andraz (2005, p. 181-182) argue that "the absence of cointegration is not problematic conceptually either. In fact, in the case of economies in a transition stage of their development, such as the Portuguese economy, not finding cointegration is hardly surprising. This means that the data does not show evidence of convergence to the so-called great ratios among the aggregate variables in the economy." However, the question is whether there is really no cointegration, or whether the finding is just a reflection of the testing procedure followed. As follows from Table 1, the conclusion of Pereira and his co-authors is always based on the Engle-Granger test for cointegration. Ligthart (2002) employs both the Engle-Granger test and the Johansen tests and finds that the tests yield different outcomes. Under the Engle-Granger test, the null hypothesis of no cointegration cannot be rejected, while the Johansen tests strongly reject the hypothesis of no cointegration in favour of at least one cointegrating relationship. In addition, Pina and St. Aubyn (2005) also report evidence of a cointegrating relationship for the case of Portugal using the Johansen tests.

3. New evidence on the impact of public capital on output using VARs

The most extensive study on the impact of public capital on output in which VARs are used is the study of Kamps (2004). This author has made a comparable data set for 22 OECD countries for the public and private capital stock, using the perpetual inventory method (Kamps, 2006).[4] The data set covers the period 1960-2001. Figure 1 presents the government-capital-stock-to-GDP ratio and the private-capital-stock-to-GDP ratio for the beginning and the end of this period. It becomes clear that there is quite some variation across the countries in the sample, both with respect to the level of the government capital stock ratio and the change of this ratio. In 2001, Japan has the highest, while Ireland has the lowest government capital ratio. In 13 countries the government capital ratio declined, while in nine it increased between 1960 and 2001. The private capital stock ratio also differs considerably among the OECD countries, both with respect to the level and its change over time.

4 Available at: http://www.uni-kiel.de/ifw/forschung/netcap/netcap.htm.

Table 1. Some VAR studies (published since 2000) on the relationship between public capital and economic growth

Study	Sample/period	Public capital	Theory	Other variables (apart from output)
Pereira (2000)	USA 1956-1977 (A)	Aggregate public investment and 5 types (in constant prices)	--	Employment, private investment
Mittnik and Neumann (2001)	Canada, France, UK, Japan, The Netherlands and Germany Different samples (Q)	Public investment	Barro (1990) and Devajaran *et al.* (1996)	Private investment, public consumption
Pereira (2001)	USA, 1956-1977 (A)	Aggregate public investment and 5 types (in constant prices)	--	Employment, 7 different types of private investment
Pereira and Roca-Sagales (2001)	Spain 1970-1993 (A)	Stock of infrastructures in transport and communications (in constant prices)	--	Employment, private capital stock
Ligthart (2002)	Portugal 1965-1995 (A)	Public capital stock (in constant prices)	Production function	Labour, private capital
Voss (2002)	US and Canada 1947.I-1998.I 1947.I-1996.IV (Q)	Investment scaled by output	Neo-classical theories of investment	Relative price of public and private investment goods, real interest rate, private investment
Pereira and Roca-Sagales (2003)	Spain and 17 regions in Spain, 1970-95 (A)	Public capital (in constant prices)	--	Employment, private capital stock
Kamps (2004)	22 OECD countries (A)	Public capital stock	Production function	Labour, private capital
Pina and St. Aubyn (2005)	Portugal 1960-2001 (A)	Public capital stock	Production function	Labour, private capital, human capital
Pereira and Andraz (2005)	Portugal 1976-1998 (A)	Public transportation infrastructure investment and 6 types of investment (in constant prices)	--	Employment, private investment
Belloc and Vertova (2006)	7 developing countries different samples (A)	Public investment	--	Private investment
Creel and Poilon (2006)	5 OECD countries 1960-2004 (A)	Public investment and public capital stock	Demand effects and production function	Employment, private investment/capital

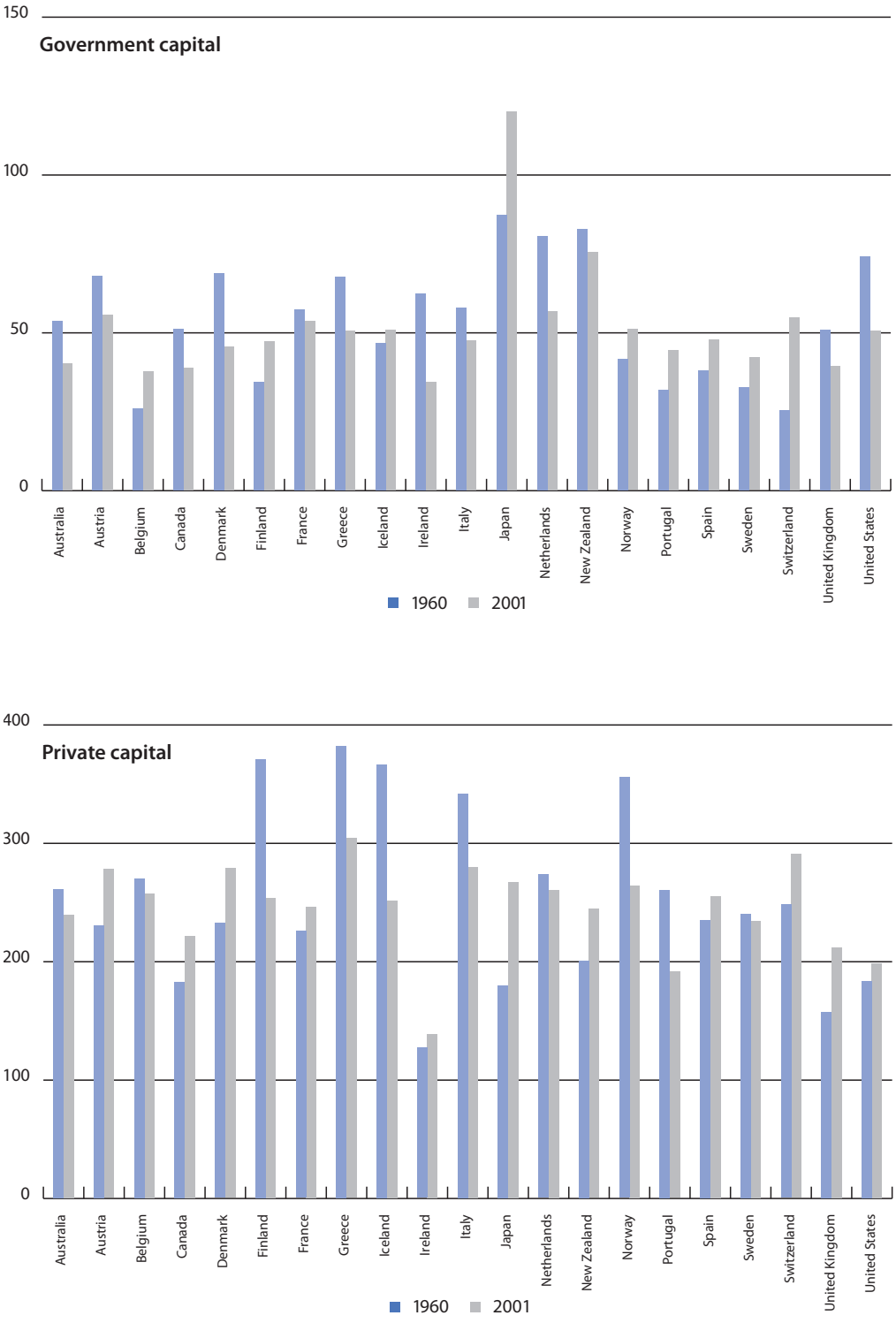
Note: A: annual data; Q: quarterly data; DF: Dickey-Fuller; EG: Engle-Granger; PP: Phillips-Perron.

Stationarity / cointegration test	Stationarity / cointegration results	Specification of output and public capital	Identification	Results
DF unit root test; EG cointegration test	Log of variables are I(1); no cointegration	Growth rate of output and growth rate of investment	Policy function (equivalent to Cholesky decomposition assuming that innovations in public inv. lead innovations in private variables)	Elasticity is 0.043 for aggregate public investment; rate of return 7.8 percent
PP and DF tests; Johansen cointegration test	Series are I(1); r varies between 0 (France, UK) and 3 (Canada)	Log of output and log of investment	Policymakers are assumed to know realizations and announce plans that private sector takes into account; private inv. simultaneously affects GDP, but not vice versa.	Elasticity no more than 0.1 and only significant for Netherlands and Germany
DF unit root test; EG cointegration test	Log of variables are I(1); no cointegration	Growth rate of output and growth rate of investment	Innovations in public investment lead private sector variables	Elasticity is 0.043 for aggregate public investment; rate of return 7.8 percent
DF unit root test; EG cointegration test	Log of variables are I(1); no cointegration	Growth rate of output and growth rate of capital stock	Cholesky where public capital leads private variables	Elasticity is 0.52
DF unit root test; EG and Johansen cointegration tests	Log of variables are I(1); 1 cointegrating vector	Log of level of output and log of level of capital stock	Cholesky	Elasticity between 0.20-0.35
No testing	--	Growth rate of output and level of investment scaled by output	Specific ordering imposed starting with output growth and ending with private investment ratio	Innovations to public investment crowd out private investment
DF unit root test; No cointegration test	Log of variables are I(1)	Growth rate of output and growth rate of capital stock	Policy function (equivalent to Cholesky decomposition assuming that innovations in public inv. lead innovations in private variables)	Aggregate elasticity is 0.523; rate of return 5.5 percent.
Johansen cointegration test	Variables cointegrated with two or three cointegrating vectors	Level of stock	Cholesky	For most countries there is a positive output effect.
Johansen cointegration test	Variables are cointegrated with one cointegrating vector	Level of stock	Cholesky	Returns between 26.7 and 37.3 percent
DF unit root test; EG cointegration test	First difference of log is stationary; No cointegration	Growth rate of output and growth rate of investment	Policy function in which information set includes past values of other variables	Elasticity of output to aggregate investment is 0.183
DF and PP unit root tests; EG and Johansen cointegration tests	First difference of log of variables are stationary; variables are cointegrated	Growth rate of output and growth rate of investment	Various Cholesky orderings in VECM	Positive output elasticities except for Malawi
No testing	--	Level of GDP, investment and stock	Various orderings	In aggregate demand framework short-lived impact; divers results for capital

The ratio of private capital to GDP declined in half of the sample during 1960-2001.

In 2001, Greece had the highest private capital ratio while Ireland had the lowest ratio. In half of the countries the private capital ratio declined, while in the other half the ratio increased during the period under consideration.

Figure 1. Government and private capital relative to GDP in percent, 1960-2001



Source: Data from Kamps (2006)

Also in terms of using adequate econometric methods, the study by Kamps (2004) is by far the best in this line of research. Therefore, we take this study as our starting point, using the same public and private capital stock data and a similar method. However, in contrast to Kamps (2004) and most other studies, we use hours worked as the indicator of labour input. For various reasons this is a better proxy than the number of employees. First, employees may work different hours. Furthermore, in many countries hours worked per employee have decreased over time. As a consequence, the number of hours worked and the number of employees may have a low correlation, as shown in Table 2. The data on hours worked and GDP are from the Total Economy Database of the Groningen Growth and Development Centre.[5]

In contrast to most other studies, we use hours worked and not the number of employees as a measure of labour input.

Table 2. Correlation of number of employees and number of hours worked, 1960-2001

France	-0.71	Ireland	0.73
Denmark	-0.56	Greece	0.76
Belgium	-0.25	Netherlands	0.76
United Kingdom	-0.09	Switzerland	0.78
Austria	-0.05	Japan	0.91
Italy	-0.02	Portugal	0.96
Sweden	0.06	Iceland	0.98
Norway	0.55	United States	0.99
Finland	0.67	New Zealand	1.00
Spain	0.68	Canada	1.00
Germany	0.70	Australia	1.00

Source: Own calculations based on data provided by Groningen Growth and Development Centre

Table 3 shows the results for the unit root tests of the variables we use. We apply the ADF test that states "presence of a unit root" as the null hypothesis, and the KPSS test by Kwiatkowski *et al*. (1992) that has stationarity as the null; in both tests a constant and a trend are included in the test equations. It follows from Table 3 that most variables are integrated of order one.[6] We therefore proceed by testing for all countries whether the series concerned are cointegrated following the approach suggested by Johansen (1991).

For each country[7] we specify a four-variable VAR model including the public net capital stock, the private net capital stock, the number of hours worked, and real GDP. Following Kamps (2004), the number of lags to be included has been chosen on the basis of the Schwarz (1978) information criterion.[8] Table 4 shows the outcomes of the maximum eigenvalue test for cointegration.[9] The table shows the probability that the null-hypothesis is true. It is assumed that the cointegrating vector(s) and the VAR include a constant. For those countries that have one or more trend stationary variables, the cointegrating vector also includes a trend. A robustness check, in which it is assumed that all series contain a unit root, does not alter the choice of the appropriate number of cointegrating vectors.

5 See www.ggdc.nl. Kamps (2004) used OECD data for GDP and therefore had various missing observations.
6 The hypothesis that the capital stocks are I(2) is clearly rejected.
7 Germany was dropped because data revisions in 1990 made it impossible to estimate a sensible model.
8 When for a given lag structure there is still residual autocorrelation in the model we increase the number of lags (up to a maximum of three) until there is no autocorrelation left in the residuals.
9 The trace statistic and the maximum eigenvalue statistic sometimes yield conflicting results. Following Johansen and Juselius (1990), we examine the estimated cointegrating vector and base our choice on the interpretability of the cointegrating relations.

Table 3. Unit root tests

Country	Series	ADF	KPSS	Unit root	Country	Series	ADF	KPSS	Unit root
Australia	government capital	0.208	0.204	yes	**Italy**	government capital	1.000	0.185	yes
	hours worked	0.054	0.083	mixed		hours worked	0.135	0.191	yes
	private capital	0.799	0.203	yes		private capital	0.717	0.215	yes
	income	0.078	0.203	yes		income	0.476	0.209	yes
Austria	government capital	0.970	0.214	yes	**Japan**	government capital	0.527	0.207	yes
	hours worked	0.891	0.191	yes		hours worked	0.997	0.167	yes
	private capital	0.626	0.208	yes		private capital	0.955	0.200	yes
	income	0.840	0.188	yes		income	0.630	0.198	yes
Belgium	government capital	0.325	0.197	yes	**Netherlands**	government capital	0.001	0.206	mixed
	hours worked	0.999	0.208	yes		hours worked	0.935	0.182	yes
	private capital	0.057	0.187	yes		private capital	0.218	0.204	yes
	income	0.447	0.190	yes		income	0.094	0.159	yes
Canada	government capital	0.186	0.190	yes	**Norway**	government capital	0.713	0.206	yes
	hours worked	0.346	0.191	yes		hours worked	0.230	0.154	yes
	private capital	0.863	0.184	yes		private capital	0.902	0.205	yes
	income	0.319	0.199	yes		income	0.897	0.197	yes
Denmark	government capital	0.000	0.210	mixed	**New Zealand**	government capital	0.942	0.210	yes
	hours worked	0.931	0.113	mixed		hours worked	0.404	0.142	mixed
	private capital	0.220	0.208	yes		private capital	0.288	0.192	yes
	income	0.194	0.177	yes		income	0.253	0.108	mixed
Finland	government capital	1.000	0.209	yes	**Portugal**	government capital	0.013	0.087	no
	hours worked	0.024	0.076	no		hours worked	0.130	0.117	mixed
	private capital	0.998	0.206	yes		private capital	0.651	0.199	yes
	income	0.491	0.175	yes		income	0.489	0.185	yes
France	government capital	0.565	0.209	yes	**Spain**	government capital	0.046	0.103	no
	hours worked	0.512	0.118	mixed		hours worked	0.556	0.114	mixed
	private capital	0.879	0.211	yes		private capital	0.445	0.204	yes
	income	0.201	0.199	yes		income	0.380	0.174	yes
Germany	government capital	0.942	0.207	yes	**Sweden**	government capital	0.068	0.199	yes
	hours worked	0.793	0.177	yes		hours worked	0.201	0.147	yes
	private capital	0.417	0.147	yes		private capital	0.854	0.209	yes
	income	0.321	0.122	mixed		income	0.214	0.176	yes
Greece	government capital	0.587	0.203	yes	**Switzerland**	government capital	0.026	0.208	mixed
	hours worked	0.784	0.201	yes		hours worked	0.260	0.128	mixed
	private capital	0.810	0.209	yes		private capital	0.294	0.199	yes
	income	0.233	0.194	yes		income	0.302	0.156	yes
Iceland	government capital	0.521	0.206	yes	**UK**	government capital	0.113	0.202	yes
	hours worked	0.103	0.060	mixed		hours worked	0.950	0.178	yes
	private capital	0.878	0.202	yes		private capital	0.614	0.201	yes
	income	0.835	0.198	yes		income	0.066	0.086	mixed
Ireland	government capital	0.009	0.209	mixed	**US**	government capital	0.392	0.104	mixed
	hours worked	1.000	0.183	yes		hours worked	0.003	0.103	no
	private capital	0.206	0.194	yes		private capital	0.494	0.202	yes
	income	1.000	0.132	mixed		income	0.017	0.137	no

Note: The ADF test assumes as null-hypothesis a unit root while the KPSS test assumes stationarity. Both tests contain an intercept and a trend. The figures shown in the ADF and KPSS columns are p-values.

We find one cointegrating vector for most countries. However, for three countries (Australia, Austria, and Denmark) the hypothesis of no cointegrating vector cannot be rejected. For these countries we therefore estimate an unrestricted VAR using the first differences of the included variables to account for their non-stationarity. For the other countries we estimate VECMs, imposing the number of cointegrating vectors as shown in the final column of Table 4.

Table 4. Cointegration tests (unrestricted cointegration rank test)

	Hypothesized number of cointegrating equations				
Country	None	at most 1	at most 2	at most 3	chosen
Australia	0.097	0.207	0.055	0.839	0
Austria	0.121	0.031	0.084	0.021	0
Belgium	0.006	0.057	0.034	0.112	1
Canada	0.001	0.284	0.123	0.002	1
Denmark	0.398	0.153	0.570	0.072	0*
Finland	0.012	0.147	0.461	0.525	1*
France	0.004	0.071	0.058	0.016	1
Greece	0.001	0.021	0.120	0.016	2
Iceland	0.003	0.284	0.285	0.054	1*
Ireland	0.022	0.030	0.012	0.914	3*
Italy	0.040	0.087	0.233	0.042	1
Japan	0.000	0.140	0.077	0.216	1
Netherlands	0.020	0.239	0.320	0.777	1*
New Zealand	0.046	0.072	0.201	0.561	1
Norway	0.001	0.107	0.025	0.088	1
Portugal	0.005	0.200	0.251	0.666	1*
Spain	0.000	0.002	0.050	0.253	3*
Sweden	0.016	0.007	0.259	0.612	2*
Switzerland	0.008	0.118	0.467	0.171	1*
United Kingdom	0.010	0.020	0.419	0.221	2*
United States	0.011	0.054	0.497	0.414	1*

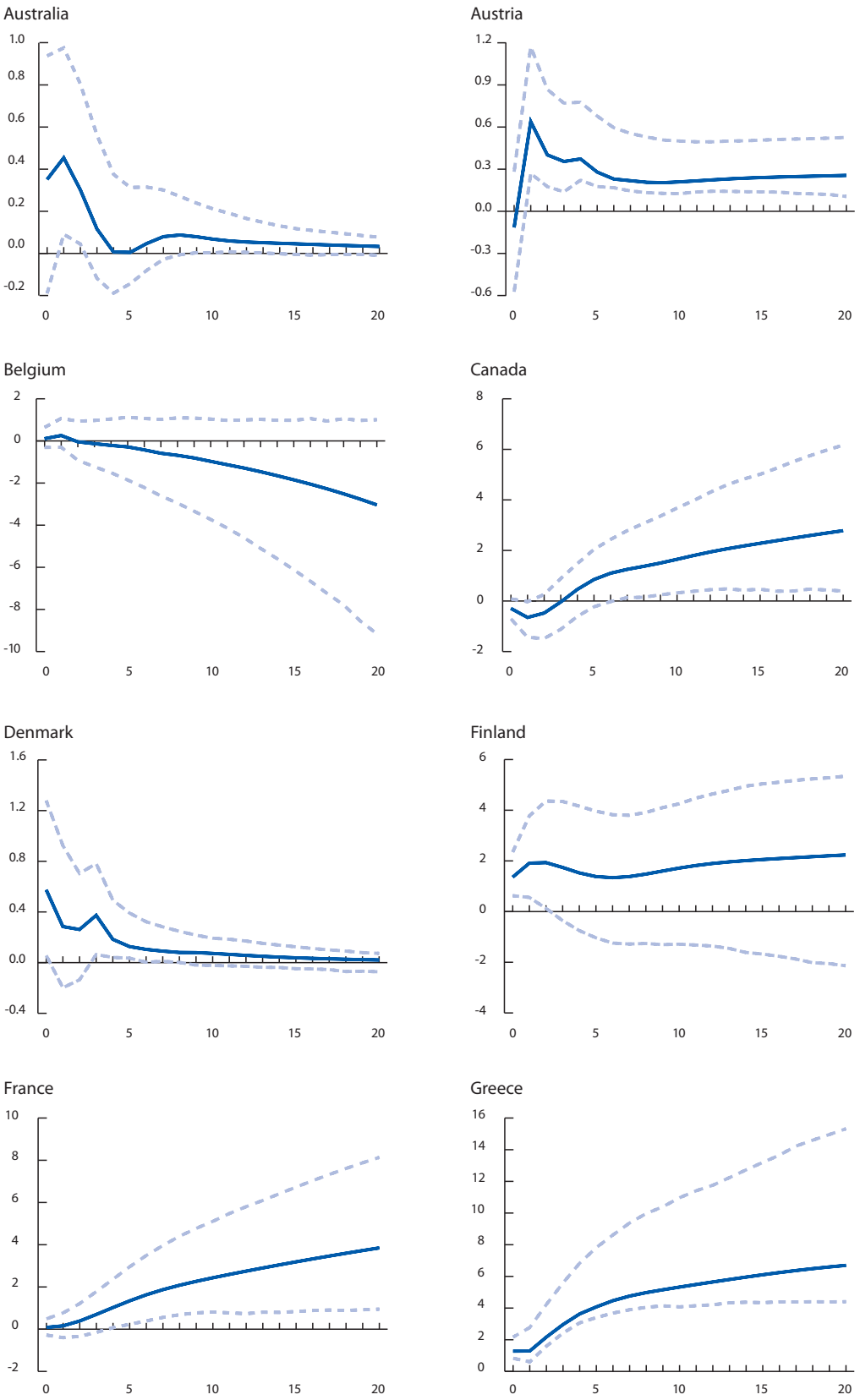
Note: Results for the maximum eigenvalue test. The table shows the probability that the null-hypothesis is true. A * indicates that the trace test yields the same number of cointegrating vectors.

Figure 2 shows the generalized impulse responses to a one standard deviation shock to public capital for a horizon of 20 years. Each graph displays a point estimate of the impulse responses as well as a 90-percent confidence interval computed following the bootstrap procedure suggested by Hall (1988). The shocks to public capital have a different size for each country, thereby precluding a quantitative comparison of the effects across countries. However, as Kamps (2004) points out, shocks of such size have the attractive feature that they can be viewed as representative for typical shocks that occurred during the sample period in the individual countries.

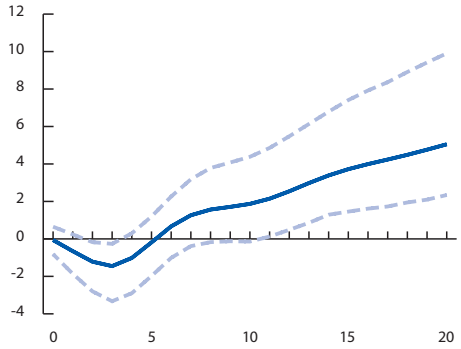
For eight countries a shock to public capital has a positive long-run impact on GDP.

Two important conclusions can be drawn on the basis of the impulse responses. First, for various countries a shock to public capital has a positive long-run impact on GDP (Austria, Canada, France, Greece, Iceland, Norway, Switzerland, and the US). But there are also quite some countries where the long-run impact is essentially zero (Australia, Belgium, Denmark, Finland, Italy, Netherlands, New Zealand, Spain, Sweden, and the UK). For three countries the effect is found to be even negative (Ireland, Japan, and Portugal). Second, our results deviate substantially from those of Kamps (2004), notably for those countries for which the correlation between the number of employees and hours worked is low.

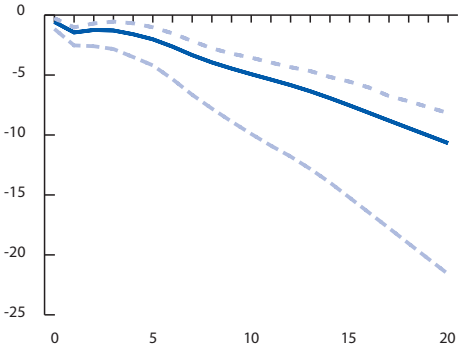
Figure 2. Impulse responses of GDP to a shock in public capital



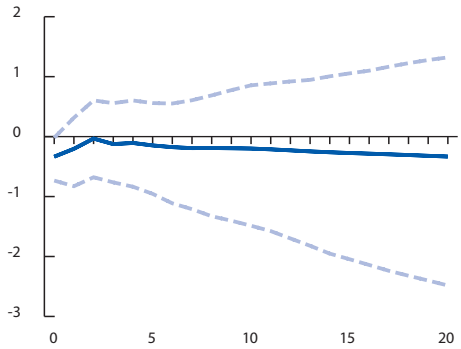
Iceland



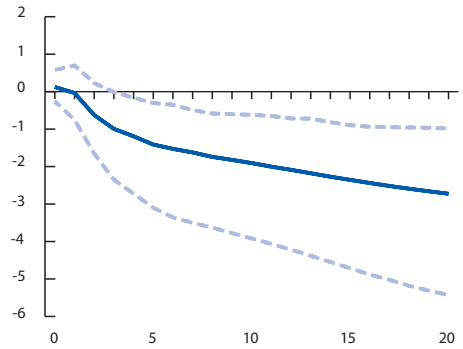
Ireland



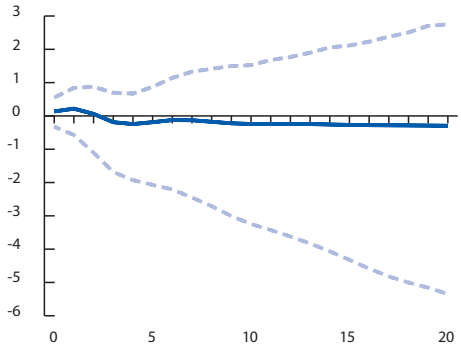
Italy



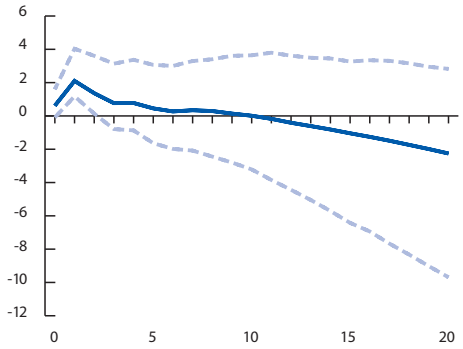
Japan



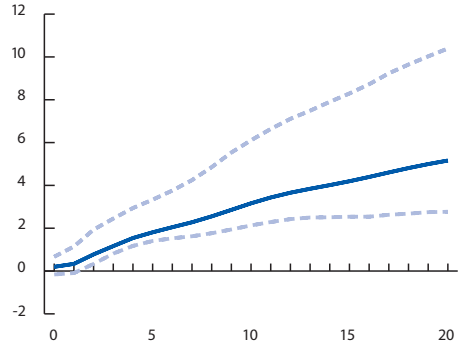
Netherlands



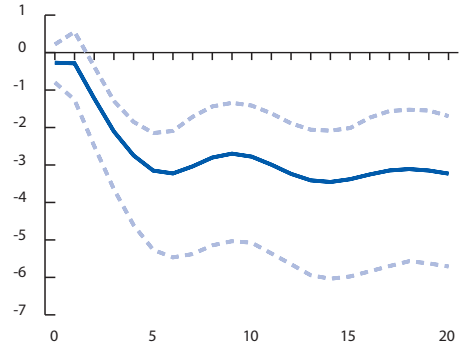
New Zealand

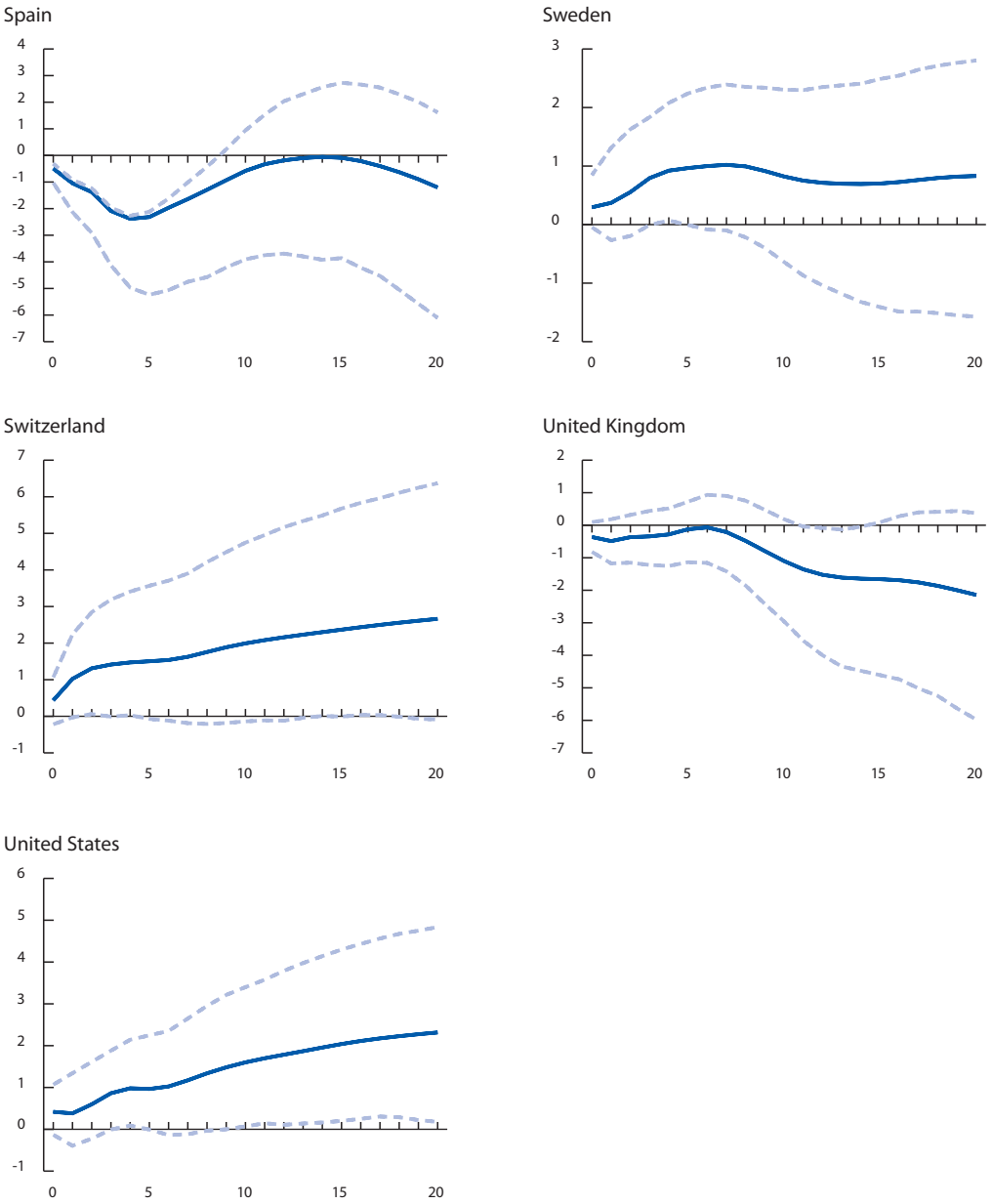


Norway



Portugal





Note: The figures show the impulse response of output to a one-standard-deviation shock to public capital over a period of 20 years.

