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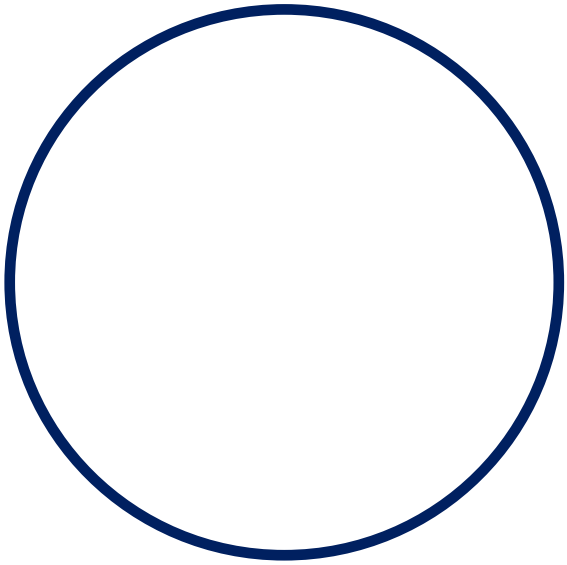

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Mind the gap: Why Germany should invest more in its future

Kersten Kellermann

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Abstract

The issue of insufficient public investment has drawn attention since Aschauer (1989) published his landmark paper about the effects of public investments on productivity. However, to assess the level of public investment, it is necessary to consider not only aspects of productivity but also aspects of efficiency. This paper therefore uses an intertemporal welfare model to deduce an applicable public investment rule that can indicate suboptimal public investment levels. The rule states that a welfare-maximizing government invests up to the point where the net marginal productivity of public capital equals the marginal social discount rate. The social discount rate is approximated using the long-term interest rate. The marginal productivity of public capital is therefore expected to move with the interest rate. However, the data shows that over the past three decades, the gap between the net marginal productivity of public capital and the interest rate has widened significantly. In Germany, it reached 19 percentage points in 2017.

Keywords: Public investments, sub-optimality, investment rule, public capital hypotheses, social discount rate.

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Inhalt

Mind the gap: Why Germany should invest more in its future

1. Introduction

According to an assessment by Adidas CEO Kasper Rorsted, the German government has completely failed in "education and digitalization". In a newspaper interview he recently stated "…when it comes to digitalization, we have gotten nowhere in Germany" (NZZ, 2021, translated by the author). In the interview, the executive also talked about what digitalization means for his company. He explained that for Adidas, digitalization affects "a lot of company areas, such as product design, communication with consumers, analysis of customer behavior, maintenance of our app users and, of course, online sales." From an economic perspective, it is obvious that many economies are experiencing a profound structural change, a significant part of which is driven by digitalization. The present paper discusses the question of whether the public decision-makers in Germany have missed important developments and whether the government, by investing too little, has neglected to address an obvious challenge. The economic literature has long been concerned with the problem of public investment gaps expanding, not only with respect to Germany. However, levels of public investment seem especially low in Germany compared to countries that are structurally quite similar, such as Switzerland and France, and even the EU-28 average (Figure 1). The public net capital stock in Germany developed at quite a dynamic pace until the mid-1970s. After that, the growth rate decreased significantly (Figure 2). From 1997 on, the public net capital stock in Germany stopped growing. The growth rates in some years were negative. The net capital stock has been decreasing in relation to gross domestic product (GDP) almost continuously since 1984 and in 2017, with a factor of 0.4, is just under half of its peak in 1983 (Figure 2).

The issue of insufficient public investment was raised as early as 1989 in a landmark paper by David Aschauer. Faced with a decline in productivity in the US, Aschauer identified the lack of public infrastructure as a key cause and showed empirically the strong potential of public infrastructure to enhance economic productivity and growth (Aschauer, 1989). Later the World Bank (1994), came to the conclusion that public capital represents the "wheels"—if not the engine—of economic activity.[1] Fueled by the obviously pressing challenges of digitization, the topic has recently come under renewed attention. For example, the rapid development of

[1] Governments can try to improve future living conditions in various ways: they can, e.g., stimulate private (foreign) investment and spend more on education and health programs in order to enhance human capital.

information and communication technologies and the associated tremendous increase in data volumes have increased the demand for high-performance broadband networks (Expertenkommission, 2015). Aschauer and many authors who have taken up his research question focused on the effects of public investments on productivity. However, identifying an investment gap, i.e., a sub-optimal level of public investment, involves considering not only productivity but also the efficiency of public infrastructure expenditure. Therefore, it becomes necessary to embed the productivity aspect in a broader, intertemporal welfare analysis.

