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# Public Sector Economics

## 2/2018

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EH TISHAM AHMAD, ANNALISA VINELLA and KEZHOU XIAO:  
Contracting arrangements and public private partnerships  
for sustainable development

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Public Finance

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### TABLE OF CONTENTS

#### Editors' introduction

- 93** KATARINA OTT and DUBRAVKO MIHALJEK  
Introduction to the Public Sector Economics 2017 Conference Issue – Public investment:  
catalyst for sustainable growth

#### Conference keynotes

- 99** BALÁZS ÉGERT  
Business investment: taking stock of the major policy drivers
- 105** EVŽEN KOČENDA  
European perspective on the links among public investments, banking and sovereign risk
- 111** MATTHIAS KOLLATZ-AHNEN and MARKUS J. ROICK  
Financing public sector investment

#### Conference introductory notes

- 125** ZDRAVKO MARIĆ  
Public investment: catalyst for sustainable growth
- 131** MANICA HAUPTMAN  
Importance of public investment for economic growth in the European Union
- 139** ZRINKA ŽIVKOVIĆ MATIJEVIĆ  
Sustainability is the issue of human capital investments

#### Articles

- 145** EHTISHAM AHMAD, ANNALISA VINELLA and KEZHOU XIAO  
Contracting arrangements and public private partnerships for sustainable development
- 171** SANJA BORKOVIC and PETER TABAK  
Public investment and corporate productivity in Croatia
- 187** GÖKÇEN YILMAZ  
Composition of public investment and economic growth: evidence from Turkish provinces,  
1975-2001
- 215** MARIA MANUEL CAMPOS and HUGO REIS  
Returns to schooling in the Portuguese economy: a reassessment

#### Book review

- 243** JEAN TIROLE  
Economics for the Common Good (*Predrag Bejaković*)

# Introduction to the Public Sector Economics 2017 Conference Issue – Public investment: catalyst for sustainable growth

KATARINA OTT, Ph.D.  
DUBRAVKO MIHALJEK, Ph.D.

Editors' introduction  
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Katarina OTT  
Institute of Public Finance, Smičiklasova 21, 10000 Zagreb, Croatia  
e-mail : [kott@ijf.hr](mailto:kott@ijf.hr)  
ORCID: 0000-0003-2242-4181

Dubravko MIHALJEK  
Bank for International Settlements, Centralbahnplatz 2, 4051 Basel, Switzerland  
e-mail: [Dubravko.Mihaljek@bis.org](mailto:Dubravko.Mihaljek@bis.org)  
ORCID: 0000-0003-4706-9534

## 1 WHY PUBLIC INVESTMENT?

The Institute of Public Finance, publisher of the journal *Public Sector Economics*, together with the Friedrich Ebert Stiftung, organized its annual conference in Zagreb on 3 November 2017. The main theme of the conference was the role of public investment in sustaining post-crisis growth, and the implications of this role for public finances in countries around the world.

The recovery from the global financial crisis had until 2016 been relatively modest and uneven, led mainly by private consumption. Business fixed investment and productivity growth had been weak and inflation low despite unprecedented monetary stimulus and historically low short- and long-term interest rates in major advanced economies. At the same time, infrastructure needs were sizeable, not least because post-crisis fiscal consolidation had significantly lowered public capital spending ratios. These conditions provided a unique opportunity to increase productive public spending: by locking in low interest rates with long-maturity borrowing, well-targeted spending on education, health or research and development, significant output gains could be obtained in the long run. In such a situation, one could expect additional public investment to generate relatively high rates of return, after allowing for risk, provided that good project governance was in place.

Against this background, many international fora recommended an increase in public investment to support demand and employment in the short run, and catalyze private investment and growth-enhancing innovations in the long run. That said, there were also questions about the ability of governments to identify and implement large-scale investment projects, as well as doubts about the size of public investment multipliers and long-term returns on public capital in a world of diminishing productivity growth, not to mention the impact of higher public investment on debt sustainability.

## 2 ABOUT THE CONFERENCE

Program committee members – Dubravko Mihaljek (Bank for International Settlements), Daniel Diaz-Fuentes (University of Cantabria), Peter Sanfey (European Bank for Reconstruction and Development), Atanas Kolev (European Investment Bank) and Josip Franić (Institute of Public Finance) – selected about twenty submissions, of which fifteen were presented at the conference. Presenters were researchers and policy experts from across the world. The five sessions covered the topics of public infrastructure and investment; lending, debt and growth; country-specific issues in investment and corporate growth; sectoral investment; and budget performance and transparency.