There is no systematic pattern for the impact of public capital on output.

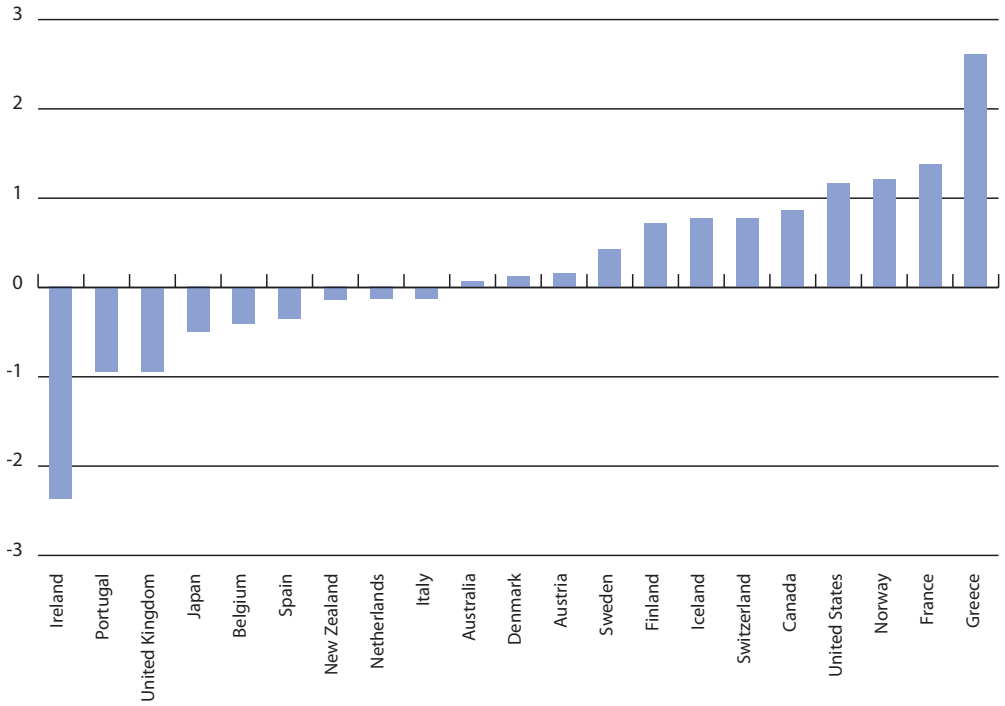
It is hard to draw clear policy conclusions from our findings. There is not a clear systematic pattern for the impact of public capital on output. According to the generalized impulse responses, the long-run impact of public capital on output can be positive, zero, or negative (see Figure 3).[10] We find the strongest negative effect in Ireland and the strongest positive effect in Greece. This diversity in results may not be surprising as the impact of public capital may depend on various factors like the level of the public capital stock. If the public capital stock is very high, there may be

10 The long run impact is defined as the response after 20 periods (as shown in Figure 2) divided by a one standard-deviation shock in public capital.

diminishing marginal returns. In the remainder of this section we will therefore examine our findings in more detail.

Marginal returns to a very high public capital stock may be diminishing.

Figure 3. Estimated long-run impact of public capital on output



Note: The figure shows (per country) the estimated long run (semi) elasticity of output with respect to public capital calculated as the response after 20 periods (as shown in Figure 2) divided by a one standard-deviation shock in public capital.

We examine whether there is a systematic relationship between our estimates of the long-run effect of public capital on output for the various countries (as shown in Figure 3) and the

- Average of the public-capital-to-GDP ratio;
- Public-capital-to-private-capital ratio;
- Change in the public-capital-to-GDP ratio; and
- Variability in the public-capital-to-GDP ratio

in these countries measured over the same sample as the one used in our VAR estimates.

Figure (4a) suggests that there is a negative relationship between the long-run impact of public capital on output and the level of public capital. The negative slope of the regression line is in accordance with the hypothesis that a higher public capital stock implies a lower impact of public capital on output. However, the relationship is not significant. The estimated t-statistic is 0.94 ($p = 0.359$). In other words, the diversity in our sample with respect to the level of public capital is not related to the diversity in our results for the long-term impact of public capital on output. Countries for which we find a positive impact of public capital on output do not have a lower or higher capital-stock-to-GDP ratio than those with a negative impact of public capital on output.

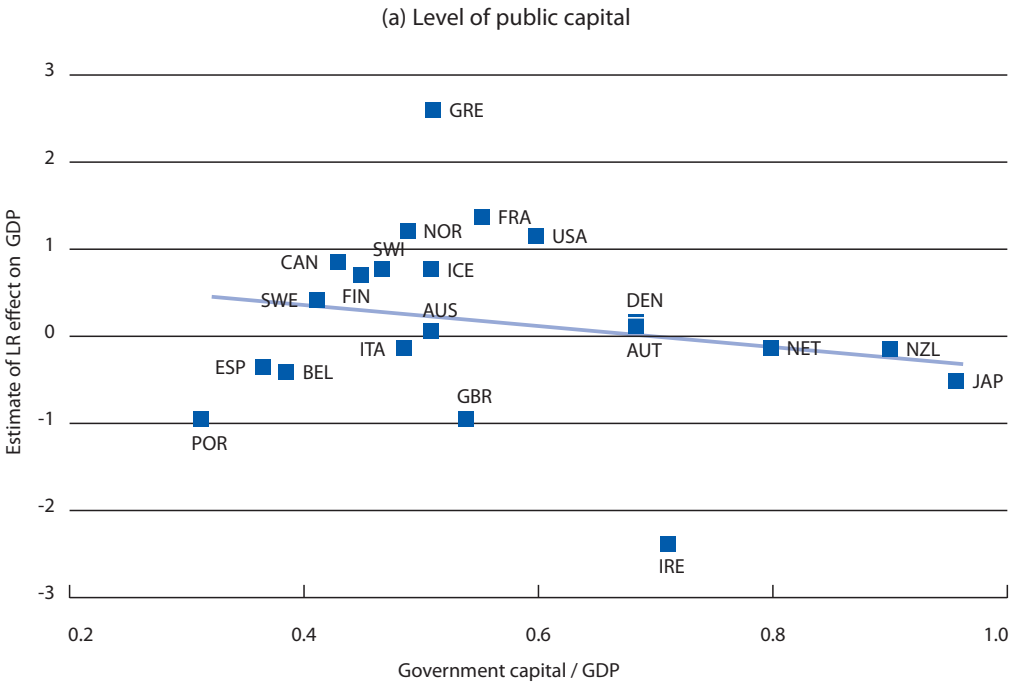
Figure (4b) shows that a high ratio of public capital to private capital is negatively and significantly related to the impact of public capital on output (the t-statistic is 2.22, with p = 0.038). Apparently, the impact of public capital does not depend on its absolute level, but on its level relative to private capital. If the public capital stock is large relative to the private capita stock, the long-run impact of public capital on output is lower.

The regression line in Figure (4c) does not yield a significant relationship (the estimated t-statistic is 0.19, with p = 0.852). So the diversity in our sample with respect to the change in the public-capital-to-GDP ratio is not related to our results for the long-term impact of public capital on output. In other words, this finding suggests that there is not a systematic difference with respect to the long-run impact of public capital on output between countries that saw their capital-to-GDP ratio decline and those that saw this ratio increase.

High variability of the public-capital stock reduces its long-run impact on output.

Finally, Figure (4d) suggests that there is a negative and significant relationship between the variability of the public capital stock and our findings for the long-term impact of public capital on output. The estimated t-statistic is -2.40 (p = 0.027). So these findings suggest that high variability of the public capital stock reduces the long-run impact of public capital on output.[11]

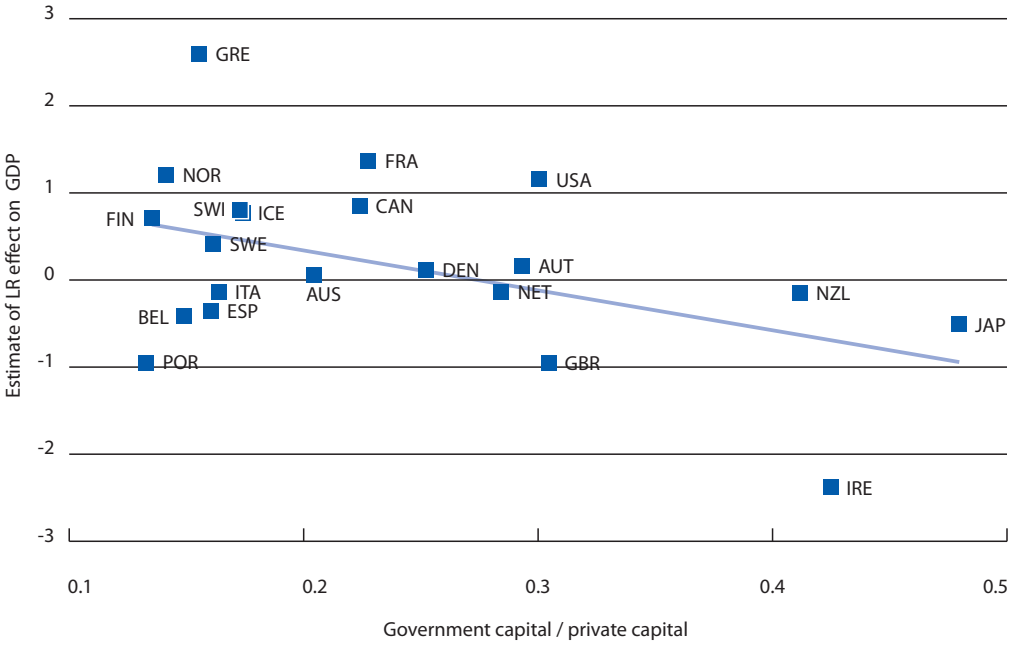
Figure 4. Government capital and its long-run effect on output, 1960-2001



Note: The vertical axis shows the long-run impact on GDP of a shock to public capital, while the horizontal axis shows the average public-capital-to-GDP ratio for the country concerned.

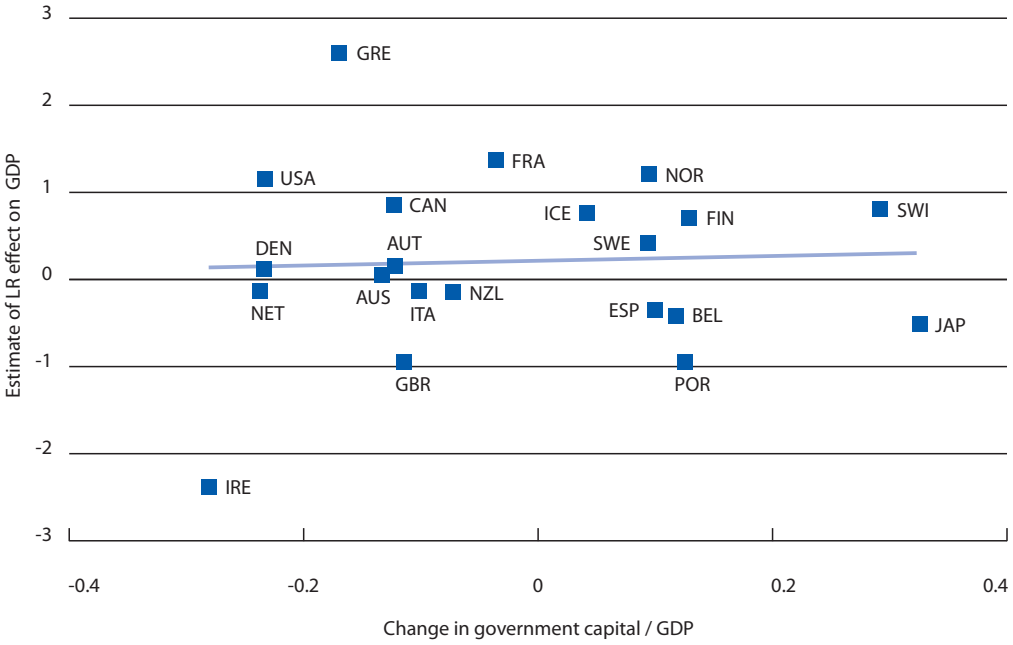
11 In principle, there may be two sources of high standard deviations in the public-capital-to-GDP ratio, (i) public investment being "erratic", and (ii) public investment having a strong trend such that it is very different at the end of the sample from its initial level. As the correlation between the absolute change and the standard deviation of the public-capital-to-GDP ratio is 0.79, we conclude that the variability in the public capital GDP to ratio is largely driven by the second source.

(b) Public-capital-to-private-capital ratio



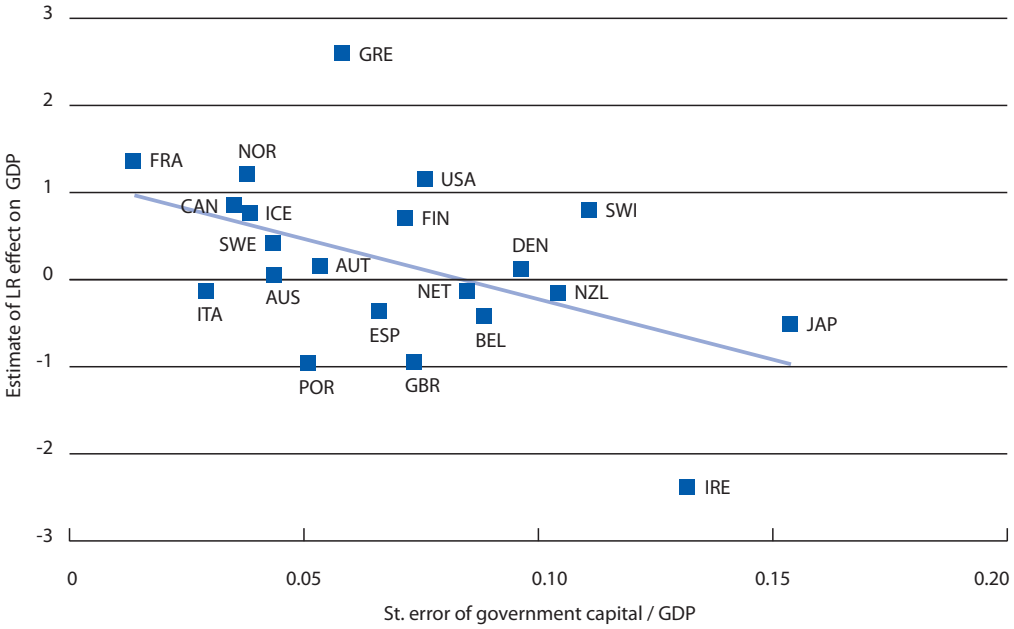
Note: The vertical axis shows the long-run impact on income of a shock to public capital, while the horizontal axis shows the average ratio of the public capital to private capital stock for the country concerned.

(c) Change in the public-capital-to-GDP ratio



Note: The vertical axis shows the long-run impact on income of a shock to public capital, while the horizontal axis shows the change in the public-capital-to-GDP ratio over 1960-2001 for the country concerned.

(d) Variability in the public-capital-to-GDP ratio



Note: The vertical axis shows the long-run impact on income of a shock to public capital, while the horizontal axis shows the standard deviation of the public-capital-to-GDP ratio over 1960-2001 for the country concerned.

4. Recursive and panel VARs

In the previous section we have focused on our first research question to see to what extent the impact of public capital differs across countries. In this section we will address our second research question, *i.e.*, to what extent the impact of public capital on output differs over time. To address this issue, we use 'recursive' VARs and 'rolling-window' panel VARs.

4.1 Recursive VARs

Has the impact of public capital on output changed over time?

This subsection reports our findings for so-called 'recursive VARs'. The purpose of this analysis is to examine whether the impact of public capital on output has changed during the 1990s in comparison to the earlier decades. Recursive estimates are done for all countries in our sample starting with the period 1960-1989 up to 1960-2001. So we start with a VAR for the period 1960-89 and then add one year to the estimation period in each step. In all VARs we impose the same number of cointegrating vectors as found for the full sample period. For each regression, the long-run effect (accumulated GDP response relative to a one-standard deviation shock in public capital) is estimated. The estimated long-run effects are shown in Table 5, with significant long-run elasticities shown in italics.

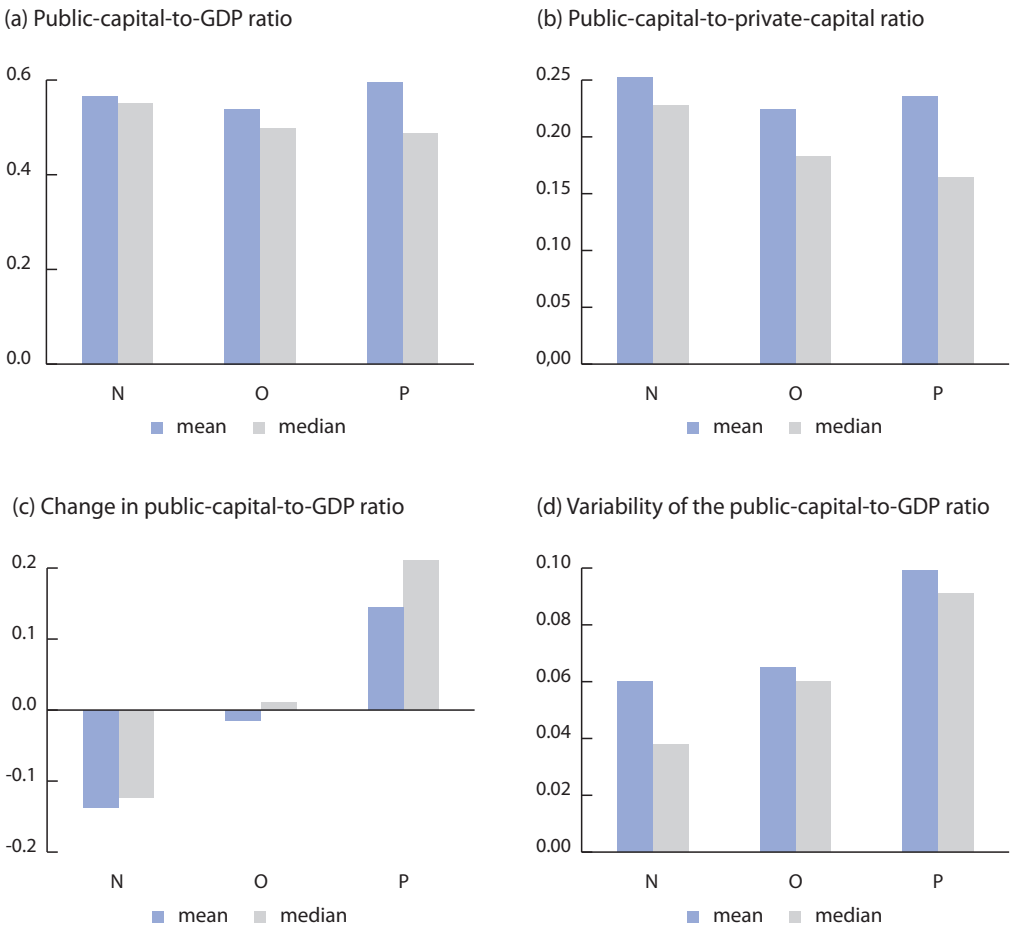
The final column in Table 5 shows the results of a regression of the estimated long-run elasticities on a time trend. We have made three groups of countries, depending on the change in the estimated elasticity over time. In the first group ("P") the estimated coefficient of the trend variable is positive and significant, suggesting that in these countries public capital has become more productive over time. In the second group ("N") the estimated coefficient is negative and significant, suggesting that public capital has become less productive over time. Finally, if the estimated coefficient of the trend variable is insignificant, the country is in the "O" group.

Table 5. Estimated long-run effects of public capital on output: Recursive VARs

Country	60-89	60-90	60-91	60-92	60-93	60-94	60-95	60-96	60-97	60-98	60-99	60-00	60-01	Trend
Australia	*0.07*	0.05	*0.11*	*0.10*	*0.10*	*0.09*	*0.09*	*0.08*	*0.07*	*0.06*	*0.06*	*0.06*	*0.06*	O
Austria	*0.13*	*0.09*	*0.14*	*0.14*	*0.15*	*0.11*	*0.11*	*0.14*	*0.15*	*0.24*	*0.11*	*0.10*	*0.15*	O
Belgium	*-1.07*	*-1.13*	*-0.90*	0.11	*0.54*	0.38	-0.02	0.25	-0.08	-0.46	-0.52	-0.65	-0.41	O
Canada	*1.94*	*1.78*	*1.51*	*1.60*	*1.32*	*1.25*	*1.07*	*0.89*	*0.93*	*0.91*	*0.97*	*0.87*	0.85	N
Denmark	*0.13*	*0.15*	*0.15*	*0.14*	*0.13*	*0.12*	*0.11*	*0.11*	*0.11*	*0.11*	*0.12*	*0.11*	*0.12*	N
Finland	-0.09	-0.27	0.16	0.20	0.43	0.24	0.44	0.40	0.53	0.62	0.63	0.62	0.71	P
France	*2.58*	*2.40*	*2.31*	*2.22*	*1.91*	*1.84*	*1.79*	*1.57*	*1.62*	*1.48*	*1.44*	*1.42*	*1.37*	N
Greece	*-7.00*	*-2.85*	*2.19*	0.87	0.21	0.30	0.87	0.99	*1.57*	*1.31*	*1.44*	*2.33*	*2.60*	P
Iceland	*2.32*	*2.07*	*1.87*	*1.91*	*1.65*	*1.33*	*1.60*	*1.22*	*1.06*	*1.04*	0.84	*0.84*	0.77	N
Ireland	*0.82*	*0.51*	*0.78*	0.28	-0.18	-0.91	*-1.77*	*-1.79*	*-2.26*	*-2.30*	*-2.64*	*-2.52*	*-2.38*	N
Italy	0.34	0.22	0.12	0.05	0.04	0.26	-0.17	-0.30	-0.21	-0.17	-0.14	-0.11	-0.13	N
Japan	*-1.17*	*-1.34*	*-0.87*	*-0.63*	-0.30	-0.30	-0.25	-0.22	-0.41	-0.50	*-0.60*	*-0.54*	*-0.51*	P
Netherlands	*3.62*	2.39	-0.47	-0.20	-0.12	-0.33	-0.19	-0.24	0.29	0.19	0.10	-0.20	-0.13	O
New Zealand	-4.98	-0.46	1.37	*2.12*	0.97	-1.36	*-3.81*	*-2.39*	-1.72	-0.18	-0.42	-0.41	-0.15	O
Norway	*1.07*	*1.00*	*0.73*	*1.20*	*1.11*	*2.87*	*1.84*	*1.84*	*1.68*	*1.73*	*1.54*	*1.54*	*1.21*	O
Portugal	-0.99	-0.94	-0.96	*-0.73*	*-1.07*	*-1.14*	*-1.21*	*-1.32*	*-1.33*	*-1.20*	*-1.04*	*-0.95*	*-0.95*	O
Spain	*1.92*	*-0.31*	*-0.91*	*-1.35*	*-0.92*	-0.18	-0.27	-0.42	-0.43	*-0.63*	*-0.72*	*-0.76*	-0.36	O
Sweden	*-1.05*	*-1.36*	-0.07	*1.01*	0.97	*0.84*	0.17	0.04	-0.01	0.00	0.16	0.49	0.42	O
Switzerland	-0.68	*-1.49*	*-1.21*	*-0.88*	-0.36	-0.26	0.01	0.09	0.22	0.29	*0.86*	0.70	*0.77*	P
United Kingdom	-0.70	-0.51	-0.41	-0.11	-0.74	-0.80	-0.92	*-0.98*	-0.46	-0.26	-0.67	-0.75	-0.95	O
United States	*1.98*	*2.28*	*1.97*	*1.90*	1.49	1.38	*1.37*	*1.43*	*1.51*	*1.53*	*1.44*	*1.38*	*1.16*	N

Note: Figures in italics are significant at the 10-percent level. The final column indicates whether the trend in the evolution of recursive coefficients is insignificant (O), positive (P), or negative (N) (5-percent significance level).

Figure 5. Public capital ratios for three groups of countries, 1960-2001



Note: The figure shows the differences in the mean (blue bars) and median (red bars) for three groups of countries. In the "P" group public capital has become more productive over time. In the "N" group public capital has become less productive. In the "O" group the productivity of public capital did not change during the 1990s. See the last column of Table 5 for the countries in the various groups.

In Figure 5 we analyse whether there is any difference across the three groups with respect to the

- Average of the public-capital-to-GDP ratio;
- Public-capital-to-private-capital ratio
- Change in the public-capital-to-GDP ratio; and
- Variability in the public-capital-to-GDP ratio.

The blue bar denotes the mean for the group, while the gray bar shows the median.

Productivity of public capital increased in countries where the public capital stock grew.

Figure (5a) suggests that the public capital stock is not systematically different across countries where the impact of public capital on output increased during the 1990s ("P") and those countries where this impact decreased ("N") or remained the same ("O"). The F-statistic of an ANOVA analysis to the test whether the capital stock ratio differs between the three groups is 0.15 ($p = 0.86$).

Figures (5b) and (5d) show that there is also hardly any systematic difference across the three groups of countries with respect to the ratio of public and private capital and the variability of the public capital stock. The F-statistics are 0.14 (p = 0.87) and 1.83 (p = 0.19), respectively. However, Figure (5c) shows that countries in the "P" group have an increasing capital-stock-to-GDP ratio, while countries in the "N" group saw this ratio decline. Indeed, the test that the change in the capital stock is equal for the three groups can be rejected; the F-statistic is 4.63 (p = 0.02).

4.2 Panel VARs

As an alternative to the time-series models reported in Section 3, we also estimate VARs for our panel of countries. We first examine the order of integration of the variables. Recent literature suggests that panel-based unit root tests have higher power than unit root tests based on individual time series. Using Eviews, we have computed five panel unit root tests, namely tests proposed by Levin, Lin and Chu (LLC) (2002), Breitung (BR) (2000), Im, Pesaran and Shin (IPS) (2003), ADF and PP tests (Maddala and Wu 1999 and Choi 2001), and a test suggested by Hadri (2000). While these tests are commonly termed 'panel unit root' tests, they are simply multiple-series unit root tests that have been applied to panel data structures. The tests suggested by Levin, Lin and Chu (2002), Breitung (2000), and Hadri (2000) assume that there is a common unit root process that is identical across cross-sections. The first two tests employ a null hypothesis of a unit root, while the Hadri panel unit root test is similar to the KPSS unit root test and has a null hypothesis of no unit root in any of the series in the panel. The Im, Pesaran, and Shin, and the ADF and PP tests allow for individual unit root processes that may vary across cross-sections.

Table 6 shows the outcomes of the panel unit root tests. YES (NO) indicates (no) evidence for a unit root. It becomes clear that the results vary widely across the various tests. While the Hadri test suggests that all series are I(1), the other tests suggest that one or more series may be trend stationary. We proceed under the assumption that all series contain a unit root. This choice can be justified as we also find that the series are cointegrated and that there are two cointegrating vectors (indicated by both the trace test and the maximum eigenvalue test). The number of lags selected is two.

Table 6. Panel unit root tests

	Government capital	Private capital	Output	Hours worked
LLC	NO	NO	NO	YES
BR	NO	NO	NO	YES
IPS	NO	YES	YES	YES
ADF	NO	YES	YES	YES
PP	YES	YES	YES	YES
Hadri	YES	YES	YES	YES

Notes: YES = evidence for unit root; NO = No evidence for unit root. The acronyms in the first column refer to the following tests: Levin, Lin and Chu (LLC), Breitung (BR), Im, Pesaran and Shin (IPS), Augmented Dickey-Fuller (ADF), and Phillips-Perron (PP).

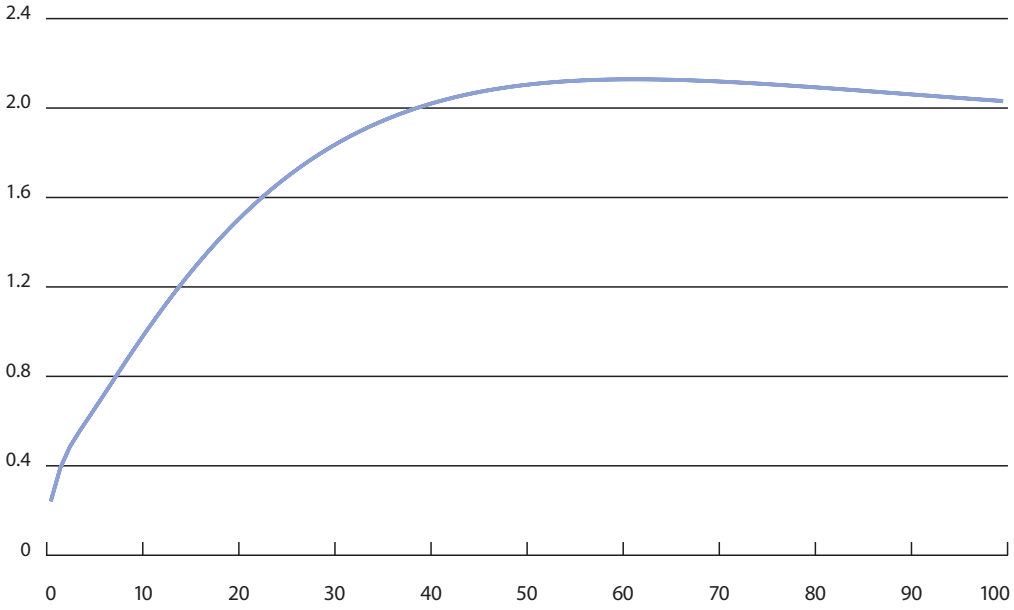
Figure 6 shows the long-run generalized impulse response for output for a one-standard-deviation shock to public capital. The impact of public capital on output is positive but we do not provide confidence intervals. To examine whether the impact of public capital on output has changed over time, we have estimated 'recursive' and 'rolling-window' VARs. Figure 7 shows the results for the latter; the results for the 'recursive' VARs are similar and are therefore not shown. The moving window for the 'rolling' VAR is 20 years. So the first VAR that we estimate covers the period 1960-1979

In the panel of countries the impact of public capital on output is positive.

The impact of public capital on output has declined over time.