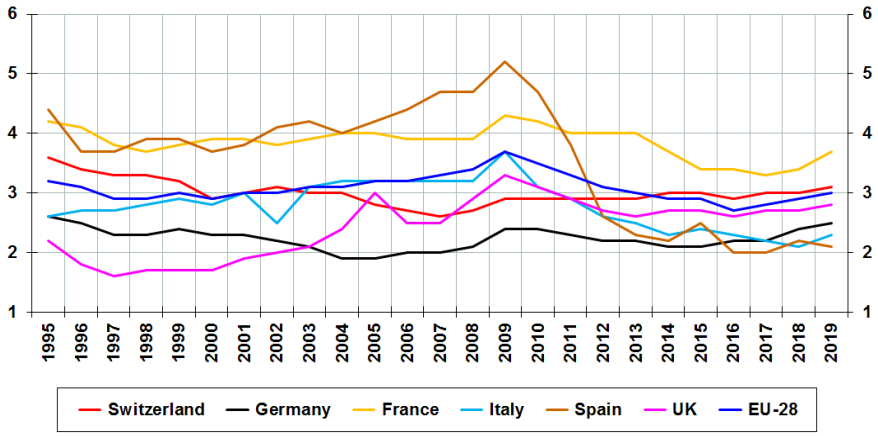

Figure 1: Public gross fixed capital formation in relation to GDP (current prices, in percent)

Source: IMF (2020), author's own calculations.

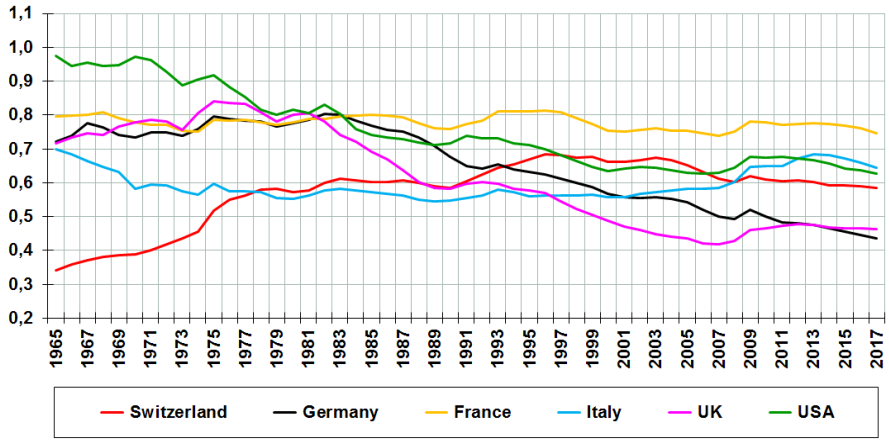

Figure 2: Public net capital stock in relation to GDP (2011 prices, in international dollars)

Source: IMF (2020), own calculations.

Using a simple optimality condition for public capital allocation, the present paper shows that the public investment gap in Germany has widened over the past few decades (Kellermann and Schlag, 2021). However, there are also signs of public investment gaps in Switzerland, the UK, and the USA. Such investment gaps weaken the competitiveness of any economy, curb private

investment, and hinder technical progress. Although there is certain evidence that firms in the private sector also have a tendency to underinvest, larger gaps can be found in the government sector (Gomme et al., 2015).

2. Methods

To detect a public investment gap, the actual public capital stock is measured against a target value to be aimed for. Already, the topic of how to correctly measure public capital stock is demanding and controversial among experts (Grömling et al., 2019). The real challenge, however, is to set an appropriate level of public capital as a reference. Potentially, an investment gap can be positive or negative; i.e., there is a risk to the government investing either too much or too little. Both scenarios result in inefficiency. A positive or negative investment gap can only be identified by comparing the status quo with a valid reference value. Various methods of measuring investment gaps are discussed in the literature.

2.1 The limits of benchmarking

Brandt et al. (2020) proposed the following three procedures to identify a public investment gap: (panel) surveys of municipalities, evaluations of databases of official statistics, and analyses of municipal annual financial statements. In Germany, surveys of public decision-makers are conducted by the Kreditanstalt für Wiederaufbau (KfW), a German state-owned investment and development bank. Based on the assessments of the municipalities' treasurers the so-called "KfW-Kommunalpanel" provides the required data to identify and quantify the "perceived investment backlog.". Since the municipal level undertakes considerable responsibility for public investments, municipal treasurers in particular are an important source of information.

The evaluation of databases, especially official statistics, also facilitates international benchmarking analyses. In the Global Competitiveness Report, the World Economic Forum publishes an annual benchmarking of countries' competitiveness, taking into account indicators for infrastructure. The Global Competitiveness Report uses official statistics and expert assessments. In Germany, another benchmarking standard lately drawn up by the Expertenkommission (2015) has attracted a great deal of attention (Christofzik et al. 2019;

Grömling et al., 2019). This standard stipulates that a public investment gap exists when the net investment of the government is negative and the depreciation of the public capital stock thus exceeds gross investment.

