

# Higher Investments in Education and Transport Infrastructure Needed



**REPORT** by C. Katharina Spieß

Investments in Education:  
The Early Years Offer Great Potential

3

**INTERVIEW** with C. Katharina Spieß

»The Quality of Early Education and Care  
Must Be Improved«

II

**REPORT** by Uwe Kunert and Heike Link

Transport Infrastructure: Higher Investments Needed  
to Preserve Assets

12

**DIW Berlin—Deutsches Institut  
für Wirtschaftsforschung e.V.**  
Mohrenstraße 58, 10117 Berlin  
T +49 30 897 89 -0  
F +49 30 897 89 -200

**Volume 3, No 10**  
11 October, 2013  
ISSN 2192-7219

#### **Publishers**

Prof. Dr. Pio Baake  
Prof. Dr. Tomaso Duso  
Dr. Ferdinand Fichtner  
Prof. Marcel Fratzscher, Ph. D.  
Prof. Dr. Peter Haan  
Prof. Dr. Claudia Kemfert  
Karsten Neuhoff, Ph. D.  
Prof. Dr. Jürgen Schupp  
Prof. Dr. C. Katharina Spieß  
Prof. Dr. Gert G. Wagner

#### **Editors in chief**

Sabine Fiedler  
Dr. Kurt Geppert

#### **Editorial staff**

Renate Bogdanovic  
Sebastian Kollmann  
Dr. Richard Ochmann  
Dr. Wolf-Peter Schill

#### **Editorial managers**

Alfred Gutzler  
Christiane Zschech

#### **Press office**

Renate Bogdanovic  
Tel. +49-30-89789-249  
presse@diw.de

#### **Sales and distribution**

DIW Berlin

Reprint and further distribution—including extracts—with complete reference and consignment of a specimen copy to DIW Berlin's Communications Department (kundenservice@diw.berlin) only. Printed on 100% recycled paper.

# Investments in Education: The Early Years Offer Great Potential

by C. Katharina Spieß

Investments in education are of great importance for the competitiveness of the German economy. In particular, early childhood education programs promise high returns—because children can benefit from them even years later and find it easier to acquire new skills. These are the results of research in the field of the economics of education in recent years, at least when high quality programs are studied.

However, these findings do not necessarily reflect public spending on the different education sectors—in reality, comparatively little is invested in young children. There is a need for more investment in education—especially to increase the quality of education programs—but not only in early childhood. Also, with regard to the expansion of all-day schools, more should be invested in the quality of such programs. In higher education, efforts are needed to improve access of educationally disadvantaged groups and therefore improve intergenerational mobility. All these measures could facilitate a more effective and efficient use of human capital. This is also of particular importance against the backdrop of a forecast decline in labor force potential and predicted skill shortages.

Education plays a key role in the future of modern economies. Effective and efficient investment<sup>1</sup> in an economy's human capital makes a significant contribution to increasing competitiveness and can also safeguard the prosperity of individual citizens. This applies equally to the German economy where investment in education is of paramount and increasing importance. The aging of German society has led to a drop in the number of people available for work. Targeted investment in education can, therefore, help to prevent the predicted skill shortages.

## German Investment in Some Areas of Education Low by International Comparison

In 2009, Germany spent 5.3 percent of its GDP on formal educational establishments<sup>2</sup> such as pre-primary facilities, schools, vocational colleges, and institutes of tertiary education (see Table 1). This ranks Germany below average both when compared with the 21 EU countries (EU average: 5.9 percent) and with the 33 member states of the Organisation for Economic Co-operation and Development (OECD average: 6.2 percent).<sup>3</sup> In this EU comparison, Denmark invests the most in education (almost eight percent of its GDP), followed by Sweden and Finland.

<sup>1</sup> The definition of investment used in this article is not the same as that used in the national accounts (Volkswirtschaftliche Gesamtrechnungen, VGR). Here, investment refers to spending by regional administrative authorities which increases the future competitiveness of the German economy.

<sup>2</sup> Expenditure on formal educational establishments refers to the amount of spending that is conventionally used in international comparisons. According to the education category in the national budget, this figure was 6.9 percent of GDP (see Federal Statistical Office, ed., Bildungsfinanzbericht (Wiesbaden: 2012).

<sup>3</sup> However, it must be borne in mind that the Länder regard Germany's spending on education to be vastly underestimated by the OECD's calculations; see Federal Statistical Office, ed., Bildungsfinanzbericht (Wiesbaden: 2012).

Table 1

**Expenditure on Formal Educational Establishments in Percent of GDP (2009)**

	Day care for children under 3 years	Pre-primary education	Primary and lower secondary education	Upper secondary education	Tertiary education	Pre-primary to tertiary education
Belgium	0.1	0.6	1.5	2.9	1.5	6.7
Denmark	0.7	1	3.4	1.3	1.9	7.9
Germany	0.1	0.6	2.1	1.1	1.3	5.3
Finland	0.8	0.4	2.5	1.6	1.9	6.4
France	0.4	0.7	2.6	1.4	1.5	6.3
Ireland	0	0.1	3.4	0.9	1.6	6.3
Italy	0.2	0.5	2	1.2	1	4.9
Netherlands	0.5	0.4	2.8	1.3	1.7	6.2
Norway	0.9	0.4	2.8	1.4	1.4	6.2
Austria	0.4	0.6	2.4	1.4	1.4	5.9
Portugal	0	0.4	2.7	1.2	1.4	5.9
Sweden	0.9	0.7	2.8	1.4	1.8	6.7
Switzerland	0.1	0.2	2.7	1.7	1.3	6
Spain	0.6	0.9	2.6	0.8	1.3	5.6
UK	0.5	0.3	3	1.5	1.3	6
OECD-33	0.3	0.5	2.6	1.3	1.6	6.2

Note: All data refer to OECD (2012a) with the exception of data on day care for children under the age of three, for information on this, see OECD (2012b). For further explanatory notes, see respective sources.

Sources: OECD (2012a: Education at a Glance 2012: OECD Indicators, OECD Publishing, Paris, Table B2.2) and OECD (2012b): OECD Family Database, OECD, Paris. ([www.oecd.org/social/family/database](http://www.oecd.org/social/family/database), download: June 2013, Chart PF 3.1.A), compiled by DIW Berlin.

© DIW Berlin 2013

By international standards, Germany spends a relatively small share of its GDP on education.

In particular, investment in primary education (Grundschule), lower secondary education (Hauptschule (low-track secondary school), Realschule (intermediate-track secondary school), and Gesamtschule (comprehensive school)), and upper secondary education (Gymnasium (academic-track secondary school)) is—relatively speaking—low. At 0.1 percent of GDP, expenditure on early education and care for children under the age of three in Germany is also below the OECD average of 0.3 percent and lower than in the Scandinavian countries.

Based on expenditure on education per student in relation to per capita GDP (see Figure 1), almost all OECD countries invest least in the pre-primary sector. Further, by international comparison, Germany spends relatively little on its students, particularly those in primary education. A further distinction between private and public expenditure illustrates that, when private investment is excluded, Germany is also below the OECD average when it comes to the pre-primary sector (see Figure 2).<sup>4</sup>

In absolute terms, in 2009, Germany's education budget was 164.6 billion euros (including 11.8 billion euros for research and development at institutes of tertiary educa-

tion).<sup>5</sup> A total of 126.4 billion euros, or over three-quarters, was spent on formal educational establishments. Private households spent a total of 5.5 billion euros.<sup>6</sup> Investment in non-formal education such as on-the-job, teacher, and other forms of training, and after-school care, crèches, youth work, and similar was 19.5 billion euros in 2009. An analysis of the individual formal education sectors shows investment of approximately 14 billion euros in children's day care facilities, almost 56 billion euros in school education, and 21.5 billion euros in basic funding of regional administrative authorities for institutes of tertiary education.

Between 1995 and 2009, public spending on education grew by 32 percent or 24 billion euros. The increase in investment in children's day care facilities (approximately 64 percent), in schools (just over 25 percent), and in institutes of tertiary education (around 32 percent) was particularly strong. Youth work, however, experienced

<sup>4</sup> It is not possible to distinguish between private and public spending across all education sectors using the OECD's data.