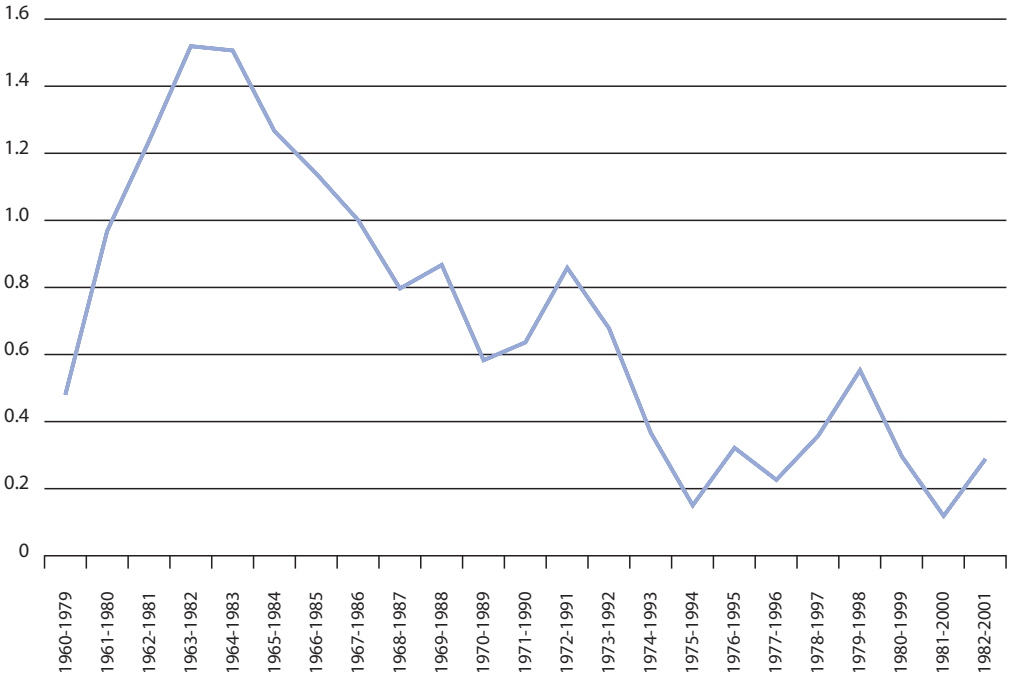
and the last refers to 1982-2001. In line with our findings for the full sample, in all these VARs the number of lags is set to two and two cointegrating vectors are imposed. Figure 7 suggests that the impact of public capital on output has declined over time.

Figure 6. Panel VECM: Impulse response of output to a shock to public capital



Note: The figure shows the impulse response of output to a one-standard-deviation shock to public capital. The horizontal axis shows the number of years after the shock.

Figure 7. Rolling panel VAR: Long-run impact on output of a shock to public capital



Note: The figure shows (for every 20-year rolling window) the estimated long run (semi) elasticity of output with respect to public capital calculated as the response after 20 periods divided by a one standard-deviation shock in public capital.

Overall, the findings of the recursive VARs and rolling-window panel VARs may be interpreted as support for the 'saturation hypothesis', according to which countries with declining marginal productivity of public capital decided to reduce public investment spending. As we have shown in Figure 1, most OECD countries saw their government capital stock in relation to GDP drop during the period under consideration. This may have been a rational decision in view of the declining long-run impact of government capital shown in Figure 7. Indeed, except for Iceland where the public capital stock slightly increased, all countries for which our recursive VARs suggest a decline in the long-run impact on income of a shock to public capital (see Table 5) reduced their public capital stock relative to GDP. However, some caution is needed here as there are alternative explanations for the relative decline in public capital. For example, there is evidence that in times of large fiscal contractions, government capital spending is reduced more than other categories of government spending (see, for instance, De Haan *et al*. 1996).

Declining public-capital-to-GDP ratios may have reflected the declining long-run productivity of public capital.

5. Conclusions

In this paper we have addressed two questions. First, to what extent does the impact of public capital differ across countries? Second, to what extent does it differ over time? In addressing these issues, we have employed Vector Auto Regression (VAR) models as they may best capture the dynamic interactions between variables.

We have applied two approaches. In the first we estimate VAR models for individual countries. We closely follow Kamps (2004) but use a better proxy for labour input (total hours worked), which leads to different results. The estimated long-run impact of public capital on output varies across countries and is negatively correlated with both the ratio of public capital to private capital and the variability of public capital over time. Using recursive VARs, we find that in the majority of countries the effect of a public-capital shock on output decreased during the 1990s. Countries where the impact of public capital on output increased had an increasing capital-to-GDP ratio and *vice versa*.

The second approach, a panel VAR model, has been motivated by the relatively short time span covered by the data for individual countries. Applying a 'rolling' time window, the results confirm that the long-run impact of public capital on output has clearly declined over time.

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ABSTRACT

This paper discusses alternative ways of defining and measuring the marginal economic cost of public funds and reviews empirical cost estimates – including estimates for EU countries. *Moreover, it illustrates how the economic cost of public funds should be accounted for in cost-benefit analyses of government expenditure, notably on public infrastructure, and how the cost-benefit assessment changes if user fees contribute to the financing of infrastructure services. The paper also clarifies why the economic cost of public funds must not be confused with the social discount rate, social opportunity cost, and the interest rate on government debt. In this context, the paper discusses how government borrowing – that is, taxing later in lieu of taxing now – affects the cost-benefit assessment.*

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The economic cost of public funds in infrastructure investment

The art of taxation consists in so plucking the goose as to obtain the largest possible amount of feathers with the smallest amount of hissing.
Jean Baptiste Colbert

1. Introduction

Armin Riess

To finance their expenditures, governments must raise taxes now – or later in case they borrow to pre-finance expenditures. Each euro raised imposes a burden of one euro on taxpayers as their opportunities to spend are cut by one euro. This burden constitutes an opportunity cost – a concept at the heart of economics, categorically expressed by Nobel laureate Kenneth Arrow (1974, p. 17) as "… this or that, not both. You can't do both."

But when funds are withdrawn from the private sector through taxation, there is more to consider than merely a one-to-one opportunity cost. Virtually all taxes – taxes on wage income, interest income, and consumption, for instance – are distortionary in the sense that they drive a wedge between the prices relevant for the supply side of markets and those relevant for the demand side. As a result, economic activity falls below the level that would materialize in the absence of distortionary taxation. This decline in activity constitutes an excess burden that comes on top of the burden of taxation, implying that the economic cost of raising one euro is larger than one euro. This has considerable implications for the cost-benefit comparison of government expenditure, effectively making less expenditure worthwhile compared to a situation without excess burden.

That said, spending tax revenue might have effects that work against this negative impact on government expenditure. To be clear, one should not think of effects related to the direct expenditure benefits. As for them, an intuitively reasonable expectation is that they should amount to at least one euro for each euro of tax revenue raised. Rather, government expenditure could have effects that essentially counterbalance the excess burden of taxation, that is, the reason why the economic cost of public funds is larger than one in the first place. More specifically, given the nature of the excess burden, one needs to think of effects that boost the economic activity hampered by distortionary taxes. For instance, consider an increase in wage taxes to raise finance for transport infrastructure. Better infrastructure might increase the supply of labour. If it does, it counters the decline in supply caused by an increase in distortionary wage taxes. Or, imagine a specific tax on TV sets is increased to finance a new public TV channel. The availability of an additional – presumably high-quality – channel might increase the demand for taxed TV sets, thereby boosting the production of TV sets – an activity curbed by the specific tax.

There are thus two opposing forces. On the one hand, distortionary taxes create an excess burden, raising the economic cost of public funds above the forgone opportunities due to transferring one euro from taxpayers to the government. Costs understood in this way depend on the type of tax since the excess burden is unlikely to be same for all taxes. On the other hand, the expenditure made possible by tax revenue might, in addition to generating direct benefits, boost activities that taxation reduces. One could consider this simply an indirect benefit that cost-benefit analyses of government expenditure need to account for. Alternatively, one could see this as a reason for redefining the economic cost of public funds. In this case, the economic cost of funds would depend not only on the type of tax imposed but on the type of expenditure, too, making the cost of funds expenditure specific – as the reference to infrastructure investment in the title of this paper suggests. Obviously, alternative ways of defining the economic cost of public funds do not change the economics of the expenditure examined. Yet, for applied expenditure and project appraisal there is a challenge: Analysts need to know whether the empirical estimate of the economic cost of public funds they use rests on the first (conventional) definition, considering just the excess burden of taxation, or the

second (modified) definition, considering also indirect benefits of government expenditure. Not knowing this is a recipe for an erroneous appraisal.

The main purpose of this paper is to analyze these issues in a manner easily accessible to project appraisal practitioners and policymakers. Although demand-supply diagrams and equations will be used, they are simple compared to the welfare economics and public finance literature on which they draw, and their sole rationale is to support the narrative of the paper.

The economic cost of public funds can be defined in different ways, is kept in check by user fees, and must not be confused with the discount rate and interest rate on government debt.

Another objective of the paper is to discuss how user fees affect the economic cost of public funds. User fees aim at partly covering the cost of providing public goods and services and they thus reduce the need to raise tax revenue and, by extension, the excess burden of taxation and the economic cost of public funds. User fees might be charged for a variety of infrastructure services – in transport, health, and education, for instance. A salient feature of these services is that charging too much for them is economically inefficient. There is then a trade-off to consider: Charging user fees is welfare enhancing as it lowers the economic cost of public funds, but charging too much is welfare reducing as it prevents demand from reaching its socially optimal level.

The paper also clarifies the distinction between the economic cost of public funds and the social discount rate used in cost-benefit analyses. A key point to recall is that discounting is simply a method of aggregating costs and benefits occurring at different points in time. There are two broad approaches to determining the social discount rate. One is based on social time preference rates, the other on social opportunity costs. Although opportunity-cost based discount rates are often seen as representing the economic cost of funds, they do not. Rather, the economic cost of public funds and discount rates are two distinct concepts, although the latter might influence the former.

After everything else, the paper will shed light on whether government borrowing and, thus, taxing later might be better for society than taxing now. An intuitive reflex tells us that this depends on the interest rate on government debt and the social discount rate. Although not wrong, it is not exactly right either. The paper will conclude that without the excess burden of taxation, society would be indifferent between taxing now and taxing later – regardless of the interest rate on government debt and the discount rate. However, with the excess burden, differences between these rates matter. Although the literature on the link between the excess burden of taxation and government borrowing is still young, indications are that borrowing does not offer a cheap way out.

The remainder of the paper proceeds as follows. Section 2 explains the excess burden of taxation and presents the difference between the conventional and the modified approach to the economic cost of public funds. Section 3 discusses how the economic cost of public funds enters the cost-benefit analysis of infrastructure investment. In this context, it will be become clear that both approaches are equivalent, in particular as to the question of whether or not the investment is economically viable. Section 4 turns to empirical estimates of the economic cost of public funds. Section 5 broadens the view by introducing user fees into the cost-benefit equation. Having merits in its own right, this extension opens, too, a fresh perspective on the privatization of public goods and services – outright or through public-private partnerships. Up to here, the analysis is cast in an atemporal, or one-period, framework. Section 6 brings in the intertemporal, or multi-period, dimension necessary to investigate the link between the economic cost of public funds, on the one hand, and discounting and government borrowing on the other hand. Section 7 concludes.

A few remarks should be made before plunging into a fascinating topic. With a few exceptions, this paper assumes individuals, or households, to be identical and treated equally by the government. With this assumption, distributional concerns are ignored. While this is a simplifying and crude

departure from reality, it allows getting to the core of the matter. Moreover, we will use the terms 'government expenditure', 'public project', and 'infrastructure investment' interchangeably. And then, what we simply call the 'economic cost of public funds' actually refers to the 'marginal (economic) cost of public funds' in the literature. With these clarifications made, we proceed.

2. The excess burden of taxation and the economic cost of public funds

2.1 Setting the scene

The excess burden of taxation and the economic cost of public funds date back to, and continue to rest on, the contributions of Pigou (1947), Harberger (1964), and Browning (1976). They will be sketched in this sub-section. Sub-section 2.2 elaborates on them under the heading the 'conventional' approach to the economic cost of public funds – a term coined by Jones (2005). Mention of a conventional approach suggests that there is another one. Borrowing again from Jones, this approach is discussed in Sub-section 2.3 under the heading the 'modified' approach to the economic cost of public funds. This approach rests on Diamond and Mirrlees (1971), Stiglitz and Dasgupta (1971), and Atkinson and Stern (1974) – to name but a few. Finally, Sub-section 2.4 summarizes and offers a few qualifying remarks.

The excess burden of taxation and the economic cost of public funds must be defined relative to an economic outcome not influenced by taxation.

To start with a very basic idea, the excess burden and the economic cost of public funds must be defined relative to a benchmark, that is, an economic outcome not influenced by taxation. To set such a benchmark, consider an economy that comprises firms and households but no government and, thus, no taxation.

Firms use labour and other factor inputs to produce goods and services and they might borrow and lend. They take input, output, and (net) borrowing decisions with a view to maximizing profits. Households – assumed to be identical – allocate their time between leisure and work; the wage income earned is used to purchase goods and services – in the present or the future.[1] Households take decisions as to the allocation of time between leisure and work, how much to consume of each good, and how much to consume now and in the future with a view to maximizing their utility.

In a perfectly competitive setting – that is, one characterized by the absence of public goods and other market failures (caused by economies of scale and externalities, for instance) – the interactions between profit-maximizing firms and utility-maximizing households result in a set of relative prices that ensures an efficient allocation of resources. Three key features characterize this allocation.

First, the structure of output – that is, how much is produced and consumed of each good – is such that the cost of the last unit produced of each good just equals households' willingness to pay for it, and for each good, its cost and households' willingness to pay equal its market price. As long as cost, willingness to pay, and price differ, profit-maximizing behaviour of firms and utility-maximizing behaviour of households jointly cause a change in the structure of output until these variables are equal. Once this is the case, further increasing the output of one good comes at a cost in excess of its market price and what households are willing to pay for it. Changing the structure of output nonetheless is inefficient and thus reduces welfare.

1 This implies that households might save part of their present income and thereby earn interest income in the future; but households can borrow, too, if they wish to consume more than they currently earn. Note also that households' income is augmented by firms' profits, as households are the ultimate owners of firms.

Second, the intertemporal structure of consumption is such that the rate at which firms can transform present output (which could be consumed today) into future output just equals the rate at which households willingly forgo present consumption for an increase in future consumption, and both rates are linked by the market interest rate. The cost of substituting future consumption for present consumption (or *vice versa*) beyond this point outweighs its benefit. Changing nonetheless the intertemporal structure of consumption reduces welfare.

Third, households' choice between leisure and work is such that the (i) extra income households require to entice them to work more (and thus forgo leisure) matches the (ii) extra income firms can generate with more work, and this extra income equals the wage rate. In the terminology used from here on, the (i) marginal value of leisure forgone is equal to the (ii) marginal product of labour, and both are equal to the wage rate. Suppose the wage rate is equal to the marginal product of labour but exceeds the marginal value of leisure. In these circumstances, households can gain by reducing leisure and working more. Gains will have been fully exhausted once leisure has become so precious that its marginal value has risen to the level of the wage rate. Likewise, for a wage rate below the marginal value of leisure, households gain from working less and increasing leisure until the marginal value of leisure has dropped to the wage rate. Departing from the optimal work-leisure choice reduces welfare. Of particular importance for the theme of this paper are situations where households work less than they would in a perfectly competitive economy without government.

In sum, in a perfectly competitive economy without government, the interactions of households and firms give rise to a set of prices (of goods, capital, and labour) that make households and firms allocate and use resources so that no further improvement in economic efficiency is possible. It is a state of bliss, and in the absence of concerns about the distribution of income, it fully describes a social welfare optimum.

Most taxes are distortionary in that they drive a wedge between prices relevant for supply decisions and prices relevant for demand decisions…

Against this benchmark, let us broaden the perspective by introducing the government as an economic agent in addition to firms and households. To finance its expenditure, the government levies taxes. In the economy considered here, it could impose a tax on specific goods, a general tax on consumption, a tax on labour income, and a tax on interest income. Besides, the government could levy a so-called lump-sum tax. The defining property of such a tax is that it is not levied on an economic activity and that it is the same for all households. Whatever the tax, the tax revenue is an involuntary transfer from the private sector to the government and this constitutes the burden of taxation. In the parlance of economics, the opportunity cost of transferring, say, one euro from the private sector to the government is one euro.

But what, then, is the excess burden of taxation and what causes it? To start with the cause, except for a lump-sum tax, taxes distort the set of prices that entice firms and household to make efficient choices. As a result of this distortion, firms and households allocate resources in a way that is inefficient compared to the benchmark presented above. This efficiency or welfare loss is the excess burden of taxation, coming on top of the burden of taxation. Thus, the cost to society of transferring one euro from the private sector to the government exceeds one euro.

To illustrate, consider the first tax mentioned above – a tax on one particular good, that is, a specific tax. The equilibrium between demand and supply that ensues after firms and households have adjusted to the tax is characterized by a lower level of output of the taxed good. More important, it is characterized by a tax wedge between the gross price households must pay (the so-called consumer price) and the net price firms obtain (the so-called producer price). But since the consumer price measures the marginal value of this good to households and the producer price measures its marginal cost, this wedge indicates that society would benefit from an increase in output and, by

extension, it suffers from the tax-induced decline in output. Note that this excess burden of taxation remains even if the government were to return the tax revenue to households.

A general tax on consumption, while not distorting the choice between goods, drives a wedge between wages and the purchasing power of wages. The former guides firms' demand for labour and they choose the input of labour so that the wage equals the marginal product of labour. The latter guides households' supply of labour and it measures the marginal value of forgone leisure. But a positive gap between these two measures indicates unexploited scope for a welfare-enhancing increase in hours worked and, thus, output. Again, this excess burden remains even if tax revenue were to flow back to households.

A tax on labour income creates an excess burden for similar reasons – only that the wedge between the marginal product of labour and the marginal value of forgone leisure manifests itself in the difference between gross (before-tax) wages and net (after-tax) wages rather than operating indirectly *via* a decline in the purchasing power of wages. The similarity between the excess burden of a general consumption tax and that of a wage tax is because although households' choice is between leisure and income-generating work, it is ultimately a choice between leisure and consumption made possible by income.

To complete the illustration, consider the excess burden resulting from a tax on interest income. Such a tax drives a wedge between net (after-tax) and gross (before-tax) interest rates. It follows that a tax on interest income makes the rate at which households are willing to forgo current consumption in favour of future consumption lower than the rate at which firms can transform current consumption into future consumption. But this implies that welfare-enhancing possibilities for increasing future consumption remain untapped. In other words, a tax on interest income makes household consume more today compared to a situation where their choice between consuming now and in the future is exclusively determined by their time preference.

In sum, except for a lump-sum tax, taxes drive a wedge between the price relevant for the supply side of the firm-household interaction and the demand side of that interaction. This creates an excess burden that comes in addition to the burden of the revenue transfer itself. But this implies that the cost of transferring tax revenue of one euro from the private sector to the government is larger than one euro. In essence, this is the fundamental result following from the conventional approach to the excess burden of taxation and the economic cost of public funds. The next sub-sections express this result in simple algebraic shorthand and illustrate it graphically. The shorthand is essential for following the remainder of the paper; the graphical illustrations and the explanations coming with them will be presented in text boxes that can be skipped without harm.

… making the cost of transferring one euro from the private sector to the government larger than one euro.

2.2 Conventional approach to the economic cost of public funds

The notion that the economic cost of public funds is larger than one can be put as

(1) Economic cost of public funds = $\alpha^C = 1 + \beta^C$ with $\beta^C \geq 0$ and, hence, $\alpha^C \geq 1$.

In Equation (1), α^C stands for the 'conventional' economic cost of public funds. It is expressed per unit of tax revenue raised. The first term on the right-hand side simply states that the opportunity cost of transferring one euro from taxpayers to the government is one euro. The second term, β^C, is the 'conventional' excess burden expressed per unit of revenue raised; as (1) suggests, it might be zero ($\beta^C = 0$), but – unless explicitly stated – we focus on situations where it is strictly positive ($\beta^C > 0$); by extension, we focus on situations where the economic cost of public funds is strictly larger than one ($\alpha^C > 1$).

The economic significance of $\alpha^C > 1$ is that tax revenues of one euro reduce households' consumption possibilities by more than one euro as the excess burden of taxation β^C adds an element to the economic cost of public funds that cannot be seen in the government budget – but which is a cost to the economy nonetheless. To illustrate, $\beta^C = 0.2$ would mean that one euro of tax revenue raised comes with an additional cost to society of 20 euro cents, resulting in economic cost of public funds of EUR 1.2 per euro raised. Arguably, there is political significance, too, as taxpayers surrender more to the government than they think they do.

Identified and described by Pigou (1947) and Harberger (1964), Browning (1976) called α^C the marginal cost of public funds. As pointed out in the introduction, we call it the economic cost of public funds. But it is useful to bear in mind that it refers to the marginal cost of raising additional revenue through an increase in tax rates although we will omit the 'marginal' most of the time for convenience.

Box 1 illustrates graphically the economics leading to Equation (1). Only some of it is crucial to follow the plot. First, the illustration is for a tax on labour income – wage tax, for short. Focussing on a wage tax is more than choosing an example, however. Many taxes – as argued with respect to a general consumption tax above – are eventually borne by labour, and most of the empirical work on the economic cost of public funds has been carried out for wage taxes.

The excess burden of taxation is due to a decline in economic activity whose social benefit exceeds its social cost.

Second, the wage tax interferes with households' work-leisure choices, making them work and produce less than they would in the absence of the tax, or without increasing the tax rate. But it is not simply the decline in hours worked and output that matters. Rather, it is that the value of output forgone is larger than the avoided economic cost of producing that output – and the difference between the two is the excess burden (β^C) of taxation. The general conclusion is that the excess burden comes in the form of a decline in economic activity and as this activity benefits society more than it costs, there is a welfare loss.

Third, it surely did not go unnoticed that we introduced the government and taxation into an apparently perfect economy without specifying what they are for. The conventional approach to the excess burden of taxation (and the economic cost of public funds) assumes that tax revenues finance a unique government expenditure, namely lump-sum income transfers to households. A defining property of such transfers is that each household receives the same amount and that they do not distort prices. Thus, a crucial assumption underlying the conventional approach is that the government raises revenues through distortionary taxes and hands them back to households in the form of lump-sum transfers. This round-tripping of funds makes households worse off, and the excess burden measures this welfare loss. Equation (1) captures all this per unit of tax revenue: The economic cost of raising funds through distortionary taxes is $1 + \beta^C$ euros; one euro is returned to households, leaving a net loss to society of β^C euros.

This raises two questions. First, why think of a government that imposes a wage tax only to hand back the tax revenue to households? There are at least two answers. For one thing, taxing labour income to finance lump-sum transfers is a means of redistributing income if the transfer to some households is higher (lower) than the taxes they have paid. In these circumstances, the efficiency loss measured by the excess burden is the cost of redistributing income. For another, assuming that tax revenues are returned lump-sum to households is an analytical device to separate the welfare effect of financing government expenditure from the welfare effect of such expenditure itself.

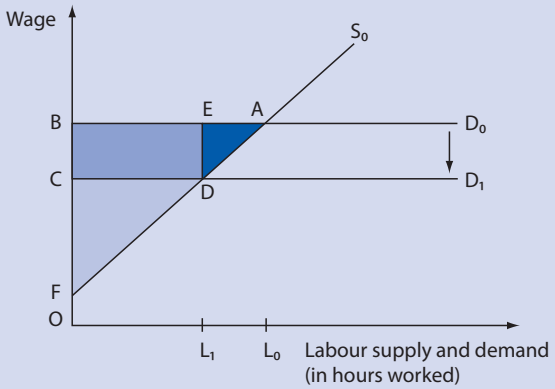
Second, what if revenues are not handed back as lump-sum transfers but, more realistically, finance expenditure such as public infrastructure investment? Answering that question takes us straight to the modified approach to the economic cost of public funds.

Box 1. Burden and excess burden of taxation – conventional approach

Figure B1 illustrates graphically the burden and the excess burden of taxation for a wage tax. It pictures the demand for and supply of labour – measured in hours worked – as a function of the wage rate. To be precise, D_0 shows firms' demand for labour when there is no wage tax. For simplicity, the demand schedule is assumed to be flat rather than downward sloping. This implies that the marginal product of labour, which sets the wage firms are willing to pay, does not fall when firms use more labour. S_0 shows households' supply of labour. A change in the supply of labour reflects a change in the hours worked by households already working (intensive labour-supply response) and a change in the labour force participation rate (extensive labour-supply response). The link between wages and labour supply is positive for two related reasons. First, working more comes at the expense of leisure and, second, the marginal value of leisure forgone rises with successive cuts in leisure. Thus, the wage households require for working more and cutting leisure rises with an increase in the amount of time allocated to working, or – equivalently – as wages go up, households wish to allocate more of their time to work and less to leisure. The labour-supply curve might be steeper or flatter than the one shown in the diagram. In fact, it might be backward-bending. These issues will be taken up in Box 3 of Section 4.

The labour-market equilibrium resulting from the interactions between firms and households yields a wage of BO, hours worked of L_0 and, thus, labour income equivalent to the area OL_0AB. As the labour-demand schedule represents the marginal product of labour, this area also represents workers' contribution to the value of output, and with constant returns to scale and in the absence of other factor inputs it equals the value of output. This value can be readily compared with the economic cost of producing it. This cost is given by the total value of leisure forgone, which equals the area OL_0AF under the labour-supply schedule. With the value of output (OL_0AB) exceeding the economic cost of generating it (OL_0AF), there is thus a labour-supply surplus of FAB. How does introducing a wage tax change this surplus and how does this change relate to the burden and the excess burden of taxation?

Figure B1. Burden and excess burden of taxation – conventional approach



A neat way of illustrating the impact of a wage tax assumes that firms make the tax payments to the government. But as they do not want to foot the bill, they offer households a lower net (after-tax) wage, and as firms demand for labour is completely elastic, they succeed in passing

on the tax burden to households. In Figure B1, D_1 shows the reduced wage offer of firms, that is, the demand for labour as perceived by households. The vertical difference between D_0 and D_1 (*BC*) is the tax per hour worked (that is, the difference between the gross wage and the net wage) and *BC/BO* is the tax rate. As a result of introducing a wage tax and, thus, reducing households take-home pay, labour supply and the number of hours worked fall from L_0 to L_1. The value of output, which continues to be measured by the area under D_0, falls to OL_1EB. It is shared between households – receiving (net) labour income of OL_1DC – and the government, which collects tax revenue *CDEB*. For obvious reasons, these revenues constitute the burden of taxation: In the absence of taxation, this part of the output value would have accrued to households for working L_1 hours.

This leaves the excess burden to explain. One way of doing this is to measure the value of output forgone due to taxation and to compare this value to the avoided economic cost of producing it. The value of output forgone is L_1L_0AE. Its economic cost equals the value of leisure households would have had to give up to produce it. Given the explanation of the labour-supply curve given above, this value is pictured by the L_1L_0AD. The difference between the value of output forgone and the avoided economic cost of producing it is the excess burden of taxation *DAE*.

Another way of looking at things is to examine the change in the labour-supply surplus, amounting to *FAB* without taxation. Introducing the tax reduces this surplus to *FDC*. The decline in the surplus *CDAB* exceeds the tax revenue *CDEB* by an amount equivalent to the triangle *DAE*, which is the excess burden of taxation. For the wage tax considered here, it is thus the difference between the decline in the labour-supply surplus (*CDAB*) and the government's tax take (*CDEB*). For distorting taxes in general, it is the difference between the decline in the private surplus and the government's tax take.

This excess burden (*CDAB – CDEB = DAE)* is commonly expressed per unit of tax revenue:

$$\text{(B1)} \qquad \textit{Excess burden} = \frac{\textit{decline in private surplus} - \textit{tax revenue}}{\textit{tax revenue}}$$

$$= \frac{CDAB - CDEB}{CDEB} = \frac{DAE}{CDEB}$$

So far, the story was about introducing a tax where there was none before. Clearly, it is more realistic to consider an increase in the tax rate of an existing tax, giving rise to a marginal burden and a marginal excess burden of taxation. It is straightforward to develop a diagram similar to the one above for an increase in the tax rate. In such a diagram the areas representing the decline in the private surplus and the additional tax revenue get only slightly more complicated. Suffice it to change definition (B1) to

$$\text{(B2)} \qquad \textit{Marginal excess burden} = \frac{\textit{decline in private surplus} - \textit{additional tax revenue}}{\textit{additional tax revenue}}$$

$$= \frac{\textit{decline in private surplus}}{\textit{additional tax revenue}} - 1 = \beta^C$$

Let us now establish the link between the (marginal) excess burden and the (marginal) economic cost of public funds. As set out in the main text, the excess burden makes the cost of transferring tax revenue of one euro from the private sector to the government larger than one euro. In fact, the cost of transferring one euro from the private sector to the government equals the decline in the private surplus per unit of additional tax revenue. Using the symbol α^C for this ratio and accounting for (B2) yields:

(B3) $$\textit{Economic cost of public funds} = \frac{\textit{decline in private surplus}}{\textit{additional tax revenue (conventional)}} = \alpha^C = 1 + \beta^C$$

This relation is identical to Equation (1) in the main text, with the term in the middle emphasizing that the economic cost of public funds equals the decline in the private surplus per unit of additional tax revenue raised. In Figure B1, α^C can be expressed as $1 + DAE/CDEB$ or as $CDAB/CDEB$.

2.3 Modified approach to the economic cost of public funds

If government expenditure boosts the economic activity that taxation curbs, there is an indirect welfare gain that counteracts the excess burden of taxation.

Public expenditure financed with the income tax revenue can be thought of as having direct and indirect welfare effects. Consider a road-safety improvement project, for example. The direct benefit of this project is a decline in road accidents and, thus, the damages that usually come with them – deaths, injuries, material damages, and so on. For ease of exposition, assume that direct benefits equal the tax revenue raised for the project. Thus far, the change in welfare is the same as in the case of returning the tax revenue to households: The direct benefits of the project exactly compensate for the tax burden, leaving the excess burden of taxation as the net welfare loss of the road-safety improvement project. And then, the view that the cost of public funds (per euro transferred from the private sector to the government) is $1 + \beta^C$ would continue to hold.

Diamond and Mirrlees (1971), Stiglitz and Dasgupta (1971), and Atkinson and Stern (1974) – among others – argue for a modification of this view because indirect benefits might partly or fully offset the outcome of distorting taxation. To illustrate, safer roads might entice households to allocate more of their time to work (and less to leisure). This could be, for instance, if the hazards of travelling to work deterred some households – or some members of a household – to take up work. With safer roads, there might thus be an increase in the supply of labour. This increase in labour supply – more generally, the boost to an economic activity hampered by distorting taxes – has been called the spending effect of the expenditure (Snow and Warren 1996).

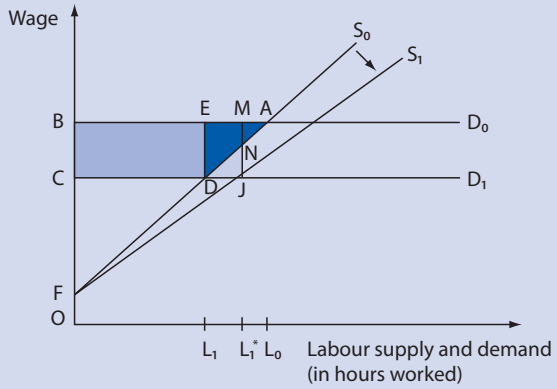
The welfare implications of this are analyzed in Box 2. The main insight is as follows. The induced increase in labour supply boosts output. Because of the tax distortion, the economic value of this additional output is larger than its cost and, thus, there is a welfare gain. A measure of this gain is the extra income tax revenue accruing to the government, which comes on top of the additional revenue following from raising the tax rate to finance the project. In essence, the extra tax revenue reduces the net financing requirement of the project.