Simple international benchmarking reaches its limits when the institutional structures of the economies under consideration are not sufficiently similar. When this is the case, international benchmarking can only provide approximate indications. The Federal Ministry for Economic Affairs and Energy (BMWi, 2020) explicitly stated that if other countries have higher quotas of public investments, it may be because their infrastructures are in worse condition. Certain so-called "best practice approaches" can be applied to facilitate complex comparisons. To do so investment gaps are explicitly estimated econometrically, which takes into account the specific institutional and economic circumstances of the countries in question (Baldi et al., 2014; European Commission, 2014; IMF, 2014; Lewis et al., 2014). The benchmark is the public investor who provides the best relative performance under given conditions. An objectively optimal level of investment thus cannot be determined; the benchmark is rather "the top of the class." An investment gap is only indicated when a region deviates sufficiently from the top public investor of its particular "class".

Concerning the potential of model-based analyses, the prevailing attitude in Germany is extremely critical. Brand et al. (2020) emphasized that "theoretical discussions" of the public investment gap are not very effective and that comprehensive standards on the optimal level of public capital can hardly be determined. Christofzik et al. (2019) took the view that it is not possible to define objective criteria for identifying investment backlogs or specifying overall investment needs. However, Krebs and Scheffel (2017) adopted a different stance. They explicitly applied modern macroeconomic methods (and, in particular, micro-based macroeconomic models) to evaluate the effects of public investments. The two economists carried out simulations to determine the macroeconomic, fiscal, and distributional effects of various investment programs and came to the conclusion that additional investment programs could make an important contribution to securing prosperity in Germany. According to Glaeser and Poterba (2020), microeconomic cost-benefit analysis should be the standard tool for evaluating investment programs.

2.2 Deriving a public investment rule from a simple intertemporal welfare model

Benchmarking is a practical but hardly satisfactory instrument for identifying investment gaps. On the other hand, comprehensive macroeconomic simulation models are often cumbersome to use and non-transparent when it comes to identifying the channels of explicit impact. This paper therefore uses an intertemporal welfare model to deduce an applicable public investment rule. This investment rule is then compared to the actual status quo. The model considers productivity and financing effects, i.e., the crowding-in and crowding-out effects of public investment. Welfare-reducing financing effects are caused by the social costs associated with the investment expenditures for building and maintaining the public capital stock. They are weighed against welfare-increasing productivity effects. Thus, the model enables the assessment of the overall welfare effects of public investment. An investment gap arises when the financing effect exceeds the productivity effect.

In an intertemporal setting, the relevant question is how public investment programs impact future consumption flows via different channels. The aggregate welfare effect is determined by discounting these changes in consumption by a so-called social discount rate (SDR). The marginal SDR is deduced from an intertemporal welfare model of a small open economy with a government whose policy choices influence the spatial and intertemporal allocation of mobile capital. Immobile private households located in the economy, private firms, and the government are price-takers in the global capital market. The government provides a public service, which is modeled as productive input. Although this public input is debt-financed, the resulting debt burden is completely covered by tax funds. If these particular taxes are levied on returns on capital, an outflow of mobile capital may occur. Hence, the government prefers the taxation of the immobile factor.[2]

The economy depends on three factors of production: labor, L_t, private capital, K_t, and public capital, G_t, which are used by private firms to produce the homogeneous output Y_t at time t. The public capital yields only production benefits, so households are not immediate

[2] The model discussed in this paper confirms the famous "zero-tax result" with respect to a source tax on mobile capital known from the tax competition literature (Razin and Sadka, 1991).

beneficiaries of public capital.[3] The price of Y_t is normalized to unity. Capital is simply non-consumed output. The aggregate production function

(1) $$F(L_t, K_t, G_t) = Y_t$$

is twice differentiable and exhibits constant returns to scale. Thus, we get positive diminishing marginal products with respect to each input and the Inada conditions hold. All factors are complements in the sense that the second-order cross derivations of the production function are positive. It proves convenient to specify a Cobb-Douglas production function, $Y_t = {L_t}^{\alpha} {K_t}^{\beta} {G_t}^{\varepsilon}$, for which the output elasticities with respect to labor, α, private capital, β, and public capital, ε, are constant. Furthermore, $\alpha, \beta, \varepsilon > 0$ and $\alpha + \beta + \varepsilon = 0$ hold. The labor supply grows at an exogenous rate, n; thus, $L_{t+1} = L_t(1 + n)$ holds. The interest rate, r, is treated as exogenous. In the private sector, private capital has two costs to the firm: the rental price of capital, given by the interest rate r, and a source-based tax on capital revenue where $\tau_{k,t}$ denotes the capital tax rate. Note that public capital generates no rent to private capital. Thus, private firms invest capital up to the point at which the marginal revenue of private investment equals costs:

(2) $$\frac{\partial({L_t}^{\alpha} {K_t}^{\beta} {G_t}^{\gamma})}{\partial K_t} = \beta \frac{Y_t}{K_t} = \frac{r}{(1-\tau_{k,t})}$$

The aggregate domestic output of the economy

(3) $$Y_t = \frac{r}{(1-\tau_{k,t})} K_t + \tau_{k,t} \frac{r}{(1-\tau_{k,t})} K_t + W_t$$

can be decomposed into an income share that goes to private capital, $(r/(1-\tau_{k,t}))K_t$, the aggregate gross wage income, W_t, and the source tax revenue of the government, $\tau_{k,t}(r/(1-\tau_{k,t}))K_t$. Since the public factor is embodied in labor and an unpaid factor, the gross wage income, W_t, contains the income share of public capital.