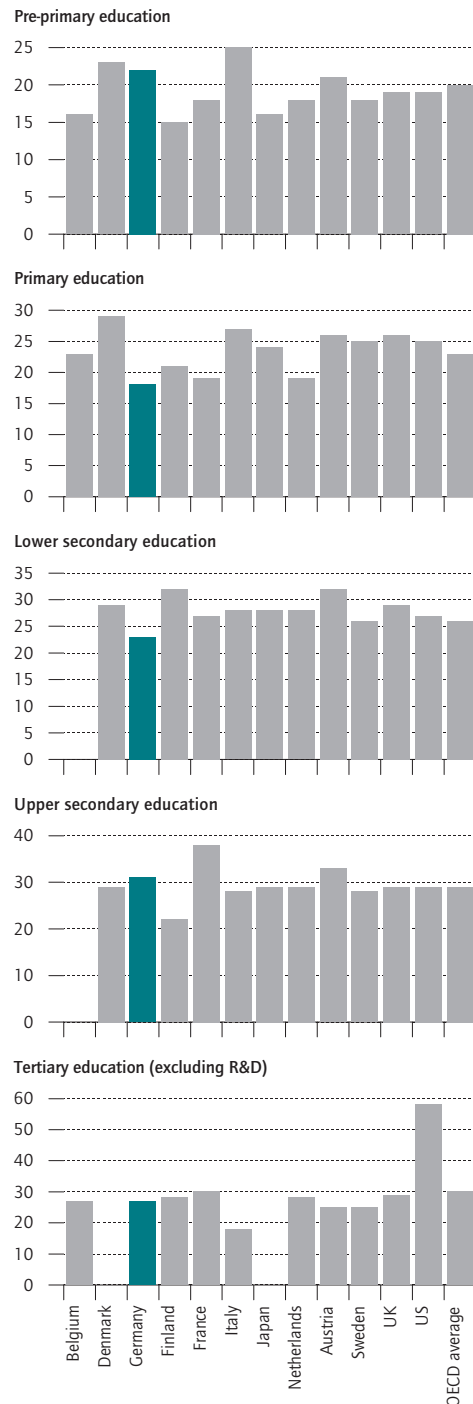
<sup>5</sup> Unless otherwise indicated, expenditure on education refers to the 2012 Report on Education Finance (Bildungsfinanzbericht 2012), Federal Statistical Office, ed., Bildungsfinanzbericht (Wiesbaden: 2012).

<sup>6</sup> This figure includes, for example, expenditure on extra tuition, school materials, and similar. To fund the subsistence costs of those in formal education, public budgets provided 13.1 billion euros in 2009 (student grants (BAföG), child benefits for adult children undergoing a vocational course of education).

Figure 1

### Expenditure on Education per Child/Student by Education Sector, 2009

Relative to per capita GDP



Notes: Data for the tertiary education sector do not include expenditure on research and development. There are no data available for Belgium (lower and upper secondary), Denmark or Japan (tertiary).

Sources: OECD (2012: Education at a Glance 2012: OECD Indicators, OECD Publishing, Paris, Table B1.4); compiled by DIW Berlin.

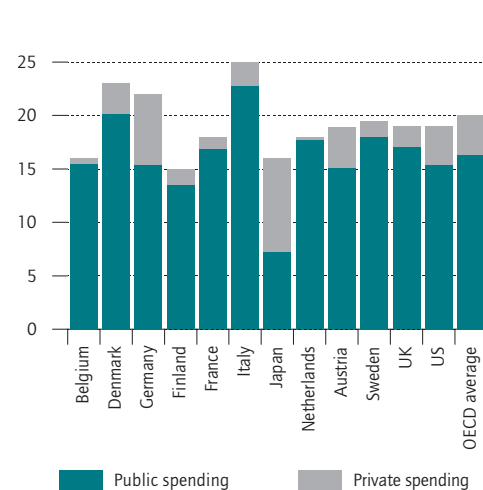
© DIW Berlin 2013

Germany's expenditure per student is particularly low in the primary education sector.

Figure 2

### Expenditure on Education per Child in Pre-Primary Education by Financing Categories, 2009

Relative to per capita GDP



Note: Lower bar segment: share of public spending; upper bar segment: share of private spending.

Source: OECD (2012: Education at a Glance 2012: OECD Indicators, OECD Publishing, Paris, Tables B1.4 und B3.2a); compiled by and calculations by DIW Berlin.

© DIW Berlin 2013

Private investment accounts for a relatively high share of spending in the pre-primary sector.

a drop in investment of seven percent between 1995 and 2009.

The role played by the different German Länder and municipalities in financing the individual education sectors varies quite dramatically.<sup>7</sup> This applies in particular to spending on children's day care facilities. However, measured against GDP, eastern German Länder such as Thuringia and Brandenburg spend more than western German ones with stronger economies such as Bavaria and Baden-Württemberg (see Table 2).

For some years now, an increasing number of educational facilities have also been in private hands, this are non-profit and for-profit providers. Between 1998 and 2010, the number of school and university students attending such establishments increased by 26.3 percent. The majority of these facilities are funded with public money. Thus, for example, in 2009, private schools were able to cover 85 percent of their outgoings with public

<sup>7</sup> For differences between the Länder, see Federal Statistical Office, ed., Bildungsfinanzbericht (Wiesbaden: 2012).

Table 2

### Expenditure on Day Care Facilities by German Federal State (2011)

German federal state	(Pure) expenditure	Share of federal state's GDP
	In thousand euros	In percent
Baden-Württemberg	1,910,196	0.5
Bavaria	2,195,901	0.5
Brandenburg	551,159	1
Bremen	137,156	0.5
Hamburg	489,062	0.6
Hesse	1,249,511	0.6
Mecklenburg-Western Pomerania	261,935	0.7
Lower Saxony	1,272,766	0.6
North Rhine-Westphalia	3,072,587	0.5
Rhineland-Palatinate	938,894	0.8
Saarland	180,740	0.6
Saxony	863,863	0.9
Saxony-Anhalt	422,679	0.8
Schleswig-Holstein	377,647	0.5
Thuringia	469,700	1
Germany	14,399,361	0.6

Note: Data on after-school care and facilities for school children are not included. No data are available for Berlin.

Sources: Federal Statistical Office, Statistik der Kinder- und Jugendhilfe, Ausgaben (Auszahlungen) und Einnahmen (Einzahlungen) für die Jugendhilfe 2011 (Wiesbaden: 2012) and AK VGR–Arbeitskreis, National Accounts of the Federal States on behalf of the statistical offices of the 16 Länder, the Federal Statistical Office, and the Citizens Registration Office (Bürgeramt), Statistik und Wahlen (2013): Bruttoinlandsprodukt, Bruttowertschöpfung in den Ländern der Bundesrepublik Deutschland 1991 bis 2012. Reihe 1, Band 1, (Frankfurt am Main: 2013), compiled by and calculations by DIW Berlin.

© DIW Berlin 2013

Eastern German Länder invested more in children's day care than those in western Germany.

funds. Even for children's day care facilities (in this case mainly non-profit providers), the corresponding figure was as high as 74 percent in 2010.

In the education sector as a whole, private investment does not play a particularly significant role. Its average contribution of approximately 20 percent is primarily made up of the fees paid by private households to educational establishments.

### Research Shows Skills Must Be Fostered Early

For many years, literature in the field of the economics of education has focused on the returns on investment in education, particularly on the individual level. In recent years, researchers have increasingly concen-

trated on analyzing the returns on investment in education throughout the phases of one life cycle. In this context, the research of the Nobel Laureate in Economics, James Heckman, and his co-authors is particularly pertinent. Heckman's series of works point to the high returns on investment in early childhood education and care programs.<sup>8</sup> According to Heckman, investment here, particularly for disadvantaged children, produces higher returns than investment made at a later age — this does not imply, however, that later investment fails to achieve its aim.