All in all, if the initial tax revenues are used to finance government expenditure, rather than handing them back to households as lump-sum transfers, and if these expenditure boost the activity that taxation curbs, there is an indirect welfare gain. This is because the spending effect of expenditure counteracts the departure from an efficient allocation of resources caused by distorting taxes.

Box 2. Burden and excess burden of taxation – modified approach

The diagram below replicates Figure B1, but shows a rightward swivel of the labour supply curve to S_1, indicating the increase in time households allocate to work because of the spending effect of expenditure such as the road-safety improvement project considered here. As a result of this induced rise in labour supply, hours worked increase from L_1 to L_1^*, while the gross wage and the net wage remain unchanged at *BO* and *CO*, respectively. With an increase in hours worked, output rises too.

Figure B2. Burden and excess burden of taxation – modified approach



In analyzing the welfare effect of the induced increase in output, there are two equally useful perspectives. One is to compare the benefit and cost of the additional output resulting from an increase in hours worked from L_1 to L_1^*. As the labour demand curve D_0 continues to indicate the (constant) marginal product of labour, the economic benefit of the extra output is $L_1 L_1^* ME$. The economic cost to households of producing this output, measured at the after-tax wage *CO*, is $L_1 L_1^* JD$. Hence, the net benefit associated with the increase in hours worked is *DJME*. The other perspective follows from simply measuring the extra income tax revenue, which is *DJME*. They accrue to the government, but can be thought of as flowing back to households or – which is the same thing – reducing the net financing needed to carry out public expenditure.

The area *DJME* pictures the positive welfare effect that needs to be compared to the negative welfare effect associated with the excess burden, which is *DAE*. Thus, the net welfare effect is the difference between *DJN* and *NAM*. Although Figure B2 suggests a positive net effect, it must be stressed that this is merely because the rotation of the labour-supply curve has been drawn with a view to keeping the graphical exposition traceable. In other words, in contrast to what the diagram suggests, the labour-supply curve might swivel very little, making the area *DJN* (*NAM*) much smaller (larger) than in Figure B2. In any case, simple graphical illustrations of what are general equilibrium effects have their limitations. That said, a positive net welfare effect is possible.

In Figure B2, the difference between the conventional excess burden *DAE* and the additional tax revenue *DJME* pictures the modified excess burden. This difference equals *NAM* – *DJN*, which is smaller than the conventional burden *DAE*. What is more, because of the spending effect and the increase in hours worked induced by it, modified tax revenues amount to *CDEB* + *DJME* rather than *CDEB*. Hence, when expressing the excess burden and the cost of funds per unit of tax revenue, both are set relative to higher tax revenue than under the conventional approach. More specifically, using Figure B2 and definition (B3) from Box 1 yields

(B4) $$\alpha^M = \frac{\text{decline in private surplus}}{\text{additional tax revenue (modified)}} = \frac{CDEB + DAE}{CDEB + DJME} = 1 + \frac{NAM - DJN}{CDEB + DJME} \gtrless 1.$$

This compares with

(B5) $$\alpha^C = \frac{\text{decline in private surplus}}{\text{additional tax revenue (conventional)}} = \frac{CDEB + DAE}{CDEB} = 1 + \frac{DAE}{CDEB} > 1$$

for the conventional approach. Comparing the conventional approach with the modified approach can thus be summarized as:

(B6) $\alpha^C = 1 + \beta^C > 1 + \beta^M = \alpha^M$,

with $DAE/CDEB = \beta^C > 0$

whereas $(NAM - DJN)/(CDEB + DJME) = \beta^M \gtrless 0$.

Strictly speaking, we have illustrated the case of introducing a tax rather than raising the tax rate of an existing tax. It is straightforward to develop a diagram similar to the one above for an increase in the tax rate.

What does all this mean for the excess burden of taxation and, thus, the cost of public funds? Clearly, there is a positive welfare effect that needs to be compared to the negative welfare effect associated with the excess burden. The net welfare effect might be negative, zero, or positive – in which case the indirect project benefits, triggered by the spending effect, would outweigh the excess burden of taxation as defined so far. One could stop here.

But one can go further. The modified approach does not simply compare the excess burden as defined so far – that is, the conventional excess burden – with indirect benefits that might counterbalance this burden. Rather – as Jones (2005) has worked out in an exemplary manner – it modifies the very definition of the excess burden and the economic cost of public funds. A stripped-down version of this modification is

(2) *Economic cost of public funds* $= \alpha^M = 1 + \beta^M$ with $\alpha^M \gtrless 1$ if $\beta^M \gtrless 0$

The structure of Equation (2) is identical to that of (1). However, because of indirect project benefits, the modified excess burden and cost of funds are smaller than their conventional siblings ($\beta^M \leq \beta^C$ and $\alpha^M \leq \alpha^C$). What is more, the modified excess burden might be negative ($\beta^M < 0$), implying that the cost of raising one euro might be less than one euro ($\alpha^M < 1$). This is in sharp contrast to the conventional approach where the excess burden of a distorting tax β^C is always positive and the economic cost of raising one euro is always greater than one euro.[2]

Modifying the definition of the excess burden and the cost of funds does not change the net benefits of the project financed by a distorting tax.

An observation of utmost importance is due: Modifying the definition of the excess burden and the cost of funds does not change the difference between the benefits and the costs of the project financed by a distorting tax. Rather, with the modified definition, indirect project benefits are counted as cost-reducing factors in the cost-benefit equation whereas with the conventional definition they are counted as benefits. This will be made explicit in Section 3 where it will become clear, too, that the practical implication of this difference is less innocuous than it appears. But before getting there, a few conclusions, extensions, and caveats should be noted.

2 More precisely, the conventional excess burden is always non-negative and the conventional economic cost of raising one euro is always at least one euro. The conventional excess burden might be zero and the conventional economic cost might be one euro if taxation does not affect the taxed activity. For a wage tax, this would be the case for a vertical labour-supply curve.

2.4 Summing up and glimpsing at extensions and caveats

The main point to take away from this section is that while distorting taxes lead to a welfare-reducing decline in taxed activities, spending tax revenue might indirectly boost the very same activities. Thus, considering the distorting effect of taxes without considering, too, indirect spending effects gives an incomplete assessment of tax-financed expenditure. To illustrate this point, this section has used the example of a wage tax and a road-safety improvement project that was assumed to positively affect the supply of labour – the activity curbed by taxation.

The welfare increase operating through an increase in taxed activities is of a more general nature. Suppose there is not only a wage tax but a petrol tax, too, which for simplicity is assumed to be levied for purely fiscal reasons, not because of environmental or other externalities. Assuming that the demand for traffic is price elastic, the petrol tax reduces traffic below its optimal level. If safer roads foster traffic, road-safety improvements come with a welfare-enhancing spending effect in addition to the one resulting from an increase in the supply of labour. This welfare effect reveals itself in additional petrol tax revenue – at a constant petrol tax rate – thereby reducing the modified cost of funds associated with an increase in the wage tax.

One could think of other expenditures that indirectly boost the supply of labour. For instance, expenditures that successfully improve public health – itself beneficial – might tilt households' choice in favour of work, thus increasing the supply of labour. And then, government research might succeed in improving occupational safety, triggering an increase in labour supply.

While distorting taxes lead to a welfare-reducing decline in taxed activities, spending tax revenue might boost the same activities – but it could also further reduce them.

That said, it is easy enough to imagine indirect spending effects of all these expenditure that reduce rather than increase the supply of labour. Consider the road-safety improvement project again. Maybe it concerns a road that links a region where households live and work with a region where they can pursue leisure activities, say, enjoying a beach or a forest. The choice between work and leisure might then change in favour of leisure, thus cutting the supply of labour. Contrary to the situation described in Sub-section 2.3, this would make the modified excess burden and cost of funds larger than their conventional siblings ($\beta^M \geq \beta^C$ and $\alpha^M \geq \alpha^C$). Likewise, environmental expenditures that make beaches and forests more enjoyable might well reduce the supply of labour. More generally, whether indirect spending effects are positive or negative depends on whether public expenditures complement or substitute for taxed activities (Ballard and Fullerton 1992). All this highlights the challenges in properly assessing the welfare implications of tax-financed expenditure, an issue Section 3 will elaborate on.

After everything else, two questions are worth mentioning briefly. First, given the negative welfare implications of distorting taxes, why not impose lump-sum taxes instead? Obviously, lump-sum taxes militate against the notion of fairness as they tax the poor as much as the rich. Second, are the costs of administering taxes, monitoring tax payments, and enforcing compliance not far more important than the excess burden of taxation? Arguably, such costs are important and they add to the total cost of taxation. However, in contrast to the excess burden of taxation, they probably change little when increasing tax rates to finance additional expenditure.

3. The economic cost of public funds in cost-benefit analyses

To start with an extreme benchmark, consider again a perfectly competitive economy. In such an environment, the allocation of resources resulting from the market interactions of firms and households is efficient and, thus, no public project – however financed – can improve the allocation of resources. This is a classic result of welfare economics, and it is succinctly presented in Dinwiddy

and Teal (1996), for instance. In fact, a cost-benefit analysis of a public project in such an environment would show that its cost exceeds its benefit.

Moving on to a more pertinent benchmark, let us introduce public goods, that is, goods and services the market fails to supply or supplies in insufficient quantities. In these circumstances, markets do not allocate resources efficiently, and government provision of public goods can make society better off. More specifically, increasing the supply of public goods enhances welfare as long as their marginal benefits exceed their marginal costs. Assuming that marginal benefits fall with an increase in public goods (and/or that marginal costs rise), the optimal level of spending on public goods is found when marginal benefits equal marginal costs. In the absence of market failures other than the public-goods market failure and with lump-sum taxes financing the provision of public goods, the condition for the optimal provision of public goods is

(3) $B = C$,

with B indicating the direct marginal benefits of public goods and C the marginal costs of producing them.[3] As in Section 2, a road-safety improvement project is used from here on as an example for the provision of a public good, with B and C indicating the project's direct benefits and its costs, respectively.

How does the cost-benefit comparison change relative to benchmark (3) if the real-world situation differs from the perfectly competitive setting not only because of the public-goods market failure but because distortionary taxes are used to finance the project? The conventional approach to the economic cost of public funds suggests that project costs need to be scaled up by the factor $\alpha^C > 1$ because the economic cost of one euro raised with distorting taxes is larger than one euro. This changes the cost-benefit rule to

The conventional approach to the economic cost of public funds suggests that for a project to be economically viable its direct benefits must be larger than its direct costs.

(4) $B = \alpha^C C$ with $\alpha^C = 1 + \beta^C$ and $\beta^C \geq 0$.

Thus, due to the excess burden of taxation ($\beta^C > 0$), the economic cost of the project becomes $\alpha^C C > C$. It follows that the cost-benefit rule (4) requires $B > C$, that is, for a project to be economically viable its direct benefit must be larger than its cost to make good for the excess burden of taxation.

To illustrate, for $\alpha^C = 1.2$, direct project benefits must exceed direct costs by 20 percent to ensure the economic viability of the project. To put it differently, a road-safety improvement project costing EUR 100 million would need to generate direct benefits of EUR 120 million. Section 4 will review empirical estimates of the parameter α^C.

Let us then consider indirect project benefits, more specifically, spending effects that boost economic activity hampered by distorting taxes. For the wage tax and the road-safety improvement project, the spending effect increases the supply of labour, output, and wage tax revenue. Induced tax revenues, which measure the welfare impact of the spending effect, accrue to the government and reduce the financing requirement for the project to $C - R$, with R representing the extra tax revenue due to the spending effect. As a result, the scaling factor α^C needs to be applied to project cost and induced tax revenue, that is, the net budgetary impact of the project. The optimality condition then becomes:

3 In essence, (3) is the Samuelson condition for the optimal provision of a public good, with B representing the aggregate marginal willingness to pay for the public good and C representing its marginal production costs.

(5) $B = \alpha^C (C - R)$

Showing the indirect benefits R with a negative sign on the right-hand side of (5) is a matter of choice. But it helps emphasize that the indirect benefits accrue as income tax revenue to the government, thereby reducing the finance needed for the project. Alternatively, the indirect benefits could be shown as $\alpha^C R$ on the left-hand side of (5).

The modified approach suggests that a project might be welfare enhancing even if its direct benefits are smaller than its direct costs.

Depending on the relative size of the economic cost of public funds (α^C), indirect project benefits (R), and direct project costs (C), a project can be viable with $B \gtreqless C$. To illustrate, suppose indirect benefits (R) of the road-safety investment amount to EUR 25 million. With project cost of EUR 100 million and $\alpha^C = 1.2$, the investment is worthwhile even if its direct benefits amount to only EUR 90 million.

The possibility that a public project might be welfare enhancing even if its direct costs exceed its direct benefits ($B < C$) and the economic cost of raising one euro is larger than one euro ($\alpha^C > 1$) has been first pointed out by Diamond and Mirrlees (1971) and Stiglitz and Dasgupta (1971).

Clearly, the view that economically viable projects require $B > C$ is the more likely to hold the greater the economic cost of funds (α^C) and the smaller indirect project benefits (R). And then, there is a combination of α^C, R, and C that requires an economically viable project to merely generate direct benefits equal to its costs ($B = C$), as cost-benefit rule (3) demands. This combination is:[4]

(6) $$R = \frac{\alpha^C - 1}{\alpha^C} C.$$

If this relation holds, a worthwhile project simply requires $B = C$. But if the left-hand side is smaller (greater) than the right-hand side, $B > C$ ($B < C$).

More important than this rather mechanical interpretation are the economics that make (5) simplify to $B = C$. Recall that the marginal excess burden of taxation β^C (which is the reason for $\alpha^C > 1$) is because raising a distorting tax results in a further decline in hours worked and output compared to the optimal level ensuing in a setting that is perfect apart from the public-goods market failure. Remember, too, that the indirect benefits R result from an increase in hours worked and output triggered by the spending effect of the road-safety improvement project. Intuition then suggests that the marginal excess burden and the indirect benefits exactly offset each other if the negative output effect associated with the former is just as big as the positive output effect of the latter, that is, if the net output effect of the project and its financing is zero. Ballard and Fullerton (1992) and Jones (2005) show that this is indeed the case. It follows that if the drop in output associated with the excess burden is smaller than the rise in output due to the spending effect, the project might be welfare enhancing even when its direct benefits fall short of its costs ($B < C$). And *vice versa*: The direct project benefits must surpass costs ($B > C$) if the fall in output caused by the tax distortion is larger than the increase in output triggered by the spending effect. This is also true, of course, if the project comes with a negative spending effect ($R < 0$), that is, if the spending reduces labour supply, hours worked, and output.

Thus far, the discussion has been cast in terms of the conventional cost of public funds α^C although the cost-benefit rule (5) incorporates indirect benefits of the spending effect, which has been presented in Section 2 as a salient feature of the modified approach to the economic cost of public funds. To recall, the definition of α^C assumes that the extra revenue resulting from raising the rate of a distorting tax is handed back to households in the form of lump-sum transfers. Clearly, this does

4 Mathematically, it can be found by searching for the combination of α^C, R, and C that makes α^C and R disappear from (5).

not happen when the extra revenue is used to finance public projects. As pointed out in Section 2, retaining that assumption nonetheless is a useful analytical device to isolate project-financing effects (α^C and C) from project-spending effects (B and R).

With this in mind, we follow Jones (2005) and rewrite the cost-benefit rule (5) so that it becomes

$$(7) \quad B = \alpha^M C \quad \text{with} \quad \alpha^M = \alpha^C \left(1 - \frac{R}{C}\right).$$

In (7), α^M indicates the modified cost of public funds. It rests on the conventional cost of funds α^C coincides with α^C for $R = 0$ (that is, when there is no spending effect), is smaller than α^C for $R > 0$, and exceeds α^C for $R < 0$. And then, for distortionary taxes, α^C is always larger than one whereas α^M can be smaller than one for $R > 0$ depending on the relative size of α^C, R, and C. To illustrate this, let us return to our numerical example: With indirect benefits (R) of EUR 25 million, direct project costs (C) of EUR 100 million, and $\alpha^C = 1.2$, we get $\alpha^M = 0.9$. Thus, the road-safety improvement is worthwhile even if its direct benefits (B) amount to only EUR 90 million, thus covering only 90 percent of its costs.

Obviously, (5) and (7) should lead to the same decision. That said, the cost of public funds α^C depends only on the marginal excess burden of taxation *à la* Pigou-Harberger-Browning and, thus, depends only on the tax used to finance the project.[5] By contrast, the modified cost of public funds α^M depends not only on the tax but also the type of project. This makes α^M a project-specific parameter unless, that is, the spending effect *à la* Diamond-Mirrlees-Stiglitz-Dasgupta is the same for all projects. This difference between α^C and α^M has considerable practical implications.

For one thing, when using (5), project appraisal practitioners can consider α^C an exogenously determined economy-wide parameter – established, for instance, by the ministry of finance. They could then focus on appraising project-specific aspects, notably *B, C, and R*. In essence, such an approach is well aligned with the separation of responsibilities between the ministry of finance and other branches of government or, for that matter, between a general economics department and the project appraisal department in international finance institutions.

For another, project appraisal practitioners need to know whether the cost-of-funds estimate they use reflects α^C or α^M. To illustrate, practitioners might work with an estimate of α^M without being aware that it incorporates indirect spending effects (of the specific public expenditure underlying that estimate). If they then account for indirect spending effects associated with the project they appraise, they double count and overstate the net benefits of the project. Such concerns would be largely irrelevant if it were clear from the literature whether it offers an estimate of α^C or α^M and, in the case of α^M, how important the spending effect of that α^M is relative to the spending effect of the project appraised. Alas, this is not so, and there is more to it than the distinction between the conventional and the modified approach to the cost of public funds – as the next section will argue.

Project appraisal practitioners need to know whether the cost-of-funds estimate they use reflects the conventional or the modified economic cost of public funds.

But before turning to that, two concluding comments are worth making. The cost-benefit rule presented here rests on a number of simplifying assumptions and certainly does not capture all possible general equilibrium effects following from raising funds and spending them on projects. For instance, projects might put upward pressure on wages. In a perfectly competitive setting, this would be immaterial as price and wage changes net out if prices and wages adjust so as to clear markets (see Johansson 1993, for instance). In a tax-distorted economy, this is no longer the case, and – as Jones (2005) shows – an increase in wages due to the project exacerbates the marginal

5 In an optimal tax system, each tax rate will be set so that the marginal excess burden is equal across all taxes. In practice, the marginal excess burden will be tax specific, however.

excess burden and thus increases the cost of public funds. All other things being equal, the direct benefits of a project need to be higher to ensure its economic profitability.

Finally, since the economic cost of funds (whether α^C or α^M) is a cost-scaling factor, it is relevant only for cost-benefit analyses, but not for cost-effectiveness analyses. Clearly, a cost-based ranking of project alternatives, meant to generate the same non-monetized benefits, does not change if all costs are scaled by the same factor.

4. Estimates of the economic cost of public funds

The previous sections suggest that the economic cost of public funds is "a potentially confusing concept" (Jones 2005, p.156). Along the same lines, Håkonsen (1998, p.229) emphasizes "The literature on the marginal cost of public funds (MCF) and the excess burden is presently a very rich one. A problem with this literature is that several different measures are interpreted as MCF." Indeed, a number of authors have tried to reconcile different estimates of the cost of public funds (Fullerton 1991; Mayshar 1990, 1991; Snow and Warren 1996; Håkonsen 1998; and Jones 2005). Against this background, the purpose of this section is threefold: First, to present Jones' (2005) review of differences between 'conventional' and 'modified' estimates; second, to explain why estimates of the conventional cost of public funds are bound to differ across countries; and third, to report on recent estimates of the conventional cost of public funds for pre-enlargement EU countries.

As the economic cost of public funds depends on country-specific circumstances, such as the tax regime, it is bound to vary across countries…

The review of Jones (2005) for wage taxes is reproduced in Table 1, showing that estimates range considerably, from 1 (Fullerton) to 1.57 (Stuart). That said, estimates for the United States suggest no striking difference between conventional and modified estimates. In any event, differences across countries might not be surprising for two reasons. Tax regimes and labour-market conditions vary across countries. As will be explained below, both features affect the distortionary impact of taxation. And then, the spending effect, which affects the modified cost of funds, depends, too, on labour-market conditions – more specifically the labour-supply response to public spending. As this response is probably country specific, estimates of the modified cost of funds are likely to differ from country to country. More fundamentally, commenting on the estimates of the modified cost of funds, Jones notes that "it is difficult to know the importance of the spending effect in each of them" (Jones 2005, p.170) – a lack of knowledge that seriously impairs the value of such estimates for the appraisal of specific public investment projects.

Turning to reasons why the cost of public funds is likely to differ across countries, differences in tax and welfare regimes are bound to be decisive, notably differences in average tax rates, marginal tax rates, progressivity of the tax system, and unemployment benefit schemes.

Differences in tax regimes combine with differences in the wage elasticity of labour supply. The excess burden of taxation and, by extension, the economic cost of public funds, is the higher the more the supply of labour reacts to a change in after-tax wages – a fact illustrated and discussed in Box 3. All other things being equal, countries with an elastic labour supply will have higher economic cost of public funds than countries with an inelastic supply. In fact, if the supply of labour is completely inelastic, an increase in the wage tax does not change labour supply and, thus, output. In this case, the conventional excess burden is zero ($\beta^C = 0$) and the conventional economic cost of public funds is one ($\alpha^C = 1$). It follows that the modified excess burden is negative ($\beta^M < 0$) and the modified economic cost of public funds is smaller than one ($\alpha^M < 1$) if the spending effect of the underlying government expenditure is positive, that is, boosts the supply of labour regardless of the after-tax wage.

Table 1. Estimates of the economic cost of public funds for wage taxes

	Country	Study	Estimate
Conventional a^C			
	United States	Fullerton (1991)	1 – 1.25
		Browning (1976,1987)	1.32 – 1.47
	Canada	Campbell (1975)	1.25
		Dahlby (1994)	1.38
	New Zealand	Diewert and Lawrence (1996)	1.18
	Australia	Campbell and Bond (1997)	1.19 – 1.24
		Findlay and Jones (1982)	1.275 – 1.55
Modified a^M			
	United States	Ballard and Fullerton (1992)	1.047 – 1.315
		Ballard *et al.* (1985)	1.16 – 1.31
		Stuart (1984)	1.07 – 1.57

Source: Jones (2005)

… but differences in cost-of-funds estimates also reflect differences in definition and measurement.

There is another reason why estimates of the economic cost of public funds vary – a reason more fundamental and unrelated to differences between countries. Two types of labour-supply curves have been used to measure and estimate the excess burden. One is the so-called uncompensated, or ordinary, supply curve. It shows the actual response of households to a wage change. The other is the so-called compensated supply curve. It represents a hypothetical response, capturing only the fact that lower wages make work less attractive but ignoring that they reduce income and, thus, increase the necessity to work. Box 3 sets out in more detail the difference between both concepts and why they affect empirical estimates of the economic cost of public funds. Suffice it to emphasize here that compensated labour-supply curves are more elastic than uncompensated ones and that cost-of-funds estimates based on the former are higher than those based on the latter.[6]

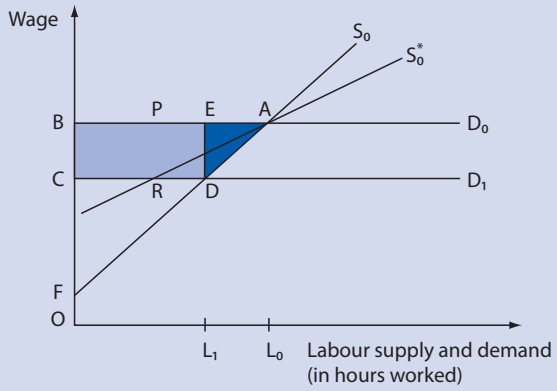
Knowing the essence of uncompensated labour-supply responses and elasticities, we are well prepared to review a study by Kleven and Kreiner (2006) that estimates the conventional cost of public funds for EU-15 countries. A salient feature of this study – setting it apart from most others – is that it explicitly distinguishes between two components of the aggregate labour-supply response. One reflects how employed people adjust the hours they work to a wage change; this is the intensive labour-supply response and the parameter measuring it is the uncompensated intensive supply elasticity. The other component reflects the entry and exit of people into the labour market due to a wage change; this is the extensive labour-supply response and the parameter measuring it is the participation elasticity or extensive supply elasticity.

6 Obviously, this statement applies to a wage tax. For a consumption tax, for instance, one needs to distinguish between compensated and uncompensated demand curves. The excess burden associated with the former is higher than that associated with the latter.

Box 3. Wage elasticity of labour supply and estimates of the economic cost of public funds

To examine the link between the elasticity of labour supply and the economic cost of public funds recall from Figure B1 and Box 1 that the conventional cost of public funds has been defined as the decline in the private surplus relative to the additional tax revenue. Both the decline in the private surplus (*CDEB* + *DAE*) and the additional tax revenue (*CDEB*) would be smaller for a flatter – that is, more wage-elastic – labour-supply curve. This is clear from Figure B3, which replicates Figure B1, but includes for comparison a more elastic labour-supply curve S_0^*. For this curve, the decline in the private surplus is *CRPB* + *RAP* and additional tax revenues amount to *CRPB* (implying an excess burden equal to *RAP*). The ratio between the two and, thus, the cost of public funds is the larger the greater the labour-supply elasticity is.

Figure B3. Excess burden, cost of funds, and elasticity of labour supply – conventional approach



Note: S_0^* can be understood to present a more elastic ordinary labour-supply curve than S_0. Alternatively, it might be understood to be the compensated labour-supply curve associated with the uncompensated (that is, ordinary) labour-supply curve S_0.

Instead of interpreting S_0 and S_0^* as two different labour-supply curves, one can, alternatively, interpret them as two curves highlighting different aspects of households' response to a change in wages. This takes us to an important subtlety we have ignored so far.

The link between wages and labour supply comprises two effects. For one thing, higher wages make leisure less attractive relative to work, enticing households to work more and reduce leisure. This so-called substitution effect implies a positive link between the wage rate and labour supply – consistent with upward-sloping labour-supply curve as shown in the diagram above. For another, higher wages boost households' income, thereby making leisure more affordable and, thus, increasing households' demand for leisure and reducing their supply of labour. This so-called income effect implies a negative link between the wage rate and labour supply, suggesting a downward-sloping labour-supply curve – in contrast to what is shown in the diagram above.

Cognizant of the substitution effect and the income effect of a wage change, there are two ways to picture households' response to a wage change. One rests only on the substitution effect triggered by a wage change, thereby considering only that lower wages render work less attractive relative to leisure. The income effect of lower wages – implying that lower wages reduce the affordability of leisure – is assumed to be compensated. Suppose S_0^* in Figure B3 shows this hypothetical 'compensated' labour-supply response.

The other way to look at things is to picture a curve that reflects actual labour supply, accounting for both the substitution effect and the income effect of a wage change. For a fall (increase) in wages, the substitution effect entices households to reduce (increase) their supply of labour whereas the income effect makes them supply more (less). As the substitution effect and the income effect work in opposite directions, this type of labour-supply curve must be steeper (that is, picture a smaller cut in labour supply for a given wage cut) than the one capturing only the substitution effect. Suppose S_0 in Figure B3 is this labour-supply curve. As the income effect is not compensated, it is called the 'uncompensated', or ordinary, labour-supply curve and the underlying wage elasticity of supply is labelled 'uncompensated', or ordinary, supply elasticity. An upward-sloping uncompensated supply curve like S_0 assumes that the substitution effect is larger than the income effect. This is not necessarily so. In fact, the uncompensated supply curve might combine an upward-sloping segment for relatively low wages (the substitution effect dominates the income effect) and a downward-sloping, or backward-bending segment for high wages (the income effect dominates the substitution effect).

Each type of labour-supply curve has been used to estimate the economic cost of public funds. For the compensated, relatively elastic supply curve, estimates should be based on the decline in surplus of *CRPB* + *RAP* and the hypothetical increase in tax revenue of *CRPB* , thereby resulting in (conventional) marginal cost of public funds of 1 + *RAP/CRPB*. For the uncompensated, relatively inelastic supply curve, estimates should be based on the decline in surplus of *CDEB* + *DAE* and an actual increase in tax revenue of *CDEB*, thereby resulting in (conventional) marginal cost of public funds of 1 + *DAE/CDEB*, which is larger than the estimate based on the compensated supply curve. That said, Jones (2005) suggests that some researchers have combined estimates of the 'compensated' decline in the private surplus based on S_0^* with estimates of the actual changes in tax revenue based on S_0 – and *vice versa*.

As in Boxes 1 and 2, Figure B3 shows the case of introducing a wage tax, although in interpreting the diagram, we had an increase in the tax rate on wages in mind. Drawing a diagram for an increase in the tax rate is straightforward and only slightly more complex.

Using elasticity estimates from the empirical literature and country-specific information on income, marginal and average tax rates, and effective tax rates on participating in the labour-market, Kleven and Kreiner simulate the economic cost of funds under alternative elasticity assumptions; they do this for both a proportional change in the marginal tax rate of all income groups (distinguishing ten groups) and a change in the marginal tax rate of one income group at a time. Table 2 contains a subset of their simulations of a proportional tax change.

Table 2. Estimates of the economic cost of public funds for wage taxes for EU-15 countries under different labour-supply elasticity assumptions

Country	S1	S2	S3	S1*	S3*
Austria	1.00	0.90	1.18	1.25	1.56
Belgium	1.00	0.83	1.32	1.41	2.14
Denmark	1.00	0.85	1.29	1.48	2.22
Finland	1.00	0.86	1.31	1.46	2.23
France	1.00	0.88	1.21	1.32	1.72
Germany	1.00	0.90	1.23	1.38	1.85
Greece	1.00	0.92	1.11	1.12	1.26
Ireland	1.00	0.89	1.16	1.21	1.45
Italy	1.00	0.89	1.19	1.22	1.52
Luxembourg	1.00	0.89	1.14	1.14	1.32
Netherlands	1.00	0.90	1.18	1.24	1.52
Portugal	1.00	0.88	1.15	1.15	1.36
Spain	1.00	0.94	1.07	1.10	1.19
Sweden	1.00	0.86	1.28	1.43	2.08
United Kingdom	1.00	0.93	1.10	1.13	1.26

Source: Kleven and Kreiner (2006)

Notes: Figures shown are estimates of the conventional marginal cost of funds, that is, a^C in the taxonomy of this paper. The first three simulations account only for intensive labour-supply responses: S1 uses an uncompensated supply elasticity of zero; S2 uses an uncompensated aggregate supply elasticity of zero, with positive (negative) elasticities for low-income (high-income) groups; S3 uses an elasticity of 0.1 for all income groups. S1* and S3*, respectively, adds an extensive labour-supply elasticity to S1 and S3. This extensive labour-supply elasticity is assumed to average 0.2 and to fall from 0.4 for the lowest income groups to zero for the highest income groups; in Kleven and Kreiner (2006), S1* and S3* is labelled S5 and S6, respectively.

Recent cost-of-funds estimates account for intensive and extensive labour-supply responses to changing wages.