The private household sector is designed according to the two-period overlapping generations model. Private households are assumed to be internationally immobile. An individual born at

[3] From an empirical point of view, it is difficult to divide public capital expenditure into productive and consumptive investment programs. A variety of different methodologies have been adopted to investigate the impact of public investment on economic activities (Romp and de Haan, 2005).

time t inelastically supplies in period t one unit of labor and receives the gross wage income $w_t = W_t/L_t$. Since workers have to pay a wage tax, $\tau_{W,t}$, net wage income is given by $(1 - \tau_{W,t})w_t$ and the wage tax is equivalent to a head tax, t_t.

In period t, each worker consumes c_t^y and saves the remainder, $s_t^y = (w_t - t_t) - c_t^y$. Later in life, the individual doesn't work or receive wage income but consumes their wealth, both interest and principal: $c_{t+1}^o = s_t^y(1 + r)$. The household maximizes utility $u(c_t^y, c_{t+1}^o) = lnc_t^y + \vartheta lnc_{t+1}^o$ subject to private budget constraint $c_t^{y,j} = (w_t - t_t) - c_{t+1}^{o,j}/(1 + r_{t+1}^*)$. The parameter ϑ denotes the subjective discount factor with $\vartheta > 0$. The first-order condition for a private utility maximum is the marginal rate of time preference of private households (MRTP)

$$\frac{\frac{\partial u}{\partial c_t^y}}{\frac{\partial u}{\partial c_{t+1}^o}} - 1 = \frac{c_{t+1}^o}{\vartheta c_t^y} - 1 = r$$

that equals the interest rate r. Thus, the consumption of the older generation can be expressed as $c_{t+1}^o = \vartheta c_t^y(1 + r)$. The private savings of a working household are thus a fixed fraction of net wage income, $s_t^y = \frac{\vartheta}{1+\vartheta}(w_t - t_t)$. Note that savings are built only from the income of the immobile factor labor. The intertemporal indirect utility function of the private household is given by

(4) $$\tilde{u}(r, w_t, \tau_{L.t}) = \frac{\vartheta ln\vartheta}{(1+\vartheta)\ln(1+\vartheta)} + \vartheta ln(1 + r) + (1 + \vartheta)(w_t - t_t)$$

The public sector of the economy is designed as follows: the government's total tax revenue is the sum of the capital tax revenue, $\tau_{k,t}(r/(1 - \tau_{k,t}))K_t$, and the wage tax revenue, $L_t t_t$. A third revenue source to finance government expenditure is public borrowing, $B_{t+1} - B_t$, where B_t is the government's interest-bearing debt in period t. Public consumption is neglected; thus, public expenditure consists of public gross investment, $G_{t+1} - (1 + \delta)G_t$, and the debt service, rB_t. The budget constraint of the public sector is further divided into a current budget

(5) $$rB_t + \delta G_t = \tau_{k,t}\frac{r}{(1-\tau_{k,t})}K_t + L_t t_t$$

and a public investment budget

(6) $$B_{t+1} - B_t = G_{t+1} - G_t$$

The government uses public-sector borrowing only to finance public net investment and thus accumulates a public net capital stock in tandem with the debt level. An additional constraint holds that in period one, $B_1 = G_1$. Social welfare is assumed to be a function, Ψ, not only of the utility of individuals who are currently members of society but also of all future generations.

(7) $$\Psi = \sum_{t=1}^{\infty} \frac{1}{(1+\lambda)^{1+t}} \tilde{u}(r, w_t, t_t)$$

The government thus takes responsibility for unborn generations and their descendants. The utility of future generations is discounted by the government at a rate $\lambda > 0$. Eq. (5) and Eq. (3) yield the available income of private households. The constraints for this public optimization problem are the public budget constraint (6) and the optimality condition of the private firms (2). In period t, the instruments at the government's disposal are public investment, $G_{t+1} - G_t$, the source tax, $\tau_{k,t}$, and the head tax, t_t.

Solving the government's constrained optimization problem results in the optimality conditions

(8) $$\frac{\partial Y_t}{\partial G} - \delta = \frac{\partial Y_t}{\partial K_t} - \delta = r \qquad \text{and} \qquad \tau_{k,t} = 0.$$

The government invests capital up to the point at which the marginal revenue of public investment equals the marginal costs given by *r*. It equals also the MRTP. The reason for this is that a welfare-maximizing government will levy no source tax. The burden of debt-financed public capital is borne by immobile private households and thus by a head tax. As a consequence, no excess burden is caused by shifting money from the private to the public sector. Since the level of domestic saving does not determine investment in the jurisdiction, an increase in public borrowing to finance public investment does not directly crowd out private investment in the jurisdiction. Global crowding-out effects potentially induced by public borrowing can thus be neglected by the government.