In a series of well-founded international cost-benefit analyses, attempts were made to quantify the high returns on investment in early childhood education and care. A cost-benefit ratio of between 1:2 and 1:16 can be achieved through the education and care programs that formed the basis of the analysis. These programs primarily consisted of very high-quality programs, with frequent close involvement of parents.<sup>9</sup>

However, in principle, high returns are not only produced by very high-quality education and care programs: the family itself is also significant for early educational processes. This is substantiated by various empirical analyses which, for example, illustrate the importance of family quality and also socioeconomic characteristics for children's development. Ultimately, on average, the family environment provided more of an explanation for developmental disparities between children than formal education.<sup>10</sup>

The fact that the returns on investment in early childhood educational programs are particularly high can be attributed to the "self productivity of skills": the skills acquired in early childhood provide the basis for easier acquisition of further skills at a later age. However, this complementarity of skills requires further in-

**8** F. Cunha, J. J. Heckman, L. Lochner, and D. V. Masterov, "Interpreting the Evidence on Life Cycle Skill Formation," Handbook of the Economics of Education 1 (2006): 697–812 and recent paper by J. J. Heckman and L. K. Raut, "Intergenerational long term effects of preschool – structural estimates from a discrete dynamic programming model," NBER Working Paper 19077 (Washington D.C.: National Bureau of Economic Research, 2013). For an overview of European studies, see recent paper by K. U. Müller et al., "Förderung und Wohlergehen von Kindern," Politikberatung kompakt, no. 73 (Berlin: DIW Berlin, 2013).

**9** For an overview, see L. A. Karoly, "Toward Standardization of Benefit-Cost Analysis of Early Childhood Interventions," Journal of Benefit-Cost Analysis 3, no. 1 (2012): 1–43 or C. K. Spieß, "Effizienzanalysen frühkindlicher Bildungs- und Betreuungsprogramme – das Beispiel von Kosten-Nutzen-Analysen," Zeitschrift für Erziehungswissenschaft (2013) (online first).

**10** See, for example, recent paper by G. Conti and J. J. Heckman, "The Economics of Child Well-Being," IZA Discussion Paper, no. 6930 (Bonn: 2012) or, for example, also E. Berger, F. Peter, and C. K. Spieß, "Wie hängen familiäre Veränderungen und das mütterliche Wohlbefinden mit der frühkindlichen Entwicklung zusammen?," Vierteljahrshefte zur Wirtschaftsforschung 79, no. 3 (2010): 27–44.

vestment over the life course—if this does not occur, the full return potential will not be achieved.<sup>11</sup> Based on these findings, both the public authorities and families themselves should invest in the development of children's skills at a very early age, while, at the same time, ensuring that early childhood education is not the only area of investment.

## Opportunities for Further Investment in Education

Against this backdrop, what are the opportunities for further investment in the German education system? And who should be making this investment? The education system is characterized by a high share of public investment, which, not least due to various market imperfections, makes sense from an education economics perspective. Therefore, the following sections primarily outline potential areas for public investment while private investment opportunities only play a peripheral role.

## Early Childhood Education: Promoting High Quality and Integrating All Target Groups

Given the significance of and high returns on investment in early childhood education, Germany in fact spends relatively little on this sector. However, the expansion of day care for children under three over recent years already demonstrates some progress in this area: the objective is that, by August this year, 35 percent of children under three are in day care – either in day care centers or in family day care. At the same time, the legal entitlement to day care from age one will also come into force. However, as a result of the difficult financial situation, particularly in the municipalities and also the Länder, some of the western German states are unlikely to meet this target. Further investment would be required to rectify this situation.<sup>12</sup>

Since the federal government also stands to profit from investment in early childhood education and care, it makes economic sense for public funds to be allocated to fostering children's early development.<sup>13</sup> For the

first time, in the context of the Childcare Funding Act (KiFöG)<sup>14</sup> the federal government has made an explicit pledge to contribute 4.5 billion euros towards expenditure in this area. Appropriate long-term financial commitments should be secured from the federal government.

Further, the available funds should be allocated to the different service providers by way of a fair competition open to all quality assured providers of children's day care. Public, non-profit and for-profit providers should have access to public financing either through child-centered grants awarded directly to their organization, or indirectly provided to the parents as vouchers or similar transfers. The latter is a system that has been introduced in Berlin and Hamburg.<sup>15</sup> To date, public transfers to all providers is not the case in every German state. However, equal access to funding for all providers could contribute to a more rapid expansion of children's day care facilities.<sup>16</sup>

Further, early childhood education and care must reach all target groups. Recent analyses indicate that not all groups make equal use of early childhood education and care options outside the family. Children under the age of three, particularly those from families where German is not spoken at home and those whose parents have a low level of education or low income,<sup>17</sup> are underrepresented in day care facilities, i.e., those who, on average, are usually classified as disadvantaged. Ideally, further investment would primarily benefit the regions with the greatest need for development here thus enabling all children to reach their full potential.

From an education economics perspective, there should be a stronger focus on the quality of early childhood education and care, in particular, since early childhood

Deutschland in T. Apolte and U. Vollmer, ed., *Bildungsökonomik und Soziale Marktwirtschaft*. (Stuttgart: Lucius & Lucius, 2010), 3–18.

<sup>14</sup> German Bundestag, "Entwurf eines Gesetzes zur Förderung von Kindern unter drei Jahren in Tageseinrichtungen und in der Kindertagespflege (Kinderförderungsgesetz – KiFöG)," Bundestag printed paper 16/9299, May 27, 2008.

<sup>15</sup> Hamburg and Berlin are the two German Länder using a "voucher system" to provide direct funding to families, i.e., the "subjects," rather than the providers, i.e., the "objects." Therefore, providers in these two city-states are only funded indirectly in the sense that parents select certain providers. On the benefits of "subject funding," see C.K. Spieß, "Zehn Mythen über Kinderbetreuungsgutscheine" in T. Betz, A. Diller, and T. Rauschenbach, ed., *Kita-Gutscheine. Ein Konzept zwischen Anspruch und Realisierung* (Munich: 2010), 99–112.

<sup>16</sup> For a more detailed account, see also C. K. Spieß, "Sieben Ansatzpunkte für ein effektiveres und effizienteres System der frühkindlichen Bildung in Deutschland" in T. Apolte and U. Vollmer, ed., *Bildungsökonomik und Soziale Marktwirtschaft* (Stuttgart: 2010), 3–18.

<sup>17</sup> P. Schober and C. K. Spiess, "Early Childhood Education Activities and Care Arrangements of Disadvantaged Children in Germany" in *Child Indicators Research* (2012) (online first).

<sup>11</sup> F. Cunha, J. J. Heckman, L. Lochner, and D. V. Masterov, "Interpreting the Evidence on Life Cycle Skill Formation," *Handbook of the Economics of Education* vol.1 (2006): 697–812.

<sup>12</sup> Federal Ministry of Family Affairs, Senior Citizens, Women and Youth (Bundesministerium für Familie, Senioren, Frauen und Jugend, BMFSFJ), ed., *Bericht über die Lebenssituation junger Menschen und die Leistungen der Kinder- und Jugendhilfe in Deutschland – 14. Kinder- und Jugendbericht* (Berlin: 2013).

<sup>13</sup> For a more detailed account, see also C. K. Spieß, "Sieben Ansatzpunkte für ein effektiveres und effizienteres System der frühkindlichen Bildung in



education and care programs can only achieve high returns if they are of high quality. Relevant analyses reveal that, on average, children's day care facilities in Germany only achieve moderate quality levels; and in fact, a significant proportion is even of inadequate quality.<sup>18</sup> One possible way to improve quality could be to develop a system of more advanced training for day care teachers, for example.<sup>19</sup> Individual initiatives have already been launched in this sector.<sup>20</sup> The success of steps to develop the aforementioned system of advanced training and an increasing academization of this occupation will, however, necessitate higher salaries which, in turn, will increase personnel costs. On average, those working in this sector currently earn significantly less than teachers working in other schools (Grundschule, Hauptschule, and Realschule).<sup>21</sup> The situation in Scandinavia, however, is quite different: the Nordic countries generally invest more in early childhood education—and, compared to teachers, personnel in this sector earn more than those in Germany.<sup>22</sup>

As well as the quality of education and care programs outside the family, in early childhood, the quality of the educational environment within the family is also particularly important. In Germany, this also varies dramatically,<sup>23</sup> indicating a need for a stronger focus on families and the family environment. One method of achieving this would be, for example, by investing more in service centers for families.<sup>24</sup> These centers, which involve the whole family, can increase the rate of return on early childhood education.