The first three simulations (S1, S2, S3) account only for intensive labour-supply responses whereas the fourth and the fifth (S1*, S3*) account for intensive as well as extensive labour-supply responses. Simulation S1 sets a benchmark by assuming that the uncompensated intensive labour-supply elasticity is zero, implying a vertical labour-supply curve. In these circumstances, the wedge between gross and net wages does not change households' work-leisure choice, the conventional marginal excess burden is zero, and the conventional marginal cost of public funds is one, that is, the welfare cost of transferring one euro from the private to the public sector is one euro. Note that in this case, the modified cost of public funds would be smaller (larger) than one for projects with positive (negative) spending effects.

Simulation S2 retains an aggregate labour-supply elasticity of zero, but has the elasticity falling from a positive value for low-income groups (0.2 to 0.1) to a negative value for high-income groups (–0.1 to –0.2), implying a backward-bending labour-supply curve (a concept explained in Box 3). Positive elasticities work towards cost of public funds larger than one whereas negative elasticities suggest cost smaller than one. The simulation shows that the latter effect dominates the former for all EU countries, implying that the positive revenue and output effect resulting from the increase in the supply of labour by high-income workers outweighs the negative revenue and output effect resulting from the decline in the supply of labour by low-income workers. The possibility

of a 'negative' excess burden due to a backward-bending labour-supply curve was first noted by Atkinson and Stern (1974).

Simulation S3 rests on an intensive labour-supply elasticity of 0.1 for all income groups. The impact of this ranges from excess cost of 7 euro cents for each euro raised in the case of Spain to 32 cents in the case of Belgium. Broadly speaking, three groups of countries can be distinguished: First, southern European and Anglo-Saxon countries and Luxembourg, with relatively low economic cost of funds (1.07 to 1.16); second, the Nordic countries and Belgium, with much higher cost (1.28 to 1.32); third, all other countries – including the large continental economies Italy, France, and Germany – with economic cost of public funds somewhere in the middle (1.18 to 1.23). Although crude, this classification hints at a positive correlation between the economic cost of public funds and the size of both the welfare system and the government's tax take. Countries with relatively generous low-income support schemes and high marginal tax rates – the Nordic countries, for instance – tend to have relatively high cost of public funds. The opposite seems to hold for countries with limited low-income support schemes, strong pressure to accept low-wage jobs, and low marginal tax rates – as in the Anglo-Saxon countries, for instance.

The economic cost of public funds is far from negligible and is positively correlated with the size of the welfare system and the government's tax take.

Simulation S1* uses the same intensive labour-supply elasticity as simulation S1 (that is, zero) but accounts for an extensive labour-supply response (for details see Table 2), thereby isolating the impact of tax-induced market entry and exit decisions on the economic cost of public funds. As a comparison between S1* and S1 shows, the impact of the extensive labour-supply response on the cost of funds is considerable. Take France, for instance, where the extensive labour-supply response would raise the economic cost funds from one euro to EUR 1.32. What is more, the difference between S1* and S1 is larger than the difference between S3 and S1, suggesting that the extensive labour-supply response (indicated by the difference between S1* and S1) has a greater impact on the economic cost of public funds than the intensive response (the difference between S3 and S1).

Finally, simulation S3* combines the extensive labour-supply elasticities of simulation S1* with the intensive labour-supply elasticities of simulation S3. The differences between S3* estimates and S3 estimates confirm the importance of the extensive labour-supply response for the economic cost of public funds. Extensive labour-supply responses seem to be especially important for the cost of funds in the Nordic countries, Belgium, Germany, and France – that is, countries with high effective tax rates on participating in the labour market. That said, S3* estimates substantiate the country ranking and grouping mentioned above.

Running through alternative simulations does not mean they are equally valid. For instance, the purpose of S1 is mainly to set a benchmark. And then, the difference between S1* and S1 is meant to single out the importance of the extensive labour-supply response, that is, wage-driven decisions to enter or exit the labour market. Kleven and Kreiner (2006, p.21) consider S3* a "natural baseline" and in the summary of their findings it takes centre stage.

To wrap up, the economic cost of public funds appears to be far from negligible – though estimates vary considerably. While there are good reasons for estimates to differ across countries, one would expect similar estimates for the same country (and the same tax). This is not the case, however, because different studies define the economic cost of public funds differently, some estimating the conventional cost of funds, others the modified cost of funds. In addition, some studies measure the cost of funds on the basis of compensated labour-supply curves while others measure them on the basis of uncompensated labour-supply curves. Notwithstanding these differences, the empirical evidence suggests that the economic cost of one euro raised with distorting taxes is larger than one euro.

5. The economic cost of public funds, user fees, and the privatization of public goods and services

In developing the cost-benefit rules (5) and (7), it was assumed that project outputs are supplied free of charge. This is a sensible assumption when these rules are used to assess the economics of pure public goods, because trying to sell such goods for a price would result in no or a suboptimal demand for them. That said, goods and services with public-goods characteristics can be and are sold for a price, although probably one not high enough to cover all cost. This is true, too, for goods that markets would undersupply because of scale economies and positive externalities. Many goods and services feature public-goods characteristics, scale economies, and/or positive externalities, notably transport infrastructure, health, and education services. Against this background, it makes sense to ask how user fees change the cost-benefit assessment.

Following Brent (2006), a simple way to introduce user fees F in our presentation is to amend Equation (5) as follows:[7]

(8) $B - F = \alpha^C (C - R - F)$

The rationale for this extension is straightforward. On the left-hand side of (8), user fees are subtracted to show the benefit of a project to users after they have paid for it. On the right-hand side of (8), user fees enter with a negative sign in the term in brackets because they reduce the project's net financing needs and, thus, the amount of public funds to which the excess burden of taxation applies. It is convenient to express user fees F as a ratio of direct project cost C. Introducing the symbol λ for this cost-recovery ratio and rearranging (8) leads to

$$(9) \quad B = \alpha^C \left[C \left(1 - \lambda \frac{\alpha^C - 1}{\alpha^C} \right) - R \right] \quad \text{with} \quad 0 \leq \lambda = \frac{F}{C} \leq 1.$$

While charging for the use of public services helps contain the excess burden of taxation …

Because of user fees and, thus, less need for distortionary taxation, the right-hand side of (9) is smaller than the right-hand side of (5). To illustrate, assume that without user fees, α^C, C, and R combine so that direct project benefits (B) must exceed direct costs (C) by, say, 20 percent; with user fees, this hurdle falls below 20 percent. A corollary is that projects not passing the cost-benefit test without user fees might become economically viable with them.

Obviously, without user fees ($\lambda = 0$), Equation (9) simplifies to (5). For the other extreme – that is, full cost recovery ($\lambda = 1$) – Equation (9) becomes $B = C - \alpha^C R$. Thus, with full cost recovery, there is no need to tax and no excess burden. What is more, for projects with positive indirect spending effects ($R > 0$), implying that distortionary tax rates can be cut, projects might be welfare enhancing even if their direct benefits (B) are smaller than their direct costs (C). And then, (9) shows that user fees would not matter for the cost-benefit comparison if the economic cost of raising one euro was one euro ($\alpha^C = 1$).

Arguably, for the goods considered here, full cost recovery ($\lambda = 1$) is not a true option. In fact, economic reasoning militates against it. Take health and education services, for example, which generate benefits to society that exceed private benefits. For simplicity, assume that the marginal costs of supplying these services are constant, thus making them equal to average production costs. The optimal supply and consumption of such services is attained when their social marginal benefits equal their marginal costs, both being larger than private marginal benefits. To make users demand

7 The arguments that follow could also be developed on the basis of Equation (7).

the socially optimal quantity, one cannot charge them more than what they are willing to pay, that is, the private marginal benefit. But this implies less than full cost recovery and a need for covering the gap between cost and user fees through taxation. To conclude, full cost recovery, while avoiding the excess burden of taxation, would result in too low a supply and consumption of health and education services.

Another example is a service characterized by economies of scale, a case in point being the service that roads, bridges, tunnels and other transport infrastructure offer. A salient feature of such services is that their average costs exceed their marginal costs. To encourage an optimal use of the infrastructure, user fees should be equal to marginal costs. Again, this would imply less than full cost recovery and a need for taxation. An alternative is to set user fees so that they cover average cost. While this would avoid the excess burden of taxation, it would result in a suboptimal use of the infrastructure.

… it might lead to a sub-optimally low demand for public services.

All this suggests a trade-off between welfare changes caused by distortionary taxation and welfare changes caused by not optimally pricing public goods and services. On the one hand, the more complete the cost recovery is, the more the consumption of public goods and services is pushed below its optimum. On the other hand, the closer user fees are to the level ensuring an optimal use of public goods and services, the greater is the need for raising funds *via* taxation and, thus, the bigger the excess burden. HM Treasury (2000) highlights this trade-off in the context of pricing the dissemination of government information resources. Engel *et al.* (2008) show how this trade-off ought to enter welfare-maximizing contracts governing public-private partnerships.

A qualification is due. As Brent (2006) points out, the link between user fees and the economic cost of public funds described above assumes that the government is the sole supplier of the goods and services under consideration. The link becomes more complex when the private sector supplies them too and when both the government and the private sector consume them. For instance, one could think of public and private roads used by public and private cars; public and private hospitals treating publicly and privately insured patients; public and private schools educating pupils paying school fees with government vouchers and pupils paying out of their parents' pockets; and so on.

In these circumstances, four relationships need to be considered. (i) The government produces for its own consumption; in this case, there is no link between user fees and the economic cost of public funds; this is because whatever user fee the government charges as a provider of services, it needs to pay as a user; hence, this relationship is irrelevant for the excess burden of taxation. (ii) This is true too when the private sector produces for its own consumption. (iii) The government produces for private consumption, which is the case captured by the equations above. (iv) The government consumes and pays for privately produced goods and services; as the government needs to raise taxes to finance its consumption, this relationship introduces an excess burden of taxation not mentioned so far.

Besides making the link between user fees and excess burden more complex, these relationships are important when the government considers ceding its own production, be that through straight privatization or public-private partnerships. Brent (2006) and Engel *et al.* (2008) discuss in greater detail how this affects the decision whether or not and how to privatize. Suffice it to note the key factors at play in Brent's analysis. Relationships (i) and (iii) – that is, those with government supply – disappear. As a result, the excess burden coming with relationship (iii) disappears, too. At the same time, government consumption initially captured by relationship (i) now falls under relationship (iv), increasing the excess burden associated with that relationship. Whether privatization is worthwhile depends on how efficient private sector production is compared to public sector production, the

level of government user fees prior to privatization, and the economic cost of public funds. Brent applies this framework to the privatization of psychiatric hospital services in the United States. Privatization can be either to for-profit private hospitals or to non-profit private hospitals. With economic cost of public funds based on Browning (1976, 1987) – see Table 1 above – Brent finds privatization to for-profit hospitals worthwhile but privatization to non-profit hospitals welfare reducing.

The link between user fees and the economic cost of public funds sheds a fresh perspective on privatization and public-private partnerships.

To summarize, with user fees appropriate for the type of goods and services examined here, economic cost of public funds larger than one remain relevant for cost-benefit analyses. User fees help contain the excess burden of taxation, thereby alleviating one type of economic inefficiency. Yet, to the extent that they prevent demand from reaching its socially optimal level, they give rise to another type of inefficiency. There is thus a trade-off to consider. What is more, the link between user fees and the economic cost of public funds sheds a fresh perspective on privatization and public-private partnerships – a perspective the literature is just beginning to explore.

6. The economic cost of public funds, discounting, and debt finance

So far, the analysis was cast in an atemporal, or one-period, framework. Clearly, in reality, project costs and benefits spread over many periods. This makes it necessary to compare costs and benefits occurring at different points in time – a task achieved by properly discounting future costs and benefits. But what is, then, the link between the economic cost of public funds and the discount rate to be used in cost-benefit analyses – that is, the social discount rate? Moreover, in an intertemporal, or multi-period, framework, the government might issue debt rather than raise taxes to finance public projects. How does debt finance change the perspective on the economic cost of public funds?

The essence of both questions can be addressed in a two-period framework. Moreover, assuming that all direct project costs C arise in the first period (the present) while direct benefits B and indirect benefits R arise in the second period (the future) simplifies the analysis without fundamentally affecting its results.

To start with the link between the economic cost of public funds and the social discount rate, we need to amend cost-benefit rule (5) so that it reflects the intertemporal nature of the problem:[8]

$$(10) \quad \frac{B_1}{1+d} = a^C C_0 - \frac{a^C R_1}{1+d}$$

In (10), d is the social discount rate, B_1 captures future direct benefits, C_0 stands for present direct costs, and $R_1 > 0$ reflects future indirect benefits. Like the discount rate, the economic cost of public funds a^C is assumed to be time-invariant. Moreover, a^C in (10) is of the same size as a^C in (5). The rationale for this is explained in Box 4. The cost-benefit rule (10) expresses the standard requirement that discounted benefits of the marginal project must equal discounted costs.

8 Alternatively, the analysis could be based on an intertemporal version of Equation (7).

Box 4. Atemporal and intertemporal economic cost of public funds

The purpose of this Box is to explain the conditions that make α^C in the atemporal world – Equation (5) – of the same size as α^C in the intertemporal world – Equation (10).

As Liu (2003) shows, in an intertemporal model, α^C is the net present value of welfare changes due to distortionary taxation (that is, the numerator in Equation (B3)) divided by the net present value of revenue changes resulting from an increase in tax rates (that is, the denominator in Equation (B3)). Hence, the intertemporal α^C might differ from the atemporal sibling for two reasons.

First, the welfare and revenue changes following the first-period changes in the intertemporal model might differ from the one-period changes in the atemporal model. Second, differences might result from discounting welfare changes (the numerator in the definition of the economic cost of funds) and revenue changes (the denominator in the definition of the economic cost of funds) at a different discount rate.

Indeed, Liu (2003) makes a case for discounting welfare changes at the after-tax (net) interest rate while discounting revenue changes at the before-tax (gross) interest rate. This makes the intertemporal α^C larger than it would be otherwise. Using the definition of α^C in Liu (2003), the intertemporal α^C is the same as the atemporal one if (i) welfare and revenue changes are constant over time – both measured relative to the situation before increasing the tax rate – and (ii) welfare changes and revenue changes are discounted at the same rate. Both assumptions are made here.

The main message transpiring from (10) is that the economic cost of public funds and the social discount rate are two different concepts, both equally important for the appraisal of public projects. This might seem surprising, and possibly confusing, given that the social discount rate is often understood to represent the cost of funds committed to a project. To clarify things, it is useful to go back to first principles and recall what the social discount rate is and how it could be measured.

The economic cost of public funds and the social discount rate are two different concepts, both important for the appraisal of public projects.

As (10) illustrates and as stated at the outset, the sole purpose of the social discount rate – more precisely of the social discount factor $1/(1 + d)$ – is to make future costs and benefits comparable to present ones. Discounting is thus nothing more than a weighing exercise. Determining the weights is tricky, however.

To see why, it is useful to return to the benchmark of a perfectly competitive economy. As discussed in Sub-section 2.1, in such an economy, equality of three rates characterize an efficient intertemporal allocation of resources: The marginal rate at which households are willing to substitute present income for future income (MRS) is equal to the rate at which firms can transform income not used today into future income (MRT), and both are equal to $1/(1 + m)$, m being the market rate of interest. The marginal rate of substitution MRS can be expressed as $1/(1 + i)$, i being the time preference rate of an individual representative household; for now, let us assume that this rate reflects society's time preference, too. The marginal rate of transformation MRT can be expressed as $1/(1 + r)$, r being the marginal productivity of capital, that is, of resources not consumed today but invested with a

view to increasing future consumption possibilities; thus, r captures the opportunity cost of present consumption, a rate that we assume to reflect society's opportunity cost, too. In sum, in this perfect world, $i = r = m$, that is, the social rate of time preference is equal to the social opportunity cost of capital and both are identical to the market interest rate. In these circumstances, choosing the discount rate d is easy. One simply selects the (observable) market interest rate, knowing that it measures social time preference and opportunity cost.

The choice of the social discount rate is complex and controversial.

Departures from this ideal benchmark make the choice of the social discount rate complex and controversial. In particular, capital market imperfections and distortionary taxes undo the equality between i, r, and m. A tax on interest income, for instance, drives a wedge between the social opportunity cost of capital (r) and the social rate of time preference (i). More precisely, a tax on interest income turns i into an after-tax return to households that is lower than the before-tax marginal productivity of capital r. Should one use i or r as the discount rate – or a combination of the two? If funds for a project had been consumed in the absence of it, there is an argument for using i. In contrast, if the project crowds out investment, it is tempting to make a case for choosing r – that is, the social opportunity cost of capital – as the discount rate. And then, there appears to be some logic to using a weighted average of i and r as the discount rate if the funds committed to the project replace consumption and investment.

This being said, setting the discount rate on the basis of the opportunity cost of capital is contentious – even if the project examined comes fully at the expense of investment. A neat way to illustrate the point is to consider a cost-effectiveness analysis – an analysis comparing the discounted resource cashflows of project alternatives that have the same non-monetized benefits. In this case, there is no logic to using a discount rate based on forgone benefits, or opportunities, because valuing the benefits of these alternatives is not the purpose of the analysis in the first place. Spackman (2004) presents this argument in greater detail in his survey of time discounting. In line with much of the literature, he concludes that the social discount rate should not be based on social opportunity cost but on the social time preference rate.[9]

Even if one were to disagree with this conclusion, a discount rate based on social opportunity cost would not introduce an additional cost-of-funds element into Equation (10). The economic cost of public funds continues to be captured exclusively by a^C, and a discount rate based on social opportunity cost merely implies that forgone opportunities are used to measure the importance of time. This is true, too, when the interest rate on government debt is used as the social discount rate, an approach favoured by Lind (1990), for instance.

This takes us to how the economic cost of public funds and the cost-benefit rule (10) might change if the government issues debt to finance public projects. To fix ideas, let us posit that Ricardian equivalence (Barro 1974) holds, implying that debt finance has no impact on aggregate demand and savings, interest rates, and capital formation. It also implies that the burden of taxation does not shift from the present to the future as households save (consume) more (less) today in anticipation of higher tax obligations tomorrow. However, as taxes will have to be raised eventually to service the

9 Spackman (2004) also recalls that the social time preference rate is typically presumed to be lower than the individual time preference rate – in contrast to the equality assumed above for simplicity. One argument on which this hypothesis rests is that as society has a longer life expectancy than individuals, it ought to be less myopic than individuals. Another argument draws on the 'isolation paradox' (Sen 1967). This argument has it that due to consumption externalities individuals give too much weight to present consumption relative to future consumption. Internalizing these externalities, which would be optimal from society's viewpoint, would result in lower individual time preference rates.

debt, debt finance shifts the excess burden of taxation from the present to the future. But there is more to it – as a period-by-period inspection will show.

In the first period, direct project costs (C_0) are the sole resource costs entering the cost-benefit equation.

In the second period, resource flows include direct and indirect project benefits (B_1 and R_1). In addition, one needs to account for the excess burden of taxation. But how big is it? As the government borrowed an amount equal to C_0 in the first period, it will have a debt service obligation of $C_0\ (1 + g)$ in the second period, g being the interest rate on government debt. Extra tax revenue equal to the debt service obligation will have to be raised, suggesting costs of public funds of $a^C\ C_0\ (1 + g)$ or, equivalently, $(1 + \beta^C)\ C_0\ (1 + g)$. Only part of this, however, constitutes a resource cost and, hence, only part of it should enter the cost-benefit equation. To identify which part, consider the following breakdown of $(1 + \beta^C)\ C_0(1 + g)$:

$$(11) \quad (1 + \beta^C)\ C_0(1 + g) \quad = \quad C_0(1 + g) + \beta^C\ C_0\ (1 + g)$$

Government borrowing defers but does not avoid the excess burden of taxation.

The first term on the right-hand side of (11) is the tax revenue required to service the debt. This term must not enter the cost-benefit equation because it does not represent a resource cost but transfers between households and the government that offset each other: Funds are taken from households through taxation and returned to them as debt repayment and interest income. By contrast, the second term – the excess burden of taxation – represents a resource cost that cost-benefit analyses must account for.

Putting the pieces together, for debt-financed public projects, the cost-benefit rule needs to include present costs (C_0), future benefits (B_1, R_1), and future resource costs $\beta^C\ C_0(1 + g)$. Using this in (10) and rearranging terms leads to

$$(12) \quad \frac{B_1}{1+d} = a^C C_0 - \frac{a^C R_1}{1+d} + \beta^C C_0 \frac{g-d}{1+d}.$$

This rule is identical to (10) for $g = d$, that is, there is no difference between taxing now or later. It is important to point out that $g = d$ can be for two distinct reasons. For one thing, the interest rate on government debt (g) might just happen to be equal to the social discount rate (d). For another, the government interest rate might be used as the social discount rate, not only eliminating the last term on the right-hand side of (12) but also substituting g for d in the remaining terms.

Suppose the choice of discount rate is so that $g > d$. In these circumstances, projects should be tax financed since debt finance reduces welfare by an amount equal to the last term on the right-hand side of (12). And *vice versa*: If the choice of discount rate is so that $g < d$, debt finance and, thus, taxing later is better than taxing now. That said, for a given government interest rate, choosing a higher social discount rate reduces the number of beneficial projects; thus, while they ought to be debt financed, there will be fewer of them. Finally, if there were no excess tax burden ($\beta^C = 0$), the choice of discount rate would be immaterial for the decision to tax now or later, but it would continue to affect the number of projects and the level of public expenditure that passes the cost-benefit test.

Given the importance of the term $g - d$ for the decision to tax now or later, it is pertinent to investigate how social discount rates used in practice compare with the government interest rate. Reviewing the

literature, Spackman (2004) finds for developed countries a social time preference rate of around 4 to 5 percent and a real return on long-term government debt of 2 to 3 percent. Adopting the social time preference rate as the social discount rate thus implies $g < d$, suggesting that society should prefer debt finance and taxing later over taxing now. The economic intuition follows from the last term on the right-hand side of (12): g measures the rate at which the deferred excess tax burden grows over time while d measures the rate at which the value of the numeraire used in the cost-benefit analysis falls over time; with the rate of fall exceeding the rate of growth, it makes sense to defer the excess burden regardless of the discount rate. Recall that this applies only to the deferred excess burden of taxation ($\beta^C C_0$) but not to the deferred burden of taxation (C_0) because repaying the debt offsets the latter, which thus does not impose any resource cost on the economy.

Lest this paints too rosy a picture of debt finance, a variety of caveats need to be mentioned. With debt finance preferred to taxation, government indebtedness goes up, government creditworthiness deteriorates, and – as a result – the interest rate on government debt increases. There is thus a tendency for g to rise until it equals d. With such an equilibrating mechanism ($g = d$), the last term in (12) drops out, making taxing later as suitable as taxing now.

More fundamental objections to the apparent advantage of debt finance follow from modifying key assumptions made so far. For a start, Ricardian equivalence might not hold, implying that debt finance reduces aggregate saving and investment, capital accumulation, and economic growth. All other things being equal, this would reduce the tax base, thereby raising the economic cost of public funds. Along similar lines, the tax rate increase needed in the future might apply to interest income, too, not only to labour income as assumed so far. This would lower the net return on savings, reduce savings, and thus shrink the tax base. These are important objections to the findings captured in (12), though they have been introduced here in a rather *ad hoc* fashion. Analyzing them more systematically requires an approach that explicitly models saving, investment, capital accumulation, and economic growth. Dahlby (2006) seems to be a first attempt to this end. Under baseline assumptions, he arrives at estimates of the economic cost of funds from government borrowing of 1.2 for Canada and 1.09 for the United States. An alternative scenario suggests estimates of 1.45 and 1.35.

The economic cost of public funds captures the welfare cost of transferring resources from the private sector to the government at any point in time whereas the social discount rate weighs costs and benefits occurring at different points in time.

All in all, this section makes two points. One is that the economic cost of public funds must not be confused with the social opportunity cost of capital – these are two distinct concepts. The former informs about the welfare cost of transferring resources from the private sector to the government at any point in time. The latter informs about the rate at which society can transfer resources across different points in time. This feature makes the social opportunity cost a candidate for time discounting, that is, for weighing costs and benefits not occurring at the same time. But it has been pointed out, too, that the social time preference rate is a better candidate for the social discount rate in cost-benefit analyses.

The other point is that the economic cost of public funds must not be confused with the cost of government borrowing, that is, the interest rate on government debt. Borrowing enables the government to defer the burden and the excess burden of taxation. When the debt falls due, debt service payments and the tax revenue required to meet them exactly offset each other and thus leave welfare unchanged. However, raising distortionary taxes to collect the revenue required for servicing the debt causes an excess burden. Whether or not society gains from facing this excess burden tomorrow instead of today depends on the interest rate on government debt and the social discount rate. The model sketched in this section suggests that, from society's viewpoint, carrying the excess burden later is as bad as carrying it now.

7. Conclusions

As the main findings have been summarized at the end of each section, four concluding remarks will do.

First, economic reasoning and empirical evidence suggest that the excess burden of taxation – and its implication that the economic cost of one euro of public funds exceeds one euro – is too important to disregard in the appraisal of government expenditure. But it is also true that government spending – on infrastructure investment, in particular – might have effects that counterbalance the excess burden. Thus, it would be wrong to consider the excess burden but to ignore effects possibly offsetting it. That said, estimates of the economic cost of public funds that account for these effects nonetheless suggest that it costs society more than one euro to transfer one euro from the private sector to the government.

The fact that the economic cost of one euro of public funds exceeds one euro is too important to disregard in the appraisal of government expenditure.

Second, for the appraisal of public infrastructure investment the most appropriate approach is to apply an estimate of the 'conventional' economic cost of public funds and to assess effects that possibly counterbalance the excess burden on a case-by-case basis. As the economic cost of public funds varies across countries, one size does not fit all and country-specific cost estimates should be used.

Third, policymakers and project appraisal practitioners might wonder whether available estimates of the cost of funds are reliable enough. Moreover, they might feel that assessing effects possibly counterbalancing the excess burden is, too, an exercise surrounded by too many uncertainties – and one taking them beyond the boundaries of project appraisal as commonly done. Clearly, accounting for the excess burden and effects offsetting it is a challenge. But so is the monetary valuation of greenhouse gas emissions, for instance, a challenge practitioners shied away from some 10 to 15 years ago, but which has become an integral part of project appraisal since then. Besides, ignoring the excess burden and effects offsetting it does not mean they have not been valued. On the contrary, it means they have implicitly been assumed to perfectly offset each other, implying a value of one for the 'modified' economic cost of public funds.

Lastly, there might be political reasons for neglecting the excess burden of taxation in the appraisal of government investment. After all, the scaling factor expressing the economic cost of public funds "declares so explicitly that taxation imposes a burden beyond the value of the revenue raised" (Spackman 2004, p. 488) and – using Browning's estimate as an illustration – requires that government investment "must be at least 9-16 percent more productive than private expenditures to produce a net welfare gain" (Browning 1976, p. 283). It does not take an overly wicked mind to suspect that this is a message spendthrift policymakers and political parties prefer to disregard. Economists will continue to argue otherwise.

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ABSTRACT

Most new EU member states (NMS) need further fiscal adjustment to support economic growth and macroeconomic stability. *In this context, achieving income convergence with other EU members rests more with maintaining productivity growth, attracting foreign savings, and improving investment efficiency than with increasing government spending (including for infrastructure). Additional institutional fiscal reforms, aimed at improving expenditure efficiency and facilitating private sector investment, will be needed to support these objectives. However, further fiscal adjustment and reforms do not necessarily need to depress public investment. New financing options for public investment – including from various EU funds and through public-private partnerships – can ease existing fiscal and macroeconomic constraints, but present both new opportunities and challenges that need to be handled carefully.*

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Macro-fiscal policy challenges and public investment in new EU member states


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1. Introduction

Fiscal policy in the new EU member states (NMS) faces a challenging dilemma.[1] On the one hand, fiscal policy must support growth and convergence by allowing increased levels of investment, not least to upgrade infrastructure. On the other hand, fiscal policy must safeguard macroeconomic stability and fulfil the budget requirements of the EU Stability and Growth Pact, while facing additional expenditure needs for complying with the European laws and standards (the so called *Acquis Communitaire*).[2] These standards call for reforms in the labour market, the tax and pension systems, subsidy schemes, and other areas, which may entail up-front costs. In addition, many countries must prepare to buffer the impact of increasing expenditure pressures related to an aging population within a sustainable medium- to long-term macro-fiscal framework.

To varying degrees, many NMS have carried out fiscal adjustment in recent years, with implications for the level of public investment. Although a large part of this adjustment has fallen upon public expenditures, including public investment, reductions in domestic funding for public investment have, to some extent, been counterbalanced by the availability of new financing support. Part of this financing has been provided by EU funds directed toward projects with a regional impact and of common European interest. In addition, many countries are advancing the implementation of public-private partnerships (PPPs) as an alternative to traditional public investment to develop infrastructure.

Against this background, this paper looks at some specific fiscal policy and public investment issues in the NMS. In particular, the paper aims to address the following questions. First, what do recent growth experiences in NMS imply for macro-fiscal coordination? Second, what has been the impact of fiscal adjustment on public investment levels? Third, where do NMS stand with respect to infrastructure? Fourth, what is the role of new financing sources, including EU funds and PPPs?

Strong fiscal positions are critical for reducing macroeconomic vulnerabilities and enhancing growth prospects in the NMS. In general, fiscal policies should aim to raise the efficient use of the whole envelope of available financing to address investment needs. Still, the diversity of growth experiences and fiscal policy stances among NMS underscores that country-specific fiscal strategies are needed. While some countries have resorted to investment cuts to consolidate fiscal positions, others have been more successful in both accommodating higher levels of investment and reducing fiscal imbalances. Also, new available financing presents opportunities as well as challenges, requiring improvements in the institutional framework for investment and PPPs. In the case of EU funds, absorbing the substantial additional resources under the new financial perspective will demand important efforts to reallocate expenditures and to step up absorptive capacities. Similarly,

1 For the purpose of this study, the NMS include the countries that became members of the EU in May 2004, plus Bulgaria and Romania that became members in early 2007.

2 This term denotes the treaties, regulations and directives passed by the European institutions as well as judgments laid down by the Court of Justice. Candidate countries must adopt, implement, and enforce all the *acquis* to be allowed to join the EU. In addition, they often have to set up or change the relevant administrative or judicial bodies which oversee the legislation. The "chapters" of the *acquis* address, for example, issues related to the free movement of goods, services, persons, and capital, company law, competition, transport, energy, research, industrial policy, education, energy, environment, culture, consumers, and health protection, as well as stipulations for cooperation in the fields of justice, customs, foreign and security policy, and financial and budgetary provisions.

while PPPs provide a promising route for channelling more resources into infrastructure investment, strengthening the institutional framework for PPPs and limiting incentives to simply move investment off budget is crucial to deliver on the expected benefits and manage the associated fiscal risks.

The rest of the paper is organized as follows. Section 2 reviews the implications for fiscal policy of efforts to enhance growth and macroeconomic stability. Section 3 analyzes fiscal developments in NMS and the role of public investment in fiscal adjustment episodes. Section 4 discusses the state of infrastructure in NMS. Section 5 focuses on the potential role of new mechanisms for financing infrastructure, particularly increased EU support following EU membership and PPPs. Section 6 concludes.

2. Economic growth and stability: The role of fiscal policies

High GDP growth in the new member states has been driven by investment but even more by productivity gains.

Mostly driven by productivity growth and investment, growth in the NMS has been high but uneven. In general, the Baltics achieved much higher growth rates than Central and Eastern European countries (CEEs). As shown in Figure 1, productivity growth was a key engine for economic growth, with a contribution of almost double that of East Asian emerging market comparators (Schadler *et al.* 2007). This reflected economic reforms that addressed large inefficiencies inherited from central planning. Capital accumulation also played a substantial role in supporting growth. In contrast, employment contributed little, likely associated with significant labour shedding during the transition.