3. Findings

The model shows that a welfare-maximizing government follows the investment rule

(9) $$\frac{\partial Y_t}{\partial G_t} - \delta_G = r = SDR_t \ .$$

The marginal productivity of public capital minus the depreciation rate is set equal to an SDR that reflects the rate at which the society is willing to trade present consumption for future consumption. Condition (9) is in line with the findings of Sandmo and Drezen (1971), who also showed that a welfare-maximizing state to which non-distorting financial instruments are available bases its investment decisions on the market interest rate. Nevertheless, in reality, various factors arise that can lead to the welfare-maximizing SDR deviating from the interest rate.

3.1 The social discount rate

In the literature, the discussion about the valid SDR is extensive (Jones, 2005). Applying the most common theoretical approaches results in a corridor in which the SDR should tend to move. According to Boardman et al. (2018) and Zhuang et al. (2007), the SDR can rise above the interest rate. These authors suggest the yield on private corporate bonds as a cap for the SDR. The lower limit of the SDR corresponds to the spot interest rate of government bonds (Kellermann and Schlag, 2021). Between the upper and the lower limits of the SDR lies a certain corridor. According to the famous Harberger rule (Jones, 2005), the valid SDR moves in this corridor and can be modeled as a weighted mean of the upper and the lower limits.

An evaluation of several databases shows that official SDRs have actually moved within the corridor over the past twenty years. Official SDRs are published in Germany by the Federal Ministry of Finance (BMF), in the USA by the Office of Management and Budget (OMB), and in the United Kingdom by the Ministry of Finance (HM Treasury), as well as by the EU Commission. Figure 3 shows the official SDRs, compiled from various sources, for the period from 1965 to 2020. Although these institutions use their own specific procedures to determine the SDR, a general decline can be observed during the observation period. Since the late 1970s, the decline has correlated with the long-term interest rates observed in the USA. Long-term interest rates will thus be used as proxies for the SDRs.

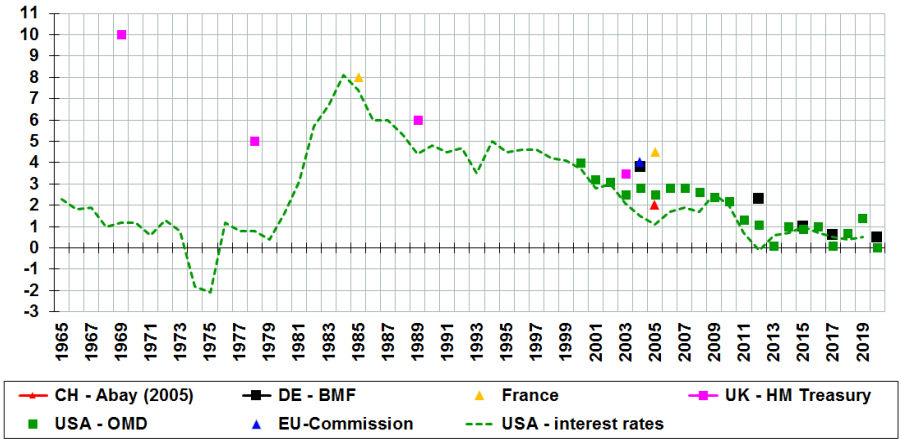

Figure 3: Official SDR and long-term interest rates (in percent)

Long-term interest rates: US government bonds (10 years), adjusted for inflation.

Source: Abay (2005), BMF (2020), Boardman et al. (2018), HM Treasury (2018), EU-Commission: AMECO.

3.2 Productivity effects of public capital

In a neoclassical setting, an increase in public capital stock always leads, *ceteris paribus*, to a positive, albeit decreasing, marginal change in production. Due to the complementarity of public and private production factors, crowding-in leads to additional indirect productivity effects. According to the welfare-maximizing public investment rule, the state will invest until the marginal net productivity of public capital corresponds to the SDR.

Kellermann and Schlag (2021) calculated the marginal productivity of public capital using an estimate of the partial output elasticity, ε, of public capital. To quantify the partial output elasticity of public capital, they carried out econometric estimates based on a panel approach with 34 industrialized countries for the period from 1960 to 2017. The output elasticity is identified as a constant, positive, and statistically significant parameter in the amount of $\varepsilon = 0.1$. The estimation result hints at a bilateral causality between the public capital stock and the output. This estimation result fits with the findings of the meta-analyses by Bom and Ligthart (2014) and Núñez-Serrano and Velázquez (2017).

For each country, the average public capital productivity, Y_t/G_t, multiplied by the partial output elasticity of public capital, $\varepsilon = 0.1$, equals the gross marginal productivity of public capital. Subtracting the public depreciation rate yields the net gross marginal productivity of public capital as $\partial Y_t/\partial G_t - \delta_G = 0.1 Y_t/G_t - \delta_G$.