Keynote lectures were delivered by Balázs Égert (OECD), Evžen Kočenda (Charles University Prague, Institute of Economic Studies) and Matthias Kollatz-Ahnen (the City Government of Berlin). Several policymakers and members of the business community provided introductory remarks to the conference: Zdravko Marić, Finance Minister of the Republic of Croatia; Manica Hauptman, Econom-

ic Adviser in the European Commission Representation in Croatia; and Zrinka Živković Matijević, Head of Research for Raiffeisenbank Austria's operations in Croatia.

The conference was supported by the European Commission Representation in the Republic of Croatia, Croatian Bank for Reconstruction and Development, HEP Group, Raiffeisenbank Austria, and Zagrebačka banka.

### 3 WHAT IS IN THIS ISSUE?

This conference issue of *Public Sector Economics* contains a selection of keynote speeches, introductory remarks, and research papers presented at the conference. *Balázs Égert* takes stock of the major policy drivers of business investment, which has been unusually weak in many advanced economies following the recent crisis. He identifies four policy areas that could help underpin business investment in the recovery phase: (i) better access to finance for firms, especially small and innovative businesses, through both banks and capital markets; (ii) simplification of corporate tax systems and a reduction in high corporate tax rates; (iii) a pro-competitive product market regulation; and (iv) lowering high regulatory uncertainty by, for example, designing and keeping transparent regulations.

*Evžen Kočenda* examines links between public investment, banking and sovereign risk. His work on the nexus between sovereign risk and banking sector characteristics in the EU suggests that less efficient and larger banking sectors are linked to higher sovereign risk, while higher foreign bank penetration and higher competition – two signs of diversified banking sectors – are associated with lower sovereign risk after the global financial crisis. There are two key implications for public finances. First, market participants now view the size of banking sectors as an upper bound for potential bailouts, which reduces fiscal space for public investment in a downturn. Second, lower creditworthiness of governments may negatively affect not only public but also private investment.

*Zdravko Marić*, Croatian Finance Minister, reviews the evolution of private and public investment in Croatia over the past fifteen years, and identifies headwinds and tailwinds for their pick-up in the medium term. Total fixed investment peaked at 28% of GDP in 2008; after the start of the crisis, it rapidly declined to less than 20%. Public investment peaked at about 6% of GDP pre-crisis, but was cut to just around 3.5% in 2006-2010. In many ways, the pre-crisis level and structure of investment, biased toward housing and infrastructure, could not have been sustained, so adjustment was unavoidable given the need for fiscal consolidation and public sector deleveraging. Recent trends show improvement, with the bulk of new investment taking place in manufacturing, tourism and, within different investment goods, in machinery, equipment and intellectual property rights. The ongoing fiscal consolidation will remain a major constraint on public investment in the period ahead, but the authorities are also trying to reduce the tax burden and improve the investment climate.

*Matthias Kollatz-Ahnen* and *Markus J. Roick* present their views on the global shortfall in infrastructure investment, particularly the gap in public investment at the municipal level in Europe. They claim that despite substantial interest of the private sector, funding shortages continue to be a major – though not the only – bottleneck for raising investment. Using the example of Berlin, they evaluate several options for financing urban infrastructure, including improving tax collection, altering the composition of the city budget, imposing user fees for public services and mobilizing private capital for public investment projects.

*Manica Hauptman* warns that despite the return of more favourable financing conditions, investment in EU has not reached its pre-crisis levels. Some of the EU policy initiatives supporting national and EU public investment have already shown concrete and positive results. However, the EU is also finding out that it is important to give enough technical support to member states to create and manage their own projects. Another catalyst for public investment is a supportive regulatory environment, a theme echoed in many presentations at the conference.

*Zrinka Živković Matijević* emphasizes the importance of human capital investment in Croatia. Despite numerous attempts to improve the educational system and make the labour market more responsive to changing economic conditions, the Croatian education system remains poorly equipped to cope with the challenges of digital technology and a modern economy. This is the case not only with the public education system, but even more so with continuous learning and skills development in both public and private corporate sectors.