Foreign savings were instrumental to financing investment. National savings have been relatively low in the NMS, with only the Czech Republic, Slovenia, and Estonia achieving rates above 20 percent of GDP. However, due to ample availability of foreign financing – which contributed between 9 and 38 percent of gross investment in the NMS – low national savings have not held back investment (Figure 2). The resulting total investment rates of about 24 percent of GDP in the CEEs and 30 percent of GDP in the Baltics are comparable to those observed in other fast growing emerging markets. European integration has likely facilitated such increased use of foreign capital.

Looking ahead, continued capital inflows and increased national savings – both needed to sustain and strengthen investment and growth – will require sound fiscal policies.[3] In most NMS, strengthening fiscal sustainability will require further efforts at expenditure- based fiscal consolidation, considering high initial expenditure levels. In this regard, Alesina *et al.* (2002) find that lower public spending can reduce labour costs and raise profits and private investment. Fiscal consolidation can also reduce the borrowing cost for the private sector to access international capital markets through reduced country risk. IMF (2005) reports that countries with lower public debt receive higher sovereign bond ratings, and Akitoby and Stratmann (2006) find that spending cuts, particularly cuts in current expenditure, are associated with lower sovereign bond spreads.

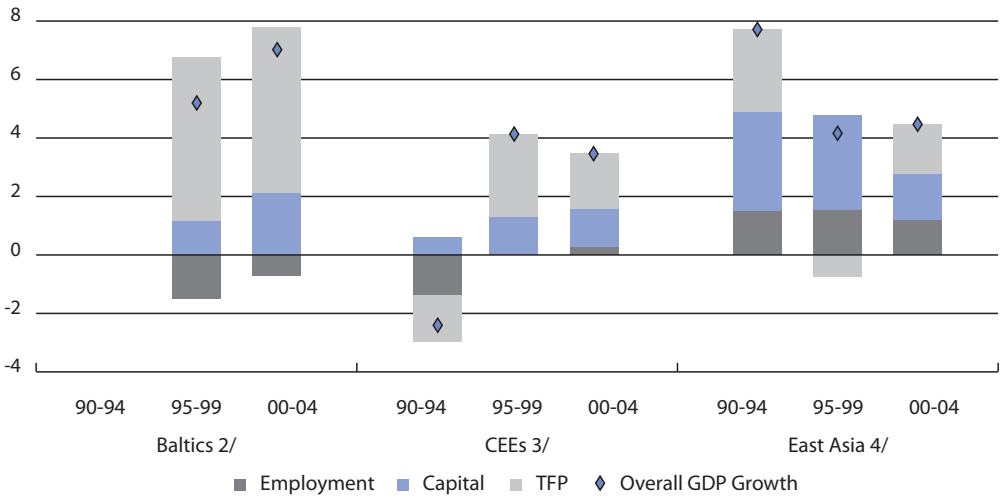
Strong fiscal policies are also needed to safeguard overall macroeconomic stability. As in many fast-growing economies, there is evidence of some build-up of macroeconomic vulnerabilities in the NMS (Figure 3). Current account deficits are high in several NMS (the Baltics and Hungary),

3 Although Ricardian equivalence theory suggests that private saving may adjust to fully offset changes in public saving, the empirical literature on developing countries only finds small Ricardian effects, which, among other things, may reflect less developed financial markets and the associated market perceptions on public sector governance and country risks. See Feldman and Watson (2002) for details.

comparable to pre-crisis levels in East Asia. Similarly, external debt indicators show some weakness in several NMS (Latvia, Estonia, Hungary, Slovenia, and Slovakia). In addition, a few NMS also exhibit low ratios in reserve coverage of short-term debt. While EU membership in itself helps to make the NMS more resilient, they have no alternative to maintaining prudent fiscal positions: Fiscal policies consistent with macroeconomic stability are both required by the Stability and Growth Pact and essential for safeguarding sustainable growth.

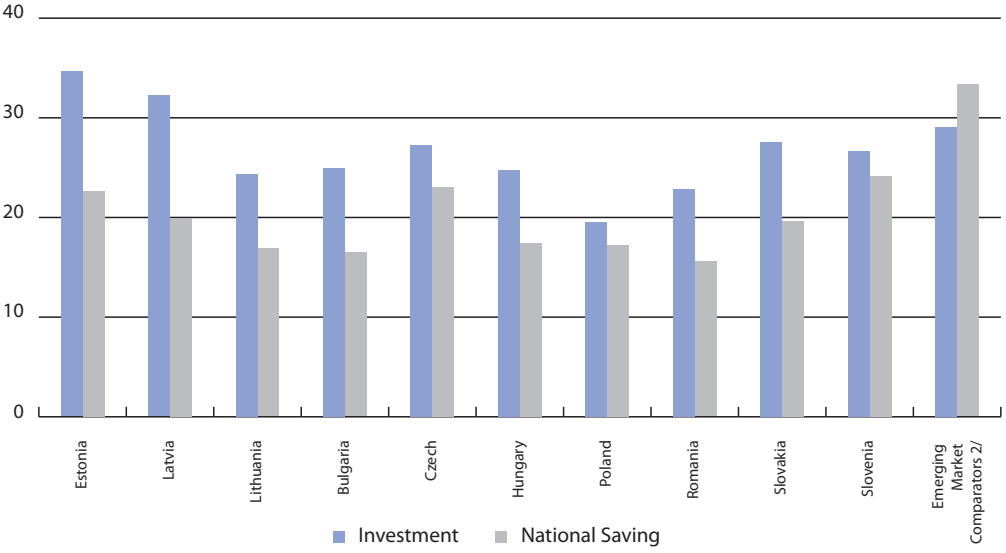
Prudent fiscal policies are essential for safeguarding macroeconomic stability and sustainable growth.

Figure 1. Contributions to average GDP growth in NMS 1/



Sources: IMF staff estimates
Notes: 1/ Data based on growth accounting by decomposing sources of growth into capital and labor inputs, and total factor productivity (TFP). See Schadler *et al.* (2007) for details.
2/ Data for 1990–94 are not available.
3/ Data only include Czech Republic, Hungary, Poland, Slovakia, and Slovenia.
4/ The group includes China, Hong Kong SAR, Indonesia, Republic of Korea, Malaysia, the Philippines, Singapore, Taiwan Province of China, and Thailand.

Figure 2. Saving and Investment in NMS 1/ (in percent of GDP)



Source: IMF (2006a)
Notes: 1/ Data refer to national gross saving and investment rate in percent of GDP.
2/ The emerging market comparators include 5 fast growing countries: Chile, China, India, Republic of Korea, and Malaysia.

Further productivity gains, including for public investment, may be more critical for economic growth than higher investment levels.

Further productivity gains, including for public investment, would be required to help support macroeconomic stability and foster economic growth. For example, for the Czech Republic, Hungary, and Slovakia, and assuming no further productivity gains, halving the income gap *vis-à-vis* the old member states over 10 to 20 years would require a dramatic increase in investment by 12 to 15 percent of GDP from the current level (Table 1). In contrast, assuming no increase in investment rates, the productivity growth needed to close the income gap is largely in line with the average level in the NMS. This suggests that, even at current levels of total investment, increases in efficiency to the level of leading peers could already go a long way toward achieving higher growth (Figure 4). For example, in 2000–2005, total investment in Slovakia was higher than in Latvia by 6 percent of GDP, but per-capita GDP growth rate was only half. Therefore, while increasing investment levels remains important, boosting the efficiency of investment, particularly public investment, may be even more critical. Policy options to improve efficiency gains may include, for example, reallocations between new investments and maintenance and optimized choices between investment alternatives for more cost-effective usage.

At the same time, fostering growth will require addressing the institutional and policy constraints that are seen as key barriers to business activity. As shown in Table 2, recent World Bank Investment Climate Surveys (ICS) suggest that, among 18 indicators, private firms consistently rank tax rates, economic and regulatory policy uncertainty, and macroeconomic instability as top constraints for businesses in the NMS. In contrast, none of the infrastructure indicators (*e.g.*, access to land, electricity, telecommunications, and transport) are among the top 12 constraints in any NMS. Therefore, private investment decisions are more closely related to the strength of government institutions and policies than to the availability of infrastructure, and public investment alone would not foster private investment if other pressing concerns are not addressed.[4]

Figure 3. Macroeconomic vulnerability indicators in NMS and East Asia

Source: IMF (2006a)
Note: Data are for 2005, unless noted otherwise.

4 This is not to say that public investment does not contribute to growth. In theory, public investment contributes to growth both as an input and by enhancing productivity. Yet, the empirical evidence is mixed. Surveys by Sturm *et al.* (1998) and de Haan *et al.* (2008) conclude that public capital stimulates economic growth, but the quantitative impact is lower than previously believed. Also, public investment has decreasing returns and, beyond certain thresholds, may crowd out private investment.

Table 1. Implications for investment and productivity growth of convergence in the NMS

	Income per capita		Convergence target 1/		Scenario I: Maintaining productivity				Ave. investment in 2000-04	Scenario II: Maintaining investment			Ave. TFP growth in 2000-04
					Growth Contribution					Growth Contribution			
	In PPP US$	In percent of Euro area ave.	Years to half the income gap	Required GDP growth rate	TFP 2/	Labor 3/	Capital 4/	**Required Investment**		Capital 5/	Labor 3/	**TFP 4/**	
					(in percent per year)			(in percent of GDP)		(in percent per year)			
Estonia	12,773	49	10	6.1	3.4	0.5	2.1	**29.5**	27.7	1.9	0.5	**3.7**	5.2
Latvia	11,148	43	11	6.5	3.7	0.5	2.3	**31.1**	24.8	1.4	0.5	**4.5**	5.8
Lithuania	12,051	46	10	6.6	3.4	0.5	2.7	**26.3**	20.6	1.7	0.5	**4.4**	5.2
Czech Rep.	17,937	69	9	4.3	1.6	0.5	2.2	**42.2**	27.2	0.8	0.5	**3.0**	1.5
Hungary	15,399	59	11	4.6	1.6	0.6	2.4	**35.3**	23.1	1.0	0.6	**3.1**	2.9
Poland	11,921	46	20	4.3	1.6	0.6	2.1	**25.1**	20.0	1.3	0.6	**2.4**	1.8
Slovakia	13,437	52	16	4.4	1.6	0.6	2.2	**38.6**	26.5	1.0	0.6	**2.9**	3.0
Slovenia	19,251	74	8	3.9	1.6	0.5	1.8	**27.4**	24.3	1.4	0.5	**2.0**	1.7

Source: Schadler *et al.* (2007)

Notes: 1/ The income convergence targets are set to half the income gap to the Euro area average in a timeframe that is 20 percent shorter than implied by the current trend with no increases in productivity growth or investment ratio. The convergence half-time is calculated based on T=ln(2)/[(g -g *)/ln(y/y*)], where g is per capita income growth; y is the income level in PPP US$; and * refers to the Euro area average.

2/ TFP growth is assumed to be 1.6 percent for the CEEs and gradually decline to the assumed level for the Baltics over ten years.

3/ Employment rates are assumed to increase by ½ percentage point per year and labor's share is 0.65.

4/ Calculated as a residual to derive the required investment or TFP growth.

5/ Assumes investment/GDP remains at the averages for 2000-04.

Table 2. Business constraints perceived by private firms in NMS 1/

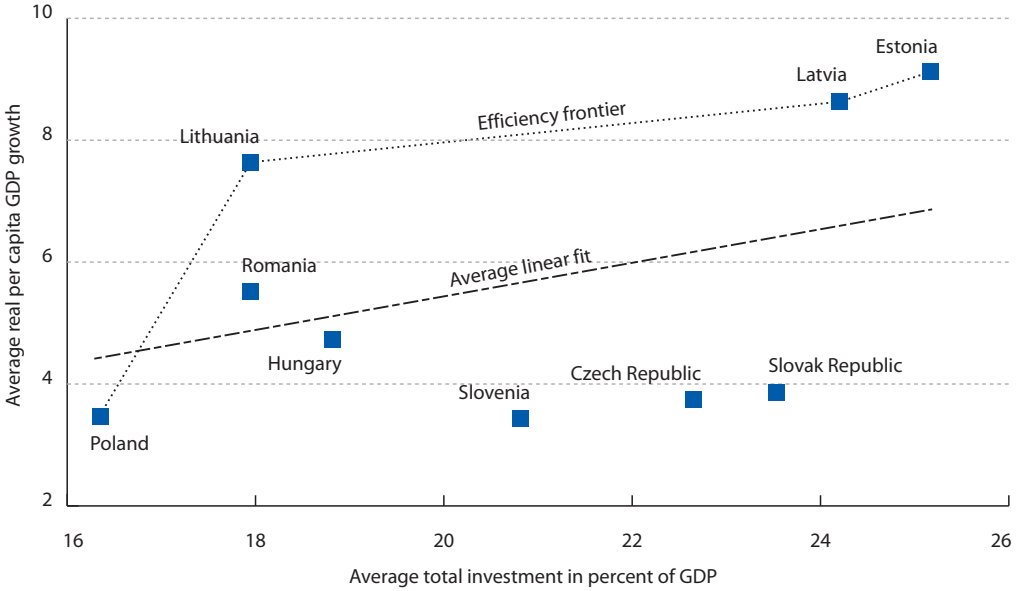
Business constraint factors	Bulgaria (2004)	Estonia (2002)	Hungary (2002)	Latvia (2002)	Lithuania (2004)	Poland (2003)	Romania (2002)	Slovakia (2002)	Slovenia (2002)	Baltics	CEEs	Group average	Bulgaria (2004)	Estonia (2002)	Hungary (2002)	Latvia (2002)	Lithuania (2004)	Poland (2003)	Romania (2002)	Slovakia (2002)	Slovenia (2002)	Baltics	CEEs	Group average
	Average score on importance												Ranking of constraints based on the average scores 2/											
Telecommunications	1.4	1.5	1.3	1.4	1.3	1.6	1.5	1.3	1.2	1.4	1.4	1.4	17	16	15	15	17	15	17	17	15	17	17	17
Electricity	1.7	1.6	1.2	1.3	1.5	1.7	1.7	1.5	1.2	1.5	1.5	1.5	15	14	17	17	15	14	15	16	17	16	16	16
Transport	1.8	1.6	1.5	1.4	1.5	1.5	1.6	1.6	1.2	1.5	1.5	1.5	14	15	14	16	16	17	16	15	16	15	15	15
Access to land	1.6	1.4	1.3	1.4	1.8	1.6	1.7	1.7	1.4	1.5	1.6	1.6	16	17	16	14	14	16	14	14	13	14	14	14
Tax rates	3.1	2.3	2.7	2.8	3.8	3.5	3.2	2.7	2.1	3.0	2.9	2.9	4	4	1	2	1	2	2	3	4	1	2	1
Tax administration	2.2	1.8	2.1	2.8	2.9	3.0	2.7	2.2	1.7	2.5	2.3	2.4	12	12	7	3	3	5	5	8	10	4	8	6
Customs and trade regulations	2.2	1.6	1.8	2.1	1.9	2.4	2.0	2.2	1.5	1.9	2.0	2.0	11	13	10	6	13	11	12	9	12	11	12	12
Labor regulations	2.3	1.8	1.8	1.9	2.2	2.5	1.9	1.9	1.7	2.0	2.0	2.0	10	11	9	8	10	10	13	13	9	10	11	11
Skills of available workers	2.2	2.8	2.1	2.1	2.7	2.3	2.0	1.9	1.8	2.5	2.0	2.2	13	1	8	5	5	12	11	12	8	3	10	8
Licensing and operating permits	2.5	1.9	1.7	1.8	1.9	1.7	2.3	2.2	1.6	1.9	2.0	2.0	9	9	11	11	12	13	9	10	11	12	13	13
Access to finance (*e.g.* collateral)	3.1	1.9	2.2	1.9	2.4	2.9	2.5	2.5	1.8	2.1	2.5	2.4	5	8	5	9	7	7	7	6	7	8	6	7
Cost of finance (*e.g.* interest rates)	3.5	2.0	2.3	2.0	2.4	3.3	2.8	2.6	2.2	2.1	2.8	2.6	1	6	3	7	8	3	4	4	2	7	4	4
Economic & regulatory policy uncertainty	3.4	2.4	2.4	2.8	2.9	3.6	3.0	3.0	2.3	2.7	2.9	2.9	2	3	2	1	2	1	3	2	1	2	1	2
Macroeconomic instability (infl., exch. rate)	3.0	2.2	2.3	2.4	2.4	3.2	3.3	3.1	2.2	2.3	2.8	2.7	7	5	4	4	6	4	1	1	3	6	3	3
Crime, theft, disorder	3.1	2.0	1.5	1.8	2.2	2.6	2.1	2.0	1.4	2.0	2.1	2.1	6	7	13	11	9	9	10	11	14	9	9	10
Anti-competitive /informal practices	3.4	2.5	2.2	1.8	2.9	2.8	2.6	2.3	2.1	2.4	2.5	2.5	3	2	6	10	4	8	6	7	5	5	5	5
Legal system/conflict res.	2.6	1.8	1.5	1.6	2.1	2.9	2.4	2.5	2.0	1.9	2.3	2.2	8	10	12	13	11	6	8	5	6	13	7	9

Source: World Bank (2004)

Notes: 1/ A higher value indicates higher importance of the corresponding factor as a business constraint for the surveyed business unit. Firms were asked to rate the importance of the potential business constraints on a 5-point Likert scale that corresponds to integer values of 0-4, and simple averages are then used to calculate country averages.

2/ A lower value corresponds to higher importance for the surveyed business unit.

Figure 4. Per-capita GDP growth and total investment, 2000-2005



Sources: Eurostat (2007) and IMF (2006a)

Note: Data refer to averages by country in 2000-2005. The efficiency frontier is indicative of the highest per capita GDP growth that can be achieved at a given level of total investment.

3. Fiscal adjustment and public investment in the new member states

How much fiscal adjustment has taken place in the NMS and how has it been achieved? While the experience has been uneven, many of the NMS now face fairly high levels of public debt and heightened macroeconomic vulnerability indicators. The need to bring down fiscal deficits and public debt has constrained the room for higher public investment. Experiences from around the world suggest that, often, governments try to achieve adjustment by increasing taxes and cutting public investment, rather than curtail current spending (IMF 2005). However, when fiscal adjustment relies on measures of poor quality, growth prospects may be compromised. This section looks particularly at whether the NMS have relied on public investment cuts to implement fiscal adjustment.

The Baltic countries have greatly improved budgetary positions, most Central and Eastern European countries less so.

Recent fiscal outcomes in the NMS have varied significantly, with some countries implementing sizable fiscal adjustment. Fiscal balances in all countries displayed considerable vulnerability to the large recession that followed the Asian crisis in 1997. However, developments have differed substantially since the early 2000s (Table 3). The Baltic countries made significant progress in reducing their fiscal deficits between 1999 and 2006. For instance, Estonia and Latvia registered a budget surplus in 2006. In contrast, the CEEs have shown more inertia in improving their budgetary positions. In particular, Hungary stands out as the NMS with the largest fiscal imbalances measured by either fiscal deficit or public debt levels, followed by Poland. Other CEEs have been able to bring deficit levels and debt levels to below the reference value under the Stability and Growth Pact. Of the most recent NMS, Bulgaria achieved strong fiscal outcomes over the last few years, while Romania posted fiscal deficits but still had comparably lower debt levels (Figure 5).

Since the 1990s, expenditure and revenue reforms have played different roles in fiscal retrenchment efforts. During the 1990s, fiscal adjustment in the NMS relied primarily on expenditure cuts. Several NMS pursued tax reforms that lowered the overall tax burden, and general government revenues have declined in the Baltic countries and Slovakia to around 35 percent of GDP. Expenditures in these

Table 3. General government revenue, expenditure, fiscal balance, and debt in NMS 1/ (in percent of GDP)

Country	Fiscal indicator	1998	1999	2000	2001	2002	2003	2004	2005	2006
Bulgaria	Total revenue	..	..	..	..	38.9	40.0	41.4	41.4	39.9
	Public investment 2/	3.2	3.9	3.7	3.5	2.7	2.5	2.7	3.4	3.7
	Other expenditure 3/	..	..	..	..	36.5	38.4	36.6	36.1	32.9
	Fiscal balance 4/	1.7	0.4	-0.5	0.2	-0.2	-0.9	2.2	1.9	3.3
	Gross debt	79.6	79.3	73.6	66.2	54.0	45.9	37.9	29.2	22.8
Czech Republic	Total revenue	38.2	38.6	38.1	38.7	39.5	40.7	41.0	40.1	39.2
	Public investment 2/	4.2	3.3	3.6	3.5	3.9	4.5	4.8	4.9	5.0
	Other expenditure 3/	39.0	39.0	38.2	41.0	42.4	42.8	39.0	38.7	37.1
	Fiscal balance 4/	-5.0	-3.7	-3.7	-5.7	-6.8	-6.6	-2.9	-3.5	-2.9
	Gross debt	12.9	13.4	18.2	26.3	28.5	30.1	30.7	30.4	30.4
Estonia	Total revenue	39.1	39.1	36.2	35.0	36.0	36.4	35.9	35.4	36.6
	Public investment 2/	4.7	4.2	3.8	4.1	4.9	4.2	3.4	3.7	4.5
	Other expenditure 3/	34.8	38.6	32.7	31.0	30.7	30.4	30.7	29.7	28.5
	Fiscal balance 4/	-0.4	-3.7	-0.2	-0.1	0.4	1.8	1.8	1.9	3.6
	Gross debt	5.6	6.0	4.7	4.7	5.6	5.7	5.2	4.4	4.1
Hungary	Total revenue	44.7	44.4	43.6	43.2	42.4	41.9	42.4	42.1	42.6
	Public investment 2/	3.4	2.9	3.2	3.7	4.9	3.5	3.5	4.0	4.4
	Other expenditure 3/	49.4	47.0	43.3	43.6	46.4	45.6	45.4	45.9	47.5
	Fiscal balance 4/	-8.2	-5.5	-3.0	-4.1	-8.9	-7.2	-6.4	-7.8	-9.3
	Gross debt	61.9	61.2	55.4	52.2	54.0	58.0	59.4	61.7	66.0
Latvia	Total revenue	40.0	36.6	34.6	32.5	33.4	33.2	34.7	35.2	37.4
	Public investment 2/	1.4	1.5	1.3	1.1	1.3	2.4	3.1	3.3	3.4
	Other expenditure 3/	39.2	40.5	36.0	33.5	34.3	32.4	32.7	32.2	33.6
	Fiscal balance 4/	-0.6	-5.3	-2.8	-2.1	-2.3	-1.6	-1.0	-0.2	0.4
	Gross debt	9.8	12.6	12.9	15.0	13.5	14.4	14.5	12.0	10.0
Lithuania	Total revenue	37.4	37.3	35.9	33.2	32.9	32.0	31.8	33.1	33.3
	Public investment 2/	2.5	2.6	2.4	2.2	2.9	3.0	3.4	3.5	4.2
	Other expenditure 3/	37.9	37.5	36.7	34.6	31.9	30.2	30.0	30.1	29.4
	Fiscal balance 4/	-3.1	-2.8	-3.2	-3.6	-1.9	-1.3	-1.5	-0.5	-0.3
	Gross debt	16.5	23.0	23.8	22.9	22.2	21.2	19.4	18.6	18.2
Poland	Total revenue	40.1	40.4	38.1	38.6	39.2	38.4	36.9	39.0	39.4
	Public investment 2/	3.9	3.5	2.4	3.4	3.4	3.3	3.4	3.4	4.1
	Other expenditure 3/	40.4	39.2	38.7	40.4	40.8	41.3	39.2	39.9	39.2
	Fiscal balance 4/	-4.3	-2.3	-3.0	-5.1	-5.0	-6.3	-5.7	-4.3	-3.9
	Gross debt	39.1	40.3	36.8	36.7	39.8	47.1	45.7	47.1	47.8
Romania	Total revenue	44.2	48.0	43.8	36.7	37.6	32.1	31.1	32.4	30.1
	Public investment 2/	1.9	2.1	1.9	2.4	3.1	3.2	3.0	3.8	2.9
	Other expenditure 3/	43.3	44.5	38.7	36.4	36.5	30.4	29.6	29.9	29.1
	Fiscal balance 4/	-1.0	1.4	3.2	-2.1	-2.0	-1.5	-1.5	-1.4	-1.9
	Gross debt	17.8	24.2	22.7	..	23.8	21.5	18.8	15.8	12.4
Slovakia	Total revenue	40.5	40.8	39.8	36.8	35.7	37.5	35.4	35.2	33.9
	Public investment 2/	3.9	2.9	2.8	3.1	3.2	2.6	2.4	2.1	2.2
	Other expenditure 3/	41.4	44.3	48.9	40.2	40.1	37.7	35.4	35.9	35.1
	Fiscal balance 4/	-4.8	-6.4	-11.8	-6.5	-7.7	-2.8	-2.4	-2.8	-3.4
	Gross debt	34.0	47.2	49.9	49.2	43.3	42.4	41.5	34.5	30.7
Slovenia	Total revenue	44.5	44.6	43.6	44.1	44.6	44.4	44.2	44.5	44.1
	Public investment 2/	3.0	3.5	3.2	3.3	3.0	3.3	3.5	3.2	3.7
	Other expenditure 3/	43.9	44.3	44.2	44.9	44.1	43.8	43.0	42.8	41.6
	Fiscal balance 4/	-2.5	-3.1	-3.8	-4.0	-2.5	-2.7	-2.3	-1.5	-1.2
	Gross debt	23.6	24.9	27.4	28.4	29.1	28.6	28.9	28.4	27.8

Source: Eurostat (2007)

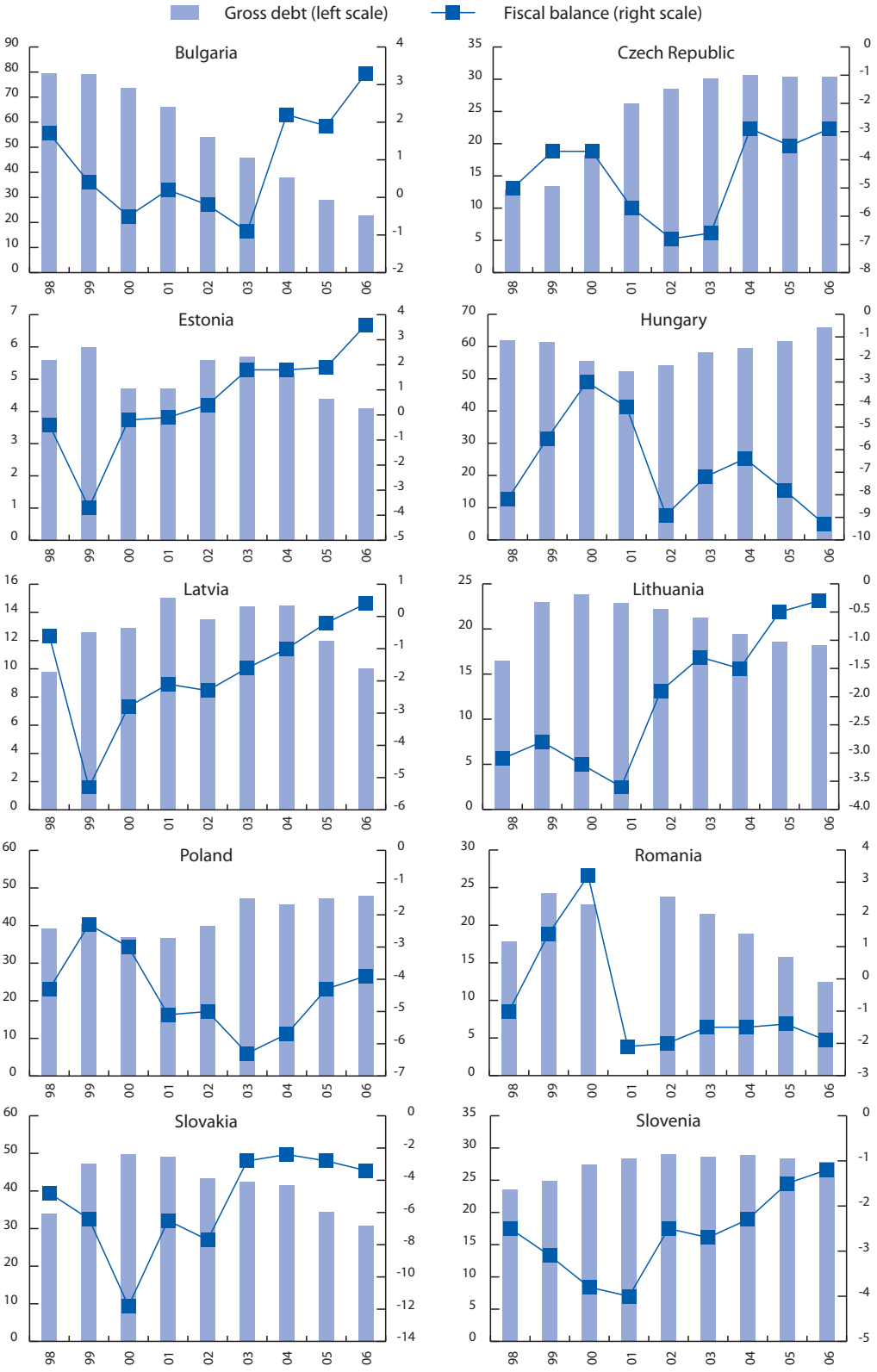
Notes: 1/ Data are based on statistics for the general government as defined in the European System of Accounts (ESA) 1995. ".." indicates that data are not available.

2/ Public gross fixed capital formation.

3/ Total expenditure excluding public investment.

4/ Net borrowing/lending.

Figure 5. Fiscal balance and government debt in NMS (in percent of GDP)



Source: Eurostat online database

Note: Data are based on ESA 1995. Gross debt is for the general government level, and fiscal balance refers to net borrowing/lending of the general government.

countries have dropped even more steeply, achieving fiscal adjustment and a lower tax burden at the same time. Since 2001, however, only Romania and Slovakia have implemented expenditure-led fiscal adjustments while revenue increases have contributed to fiscal adjustment in the Czech Republic and Poland.

Fiscal adjustment has not necessarily constrained public investment. While some countries cut public investment to consolidate fiscal positions, others managed to increase public investment levels despite tighter budgets. Table 4 presents changes in the overall balance, revenues, and expenditures, during years of fiscal adjustment in the NMS, defined as those years during which the fiscal balance improved. Among 44 episodes of fiscal adjustment during 1999–2006, only 30 percent included cuts in public investment. In comparison, 53 percent involved revenue increases, and 77 percent cuts in other non-investment expenditures. For example, Slovakia improved its fiscal position through cuts in both investment and other expenditure in 2003–2004, whereas Latvia implemented fiscal consolidation with higher public investment of about 0.5 percent of GDP per year in 2003–2006, supported by much enhanced revenue efforts and cuts in other expenditures. The Czech Republic, Lithuania, and Poland were also successful in both reducing fiscal deficits and increasing public investment.[5]

Furthermore, private investment has boosted total investment in some of the NMS, particularly those with stronger fiscal positions. There are two general patterns (Table 5). In countries with strong fiscal positions and modest debt, private investment has increased and has often more than offset cuts in public investment (*e.g.*, Estonia). In contrast, in countries with sizeable debt and persistent fiscal deficits, private investment has declined considerably in recent years, leading to lower total investment even when public investment increased (*e.g.*, the Czech Republic and Poland). The link between fiscal positions and private investment may be reflective of private sector perceptions of good governance (IMF 2005): Good public governance, as manifested by strong fiscal balances, also translates into lower cost of international financing for the private sector and higher foreign capital inflows (Figure 6). Similarly, pro-growth economic policy reforms have a positive knock-on effect on private investment. For example, Figure 7 shows that, in infrastructure sectors, private investment is positively related to perceived sector reforms in the NMS.