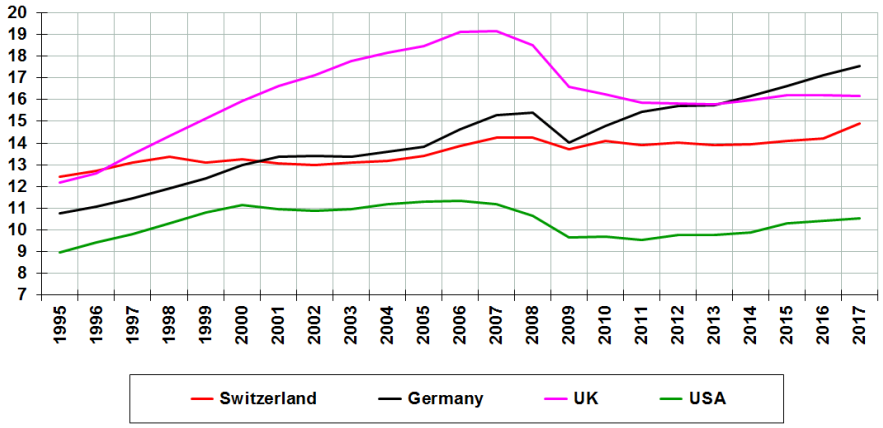

Figure 4: Net marginal productivity of public capital

Source: IMF (2020), author's own calculations.

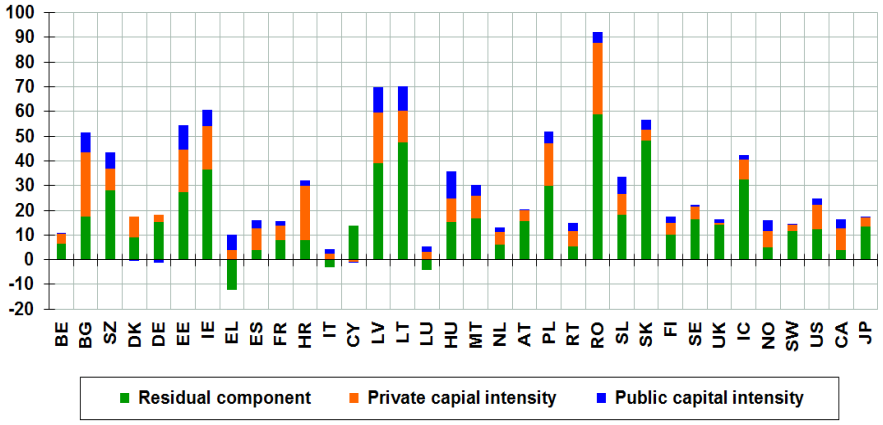

Figure 5: Growth accounting (labor productivity growth, 2000–2017, 34 countries, in percent)

Source: Kellermann and Schlag (2021).

Figure 4 shows the development of the net marginal productivity of public capital for Germany as a steeply rising black line. In the UK, too, marginal productivity rose rapidly until the 2007 financial crisis. After that, however, public investment in the UK increased and maintained productivity at a stable level. In order to make the general productivity effects of public capital more tangible, the useful method of growth accounting is applied. It allows a straightforward interpretation of the estimation results by dividing the aggregate growth rate of the GDP according to the growth contributions of individual production factors. Figure 5 shows the growth contributions of public capital, private capital, and the residual for 34 countries. The investigation period was from 2000 to 2017. The growth contribution of public capital—shown as the blue column in Figure 5—is only negative in Germany (DE), Denmark (DK), and Cyprus (CY). In Germany (DE), labor productivity grew by 17.1% between 2000 and 2017, when public capital made a negative contribution of -1.1 percentage points. For all other countries, public capital contributed positively to growth, albeit in some cases only to a small extent.

Adding private and public capital together, the common contribution to growth remains below the residual in most countries.

3.3 The public investment gap

If the optimality condition (9) holds, it is to be expected that the marginal productivity of capital moves with the interest rate. A sustained decline in interest rates should thus be reflected in the decline in capital productivity caused by enhanced investments. However, over the past three decades, the difference or gap between the marginal productivity of public capital and the interest rate

$$(10) \qquad Gap_{G,t} = \left(\frac{\partial Y_t}{\partial G_t} - \delta_G\right) - r_t$$

has been showing a strong tendency to expand. Figure 6 illustrates the development of $Gap_{G,t}$ calculated as the difference between the net marginal productivity of public capital and the long-term interest rate in the period from 1995 to 2020 for Germany, Switzerland, the UK, and the USA. In all four countries, $Gap_{G,t}$ has been increasing. Unsurprisingly, the front runner is Germany, where the gap in the public sector has increased by more than 12 percentage points from an original six percentage points to almost 19 in 2017. However, in the UK and USA, the gaps have also increased significantly, by nine and six percentage points, in the years before the financial crisis. After that, however, this development slowed considerably and became a sideways movement, albeit a volatile one.