**18** W. Tietze, F. Becker-Stoll, J. Bense, A. Eckhardt, G. Haug-Schnabel, B. Kalicki, H. Keller, and B. Leyendecker, NUBBEK. Nationale Untersuchung zur Bildung, Betreuung und Erziehung in der frühen Kindheit. Fragestellungen und Ergebnisse im Überblick (Berlin: 2012).

**19** See, for example, L. Wößmann and M. Schlotter, "Frühkindliche Bildung und spätere kognitive und nichtkognitive Fähigkeiten: Deutsche und internationale Evidenz" in Vierteljahrshefte zur Wirtschaftsforschung 79, no. 3 (2010): 99–120.

**20** See WIFF Initiative, [www.weiterbildungsinitiative.de/](http://www.weiterbildungsinitiative.de/) (download: June 2013).

**21** Author's own estimates based on the 2009 Microcensus revealed that the net salary of early childhood education personnel was about 60 percent of that of teachers.

**22** OECD, Education at a Glance 2012: OECD Indicators (OECD Publishing: Paris, 2012) (Indicator D3). There are no recent calculations on the potential extent of the short- and longer-term costs of the academization or the higher professional grading of early childhood education personnel. For earlier calculations, see P. Pasternack and A. Schildberg, "Die finanziellen Auswirkungen einer Akademisierung der ErzieherInnen-Ausbildung" in Sachverständigenkommission Zwölfter Kinder und Jugendbericht, ed., Entwicklungspotentiale institutioneller Angebote im Elementarbereich 2 (Munich: 2005), 9–133.

**23** W. Tietze, F. Becker-Stoll, J. Bense, A. Eckhardt, G. Haug-Schnabel, B. Kalicki, H. Keller, and B. Leyendecker, NUBBEK. Nationale Untersuchung zur Bildung, Betreuung und Erziehung in der frühen Kindheit. Fragestellungen und Ergebnisse im Überblick (Berlin: 2012).

**24** For more detail on this recommendation, see G. Stock, H. Bertram, A. Fürnkranz-Prskawetz, W. Holzgreve, M. Kohli, and U. M. Staudinger, eds., Zukunft mit Kindern (Campus Verlag: Frankfurt and New York, 2012).

Further investment in early childhood education and care—whether in the form of children's day care facilities or through supporting the family—can also help to improve reconciliation of work and family. Empirical analyses demonstrate that the expansion of day care, particularly for children from ages one to three, increases the participation of mothers in the workforce.<sup>25</sup> From a family and labor market policy perspective, therefore, this might also be an effective and efficient investment which could counteract the declining labor force potential and the associated shortage of skilled professionals.<sup>26</sup>

### School Education: Improving Quality of All-Day Programs

Investment in education should not be restricted to the early childhood sector. The human capital of older children, adolescents, and young adults is also of considerable economic importance. The aim here should be to increase investment to ensure that as many students as possible graduate from school with a school-leaving qualification, to reduce the share of "at risk students,"<sup>27</sup> and to maximize the number of young people acquiring the skills required for successful integration into the labor market and society. The extent to which the current expansion of all-day schools can contribute to this cannot be clearly determined using existing empirical studies. All-day schooling does not necessarily improve all students' academic performance.<sup>28</sup> However, when a high-quality school is combined with longer term participation in all-day schooling, it is possible to see positive effects on school grades, motivation to learn, and the probability of graduating to the next grade.<sup>29</sup> However, in general, more positive effects of all-day schooling are identified for social behavior.<sup>30</sup>

**25** See recent paper by K. U. Müller et al., "Förderung und Wohlergehen von Kindern," Politikberatung kompakt, no. 73 (DIW Berlin: Berlin, 2013).

**26** Federal Ministry of Labour and Social Affairs (Bundesministerium für Arbeit und Soziales), Fortschrittsbericht 2012 zum Fachkräftekonzept der Bundesregierung (Berlin: 2012).

**27** The PISA studies define "at risk students" as those who, at the age of 15, have reading and math skills that do not exceed primary school level. On this, see L. Wößmann and M. Piopiunik, Wirksame Bildungsinvestitionen. Was unzureichende Bildung kostet. Eine Berechnung der Folgekosten durch entgangenes Wirtschaftswachstum, a study commissioned by the Bertelsmann Foundation (Gütersloh: 2009).

**28** See, for example, E. Klieme and T. Rauschenbach, "Entwicklung und Wirkung von Ganztagschule. Eine Bilanz auf Basis der StEG-Studie" in N. Fischer et al., ed., Ganztagschule: Entwicklung, Qualität, Wirkungen (Weinheim et al.: 2011), 342–350.

**29** StEG-Konsortium, Ganztagschule: Entwicklung und Wirkungen – Ergebnisse der Studie zur Entwicklung von Ganztagschulen 2005–2010 (2010), [www.bmbf.de/pubRD/steg\\_2010.pdf](http://www.bmbf.de/pubRD/steg_2010.pdf) (June 2013).

**30** H. P. Kuhn and N. Fischer, "Entwicklung der Schulnoten in der Ganztagschule. Einflüsse der Ganztagsbeteiligung und der Angebotsqualität" in



Further investment should be focused on improving the quality of these education and care programs. All-day schooling also supports family and labor market policy goals. It helps mothers of primary school children, in particular, to reconcile family and working life.<sup>31</sup> All-day schools—albeit only the high-quality programs—counteract the forecast shortage of skilled professionals in two respects: in the short term, because they may well increase the probability of mothers taking up employment, and in the long term because they should broaden the skills acquired by children and young people. From a macroeconomic perspective, investment that fulfills education, family and labor policy goals makes particular sense.

### Higher Education: Increasing Intergenerational Mobility in education

The level of investment in tertiary education, i.e. in higher education, is, in relative terms, already quite high. However, there is certainly no room for cutbacks: one weakness, for example, is the intergenerational mobility of German school and university students which is, by international comparison, quite limited. This ultimately means that the human capital available in Germany is not fully captured. The impact of parental education on their children's access to higher education in Germany is significant—not least as a consequence of inequalities and disparities in academic achievement in the earlier stages of education. Yet, even with the same levels of achievement and a higher education entrance qualification, higher education admission rates depend heavily on parental educational background. If at least one parent has a university degree, the probability of their child going to university is 81 percent—for children with at least one parent who has completed an apprenticeship or has no vocational qualification, the corresponding figure is only 62 percent. Recent years have seen barely any change in this disparity.<sup>32</sup>

Various education policy measures which could contribute to an improvement in educational mobility are currently being discussed. When starting higher education, students should have access to information, on the one hand, about the medium- to long-term benefits of a degree and, on the other hand, about the available

funding opportunities: the risk of unemployment after graduating is, on average, following a downward trend, and the probability of earning a higher income—compared to those with vocational qualifications—is on the increase. A second policy measure is the provision of effective financial assistance. Empirical analyses indicate that an increase in the size of student grants (under the Federal Education and Training Assistance Act, BAföG) does have an impact, if only marginal.<sup>33</sup> As well as public investment, private investment is also an option in the form of grants provided or programs implemented by private foundations that focus on access to university for educationally disadvantaged groups.<sup>34</sup>

### Conclusion

Investment in human capital is of major importance for the German economy. Research findings from the field of education economics indicate opportunities for public investment in various areas of education:

In the early childhood education and care sector, further investment, including the long-term financial commitment of the German government, should advance the expansion of children's day care. Nationwide, all providers fulfilling predetermined quality criteria should receive public funding. The quantitative expansion should—and this is key—be accompanied by further investment to facilitate an improvement in the quality of early childhood education and care. As a matter of principle, all children, regardless of their parents' level of education, should have access to high quality education and care programs. Further, families should receive support to help them care for and foster the development of their child. The expansion of centers for families could be a starting point here. Investment in early childhood education is, also from a family and labor market policy perspective, extremely beneficial.