*Ehtisham Ahmad*, *Annalisa Vinella* and *Kezhou Xiao* examine the “how” of investment for sustainable development, focusing on public-private partnerships (PPPs) as a vehicle for pooling financial and management resources in the planning and implementation of infrastructure projects. They highlight interactions of investment decisions with tax policy options, institutional arrangements, and information flows. These interactions influence incentives facing firms, households and governments at different levels. To be successful, PPPs require public finance management arrangements such as the recording of public liabilities (including those of subnational governments and state-owned enterprises) in general government balance sheets. Without full information on the nature, generation and time-profile of liabilities, PPPs can easily become opportunities to “kick the fiscal can down the road”, and create opportunities for game-play among the different levels of government, and among the private and public partners. Ahmad, Vinella and Xiao also study the choice between alternative contractual arrangements at different stages of a project’s life cycle, noting that information asymmetry makes it possible for the private partner to extract extra rents, and for local governments to hide liabilities. This makes PPP contracts highly complex, and provides an opportunity for multilateral development banks with expertise in this area to assist emerging market economies in the design of such contracts.

*Sanja Borkovic* and *Peter Tabak* from the European Bank for Reconstruction and Development investigate the relationship between public investment and productivity of Croatian firms. On a sample of some 48,000 firms over 2007-2015 they find that government investment in general has a significant positive effect on total factor productivity growth of private companies, but not on that of state-owned enterprises. Public investment in transport infrastructure tends to enhance productivity growth throughout the economy; public R&D investment has the most significant effect on productivity growth of manufacturing companies, while productivity effects of public human capital investment seem to be largest for tourism firms. Borkovic and Tabak also find that public investment affects productivity with long lags, in transport and human capital formation, for instance, after four to five years.

*Gökçen Yılmaz*, from the School of Economics, Sinop University, studies how the allocation of public investment affected productivity growth in Turkey in 1975-2001. Her work highlights the importance of considering the sectoral breakdown of public investment when assessing its efficiency: shifting investment from transportation and communication to education, health care, city infrastructure, and security and energy infrastructure contributed positively to real productivity growth in Turkey. This finding implies that the government overinvested in transportation and communication services, and underinvested in the latter sectors, notably public energy infrastructure. In other words, public policy could have achieved a higher growth rate simply by reallocating investment resources across sectors.

*Maria Manuel Campos* and *Hugo Reis*, from Banco de Portugal, study the evolution of private returns to schooling in the Portuguese economy during 1986-2013. Using a matched employer-employee dataset that allows the tracing of individuals across time, they find the returns to schooling to be high, particularly for women, and to be the highest for tertiary education. As investment in lower schooling levels increases the returns to subsequent ones, while the government faces a budget constraint, the challenge for policymakers is to ensure the quality of public school system while providing low-income households access to tertiary level education. Given that private returns to tertiary education are high while social returns are lower relative to those for primary and secondary education, the findings of Campos and Reis also suggest that public policy needs to find some way to increase individual participation in financing of tertiary education.

These articles represent a selection of papers presented at the Conference; several more are expected to appear in subsequent issues of the Journal.

The issue ends with a review of Jean Tirole's landmark book "Economics for the Common Good".





# Business investment: taking stock of the major policy drivers

BALÁZS ÉGERT, Ph.D.\*

Conference keynote

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Balázs ÉGERT

OECD Economics Department, 2 rue Andre Pascal, 75775 Paris Cedex 16, France

e-mail: [balazs.egert@oecd.org](mailto:balazs.egert@oecd.org)

## 1 INTRODUCTION

Business investment in many advanced OECD countries has been weak following the 2007/08 financial and economic crisis. This is mostly due to the cyclical effects of weak domestic and foreign demand (the accelerator effect) (Lewis et al., 2014; OECD, 2016). Other factors include funding constraints, increased macroeconomic uncertainty and lower business confidence (Millar and Sutherland, 2016). Other structural factors may have also contributed to this trend of decline. In the longer run, weak investment can have a negative impact on potential growth. Policies should seek to give a boost to investment to prevent permanently lower levels of investment and economic growth. This short note overviews some of the important policy areas capable of helping to underpin business investment.