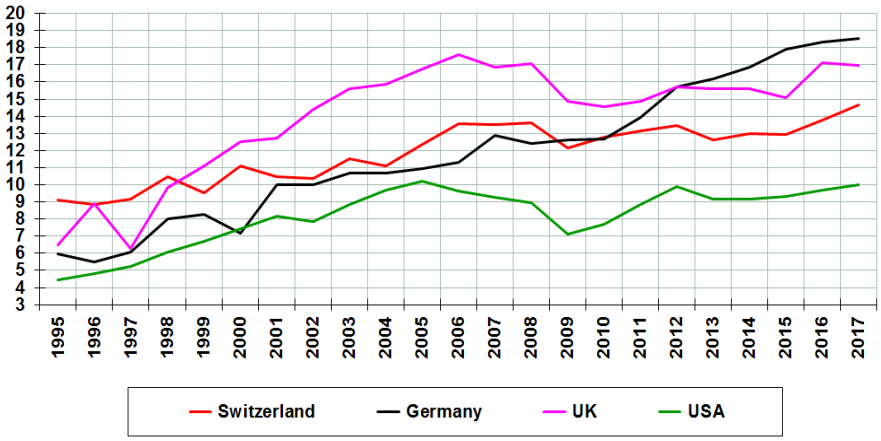

Figure 6: Gaps between the marginal productivity of public capital and the long-term interest rates (in percentage points)

Source: Kellermann and Schlag (2021).

4. Discussion and conclusions

Evidence of declining public investment is not sufficient to indicate a lack of public capital. However, general assessment standards haven't emerged, although criteria for determining an adequate level of public capital are widely discussed in the literature (Baldi et al., 2014; Christofzik et al., 2019; European Commission, 2014; Expertenkommission, 2015; IMF, 2014; Krebs and Scheffel, 2017; Lewis et al., 2014). In the present paper, an attempt is made to identify a simple rule for determining the optimal level of public capital investment on the basis of a dynamic welfare analysis. Empirically, it can be shown that there is a positive relationship between the stock of public capital and aggregate productivity. Since the welfare-reducing financing effects of public investments depend positively on the interest rate, one would expect public investment to rise if interest rates fall. However, the data for Germany, Switzerland, the UK, and the USA show a widening discrepancy between the marginal productivity of public capital and interest rates over the past decades. This development can be interpreted as an indicator of a growing public investment gap.

Recently, a certain consensus has emerged in Germany that the high marginal productivity of public capital, in combination with low interest rates, indicates that an increase in public investment harbors the potential for welfare gains. Several economists have posited concrete suggestions for future investment programs. Grimm et al. (2020) emphasized that farther-reaching digitalization of the public administration could increase the productivity of the public and private sectors. They also advocated for the consistent implementation of digitalization in schools through investments in information and communication technology and the training of teachers. The digitalization of municipal health institutions and authorities is also important. Dullien et al. (2020) focused on the development and application of hydrogen technology, artificial intelligence, and quantum technology in the context of the digitalization of the German economy.

In terms of welfare economics, there is currently little to be said against an increase in public investment expenditure. From a public choice perspective, however, problems with respect to the efficient implementation of a future-oriented public finance and investment policy may remain. This holds especially true when public investments are debt-financed. In this case, it cannot be ruled out that suboptimal public debt management will pose problems for the public budget retrospectively. As for the expenditure side of the budget, the challenges are likely to

prove even greater. Despite the public investment gap, not every investment project is promising. Glaeser and Poterba (2020) underscore the usefulness of cost-benefit analysis while emphasizing that this evaluation tool has to be further developed. Nevertheless, this paper supports the view that valid strategies for choosing the right projects and effectiveness in the handling of public funds can lead to welfare improvements.

References

Abay, G. (2005). *Diskontsatz in Kosten-Nutzen-Analysen im Verkehr*, Forschungsauftrag VSS 2003/201 auf Antrag des Schweizerischen Verbandes der Strassen- und Verkehrsfachleute (VSS).

Aschauer, D. A. (1989). Is Public Expenditure productive?, *Journal of Monetary Economics, 23*, 177–200.

Baldi, G., Fichtner, F., Michelsen, C., & Rieth, M. (2014). Schwache Investitionen dämpfen Wachstum in Europa, *DIW Wochenbericht*, *27*, 637–651.

BFS – Bundesamt für Statistik (2013). *Multifaktorproduktivität: Methodenbericht*, Neuchâtel.

BMF – Bundesministerium der Finanzen (2020), *Öffentliche Investitionen in der Diskussion*. Bundesministerium der Finanzen, Monatsbericht März, 45-52.

BMWi – Bundesministerium für Wirtschaft und Energie (2020), *Öffentliche Infrastruktur in Deutschland: Probleme und Reformbedarf*. Gutachten Wissenschaftlicher Beirat beim Bundesministerium für Wirtschaft und Energie.