Where fiscal positions were sound, private investment has increased faster and foreign capital has flown in more readily than elsewhere.

It is not surprising then to find also that foreign investment has generally been more forthcoming where fiscal positions are stronger. As shown in Figure 6a, improvements in fiscal positions are generally rewarded by more favourable ratings on sovereign bonds. For example, fiscal consolidations in Lithuania in 2001-2004 and Slovakia in 2003-2005 were accompanied by bond ratings upgrades of about one notch each year. As these ratings are important benchmarks to determine access and cost of financing from the international capital markets to the private sector in the NMS, higher ratings are more likely to attract capital inflows. Figure 6b indeed indicates that net foreign capital inflows are positively associated with the fiscal balances in the NMS, offering countries an important source to finance growth notwithstanding low national savings.

5 These facts are consistent with recent findings on fiscal rules for public investment in Europe. For example, Turrini (2004) argues that higher fiscal balances may help to create space for public investment, and Perée and Välilä (2005) find no evidence of a negative long-run impact of fiscal rules on public investment.

Table 4. Fiscal adjustment and public investment in NMS (in percent of GDP) 1/

Country	Years with higher fiscal balance	Changes in fiscal balance	Changes in total revenue	Changes in public investment	Changes in other expenditure
Bulgaria 2/	2004	3.1	1.4	0.2	-1.8
	2006	1.4	-1.5	0.3	-3.2
Czech Republic	1999	1.3	0.4	-0.9	0
	2003	0.2	1.2	0.6	0.4
	2004	3.7	0.3	0.3	-3.8
	2006	0.6	-0.9	0.1	-1.6
Estonia	2000	3.5	-2.9	-0.4	-5.9
	2001	0.1	-1.2	0.3	-1.7
	2002	0.5	1	0.8	-0.3
	2003	1.4	0.4	-0.7	-0.3
	2005	0.1	-0.5	0.3	-1
	2006	1.7	1.2	0.8	-1.2
Hungary	1999	2.7	-0.3	-0.5	-2.4
	2000	2.5	-0.8	0.3	-3.7
	2003	1.7	-0.5	-1.4	-0.8
	2004	0.8	0.5	0	-0.2
Latvia	2000	2.5	-2	-0.2	-4.5
	2001	0.7	-2.1	-0.2	-2.5
	2003	0.7	-0.2	1.1	-1.9
	2004	0.6	1.5	0.7	0.3
	2005	0.8	0.5	0.2	-0.5
	2006	0.6	2.2	0.1	1.4
Lithuania	1999	0.3	-0.1	0.1	-0.4
	2002	1.7	-0.3	0.7	-2.7
	2003	0.6	-0.9	0.1	-1.7
	2005	1	1.3	0.1	0.1
	2006	0.2	0.2	0.7	-0.7
Poland	1999	2	0.3	-0.4	-1.2
	2002	0.1	0.6	0	0.4
	2004	0.6	-1.5	0.1	-2.1
	2005	1.4	2.1	0	0.7
	2006	0.4	0.4	0.7	-0.7
Romania	1999	2.4	3.8	0.2	1.2
	2000	1.8	-4.2	-0.2	-5.8
	2002	0.1	0.9	0.7	0.1
	2003	0.5	-5.5	0.1	-6.1
	2005	0.1	1.3	0.8	0.3
Slovakia	2001	5.3	-3	0.3	-8.7
	2003	4.9	1.8	-0.6	-2.4
	2004	0.4	-2.1	-0.2	-2.3
Slovenia	2002	1.5	0.5	-0.3	-0.8
	2004	0.4	-0.2	0.2	-0.8
	2005	0.8	0.3	-0.3	-0.2
	2006	0.3	-0.4	0.5	-1.2
		(Mean)			
Czech Republic		1.5	0.2	0.0	-1.3
Estonia		1.2	-0.3	0.2	-1.7
Hungary		1.9	-0.3	-0.4	-1.8
Latvia		1.0	0.0	0.3	-1.3
Lithuania		0.8	0.0	0.3	-1.1
Poland		0.9	0.4	0.1	-0.6
Romania		1.0	-0.7	0.3	-2.1
Slovakia		3.5	-1.1	-0.2	-4.5
Slovenia		0.8	0.1	0.0	-0.7
Group		1.2	-0.2	0.1	-1.7
		(Median)			
Czech Republic		1.0	0.3	0.2	-0.8
Estonia		1.0	-0.1	0.3	-1.1
Hungary		2.1	-0.4	-0.3	-1.6
Latvia		0.7	0.2	0.2	-1.2
Lithuania		0.6	-0.1	0.1	-0.7
Poland		0.6	0.4	0.0	-0.7
Romania		0.5	0.9	0.2	0.1
Slovakia		4.9	-2.1	-0.2	-2.4
Slovenia		0.6	0.1	-0.1	-0.8
Group		0.8	0.0	0.1	-1.0

Source: Eurostat (2007)

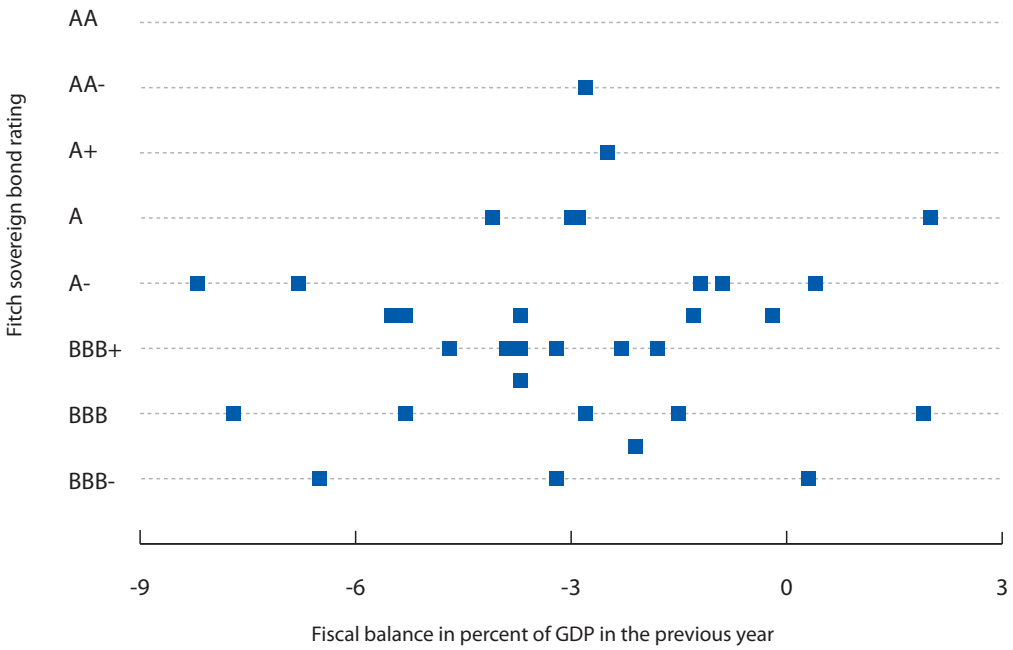
Notes: 1/ Data are limited to years in which fiscal balances increase compared to the previous year during 1999–2006.
2/ Data are available after 2003.

Table 5. Public and private investment in NMS, 2001–2006 (in percent of GDP)

	Total investment		Public investment		Private investment		Changes 1/		
	2001-03	2004-06	2001-03	2004-06	2001-03	2004-06	Total	Public	Private
Estonia	29.4	32.0	4.4	3.9	25.0	28.2	2.6	-0.5	3.2
Latvia	24.4	30.8	1.6	3.3	22.8	27.6	6.5	1.7	4.8
Lithuania	20.5	23.3	2.7	3.7	17.8	19.6	2.8	1.0	1.8
Bulgaria	18.6	23.6	2.9	3.3	15.7	20.4	5.1	0.4	4.7
Czech Republic	27.4	25.1	4.0	4.9	23.4	20.2	-2.3	0.9	-3.2
Hungary	22.7	22.3	4.0	4.0	18.7	18.3	-0.4	-0.1	-0.3
Poland	19.2	18.7	3.4	3.6	15.8	15.1	-0.5	0.3	-0.7
Romania	21.1	23.2	2.9	3.2	18.2	19.9	2.0	0.3	1.7
Slovenia	24.1	25.7	3.2	3.5	20.9	22.2	1.5	0.3	1.3
Slovakia	26.9	25.8	3.0	2.2	24.0	23.5	-1.2	-0.7	-0.4
Memorandum items:									
Euro area 2/	20.4	20.6	2.5	2.5	17.9	18.1	0.2	0.0	0.2
Baltics	24.8	28.7	2.9	3.6	21.9	25.1	4.0	0.7	3.2
CEEs	22.9	23.5	3.3	3.5	19.5	20.0	0.6	0.2	0.4

Source: Eurostat
Notes: 1/ Data refer to changes from 2001-2003 to 2004-2006, and positive values indicate an increase.
2/ Data refer to weighted averages of 12 countries in the Euro area.

Figure 6a. Fiscal balances and sovereign ratings, 2000-2005 1/



Sources: Eurostat (2007), Fitch Ratings (2007), and IMF(2006a)
Note: 1/ Fitch sovereign rating refers to annual average ratings of long-term foreign currency sovereign bonds, and BBB is the minimum rating for investment grade. The rating on sovereign bonds is generally considered a ceiling of ratings for private sector financing in the same country, and a higher rating is associated with lower cost of financing. See IMF (2005) for details.

Figure 6b. Fiscal balances and foreign capital inflows, 2000-2005

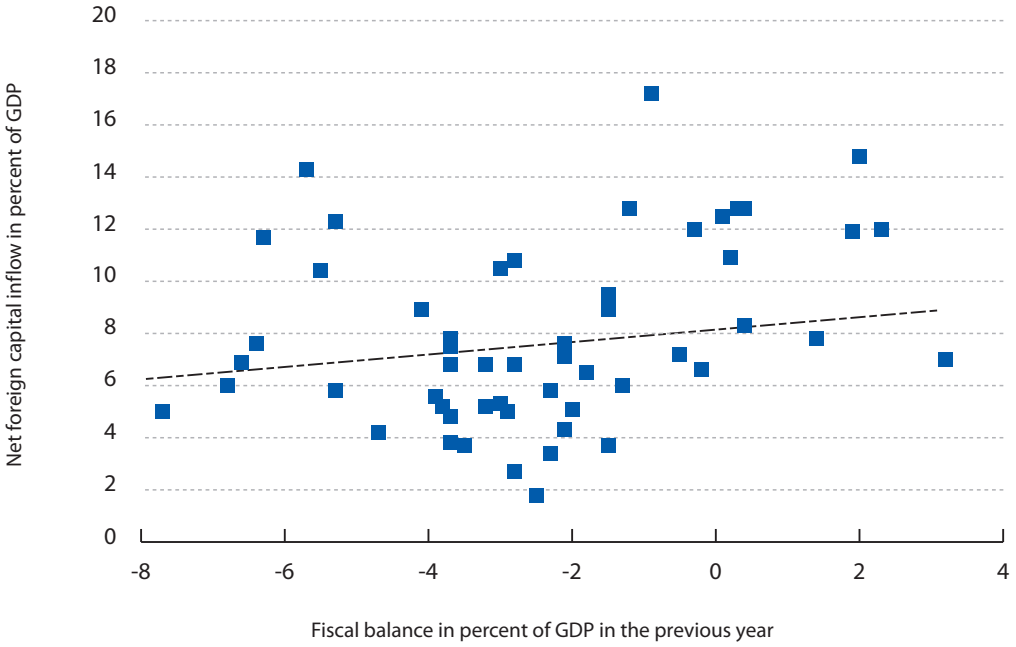
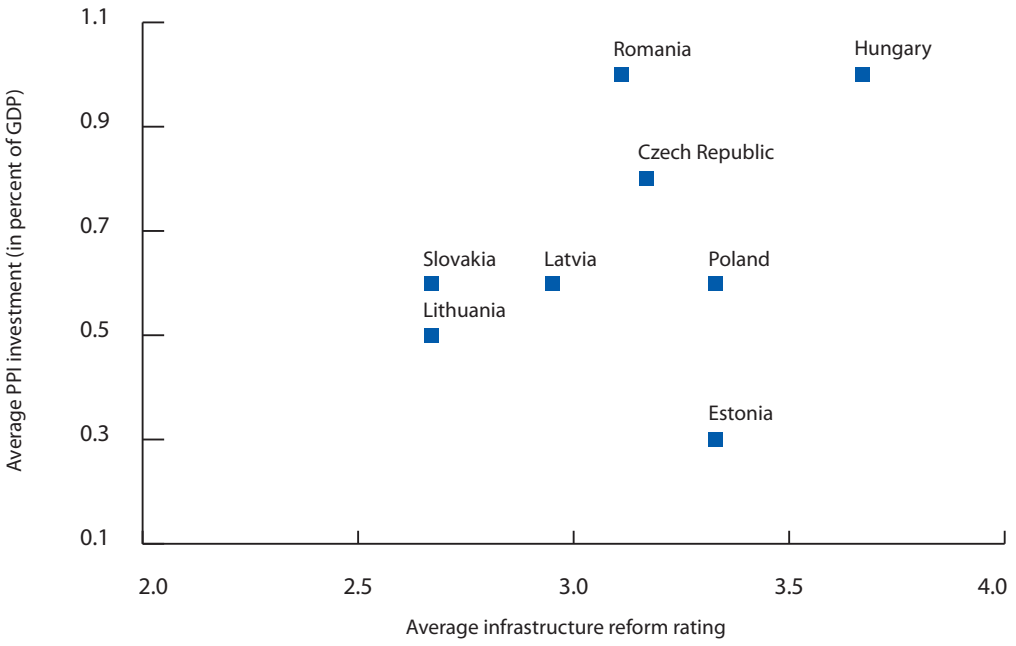


Figure 7. Private infrastructure investment and infrastructure policy ratings



Sources: EBRD (2006) and World Bank (2007)

Note: Private infrastructure investment refers to total contractual commitments in private participations in infrastructure (PPI) projects classified as management and lease contracts, concessions, and greenfield projects, but exclude privatization projects. Data are averages for 2000-2005 for the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, and Slovakia. Infrastructure policy ratings are published by the EBRD to measure country-specific policy progress in infrastructure and range between 1 and 4.33, with higher scores corresponding to higher standards and performance-levels.

4. Infrastructure in the new member states

The usual rationale for raising public investment in NMS has been the need to upgrade infrastructure. Underlying this are concerns that poor infrastructure may become a bottleneck to economic growth (*e.g.*, European Commission 2001). However, "needs" have to be matched with fiscal realities and macroeconomic constraints.

At the start of their transition to market economies, infrastructure networks in most NMS were in a state of serious disrepair. Central planning priorities paid little attention to cost, efficiency, or environmental considerations. But the picture differed from sector to sector. In the telecommunications sector, technology was outdated and households and businesses lacked sufficient access. The railway sector was mostly focused on the needs of heavy industry, *e.g.*, long-distance haulage of raw materials. Investment in roads was limited and use of private cars was discouraged. Finally, water supplies were generally unreliable and of low quality, and waste water disposal was not environmentally friendly (European Bank of Reconstruction and Development (EBRD) 2004).

Since then, important progress has been made. The EBRD indicator of reform in key infrastructure sectors[6] suggests that all NMS have made considerable progress in reforming infrastructure, but this has not been uniform across countries (Table 6). Overall, Hungary comes closest to standards in advanced countries, with an average indicator of 3.67. Estonia, the Czech Republic, Poland, and Romania, come in second place, while the rest of the NMS are further away from standards in industrialized countries.[7]

Despite progress, infrastructure density is still lower in most new member states than in more advanced European countries.

Despite progress, most NMS lag behind the more advanced European countries in terms of infrastructure. Table 7 presents infrastructure indicators in the NMS and the EU-12 in the telecommunications, energy, and transport sectors. Since the mid-1990s, infrastructure modernization proceeded the fastest in telecommunications, with the average number of phone subscribers in the NMS increasing four-fold in recent years. However, access in telecommunications in NMS remains about half the level in the EU-12. Progress in the energy and road sectors was more heterogeneous across NMS. In energy, rapid increases in generation capacity in the CEEs (except for Poland) compare with less marked improvements in Bulgaria and Romania, and the Baltics. In contrast, the Baltics have made important strides expanding their road networks, followed by the CEEs, while Romania and Bulgaria remain significantly behind.

Estimates of infrastructure investment needs in the region are scarce, but point to large efforts that would be needed. Auer (2004) and Brenck *et al.* (2005) suggest that investments of over EUR 500 billion or about 5 percent of GDP over the next 15 years are required to upgrade infrastructure in the NMS to levels in the old members (Table 8). The sectors requiring the most investment include water and sanitation and energy, accounting for about 60 percent of total investment needs. The modernization of the telecommunications and transportation sectors is likely to require moderate investment, while environmental investment needs appear somewhat less significant.[8]

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6 Since the end of the 1990s, the EBRD has produced an indicator to assess the status quo and pace of reform in key infrastructure sectors in transition countries. Key criteria include the path of reform to adjust tariffs, to commercialize, to deregulate markets, and to open them to the private sector. Scores range from 1 (no reform) to 4.33 (advanced country levels).

7 A high rating in infrastructure policy indicates the adoption of good policy and regulatory practices but not necessarily the presence of high-quality infrastructure stock or service.

8 According to estimates by CASE (2005), the environmental investment needs of the EU-8 are estimated at EUR 47-69 billion (Poland 22-45 billion, Hungary 10 billion, and the Czech Republic 9.4 billion).

Table 6: Indicators of infrastructure policy reforms 1/

Country	Sector	2000-04 2/	2005	2006	Sector	2000-04 2/	2005	2006
Estonia	Overall infrastr. reform	3.33	3.33	3.33	Railways	4.20	4.33	4.33
Latvia		2.93	3.00	3.00		3.33	3.33	3.67
Lithuania		2.67	2.67	3.00		2.33	2.33	2.33
Bulgaria		2.93	3.00	3.00		3.26	3.33	3.33
Czech Rep.		3.13	3.33	3.33		2.60	3.00	3.00
Hungary		3.67	3.67	3.67		3.33	3.33	3.33
Poland		3.33	3.33	3.33		4.00	4.00	4.00
Romania		3.07	3.33	3.33		4.00	4.00	4.00
Slovak Re.		2.60	3.00	3.00		2.53	3.00	3.00
Slovenia		2.93	3.00	3.00		3.00	3.00	3.00
Estonia	Electric power	3.27	3.00	3.33	Roads	2.33	2.33	2.33
Latvia		3.07	3.33	3.33		2.33	2.33	2.33
Lithuania		3.07	3.33	3.33		2.33	2.33	2.33
Bulgaria		3.40	3.67	3.67		2.33	2.67	2.67
Czech Rep.		2.93	3.33	3.33		2.93	3.00	3.00
Hungary		4.00	4.00	4.00		3.33	3.67	3.67
Poland		3.20	3.33	3.33		3.20	3.00	3.00
Romania		3.07	3.33	3.33		3.00	3.00	3.00
Slovak Re.		3.40	4.00	4.00		2.33	2.33	2.33
Slovenia		3.00	3.00	3.00		3.00	3.00	3.00
Estonia	Telecoms.	4.00	4.00	4.00	Water and waste water	4.00	4.00	4.00
Latvia		3.00	3.00	3.00		3.26	3.33	3.33
Lithuania		3.33	3.33	3.67		3.26	3.33	3.33
Bulgaria		3.07	3.33	3.33		3.00	3.00	3.00
Czech Rep.		4.00	4.33	4.33		4.00	4.00	4.00
Hungary		4.00	4.00	4.00		4.00	4.00	4.00
Poland		4.00	4.00	4.00		3.26	3.33	3.33
Romania		3.00	3.00	3.33		3.07	3.33	3.33
Slovak Re.		3.06	3.67	3.67		2.53	3.00	3.33
Slovenia		2.87	3.00	3.00		3.33	3.33	3.33

Source: EBRD (2006)

Notes: 1/ Indicators refer to ratings based on judgment of the EBRD's Office of the Chief Economist about country-specific progress in transition. The sector ratings range from 1 to 4.33 with highest scores corresponding to possessing standards and performance typical of advanced industrial economies. The overall ratings refer to average performance across all sectors.

2/ Data refer to simple averages.

Table 7. Infrastructure indicators in NMS and the EU-12 (per 1,000 people)

		Electricity generation (kwh)		Fixed and mobile phone subscribers		Road networks (km)		Internet users	
		1991-1995	1998-2002	1991-1995	1998-2002	1991-1995	1998-2002	1991-1995	1998-2002
Baltic states	Estonia	7.1	6.2	245.6	740.1	5.3	8.2	10.5	228.5
	Latvia	1.7	1.9	261.8	506.5	5.6	22.7	..	68.6
	Lithuania	4.6	4.2	235.1	514.6	12.3	19.5	..	64.0
Central and Eastern European countries	Czech Republic	5.8	6.9	197.9	816.9	5.4	12.4	11.0	121.5
	Hungary	3.2	3.6	161.9	714.3	6.5	6.8	2.8	95.3
	Poland	3.5	3.7	118.5	413.5	6.2	6.5	2.4	99.2
	Slovak Republic	4.5	5.5	173.2	564.6	4.0	6.9	3.2	92.1
	Slovenia	6.2	7.0	273.7	925.6	5.7	10.1	14.4	210.7
Recently acceded members	Bulgaria	4.5	5.1	281.4	485.2	4.0	4.3	0.5	50.9
	Romania	2.5	2.4	117.5	297.4	3.4	4.5	0.4	46.1
Memorandum items:									
Group average		4.6	4.9	208.5	649.5	6.4	11.6	7.4	122.5
Baltic states		4.5	4.1	247.5	587.0	7.7	16.8	..	120.3
Central Eastern Europe		4.6	5.3	185.0	687.0	5.6	8.6	6.8	123.7
Recently acceded members		3.5	3.7	199.5	391.3	3.7	4.4	0.4	48.5
EU-12 average		5.5	6.5	473.1	1,119.1	11.1	15.4	10.6	234.9

Source: World Bank (2005)
Note: EU-12 average refers to simple averages of the 12 countries of the Euro area before 2007: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxemburg, the Netherland, Spain, and Portugal.

Table 8. Infrastructure investment needs for NMS, 1995-2010

Sector	Reference	Investment needs	
		in EUR billion	in percent of GDP
Roads	Modernization/construction to EU-15 average density	44	0.5
Railways	Modernization/construction to EU-15 average density	37	0.4
Telecoms	Telecom density of 35 mainlines per 100 citizens	63	0.9
Water/Sewage	European standards for collection and treatment	180	1.5
Energy	Network development, oil, gas and coal sector reforms	110	1.4
Environment	EU-Directive Air Pollution and Waste	71	0.3
Sum		505	5.0

Source: Brenck *et al.* (2005)

Most estimates of investment needs have significant shortcomings regarding the concepts and methodologies used. A particular limitation of most estimates of infrastructure investment needs is that they abstract from country-specific resource and absorption capacity constraints (IMF 2005). Therefore, they cannot provide concrete policy guidance on how and within what timeframe to meet these needs. Furthermore, they also cannot distinguish priority needs (*i.e.*, those that address growth bottlenecks) and low-priority needs. Hence, these approaches need to be complemented with assessments of the scope for mobilizing both private and public resources for infrastructure spending on the basis of a macro-fiscal policy framework and a clear prioritization of projects based on their economic and social rates of return.

Macro-fiscal frameworks and social-returns analyses should be used to select projects and to decide when and how to implement them.

The appropriate public investment strategy for the NMS will vary from country to country and critically depend on the macro-fiscal environment. In principle, countries have several options for upgrading their infrastructure. These include: raising financing for public investment by borrowing, increasing public saving, and reallocating public spending from other sectors; getting more out of their investments by improving investment planning and project evaluation and implementation procedures; and encouraging private sector investment. These can be classified according to whether they operate primarily through the private sector or the public sector, and the time needed to implement them (IMF 2005) (Table 9).

That said, all EU countries must adhere to the common public deficit and debt ceilings of the Stability and Growth Pact, which limits their room for manoeuvre with regard to public investment. In addition, the particular fiscal and macroeconomic environment in the NMS further constrains some of the options for increasing public investment. Countries with stronger fiscal positions, like the Baltics, usually have more policy flexibility, although they may be constrained by other considerations (*e.g.*, an overheating economy). In contrast, countries with large fiscal deficits and debt levels, such as Hungary, would generally need to match increases in public investment with similar increases in public saving, which will need to be driven by reforms aimed at limiting current expenditures given an already large tax burden.

Table 9. Possible policy instruments to help increase total infrastructure investment

	Private Investment	Public Investment
Short- to Medium-Term	Use public-private partnerships.	Reallocate public expenditure.
	Provide government guarantees.	Implement tax policy measures.
		Relax fiscal targets, financed by debt or the sale of state assets.
Medium- to Long-Term	Implement improvements in market- supporting institutions that help strengthen the rule of law, property rights, and the regulatory framework.	Carry out structural reforms, incl. civil service reform and social security reform to help reduce current expenditure.
	Deepen financial markets.	Improve tax administration and expenditure management systems to improve efficiency.

Source: IMF (2005)

5. New sources of infrastructure financing in the new member states

5.1. The role of EU support mechanisms

EU funds provide additional resources but they tilt spending toward EU projects and pose unique challenges to new member states.

In this general context, a unique challenge for the NMS is posed by the availability of EU funds for infrastructure investment. EU financing schemes provide additional resources for the NMS to upgrade infrastructure, but they also alter government spending patterns toward EU priorities and challenge fiscal, macroeconomic, and absorptive capacities. For example, EU funds provide additional resources to the NMS, but may adversely affect fiscal balances in the short run, particularly due to additionality requirements, which usually lead countries to increase spending on programmes financed with EU support. As most countries have limited room to accommodate additional spending through higher deficits, EU funds are likely to have a significant effect on spending allocation patterns. In addition, the use of EU funds poses challenges from a public expenditure management perspective, requiring countries to step up efforts to effectively absorb the increased allocations.

EU accession provided the NMS with access to different types of EU funds. These funds serve three main objectives: Income convergence, agricultural support, and the development of internal market institutions. EU funds are significant from the point of view of the NMS. In the last 15 years, nearly EUR 30 billion has been transferred to the NMS; and, under the new financial perspective 2007-2013, EU transfers would be notably larger than in the pre-accession and 2004-2006 periods. Net transfers (taking into account the NMS contributions to the EU budget) are expected to almost triple from an average of 1 percent of GDP in 2004-2006, with smaller net transfers observed in the beginning of the period and with poorer countries expected to receive more (European Commission 2006) (Table 10).

Table 10. EU funds for NMS, 2004-2013

	2004	2005	2006	2007	2008	2009	2010	2011	2012 /2	2013 2/
						(in EUR million)				
Bulgaria 1/	..	..	..	1,130	1,543	1,872	1,766	1,838	1,951	2,060
Romania 1/	..	..	..	5,113	5,947	6,035	5,645	5,820	5,989	6,251
Czech Republic	1,627	1,915	2,028	3,998	4,140	4,255	4,413	4,558	4,694	4,826
Estonia	400	428	474	238	557	754	824	699	629	1,160
Hungary	1,764	2,107	2,377	4,090	4,270	4,465	4,681	4,891	5,116	5,351
Latvia	665	706	699	720	757	794	842	885	930	974
Lithuania	984	1,124	1,182	1,326	1,383	1,441	1,518	1,593	1,669	1,745
Poland	6,584	8,165	9,062	11,118	11,711	12,300	12,587	13,177	13,753	14,331
Slovakia	946	1,057	1,187	1,825	1,907	1,995	2,101	2,208	2,315	2,421
Slovenia	473	527	527	788	789	788	797	803	809	814
						(in percent of GDP)				
Bulgaria 1/	..	..	..	4.7	5.9	6.5	5.7	5.4	..	..
Romania 1/	..	..	..	4.8	4.9	4.4	3.7	3.4	..	..
Czech Republic	1.9	1.9	1.8	3.3	3.2	3.0	2.9	2.8	..	..
Estonia	4.4	4.1	3.9	1.8	3.7	4.5	4.5	3.5	..	..
Hungary	2.2	2.4	2.9	4.8	4.7	4.7	4.7	4.7	..	..
Latvia	6.0	5.6	4.6	4.0	3.7	3.4	3.3	3.2	..	..
Lithuania	5.4	5.5	5.1	5.2	4.9	4.7	4.5	4.4	..	..
Poland	3.2	3.4	3.4	4.0	4.0	4.0	3.9	3.8	..	..
Slovakia	2.8	2.8	2.8	3.8	3.6	3.4	3.3	3.1	..	..
Slovenia	1.8	1.9	1.9	2.7	2.6	2.4	2.3	2.2	..	..

Sources: IMF (2006a, b, c, d; and 2007) and Rosenberg and Sierhej (2007)
Notes: 1/ ".." indicates data are not available.
2/ GDP projections for 2012 and 2013 are not available.

For infrastructure development, Structural and Cohesion Funds are the most important EU sources. EU funds most relevant to the provision of infrastructure are: (i) the Structural Funds (particularly the European Regional Development Fund and the European Social Fund); and (ii) the Cohesion Fund (Box 1 and Annex).[9] Both are grouped in the EU terminology under the heading "structural actions" and are aimed at fostering income convergence. Therefore, they account for a larger share of EU commitments in the less wealthy NMS. Structural and Cohesion Funds are set to increase substantially under the new EU financial perspective for 2007–13. The committed amounts for EU transfers under the new EU financial perspective range from 1.5 percent of GDP in Slovenia to over 3 percent of GDP in Hungary.

EU funds require domestic co-financing and additionality. Depending on the domain, EU funds can be used to finance up to 75-85 percent of a project. The rest may come from domestic public or private sources.[10] Co-financing as such does not necessarily have an adverse impact on the budget since resources can be reallocated from existing budget lines. This is not possible, however, for Structural Funds, which are subject to additionality rules. These require that spending in a certain category, including co-financing, be higher than the average spending in the preceding two years. A similar additionality requirement does not exist for the Cohesion Fund, internal policies, or transitional expenditure.

Various empirical studies confirm that EU funds lead to 'fiscal drag' due to co-financing and additionality rules.

Although each NMS is a net receiver of EU transfers, the net impact on the country's fiscal position depends on the substitution between transfers and existing expenditures. EU transfers impact both the revenue and the expenditure side of the budget. The net effect will critically depend on how much national spending can be substituted with EU-financed support. Some argue that EU transfers mainly lead to the restructuring of the national budgets because EU funding replaces existing national expenditure. For example, Hallet and Keereman (2005) estimate that, in 2004–06, EU transfers raised fiscal balances in NMS by 0.5 percent of GDP on average. Others, however, contend that co-financing requirements lead to additional spending and therefore may result in "fiscal drag." For instance, recent IMF country reports for several NMS suggest a negative net budget impact, with estimates ranging from -0.1 percent of GDP in Romania to -2.6 percent of GDP in Bulgaria in 2007 (IMF 2006b, 2006c, 2006d, and 2007). Sommer (2003) and Kopits and Székely (2002) also estimate that the fiscal impact would be negative. More recently, Rosenberg and Sierhej (2007) undertook the first ex-post assessment, and concluded that EU funds may have led to a fiscal drag of about 0.5 percent of GDP. For some NMS (*e.g.*, Hungary and Slovakia), this is the first study that uses actual post-accession budget data.