In the field of school education, with the expansion of all-day schooling, particular attention should be paid to the quality of education and care. Here too, it is possible to achieve education, family, and labor market policy goals simultaneously.

The primary objective in the tertiary education sector should be to improve intergenerational mobility in re-

N. Fischer et al., ed., *Ganztagsschule: Entwicklung, Qualität, Wirkungen* (Weinheim et al.: 2011), 207–226.

**31** For an overview, see C. K. Spieß, "Vereinbarkeit von Familie und Beruf – wie wirksam sind deutsche „Care Policies“?" in *Perspektiven der Wirtschaftspolitik*, Special Issue 12 (2011): 4–27.

**32** Autorengruppe Bildungsbericht, *Bildung in Deutschland 2012*. Ein indikatorengestützter Bericht mit einer Analyse zur kulturellen Bildung im Lebenslauf (Bielefeld: 2012).

**33** V. Steiner and K. Wrohlich, "Financial Student Aid and Enrolment in Higher Education: New Evidence from Germany," *Scandinavian Journal of Economics* 114 (2012): 124–147.

**34** On this, see, for example, the Federal Ministry of Education and Research (BMBF) initiative, "Alliance for Education" (Allianz für Bildung), that unites private and public actors. [www.bmbf.de/de/15799.php](http://www.bmbf.de/de/15799.php) (download: June 2013).

spect to education. To increase the share of university entrants from groups from families with lower education, better information should be made available regarding the benefits of a degree and the existing funding opportunities, and the financial hurdles to start university should be reduced. Further investment aimed at specific target groups would be the most advisable step to take here.

C. Katharina Spieß is Head of the Education Policy Department at DIW Berlin  
| [kspiess@diw.de](mailto:kspiess@diw.de)

JEL: I2, I22, I28

Keywords: Education policy, early education, rate of return, investments

First published as »Investitionen in Bildung: Frühkindlicher Bereich hat großes Potential«, in: DIW Wochenbericht no. 26/2013.



Prof. Dr. C. Katharina Spieß, Head of the Education Policy Department at DIW Berlin

#### FIVE QUESTIONS TO C. KATHARINA SPIESS

## »The Quality of Early Education and Care Must Be Improved«

1. Professor Spieß, Germany is an industrial nation which essentially profits from its know-how. Nevertheless, the amount spent on education is often debated. Is enough money being invested in education in Germany? If you think about how important education is for the competitiveness of an economy like Germany's and we look at what we are investing in education in Germany, then we are actually already doing a great deal in this sector. But considering the importance of education for the German economy, we are not investing enough in it and must put more into this sector in the years to come.
2. In which areas of education have you found the biggest investment deficits? If we look at what we are investing in the different areas of education in Germany, it becomes apparent that early childhood education is not receiving as much as we should be according to research findings in the field of education economics. Admittedly, we have made considerable progress by expanding the provision of children's day care facilities also for children under three. However, the issue remains that the quality of service provided in these educational and child care facilities is not as good as it should be in order to be able to achieve the really high returns on investment in education. Therefore, I very strongly advocate investing a great deal more in the quality of early learning than we have done to date.
3. What's the situation like at universities? We are also doing relatively well in Germany by international standards as far as our expenditure on tertiary education is concerned. However, here, too, we have various shortfalls. One example is that in Germany the number of educationally disadvantaged people entering higher

education is very low in comparison with other European countries. Here, we are speaking about low intergenerational mobility, i.e., educationally disadvantaged groups with the same level of performance are less likely to be represented at universities. In this respect, I would call for further measures to be implemented and also the funding for these measures to actually be made available.

4. How is German investment in education to be evaluated by international standards? By international standards, according to calculations by the OECD, at 5.3 percent of GDP, Germany's expenditure on education is below the OECD average. There are also other calculations which show Germany in a slightly better light. But this also indicates that it is very important to look at the different areas individually. We know, for example, that particularly in elementary and lower secondary education we are not doing very well by international standards. And our spending is below average here. In the pre-school sector, in other words, in the field of early education, it should also be borne in mind that there is a relatively high level of private investment and/or expenditure.
5. Germany is taking austerity measures. Where's the money going to come from? The education sector is very much dependent on public expenditure. Here, the Länder are very strongly represented and, in early childhood education in particular, the municipal authorities. The national government is also very actively involved now. Ultimately, it is a question of all public actors having to set priorities. Education is key to being able to make savings again in the short, medium, and long term. It is false economy to cut costs here if we also want to make good human capital available for future generations.

Interview by Erich Wittenberg.

# Transport Infrastructure: Higher Investments Needed to Preserve Assets

by Uwe Kunert and Heike Link

A quantitatively and qualitatively efficient transport infrastructure is a fundamental requirement for the success and prosperity of the German economy, with its high degree of labor division, its many exchange relationships, and its central European location. The transport infrastructure represents a considerable economic capital stock with gross fixed assets of 778 billion euros. This corresponds to six percent of the gross fixed assets of all economic sectors in Germany. Despite the importance of this sector for the economy, there is a serious lack of investment in the maintenance and quality assurance of the transport infrastructure.

Against this backdrop, a brief survey on the transport sector has been developed for this article based on an ex-post comparison of replacement demand and replacement investment made from 2006 to 2011. The analysis shows that, in the past, there has been an investment shortfall of almost four billion euros for the maintenance of the transport infrastructure. Assuming that this investment gap will need to be closed in order to maintain the transport infrastructure in coming years, and if the cumulative result of years of neglect is also taken into account, the additional annual investment requirement is likely to be at least 6.5 billion euros. There are also additional investment requirements for vehicles and selective network and capacity expansion that are difficult to estimate.

The internationally recognized benchmark for investment in transport infrastructure is roughly one percent of GDP.<sup>1</sup> The actual demand for transport infrastructure and suitable measures for its financing, however, cannot really be derived from international comparisons, since country-specific characteristics, such as the level of infrastructure development, topography or the transport intensity of the economy vary too greatly. One percent of GDP may be too low for countries in an expansion phase and too high for countries with a highly developed infrastructure.

Germany, with its central European location and its international economic diversification, needs an efficient transport system. A comparison of the transport infrastructures of western European countries shows that Germany is well positioned with its advanced rail transport, but its road network is only mediocre.<sup>2</sup> This is reason enough to secure the quality of transport supply and enable the networks for an environmentally compatible traffic management.

## Development of Investments and Capital Stock

Each year the public and private sectors invest nearly 35 billion euros in traffic routes, nodes, and vehicles (see Table 1). This represents approximately seven percent of gross fixed capital formation in all economic sectors. Investment in transport infrastructure plays a particularly important role since it is essential for a spatially differentiated economy based on the division of labor. This sector is highly dependent on government inves-

<sup>1</sup> See OECD/ITF, *Spending on Transport Infrastructure 1995–2011* (Paris: 2013).

<sup>2</sup> See K.-H. Hartwig et al., *„Verkehrsinfrastruktur-Benchmarking Europa“ ifmo-studien* (Berlin: 2007).

## Box

### Definitions and Methods of Calculation

Replacement investments include replacing worn parts of infrastructure installations as part of major repairs and renewal measures. A distinction is made here between simple restoration to its original form and a qualified securing of its asset value, which takes into account the quality standards of the replacement applicable at the time of the renewal and modified construction standards. The expansion of the network to include new lanes or tracks are net investments which are not part of replacement demand. Replacement and net investments together constitute gross investments.