Boardman, A. E., Greenberg, D. H., Vining, A. R., & Weimer, D. L. (2018). *Cost-Benefit-Analysis*, Fifth Edition, Cambridge University Press.

Bom, P. R., & Ligthart, J. E. (2014). What Have We Learned from Three Decades of Research on the Productivity of Public Capital? *Journal of Economic Surveys, 28*(5), 889–916.

Brand, S., Krone, E., Scheller, H., & Steinbrecher, J. (2020). *Zur Messung kommunaler Investitionsrückstände. Zwischen begrifflichen Abgrenzungsschwierigkeiten, statistischen Brüchen und notwendiger Methodenvielfalt*. Deutsches Institut für Urbanistik (Difu), Difu-Sonderveröffentlichung, Berlin.

Christofzik, D. I., Feld, L. P., & Yeter, M. (2019). *Öffentliche Investitionen: Wie viel ist zu wenig?* Sachverständigenrat zur Begutachtung der gesamtwirtschaftlichen Entwicklung, Arbeitspapier 01/2019, Wiesbaden.

Dullien, S., Rietzler, K., & Tober, S. (2021). Öffentliche Investitionen im Konjunkturprogramm als Einstieg in die sozial-ökologische Transformation. *Wirtschaftsdienst, 101*(3), 172–175.

European Commission (2014). *Infrastructure in the EU: developments and impact on growth*, European Economy: Occasional Papers 203.

Expertenkommission – Expertenkommission „Stärkung von Investitionen in Deutschland“ (2015), *Bericht der Expertenkommission im Auftrag des Bundesministers für Wirtschaft und Energie, Sigmar Gabriel*, Berlin.

Feld, L. P., Reuter, W. H., & Yeter, M. (2020). *Öffentliche Investitionen: Die Schuldenbremse ist nicht das Problem*. Sachverständigenrat zur Begutachtung der gesamtwirtschaftlichen Entwicklung, Arbeitspapier 01/2020, Wiesbaden.

Glaeser, E. L., & Poterba, J. M. (2020*). Economic Analysis and Infrastructure Investment.* National Bureau of Economic Research (NBER), NBER Working Paper 28215, Cambridge, MA.

Gomme, P., Ravikumar, P., & Rupert, P. (2015). Secular Stagnation and Returns on Capital, *Federal Reserve Bank of St Louis Economic Synopsis*, 19.

Grimm, V., Nöh, L., & Schwarz, M. (2021). Investitionen für nachhaltiges Wachstum in Deutschland: Status quo und Perspektiven. *Wirtschaftsdienst, 101*(3), 161–167.

Grömling, M., Hüther, M., & Jung, M. (2019). Verzehrt Deutschland seinen staatlichen Kapitalstock? *Wirtschaftsdienst, 99*, 25–31.

HM Treasury (2018). *The Green Book: Central Government Guidance on Appraisal and Evaluation*. London.

IMF – International Monetary Funds (2014). *Is it time for an infrastructure push? The macroeconomic effects of public investment*. IMF World Economic Outlook, Chapter 3, September 2014, Washington D.C.

IMF – International Monetary Funds (2020). *FAD Investment and Capital Stock Database 2020*. Washington D.C.

Jones, C. (2005). *Applied Welfare Economics*. Oxford University Press.

Kellermann, K. und C.-H. Schlag (2021), *Gibt es in der Schweiz Anzeichen für eine öffentliche Investitionslücke?*, Grundlagen für die Wirtschaftspolitik Nr. 29. Staatssekretariat für Wirtschaft (SECO), Bern.

Krebs, T., & Scheffel, M. (2017). Lohnende Investitionen. *Perspektiven der Wirtschaftspolitik, 18*(3), 245–262.

Lewis, C., Pain, N., Stráský, J., & Menkyna, F. (2014). *Investment Gaps after the Crisis*. OECD Economics Department Working Papers No. 1168.

Núñez-Serrano, J. A., & Velázquez, F. J. (2017). Is Public Capital Productive? Evidence from a Meta-analysis, *Applied Economic Perspectives and Policy*, *39*(2), 313–345.

NZZ – Neue Zürcher Zeitung (2021). Von einer Fussball-WM alle zwei Jahre halte ich nichts. October 9, 2021, 24-25, Zürich.

Razin, A., & Sadka, E. (1991). International tax competition and gains from tax harmonization. *Economic Letters, 37*, 689–701.

Romp, W., & de Haan, J. (2007). Public Capital and Economic Growth: A Critical Survey. *Perspektiven der Wirtschaftspolitik, 8*(S1), 6–52.

Sandmo, A., & Dreze, J. H. (1971). Discount rate for public investment in closed and open economies. Economica, V 01.38, 395–412.

World Bank (1994). *Annual Report*. World Bank.

Zhuang, Z., Liang, Z., Lin, T., & De Guzman, F. (2007). *Theory and Practice in the Choice of Social Discount Rate for Cost-Benefit Analysis: A Survey*. Asian Development Bank, ERD Working Paper Series, No. 94.

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