## 2 BETTER ACCESS TO FINANCE IS AN IMPORTANT DRIVER OF INVESTMENT

It is well understood that good access to finance raises business investment. Financial constraints arise from two sources. First, in countries dominated by bank finance, difficulties in accessing bank loans may penalise small and medium sized firms. This may arise because of weaknesses on the asset side and higher borrowing costs, which can be aggravated by high non-performing loans in the banking sector. Small businesses may face credit rationing as a result of asymmetric information problems, given that they have limited collateral. In part, credit rationing may be explained by lending conditions having been too lenient during the pre-crisis period (Millar and Sutherland, 2016).

Improving the banking sector's efficiency would go a long way to improving access to bank lending. In a number of countries, non-performing loans act as a drag on bank lending. Regulators should help reduce non-performing loans in banks' balance sheets, increase the securitisation of SME debt and introduce credit registry to limit problems related to asymmetric information. Second, deeper equity markets would help channel capital to small and innovative new businesses as they may help bring together high-risk firms with risk-loving investors. For instance, simplifying equity listing would increase the attractiveness of stock markets (Pisu, 2017). Venture capital funding plays a minor role in most OECD countries. One important reason for the domination of bank (and debt) finance over equity finance is the favourable tax treatment of debt. Reducing the tax bias towards debt financing through tighter limits on interest deductibility and tax allowances for corporate equity would help re-establish tax neutrality.

## 3 COMPLEX CORPORATE INCOME TAX SYSTEMS COUPLED WITH HIGH RATES MAY PENALISE INVESTMENT

There is consensus that higher corporate tax rates have a negative impact on business investment via increasing the cost of capital (Sorbe and Johansson, 2016). Large firms benefit more from tax reductions and exemptions whereas small and young firms are less concerned, as they are generally not very profitable (Arnold, Javorick and Mattoo, 2011). For instance, Sorbe and Johansson (2016) show that

a 5 percentage point increase in the effective marginal corporate tax rate would lower investment on average across industries by about 5% in the long term. But this effect would be nearly 50% lower in industries with a high concentration of multinational firms. Profit shifting appears to be partly operating through FDI flows. Such flows alter the cross-border allocation of investment and tax revenues (Skeie, 2016).

Investment in information and communication technology (ICT) and knowledge-based capital (KBC) is an important driver of productivity growth. Many OECD countries lag behind in investment in ICT and KBC. Framework conditions including product and labour market regulations, access to venture capital and bankruptcy laws determine the return on investment in KBC. These framework conditions should not penalise failure (and risk taking) excessively and should allow a rapid reallocation of traditional labour and physical capital to maximise returns on investment in KBC. Public support including R&D tax incentives and direct support can boost private investment in KBC (Andrews and de Serres, 2012; Andrews and Criscuolo, 2013; Westmore, 2013).

#### 4 TOO MUCH PRODUCT MARKET REGULATION CAN HARM INVESTMENT

Less stringent product market regulations are often viewed as boosting investment. If the direct and indirect costs of starting a business are low, the number of business start-ups will increase. This in turn can translate into more investment. Similarly, pro-competitive product market regulation is likely to push firms to invest more to stay ahead of competitors or to allow the entry of new competitors willing to invest. Cutting red tape and administrative burdens reduces the costs related to capital stock adjustment. This could boost investment (Nicoletti and Scarpetta, 2005). More competition (up to a point) gives incentives to invest and innovate to stay ahead of competitors. It pushes for the adoption of better management practices, encourages the investment in organisational, KBC and ICT capital (Fuentes Hutfilter et al., 2016). Therefore, public policies should strive to ease the regulatory burden on starting and running businesses.

Difficulties in restructuring inefficient businesses may keep capital and labour in low-productivity firms and hence penalise investment. Capital trapped in inefficient firms is particularly relevant in Italy, Spain and Finland (Adalet McGowan, Andrews and Millot, 2017). Insolvency regimes are very important for the orderly exit of failing firms. The specific design matters for the efficient functioning of insolvency regimes (Adalet McGowan and Andrews, 2016).