The methodological basis for calculating the demand for replacement investment is the investment and fixed assets calculation by DIW Berlin for the transport sector. This uses a perpetual inventory model to determine fixed assets, asset disposals (monetary equivalent of physical asset losses no longer on inventories) and write-downs (imputed depreciati-

on), in which fixed assets are updated through the accumulation of individual annual investments, taking depreciations and disposals into account. Gross fixed assets represent the replacement value of traffic systems created over time on a uniform price basis, while net fixed assets represent present value.

The disposals of assets calculated by the perpetual inventory model can be considered the requirement needed to restore assets to their original construction. Additional demand for the qualified securing of asset value was derived from previous studies by DIW Berlin which compared model results for asset disposals and funds used in the past for replacement or renewal measures.

ment.<sup>3</sup> In 2011, 20 billion euros, or almost 60 percent of all transport investment, was spent on infrastructure. This represents nearly 0.8 percent of GDP. Approximately 40 percent was spent by passenger and freight transport service providers on vehicles and equipment which corresponds to a total of approximately 14 billion euros.

## Transport Infrastructure Represents Large Capital Stock

Compared internationally, Germany's transport infrastructure is well developed. Germany has 12,800 km of highways, 39,700 km of major national roads (more than 2,000 km of which are of freeway standard), about 600,000 km of state, district, and municipality roads, 33,600 km federal railroads, 4,200 km non-federal railroads, 7,300 km federal waterways, and about 3,400 km of railroads for suburban trains and trams. According to calculations by DIW Berlin (see box), the transport infrastructure (routes and nodes, such as the 5,600 passenger stations) represents a significant economic capital stock with gross assets of 778 billion euros and net fixed assets of 511 billion euros (as at 2011, at 2005 prices) (see Table 1), which amounts to around six percent of the

gross assets of all sectors of the economy.<sup>4</sup> Nearly half of

<sup>4</sup> The gross assets of the entire transport sector amount to approximately seven percent of the assets of all economic sectors.

Table 1

### Plant and Equipment Investment and Fixed Assets of the Transport Infrastructure 2011

In million euros

	Gross fixed investment <sup>1</sup>	Gross fixed assets <sup>2</sup>	Net fixed assets <sup>2</sup>
Transport infrastructure	20,166	777,960	511,362
Including:			
Transport routes	16,448	695,711	460,512
Including:			
Federal transport routes	9,092	362,852	240,330
Including:			
Federal highways	5,110	195,610	133,572
DB infrastructure	3,032	126,678	82,300
Federal waterways	950	40,564	24,458
Transport nodes <sup>3</sup>	3,718	82,249	50,850
Transport sector, total	34,540	952,016	610,277

<sup>1</sup> Excluding land acquisition. Nominal.

<sup>2</sup> Year-end stock. Excluding land acquisition. At 2005 prices.

<sup>3</sup> Transport nodes include DB stations, airports, inland ports and seaports.

Source: Calculations by DIW Berlin.

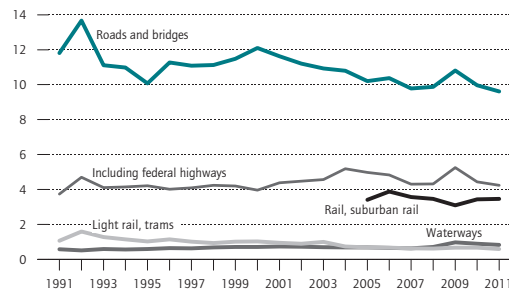
<sup>3</sup> Only 15 percent of gross fixed capital formation went in airports, river ports, sea ports, and pipelines, where the private sector also invested in infrastructure.

The transport infrastructure represents considerable national economic capital stock.

Figure 1

### Gross Investments in Transport Infrastructure

In billion euros at 2005 prices



Source: *Transport in figures for 2012*, calculations by DIW Berlin.

© DIW Berlin 2013

Investments have fallen in recent years.

this capital stock is transport infrastructure that falls under the responsibility of central government (freeways, major national roads, Deutsche Bahn AG railroads, federal waterways).

### Investment Recently Declined

This high level of fixed assets is the result of continuous investment activity up until the end of the 1980s, especially in West Germany, and investments made since 1991 to meet backlog demand for the renovation and modernization of the transport infrastructure in eastern Germany. From 1991, annual gross fixed capital investment in the road network in real terms remained virtually constant at 11 to 12 billion euros (at 2005 prices).<sup>5</sup> In recent years, however, this figure fell to less than ten billion euros (see Figure 1). This includes annual federal government investment of four to five billion euros in the federal highway network. In contrast, since the completion of the service and financing agreement (Leistungs- und Finanzierungsvereinbarung, LuFV),<sup>6</sup> the provision of replacement investments in Deutsche Bahn (DB) railroads has been constant or even slightly increased. In

real terms, between 2.3 and 2.7 billion euros has been invested annually in the railroad infrastructure since 2005. Including the hubs (passenger and freight stations), annual investment has been close to 3.5 billion euros. After the unification-related increase in funds, annual investment in federal waterways in the early 1990s fluctuated between 0.6 and 0.8 billion euros.

In particular, infrastructure sectors that fell under the financial remit of other government authorities (Länder, districts, municipalities) recorded declines in real investment. This affected not only roads but particularly regional public rail transport (urban railroads, tramways). Taking into account declining investment in local roads, which also had an impact on local bus transport, it can be concluded that there was declining investment particularly in all areas of regional public transport.<sup>7</sup>

### Fixed Capital Consumption in Road and Rail Infrastructure

The development of both fixed assets in terms of monetary value and of the technical condition of the transport infrastructure over time shows that investment activity in recent years has not been sufficient to maintain the desired infrastructure quality. Accordingly, there was a slight decrease in net assets in these areas (see Figure 2).

In addition, the condition of the infrastructure has deteriorated significantly. Consequently, an assessment of the condition of federal highways showed that around 20 percent of highways and 41 percent of major national roads have exceeded the 3.5 score considered a warning value; 46 percent of highway bridges exceeded their respective warning value receiving a score of 2.5.<sup>8</sup> The deterioration of municipal roads is obvious in many places, but documentation for minor roads is neither adequate nor uniform.<sup>9</sup> Since the LuFV is in effect, reports published annually have shown that the condition of DB's rail infrastructure does indeed meet all the quality indicators, so it cannot be concluded that investment has been neglected here.<sup>10</sup> However, according to the infrastructure condition report, the scores awarded to railroad bridges have deteriorated, and are currently

<sup>5</sup> All figures given here refer to 2005 prices and have been recalculated using the asset-specific price indices of the Federal Statistical Office. They therefore differ from information about investments in the Commission's "Future of Transportation Infrastructure Finance" report which were calculated using a less precise procedure (GDP as a deflator). Certainly this less precise method has led to differing statements on the development of investment. See Bundesrat, Commission report „Zukunft der Verkehrsinfrastrukturfinanzierung“ from December 2012.

<sup>6</sup> In 2009, central government and DB concluded a service and financing agreement (LuFV) to maintain the rail infrastructure which contained the maintenance standards and financing for the railroads.

<sup>7</sup> More than two-fifths of public transport passengers traveled on buses. This makes it clear that public transport needs a high quality road network in cities.

<sup>8</sup> See Bundesrat "Zukunft der Verkehrsinfrastrukturfinanzierung" (2012) and Deutscher Bundestag, Verkehrsinvestitionsbericht für das Berichtsjahr 2011, Bundestag printed paper, no. 17/12230 (2013).

<sup>9</sup> A. Grossmann, R. Roos, and D. Wenzel, "Systematik für eine objektive Dringlichkeitsreihung im Rahmen der Straßenerhaltung in Kommunen, Straße und Autobahn 59", no. 10 (2008): 641-647.