In addition to their net fiscal impact, EU funds are likely to impact expenditure allocation patterns, with spending on EU programmes taking priority over domestically financed projects. This results from both the need to make room for co-financing requirements under tight fiscal budgets, and from additionality rules, which will necessarily displace other spending under a fixed expenditure envelope. In effect, *ex-ante* additionality tables for Structural Funds for the 2004-2006 period suggest that expenditure composition would be affected. Figure 8 suggests that the share of infrastructure spending in total spending would actually decline, with increasing allocations toward

9 Some countries also continue to have access to the pre-accession funds PHARE and ISPA, which also foster infrastructure development. The discussion in this section focuses only on EU funds available after accession.

10 The European Commission (2006) estimates that co-financing in 2004 amounted to about 0.3 percent of GDP in 2004 for the NMS, ranging from 0.1 percent of GDP in the wealthier NMS (Slovenia and Malta) to 0.6 percent of GDP in the poorer Baltic States that receive relatively more EU assistance.

Box 1. EU funding relevant to infrastructure development

Funds for Objective 1a: Competitiveness for Growth and Employment

The European Development Fund (ERDF) and the European Social Fund (ESF) are the key financing instruments for programmes under this heading, and many programmes are relevant for infrastructure development.

- *Eligibility*: All EU member states and sub-national regions
- *Project financed*: Infrastructure projects covered by the defined scope of the relevant programmes, such as the Trans-European Networks in energy, telecom, and transport, Marco Polo II (environment-friendly transport), the 7th Research Framework Programme (including R&D infrastructure), and CIP (including energy).
- *Grant financing*: Variable, depending on the project type and the income of the hosting countries or regions, but generally up to 50 percent of total eligible expenditure
- *Total budget available*: About EUR 40 billion for infrastructure related programmes (2007-2013)

Structural Funds

Four types of structural funds were established to support structural economic and social development. The ERDF and ESF are the two types most relevant for infrastructure, and also the only two remaining structural instruments in the 2007-2013 framework.

- *Eligibility*: All EU member states and sub-national regions can qualify for some type of structural funding.
- *Projects financed*: The ERDF finances productive investment for more jobs, infrastructure, and small and medium-sized enterprises. The ESF funds programmes to develop human resource and labour market, such as vocational training, education and careers advice, and entrepreneurship support.
- *Grant financing*: Variable, depending on the income of the hosting countries or regions, but generally up to 85 percent of total eligible expenditure.
- *Total budget available*: EUR 195 billion (2000-2006); EUR 278 billion (2007-2013)

Cohesion Fund

The Cohesion Fund was established in 1993 to complement the structural funds. It helps less prosperous Member States reduce economic and social disparities in order to strengthen cohesion and solidarity in the EU, and mainly finances projects in environmental and transport infrastructure.

- *Eligibility:* Member states with per capita GNI (measured in purchasing power parities) below 90 percent of the EU average and a programme designed to fulfil the conditions of economic convergence. The initial recipients are Ireland, Greece, Spain, and Portugal, but Ireland no longer qualifies since 2004. The eligibility also extends to the 10 new members joined in May 2004 and to Bulgaria and Romania joined in January 2007.
- *Projects financed*: Projects in environmental or transport infrastructure. Energy efficiency or renewable energy projects may also qualify in 2007-2013.
- *Grant financing*: Up to 85 percent of the total eligible expenditure
- *Total budget available:* EUR 18 billion (2000-2006); EUR 70 billion (2007-2013)

Sources: European Commission (2005a, 2005b)

programmes for the production environment.[11] For 2007-13, however, there has been a reorientation of expenditure, particularly in favour of policies aimed at growth and employment, with resources for transport and energy increasing by nearly 139 percent (Box 2). These changes would be consistent with previously identified investment needs.[12]

In some new member states there is a serious lack of administrative absorption capacity, which could jeopardize planned increases in infrastructure investment.

The impact, however, will not be very evident until the NMS step up absorption of EU funds. As noted by Rosenberg and Sierhej (2007), absorption of Structural and Cohesion Funds has picked up only slowly in some countries. Demand is high and the contracting of funds already committed under the 2004-2006 financial perspective is proceeding swiftly. Key bottlenecks come from limited administrative capacities for handling (i) project supervision, (ii) efficient implementation, and (iii) co-financing requirements after the submission of proper documentation. Increased allocations under the new financial perspective for 2007-13 are likely to pose additional challenges. In particular, they require an acceleration of past absorption rates if funds are not to be de-committed under the n+ rules, which stipulate that if a country fails to use the allocated EU fund within a certain period after the year in which it was committed, it will lose such unused allocation.

Box 2. Changes in expenditure orientation in the new EU financial perspective

Under the new EU financial perspective for 2007-2013, there is a reorientation of expenditure in favour, in particular, of policies aimed at growth and employment. Main changes for 2007-2013 compared to 2000-2006 are as follows:

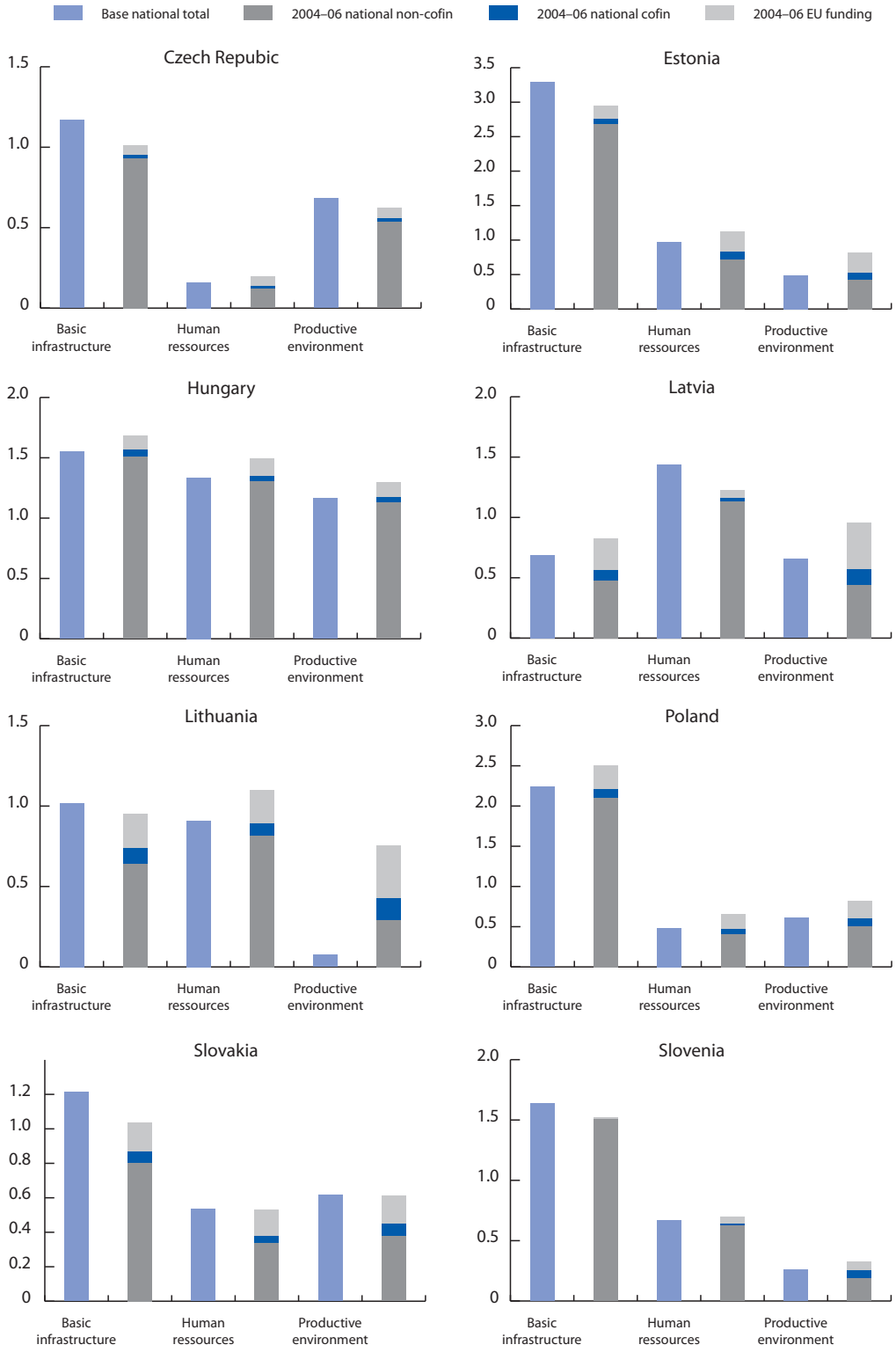
- 69 percent increase for Competitiveness for growth and employment (sub-heading 1a), including:
  - 139 percent increase for transport and energy
  - 81 percent increase for environment-friendly transport (Marco Polo II)
  - 75 percent increase for research (7th Research Framework Programme)
  - 60 percent increase for the Competitiveness and Innovation Programme (CIP)
  - 52 percent increase for knowledge/training (Life Long Learning and Erasmus Mundus programmes)
- 21 percent increase for Cohesion for growth and employment (sub-heading 1b), including:
  - 11 percent increase for structural funds
  - 74 percent increase for the Cohesion Fund
- 8 percent decrease for the Preservation & management of natural resources (heading 2)
- 78 percent increase for Citizenship, freedom, security and justice (heading 3)
- 8 percent increase for the EU as a global player (heading 4)

Source: European Commission (2005b)

11 Basic infrastructure includes sectors such as transport, telecommunication, energy, *etc.*; human resources includes sectors such as education, training, and research and development; and production environment includes sectors such as agriculture, industry and services, and tourism.

12 Discussions with the European Commission on the specific country priorities regarding the use of these funds are based on the National Strategic Reference Frameworks prepared by countries and sent to the European Commission.

Figure 8: Additionality and Structural Funds, 2004-06 (in percent of GDP)



Sources: European Commission (2006) and IMF(2006a)

Note: Data only cover allocations in three categories, and the time frames for the allocations referred to as base national total in the graphs differ slightly due to data availability: Simple averages in 2001-02 for Czech Republic, Hungary, Lithuania, and Slovenia; and simple averages in 2000-02 for Estonia, Latvia, Poland, and Slovakia.

5.2. Public-private partnerships

Another challenge for fiscal and macroeconomic policy in the NMS is the increasing use of PPPs in infrastructure investment. PPPs refer to arrangements in which the private sector supplies infrastructure assets and services traditionally provided by the government. Most PPP definitions point to three key characteristics: (i) private execution and financing of public investment; (ii) an emphasis on both investment and service provision by the private sector; and (iii) risk transfer from the government to the private sector. The World Bank (2007) reports that annual total investments in PPP infrastructure projects have increased from USD 29 billion in 2001–03 to USD 44 billion in 2004–06 on average in NMS.[13]

PPPs offer new opportunities to finance public infrastructure with potential efficiency gains. It is often argued that, through private-sector management and innovation, as well as more optimized risk allocation, PPPs provide better value-for-money than public procurement of the same assets and services. Yet, the delivery of net benefits in PPPs requires sufficient efficiency gains to cover (i) the typically higher private-sector borrowing costs; and (ii) the significantly higher transaction costs,[14] which are passed on to the government.

PPPs offer new opportunities to finance public infrastructure and enhance efficiency but they generate substantial fiscal risks.

PPPs usually also generate substantial fiscal risks. PPPs can be used to move public investment off budget and debt off the government balance sheet by financially constrained governments without value for money consideration. In particular, NMS may have an incentive to use PPPs solely to by-pass fiscal controls due to the constraints of the Stability and Growth Pact and the lack of strict rules in accounting and reporting. But even if not recorded immediately in deficits and debt levels, PPPs do create future liabilities and do not alleviate the intertemporal budget constraints unless they generate net efficiency gains or facilitate additional resource mobilization, such as through user fees. Fiscal risks can be compounded further by inappropriate institutional arrangements and inadequate government expertise to identify, quantify, and manage the complexities involved in PPPs. As a result, governments can end up facing large fiscal costs down the road (Box 3).

Reaping the benefits and managing fiscal risks from PPPs requires a sufficiently strong legal and institutional framework. Clearly, political commitment and good governance would be overarching conditions for the success of PPPs, while pervasive corruption would be a serious obstacle. Furthermore, fiscal risks from PPPs are more likely to arise when investment projects are of poor quality; the legal and fiscal institutional frameworks are weak; and PPP accounting and reporting systems do not transparently disclose their fiscal implications. Hence, reaping the potential benefits of PPPs (and minimizing their fiscal risks) requires governments to strengthen the overall framework for public investment planning; develop the legal and institutional framework to handle PPPs; and implement transparent accounting and reporting (see Corbacho and Schwartz 2008 for a full discussion of fiscal risks and PPPs).

First, PPP projects should be integrated with the government's investment strategy, its medium-term fiscal framework, and the budget cycle. PPP projects should be part of the government's investment strategy within a medium- to long-term budget framework and be pursued only when they offer value for money compared to standard public procurement. This will typically involve

13 Data refer to total annual investment committed at contract signing for infrastructure projects that resemble PPPs on the basis of some key characteristics (see World Bank 2007 for details).

14 Higher transaction costs arise from the complexity of PPP contracts compared to traditional public procurement. Recent EIB studies have shown that total transaction costs (bidding and negotiation) during the procurement stage average 10 percent of a project's capital value. See Dudkin and Välilä (2005). Higher transaction costs led the United Kingdom to set a floor on the size of PPP projects of £21 million. Brazil's PPP law also sets a floor on the size of PPPs.

Box 3. PPPs and fiscal risks: Selected experiences in the highway sector in NMS

Fiscal risks in the implementation of PPPs in the highway sector have already manifested themselves in several NMS. One problem that has plagued PPP implementation in this sector is related to overoptimistic demand projections. The upward bias in projections is partly due to the inherent technical difficulty of projecting traffic flows. However, moral hazard is also likely to play a role, since bidders have an incentive to overestimate demand and promise low tolls, while counting on renegotiations once the contract has been awarded because infrastructure projects are often too important to fail. Limited government capacity in evaluating PPP proposals and a the lack of a clear PPP legal framework often imply costly renegotiations for the government.

The experience of Hungary illustrates some of the problems that can result from overly optimistic traffic forecasts, overestimation of users' willingness to pay, and inefficient risk allocation. Hungary's M1 Highway PPP came to be heralded as the Euromoney magazine "finance project of the year 1995." It quickly became clear that traffic forecasts had been too optimistic. There was a strong diversion of traffic to a toll-free parallel road. Moreover, several litigation procedures were initiated against the consortium holding the concession. By the time construction ended, the private partner had suffered important financial losses. In 1999, the project was renationalized. Similarly, in the case of the M5 Highway, also a PPP, the original contract was renegotiated in 1995, only a year after it was signed, to provide minimum revenue guarantees. When the first stretches of the M5 were opened, traffic was at 85 percent of the original forecast, requiring compensation from the budget. The contract was renegotiated again in 1997 with the government fully assuming the traffic risk.

Poland's experience with PPP projects in the highway sector has also been mixed. A 150 Km stretch of the A2 highway, for example, was awarded in 2000 as a 40-year concession including the right to levy tolls. However, demand was lower than expected, as most freight transporters bypassed the tolled stretch of the highway. This situation led the government and the concessionaire to negotiate compensation payments. Similarly, a 35-year concession for a 152 kilometres stretch of the A1 highway – which was awarded in 1997 – did not reach financial close, leading to the concessionaire's request for governmental support for the project.

Another example of the fiscal risks involved in PPP implementation is provided by the Czech Republic, where several attempts to implement PPPs in the highway sector have failed. An early attempt to implement a toll-based concession for the D5 highway (from Prague to the German border) was abandoned as it became evident during the tendering process in 1993 that demand for the toll road would be too low to ensure cost recovery. In 2001, the government directly awarded a concession for a 80 Km long stretch of the D47. However, criticism of the direct concession award and overpriced remuneration led to cancellation of the contract. As a consequence, the government was forced to pay about EUR 20 million for breach of contract.

Source: Based on Brenck *et al.* (2005)

a first-stage decision on whether a particular project is worthwhile based on standard project appraisal techniques such as cost benefit analysis, and a second-stage decision on whether the project should be undertaken as a government investment or as a PPP. To ensure full accounting of their fiscal implications, PPP projects should not be allowed to move forward outside the regular budget cycle that governs other investment projects.

Governments should first see if a project is worthwhile and only then decide whether to undertake it as a PPP.

In this context, public investment frameworks need to be strengthened to be conducive to successful PPPs. In most NMS, public investment planning is still not embedded in a medium- to long-term budget framework; a full-fledged framework would help investment planning and prioritization and facilitate the development of good PPPs. In addition, NMS also need to improve technical aspects of investment planning and evaluation: The experience indicates that tools for evaluating costs and benefits are often not applied appropriately. In some cases, cost benefit analysis and value for money assessments are carried out only after the decision to go ahead with the PPP project has been taken.

Second, successful PPPs should be supported by a strong legal and institutional framework. Such a framework can help minimize political and regulatory risks for the private sector and thus increase the value for money the government can obtain. In particular, the legal framework should cover all major aspects of the PPP process and be conducive to private participation. Moreover, competitive bidding should be used to find the most efficient PPP concessionaire and minimize corruption. Furthermore, governments should develop the appropriate structures to manage PPPs. The institutional setup for PPPs may vary by country, but experience suggests that a central PPP unit, preferably at the Ministry of Finance, can serve as a useful vehicle to facilitate PPPs. The Ministry of Finance should act as a "gate keeper" to ensure that PPPs are consistent with broader macro-fiscal objectives, while a unit elsewhere in the government can handle PPP promotion functions.

Strong legal and institutional frameworks are needed to curb excessive renegotiation.

The institutional framework affects the quality and outcome of PPP projects. Given the complexities of large PPP projects, contracts are often incomplete, and therefore, many PPPs are subject to renegotiations. Guasch (2004) finds that most renegotiations are initiated by private firms and grant them more favourable outcomes (Table 11). For example, more than 60 percent of the renegotiations results in delay or reduction of the private firms' obligations or cost pass-through. However, the institutional framework, such as the legal and regulatory setups, significantly affects the incidence of renegotiations. For example, 61 percent of renegotiations occur in the absence of a regulatory body, while only 17 percent occur when there is one in place. Therefore, a solid institutional framework provides an *ex-ante* incentive for better PPP contracts to deliver the expected results.

The NMS have made progress in developing appropriate legal and institutional frameworks but still face considerable challenges. A PPP policy framework has been established in a number of NMS through government resolution (*e.g.*, Czech Republic and Latvia) or publication of strategy papers (*e.g.*, Bulgaria). In others, however, a general PPP policy framework is lacking. Even in countries with an appropriate PPP policy framework, the existence of such a framework does not necessarily imply an appropriate legal framework. Similarly, the progresses in developing a legal framework for PPPs vary in NMS. Some countries reached international standards by regulating PPPs through contract, public procurement, and other civil legislations with no specific PPP/concession Law (*e.g.*, Czech Republic, Estonia, and Slovenia). In contrast, a few countries that have enacted a specific PPP law still lack sufficient details in core areas to meet international standards (*e.g.*, Hungary and Croatia).[15] Furthermore, the legal and institutional framework in many NMS is not conducive to the competitive selection of the concessionaire and does not regulate the gate-keeping role of the Ministry of Finance to address fiscal risks in the PPPs.

15 Core areas, as defined in the EBRD (2005), include (i) general policy framework, (ii) general concession legal framework, (iii) definitions and scope of the concession law, (iv) selection of the concessionaire, (v) project agreement, (vi) security and support issues, and (vii) settlement of disputes and applicable law.

Table 11. Institutional framework and concession renegotiations

Selected institutional factors	In percent in all renegotiations	Selected renegotiation outcome	In percent in all renegotiations
Regulation criteria			
Investment requirements (regulate by means)	70	Delays on investment obligation targets	69
Performance indicators (regulate by objectives)	18	Reduction in investment obligations	62
Regulatory framework		Extension of concession period	38
Price cap	42	Tariff increases	62
Rate of return	13	Increase of cost components with automatic pass-through to tariffs	59
Existence of regulatory body			
In existence	17	Adjustment of fee payment to government	
Not in existence	61	favorable to operator	31
Impact of legal framework		unfavorable to operator	17
Embedded in law	17	Changes in asset-capital base	
Embedded in decree	28	favorable to operator	46
Embedded in contract	40	unfavorable to operator	22

Source: Guasch (2004)

Finally, PPPs should be supported by transparent accounting and reporting. Accounting and reporting standards provide the basis for sound value for money evaluation and risk management. More important, they facilitate public oversight and enhance quality and accountability in the use of PPPs. However, there are currently no internationally accepted comprehensive accounting and reporting standards for PPPs, and existing practices are often characterized by fairly lax standards (Schwartz *et al*. 2008, Part IV). As a result, PPPs have often been motivated by a desire to circumvent fiscal controls. This has gone hand-in-hand with the emergence of government guarantees and contractual obligations that give rise to sizeable contingent liabilities. It is thus critical to strengthen transparent accounting and reporting to achieve the net gains from PPPs while managing fiscal risks.

In the EU context, the 2004 Eurostat decision provides only a minimum standard to reflect the fiscal implications of PPPs.[16] The private sector typically bears construction and availability risk, and the decision would therefore make it easier for governments to record PPP projects as private investment and ignore their fiscal implications in most cases, leading to significant fiscal risks. Also, this simple "on-budget/off-budget" treatment provides strong incentives for PPP designs to "pass" the Eurostat test rather than to optimize the risk allocation to achieve value for money. For example, if a PPP project is at least as costly as traditional public investment, applying the Eurostat criteria would favour delaying the expenditure at a higher overall cost over time. From an economic perspective, it would be difficult to justify recording such a project off budget.

Additional fiscal reporting – even when a PPP is classified as private investment – would enhance transparency.

A better standard would be to require that additional fiscal reporting requirements be met even if a PPP project is recorded as a private investment. In general, classifying the assets of a PPP project as either public or private does not capture the actual extent of risk transfer or sharing. The Eurostat approach does not do justice to the fact that PPP projects are essentially risk sharing arrangements that require each of the partners to assume and manage specific risks in the provision of infrastructure services. Hence, the IMF suggests that budget documents report PPP operations even when projects are classified as private (Box 4). In addition, the fiscal implications of PPPs should be reflected in medium-term budgets and debt sustainability analysis. This will require governments to strengthen their ability to assess risks from contingent obligations.

Most NMS currently do not follow best practice for transparent disclosure of the fiscal implications of PPPs. These fiscal implications (*e.g.*, expenditures linked to availability payments) are usually not explicitly identified. Some countries (*e.g.*, Bulgaria and Hungary) only include some information on government liabilities related to PPPs. In Hungary, the budget documents contain a summary table of PPP operations, their total expected costs, and the estimated impact of associated availability fees on the budget in the coming three years, but fiscal risks stemming from PPPs are not fully quantified nor transparently disclosed. Overall, capacity to identify contingent liabilities implied by PPPs is low to non-existent in NMS. Capacity in this area should be increased so that NMS can properly assess the trade-offs in risk transfer.

NMS have a long way to go in building appropriate institutional frameworks for PPPs and addressing related fiscal risks. As discussed above, PPPs are generally not imbedded in public investment planning and medium- to long-term budget frameworks that allow proper project selection based on cost benefit analysis and value for money considerations. The generally lax fiscal accounting and reporting standards further encourage the use of PPPs to by-pass fiscal controls, usually leaving

16 According to the 2004 Eurostat decision, PPP projects should be classified as non-government assets and recorded off balance sheet for the government under two conditions: (i) the private partner bears the construction risk; and (ii) the private partner bears either availability or demand risk. When PPP projects involve limited risk transfer to the private sector, the project's assets would be classified as government assets. National statistics offices are responsible for adopting and implementing this decision, based on information from project contracts.

governments with significant fiscal risks. Furthermore, several aspects of the legal and institutional framework also need strengthening, particularly in competitive bidding. Regarding institutional setups, while progress has been made in building dedicated PPP units, the gate-keeping role of the Ministry of Finance is often found to be too weak.

New member states need to reduce fiscal risks from PPPs and strengthen their legal and institutional frameworks.

Box 4. Disclosure requirements for PPPs and guarantees

PPPs

For each PPP project or group of similar projects, budget documents and end-year financial statements should provide information on the following:

- Future service payments and receipts (such as concession and operating lease fees) by government specified in PPP contracts over the following 5–30 years.
- Details of contract provisions that give rise to contingent or variable payments or receipts (*e.g.*, guarantees, shadow tolls, profit sharing arrangements, events triggering contract renegotiation), which need to be valued to the extent feasible.
- Amount and terms of financing and other support for PPPs provided through government on-lending or via public financial institutions and other entities (such as special purpose vehicles (SPVs) owned or controlled by the government).
- Information on how the project affects the reported fiscal balance and public debt, and whether PPP assets are recognized as assets in the government balance sheet. It should be noted whether PPP assets are recognized as assets on the balance sheet of any SPV or private sector partner.[1]

Guarantees

Irrespective of the basis of accounting, information on guarantees should be disclosed in budget documents, within-year fiscal reports, and end-year financial statements. Guarantees should ideally be reported in a *Statement of Contingent Liabilities* which is part of the budget documentation and accompanies financial statements, with updates provided in fiscal reports. Information to be disclosed annually for each guarantee or guarantee programme includes:

- A brief description of its nature, intended purpose, beneficiaries, and expected duration.
- The government's gross financial exposure and where feasible, an estimate of the likely fiscal cost of called guarantees.
- Payments made, reimbursements, recoveries, financial claims established against beneficiaries, and any waivers of such claims.
- Guarantee fees or other revenue received.
- An indication of the allowance made in the budget for expected calls on guarantees, and its form (*e.g.*, an appropriation, a contingency).
- A forecast and explanation of new guarantees to be issued in the budget year.

During the year, details of new guarantees issued should be published (*e.g.*, in the Government Gazette). Within-year fiscal reports should indicate new guarantees issued during the period, payments made on called guarantees, and the status of claims on beneficiaries, and update the forecast of new guarantees to be issued in the budget year and the estimate of the likely fiscal cost of called guarantees. Finally, a reconciliation of the change in the stock of public debt between the start and end of the year should be provided, showing separately that part of the change attributable to the assumption of debt arising from called guarantees.

1 The suggested disclosure of the private sector partner's accounting treatment is made by Heald (2003).

6. Concluding remarks

Many NMS need to continue to implement fiscal adjustment to support growth and macroeconomic stability. An analysis of the determinants of economic growth in the NMS suggests that achieving income convergence with other EU members rests more with maintaining productivity growth, attracting foreign savings, and improving investment efficiency than with increasing spending (including for infrastructure). Also, as macroeconomic vulnerability indicators remain high, and in some countries are approaching critical values, strong fiscal positions are needed to avoid a further deterioration in the macroeconomic framework and support medium-term economic growth.

Fiscal adjustment and reforms need not depress public investment.

Yet, fiscal adjustment does not necessarily have to constrain public investment. Several NMS have successfully increased public investment with the support of higher revenue efforts and cuts in other expenditures, while at the same time consolidating their fiscal positions. In general, further fiscal adjustment can lead to stronger private-sector-led growth, including through private investment and foreign capital inflows. The EU experience shows that countries with strong fiscal positions and modest debt have generally been able to stimulate higher private investment to more than offset cuts in public investment. Finally, success in achieving the convergence objective requires higher efficiency in investment, which can be facilitated by properly designed fiscal adjustment.

In most NMS, institutional reforms will be needed to enhance the efficiency of investment. Addressing infrastructure bottlenecks usually requires both more investment and more efficient investment. In all NMS, further institutional reforms play a critical role in improving efficiency and encouraging private sector investment. Policy options will need to be country-specific with due consideration to the overall macroeconomic and fiscal framework, infrastructure bottlenecks, business constraints, and the efficiency of investment.

New financing options can ease fiscal constraints but present both new opportunities and challenges. One such option, various EU funds, make additional resources available for investment but their net fiscal impact may be negative in the short run unless countries can reallocate spending away from domestically-funded programmes. Appropriate project selection procedures are crucial to ensure the efficient use of funds. Additional resources also pose challenges for absorptive capacities in many NMS. Another option, PPPs, provide a promising route for channelling more resources into infrastructure investment but require an urgent strengthening of the institutional framework to handle PPPs, and limiting incentives to move investment off budget. Benefits can only be expected to materialize to the extent that the risks and complexities inherent in this investment route are adequately managed.

Annex: EU funding available for new member states[17]

Pre-accession aid

Aimed to facilitate adjustment to full membership. The disbursements on remaining pre-accession funds continue also after accession. There were three pre-accession instruments:

- Poland and Hungary: Assistance for Restructuring of the Economy (PHARE);
- Instrument for Structural Policies for pre-Accession (ISPA);
- Special Accession Programme for Agriculture and Rural Development (SAPARD).

Structural funds

Aimed at the following objectives: (1) economic catch-up in less developed regions (GDP per capita less than 75 percent of EU average, (2) economic and social cohesion in areas facing structural difficulties (*e.g.*, rural, fisheries); (3) training and promotion of employment (in less developed regions included in (1)). These three objectives account for 94 percent of structural allocations for the NMS. There are four structural funds to finance the above objectives:

- European Regional Development Fund (ERDF): financing objectives (1) and (2)
- European Social Fund (ESF): financing objectives (1), (2), and (3)
- European Agricultural Guidance and Guarantee Fund (EAGGF) – guidance section: financing objective (1) in agriculture;
- Financial Instrument for Fisheries Guidance (FIFG): financing objective (1) in the fisheries sector.

Other structural funds, so called Community Initiatives, include: *Interreg III* (cross-border cooperation), *Urban II* (innovative strategies in urban areas), *Equal* (combating labour market discrimination), and Leader + (rural development initiatives).

Cohesion Fund

Available to countries with GDP per capita below 90 percent of the EU average. This finances large infrastructure projects in environment and transportation.

Common Agricultural Policy (CAP)

The CAP policy has several components:

- Market measures: Purchase of unprocessed food at intervention price and subsidies to non-EU exports;
- Direct payments: Payments to farmers based on farm area and type of production;
- Rural development (EAGGF guarantee section): So-called CAP pillar II to provide support to farms in less favorable areas (LFA), forestation of land, structural pensions (paid to those who transfer farms to young farmers), food-processing, or training of farmers.

Internal policies

Funds to finance existing EU policy priorities, NMS mainly receive funds for:
- Nuclear safety: Decommissioning of power plants;
- Schengen: Strengthening control on the EU border and complying with the Schengen Treaty.

17 This Annex draws on Rosenberg and Sierhej (2007).

Budget compensation

Unconditional payment from the EU agreed at the last stage of the accession negotiations. Its main goals are to ensure that new members would not become net contributors, and to improve budget liquidity in countries where there is no such risk. This is not a "regular" EU funding vehicle (it will not continue after 2006). This transfer is in part financed directly from the EU budget and in part with resources shifted from structural funds originally allocated for the new member states.

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