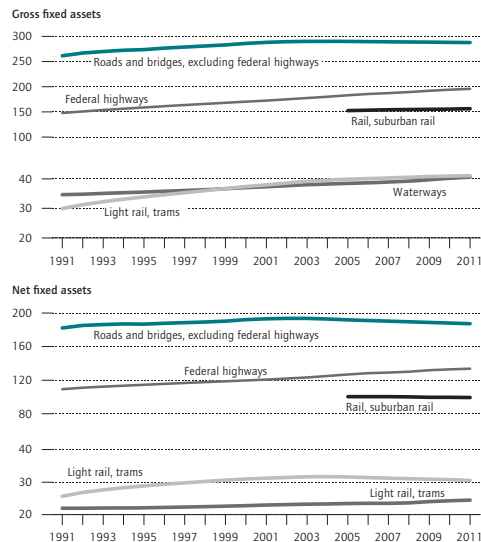
<sup>10</sup> See Deutsche Bahn AG, Infrastrukturzustands- und -entwicklungsbericht 2011 (2012).



Figure 2

### Transport Infrastructure Fixed Assets

In billion euros at 2005 prices



Source: *Transport in figures for 2012*, calculations by DIW Berlin.

© DIW Berlin 2013

There has been an erosion of assets on some routes in recent years.

averaging 2.05, implying a need for improved modernization in future. Fixed capital consumption has also occurred in non-state-owned railroads (NE railroads). This is the result of financial bottlenecks in the Länder and due to the acquisition of decommissioned DB routes by NE railroads for which there was no longer any government funding.

### Greater Demand For More Investment

The development of net assets described above implies a need for more investment which will be estimated in this section. Basically, we can distinguish between the following investment areas: replacement and backlog investment in transport infrastructure, network and capacity expansion, and investment in vehicles.

In 2001, in a report for the Federal Ministry of Transport, DIW Berlin highlighted that the maintenance of national transport routes was being neglected, that there was a correspondingly significant need to implement overdue and replacement investment, and called for repair and replacement to take priority over new const-

ruktion.<sup>11</sup> The now updated comparison of replacement demand with the volume of maintenance investments for the period of 2006-2011 includes national transport routes, state, district, and municipality roads, and the infrastructure of railbound public passenger transport, ÖSPV (see box).<sup>12</sup>

Accordingly, replacement demand in these infrastructure sectors during the period mentioned amounted to approximately 13.2 billion euros annually at 2005 prices (see Table 2). Of this amount, only 9.4 billion euros were actually invested leading to an annual investment gap of 3.8 billion euros, or nearly one-third. The largest gap between demand and actual replacement investment is for state, district, and municipality roads (almost 40 percent).<sup>13</sup> In absolute terms smaller, but in relative terms larger gaps are found in the infrastructure of railbound public transport (over 50 percent), and the waterways (over 60 percent).

Assuming that an investment gap of this size also occurs in the coming years, given the external conditions remain unchanged, and that this underfunding, which has existed for a number of years, results in corresponding pent-up demand, then the annual investment deficit calculated here of 3.8 billion euros can be considered the minimum level of additional reinvestment required.<sup>14</sup> Using a comparable definition, the "Transport Infrastructure Funding" commission estimates the additional backlog due to lack of replacement investment at 2.65 billion euros which would take a period of 15 years to work off. Consequently, annual replacement and backlog investment of around 6.5 billion euros would be required.<sup>15</sup>

Given the favorable state of Germany's transport infrastructure and the high demand for maintenance inves-

<sup>11</sup> See, U. Kunert, H. Link, "Bundesverkehrswege: Neubau auf Kosten der Substanzerhaltung künftig nicht mehr vertretbar". Wochenbericht des DIW Berlin, no. 42 (2001). For the forecast period up to 2020, replacement demand was calculated to be two-thirds of total planned investment.

<sup>12</sup> This definition counts for 90 percent of transport infrastructure assets. It does not include NE railroads, airports, inland ports, seaports, and pipelines. In addition to the analysis period mentioned above, comparison calculations for the period 2000-2011 were also made, leading to annual demand figures on a comparable scale.

<sup>13</sup> The German Institute of Urban Affairs (das Deutsche Institut für Urbanistik) calculated similarly high replacement demand for municipal roads, see Difu, *Investitionsrückstand und Investitionsbedarf der Kommunen* (Berlin: 2008).

<sup>14</sup> In addition, the fixed asset account for individual aggregate investment identifies future increases in asset disposals, including, in particular, for the railroad's engineering structures (mainly bridges).

<sup>15</sup> This is essentially derived from ex-post analyses. Additional ex-ante studies would be required with projected investment lines and according to calculations differentiating between the investment aggregates (bridges, superstructure, etc.)



Table 2

### Annual Replacement Demand According to DIW's Fixed Assets Calculation for 2006-2011

In million euros at constant 2005 prices

	Replacement demand <sup>1</sup>	Replacement investments <sup>2</sup>	Outstanding replacement demand	Proportion of outstanding replacement demand in percent
Federal highways	2,700	2,200	500	19
State, district, and municipality roads	6,400	3,900	2,500	39
DB infrastructure	3,110	2,910	200	6
Infrastructure of public rail passenger transport	480	220	260	54
Federal waterways	520	190	330	63
Total	13,210	9,420	3,790	29

1 Calculated from physical disposals according to DIW asset model plus a surcharge for the qualified securing of asset value.

2 Data on replacement investments: for federal highways, DB, and federal waterways, nominal data from the Federal Ministry of Transport, Building and Urban Development, were deflated to 2005 prices using sector-specific price indices to make them comparable with replacement demand. For other roads: estimate by DIW. For public rail passenger transport information: Association of German Transport Companies. Source: Calculations by DIW Berlin.

© DIW Berlin 2013

The investment gap is particularly large for roads in Länder, districts, and municipalities.

tment in all transport modes, extensions to the network and capacity of the transnational network are limited to the removal of bottlenecks and the development of important connections, especially in freight transport. Examples of this are German rail routes that feed transalpine traffic and the hinterland connections of seaports. Both the former and the present governments have acknowledged a structural under-financing of the transport infrastructure. The current investment framework for the period 2011 to 2015 has set aside 50 billion euros for the national transport infrastructure. However, due to the advanced planning stages of many economically viable infrastructure projects, the additional investment potential of transport routes under the responsibility of the federal government alone would total over five billion euros more than the available budget.<sup>16</sup>

In regional and urban transport, passenger numbers in public transport have risen by a tenth in the past decade despite some poor quality services. Since increased

transport in urban areas cannot be absorbed by road transport for environmental and road capacity reasons, public transport services should be expanded and the quality improved. The Association of German Transport Companies (Verband Deutscher Verkehrsunternehmen) reported investment demand up to 2025 of at least 12 billion euros for the public rail passenger transport infrastructure alone.<sup>17</sup>

The quality and scope of transport services depend not only on the infrastructure, but also on the vehicles. Thus, investment by transport providers in passenger and freight vehicles plays an important role. In public passenger transport, the type of vehicles available to customers also determines the quality of the service and can therefore have a positive or negative effect on demand. In this transport sector, similar volumes of rail and road vehicles have been procured. The problems with the quality of rolling stock in regional and long-distance transportation that have repeatedly arisen over recent years imply that more investment is needed. New low-noise rolling stock is now imperative for rail freight.<sup>18</sup>

Overall, for the necessary replacement investment in the transport sector, the pent-up demand for neglected replacement measures, and new investments beyond the current investment lines, an estimated additional annual requirement of at least 10 billion euros is needed to maintain and improve installations and rolling stock.<sup>19</sup>

### Financing Concepts Needed for Infrastructure Investment

The bulk of investment in the aforementioned infrastructure sectors must be financed by the government. There are separate regulations at each level of government for assessing the financial viability of investment projects, for the legal and planning conditions, and with regards to financial instruments. Consequently, at federal level, federal transport route planning is used as an instrument for project assessment and planning that functions across all transport modes. It is essentially funded from the federal budget through taxes (including

<sup>17</sup> Excluding regional passenger rail transport (SPNV), based on 2007 prices, Association of German Transport Companies (Verband Deutscher Verkehrsunternehmen), ed., *Finanzierungsbedarf des ÖPNV bis 2025* (Cologne: 2009). The ÖPNV plans, inter alia, to introduce new suburban trains, to improve wheelchair access and new information systems. For regional passenger rail transport, there are plans for additional suburban railroad lines and the expansion of regional railroads, such as the Rhein-Ruhr-Express.

<sup>18</sup> See "Quiet Freight" pilot and innovation program, Federal Ministry of Transport, Building and Urban Development.

<sup>19</sup> The volume of investment included in this figure for expansion is more difficult to assess because it depends on the transport demand, the economic evaluation of individual projects, and the development funding available.

<sup>16</sup> See Federal Ministry of Transport, Building and Urban Development, *Investitionsrahmenplan 2011-2015 für die Verkehrsinfrastruktur des Bundes* (Berlin: 2012). The viability of the individual projects is demonstrated using cost-benefit analyses as part of federal transport infrastructure planning.

duties paid by users, such as car and energy taxes) and revenues from the toll roads. The LuFV, which is currently being renegotiated, has been available as an instrument for financing replacement investment in DB railroads and stations since 2009. As a result, there are various sources of funding for the different transport routes,<sup>20</sup> though the percentage of financing coming directly from fees paid by users and contributions from transport-specific taxes varies dramatically.

Funding for infrastructure is significantly less regulated, less secure, and less transparent at Länder, district, and municipal level than at central government level. Only a small number of specific instruments are regulated in the Regionalization Act (Regionalisierungsgesetz), such as financing of public transport from federal funds and the partial financing of municipal roads and the local rail passenger transport through revenues from the central government's energy tax, regulated in the (expiring) Municipal Transport Financing Act (Gemeindeverkehrsfinanzierungsgesetz, GVFG). Thus, given the figures presented in this report, investment deficits at municipal level are hardly surprising.

## Conclusion and Policy Recommendations

An efficient transport infrastructure is a basic prerequisite for the German economy. However, insufficient investments have been made in the transport infrastructure in recent years. According to calculations by DIW Berlin, there is an annual investment gap of around 3.8 billion euros for the necessary reinvestment in infrastructure alone. In addition, there are pent-up replacement investment needs, and a need for investment in rolling stock and the expansion and extension of the network. In total, this results in an investment gap of at least ten billion euros per year.

Although the problem of financing transport infrastructure has been acknowledged in political circles for some time, and has led to various proposals for generating the required revenue (for example, extending the existing toll to include other vehicle classes or extending the network of toll roads), there is still no solid, self-contained or feasible concept for financing the infrastructure.<sup>21</sup> A concept of this kind should clarify the primary purposes of charging user fees, such as rail track charges,

road tolls and waterway duties. For example, the goal of generating revenue might compete with achieving environmental targets, such as the reduction of pollution and noise emissions. User fees can also help to reduce infrastructure congestion (congestion charges). In addition, the scope and aim of transport-specific taxes, such as energy and road taxes, need to be defined (for example, energy taxation as an instrument for pricing CO<sub>2</sub> emissions) and how a practically implementable policy path can be determined for such instruments.<sup>22</sup> Furthermore, it would also be necessary to clarify the use of revenues for transport infrastructure, compensatory measures for burdened users and, not least, EU compatibility of the measures.

There is a lack of a balanced approach, not only at federal level, but in particular, for infrastructure financing which is the responsibility of the Länder, districts, and municipalities. Interesting international examples here are the commuter tax in France and the mutual fund schemes in Swiss municipalities. Considering the financial deficits shown in this report, particularly in areas of non-federal infrastructure, the need for action is especially urgent here.

Uwe Kunert is Research Associate in the Department of Energy, Transportation, Environment at DIW Berlin | [ukunert@diw.de](mailto:ukunert@diw.de)

Heike Link is Research Associate in the Department of Energy, Transportation, Environment at DIW Berlin | [hlink@diw.de](mailto:hlink@diw.de)

JEL: R41, R42, L92

Keywords: Investment, transportation, infrastructure, replacement

First published as »Verkehrsinfrastruktur: Substanzerhaltung erfordert deutlich höhere Investitionen«, in: DIW Wochenbericht No. 26/2013.

<sup>20</sup> Federal highways: financed from federal budget and toll revenues, DB: financed by revenues from fees for the use of routes and stations, and the LuFV from the federal budget, waterways: financed by the federal budget and revenue from duties charged for using the waterways.

<sup>21</sup> The work carried out by the „Future of Transport Infrastructure Financing“ Commission was continued by another Commission of the Conference of Ministers of Transport, recommendations are presented in October 2013.

<sup>22</sup> So, for example, in the current debate on passenger vehicle tolls, the issues are whether to levy tolls on vehicles with a total weight of 3.5 t to 12 t, on what roads tolls should be levied, and how this is to be achieved in technical terms. The suitability of the TOLLCOLLECT system to deal with the correspondingly high number of transactions appears to be in doubt.

Discussion Papers Nr. 1327/2013

Luis Ángel Herrera, Juan Rosellón



## On Distributive Effects of Optimal Regulation for Power Grid Expansion

PTo date, the distributive implications of incentive regulation on electricity transmission networks have not been explicitly studied in the literature. More specifically, the parameters that a regulator might use to achieve distributive efficiency under price-cap regulation have not yet been identified. To discern these parameters is the motivation for the research presented in this paper. We study how different weight parameters affect the distributive characteristics of optimal price-cap incentive regulation for electricity transmission. We find that a regulator's use of ideal (Laspeyres) weights tends to be more beneficial for the Transco (consumers) than for consumers (the Transco).

JEL-Classification: L50, L51, L94, Q40, Q42

Keywords: Electricity transmission, incentive regulation, distributive efficiency

[www.diw.de/publikationen/diskussionspapiere](http://www.diw.de/publikationen/diskussionspapiere)

SOEPpapers Nr. 588/2013

Veronika V. Eberharter



## The Intergenerational Dynamics of Social Inequality: Empirical Evidence from Europe and the United States

Based on nationally representative data from the German Socio-Economic Panel (SOEP), the Panel Study of Income Dynamics (PSID), and the British Household Panel Survey (BHPS) we analyze the intergenerational transmission of economic and social (dis-)advantages in Germany, the United States and Great Britain. We test with the hypotheses that the extent and the determinants of intergenerational income mobility and the relative risk of poverty differ with respect to the existing welfare state regime, family role patterns, and social policy design. The empirical results indicate a higher intergenerational income elasticity in the United States than in Germany and

Great Britain, and country differences concerning the influence of individual and parental socio-economic characteristics, and social exclusion attributes on intergenerational income mobility and the relative risk of poverty.

JEL-Classification: D31, J24, J62

Keywords: Social and economic inequality, intergenerational income mobility, poverty, social exclusion

Discussion Papers Nr. 1328/2013  
Eric Borden, Wolf-Peter Schill



## Policy Efforts for the Development of Storage Technologies in the U.S. and Germany

Recent developments in electricity markets such as the increased deployment of variable renewable generation have prompted renewed interest over the role of energy storage. While storage technologies can in principle provide various benefits for the functioning of an electrical grid, many energy storage technologies are in initial stages of development and demonstration. The role of public policy is thus vital for development and market integration of storage technology. We identify and discuss selected policy efforts by the United States of America and Germany with a focus on less-developed storage technologies. While research and demonstration of

storage technologies has increased in both countries, we find that public funding is still small compared to overall energy-related expenditures. Both countries use technology-push and market-pull approaches. Whereas the U.S. focuses on technologies which are useful to improve system stability, like batteries, capacitors, and flywheels, Germany has a stronger focus on bulk seasonal storage that may aid the integration of variable renewables, for example power to gas. We conclude that increased data-sharing and cooperation between the two governments and research institutions will help enhance the efficacy of both countries' publicly funded storage research. U.S. research institutions that link basic research with commercialization of technology, as well as developments in U.S. regulation of ancillary markets, may provide useful models for Germany. The U.S., on the other hand, may look to Germany's institutions as inspiration for its loan guarantee program.

JEL-Classification: Q38, Q42, Q48

Keywords: Energy Storage, Technology-Push, Market-Pull, U.S., Germany

[www.diw.de/publikationen/diskussionspapiere](http://www.diw.de/publikationen/diskussionspapiere)