There is a negative link between foreign direct investment (FDI) and regulations aimed at FDI (Nicoletti et al., 2003; Fournier, 2015). Regulations applying to overall/domestic investment have more ambiguous effects. First, entry barriers to specific sectors are likely to discourage greenfield investment but they would encourage foreign investment in already existing firms, which have some market power arising from the existing entry barriers. Second, domestic regulations

increasing production costs can deter FDI in the export sector, as higher costs would make products less competitive internationally. But stringent regulations can boost the inflow of FDI in the production of goods and services for the domestic market. Less restrictive regulations abroad and the resulting more efficient production structure of firms can give rise to a competitive edge over incumbent domestic firms bogged down by domestic regulation (Nicoletti and Scarpetta, 2005). For instance, reducing cross-country heterogeneity in regulation by 20% would boost FDI on average by about 15% (Fournier, 2015).

The impact of labour market regulation on investment is not straightforward. If capital and labour are complementary, more stringent labour market regulations will also have a negative effect on investment and hence capital deepening. But if capital and labour are substitutes, stricter labour market regulations will boost investment as capital will substitute for labour. The influence of environmental policies on investment is also not very clear. More stringent environmental regulations can trigger investment in more energy-efficient assets. On the other hand, tighter environmental regulations can reduce business investment though raising the costs of capital (Dlugosch and Kozluk, 2017).

Product and labour market regulations need to be coordinated. Even though it is easy to start a business, business dynamics may suffer if labour market regulations are binding (Zwart, 2016). Strict labour market regulations implying costly labour reallocation provides few incentives to invest in and experiment with new technologies (Fuentes-Hutfilter et al., 2016). Also, collective bargaining covering entire sectors can prohibit the entry of new firms as new entrants might pay lower wages than the incumbents (Arnold, 2017).

## **5 HIGH REGULATORY UNCERTAINTY IS NOT HELPFUL FOR INVESTMENT**

The higher the uncertainty about the framework conditions, the higher the level of risk, the lower the incentives to invest. Regulatory uncertainty can have damaging effects on investment. Regulatory uncertainty arises if regulations are very complex and difficult to interpret. But regulatory uncertainty also arises if there are frequent and unexpected changes in overall business conditions including administrative procedures involved in starting a business, taxation and product and labour market regulations (OECD, 2016). Designing and sticking to transparent regulations are crucial to boosting business investment.

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# European perspective on the links among public investments, banking and sovereign risk

EVŽEN KOČENDA, Ph.D.\*

Conference keynote\*\*

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Evžen KOČENDA

Institute of Economic Studies, Charles University, Faculty of Social Sciences, Opletalova 26, 110 00 Prague, Czech Republic

Department of Econometrics, Institute of Information Theory and Automation, Pod Vodárenskou věží 4, 182 08 Prague, Czech Republic

Center for Economic Studies, Leibniz Institute for Economic Research at the University of Munich, Poschingerstr. 5, 81679 Munich, Germany

Leibniz-Institute for East and Southeast European Studies, Landshuter Str. 4, 93047 Regensburg, Germany

e-mail: [evzen.kocenda@fsv.cuni.cz](mailto:evzen.kocenda@fsv.cuni.cz)

ORCID: 0000-0003-4110-1169

## 1 INTRODUCTION

Sovereign risk has become a pressing issue for the European Union (EU) in the aftermath of the global financial crisis (GFC) of 2007-2008. At the same time, the link between sovereign risk and the banking sectors of EU countries emerged, as several EU governments had to intervene to stabilize their banking sectors during the severe turmoil of the GFC (Correa et al., 2014). After all, based on the ECB Statistical Warehouse data, on average around 9% of total assets of EU banks consists of sovereign bonds of EU countries.

The sovereign risk and banking sector nexus in the EU has important implications for public finances in EU member states. When governments see banks in their countries in need of help, they might decide to prepare a bail-out package to save the financial institutions. Such a solution might become a burden on public finances: a government must borrow funds and at the same time there is less fiscal space for public investments. One outcome is that sovereign risk might increase. On the other hand, a bail-out of the banking system can be considered a cost-effective option if it prevents the economy from collapsing. Arguably, an economic collapse would negatively affect public finances to an even greater extent.

Brůha and Kočenda (2018) analyze the potential nexus between sovereign risk and the characteristics of banking sectors in the EU, including their quality and performance. Their analysis allows general conclusions to be drawn about the whole of the EU as well as those specific to regional groups. It also offers potential policy implications regarding public finances and public investments in EU countries.

## 2 BACKGROUND

In general there are three channels linking sovereign risk and banking sectors. First, circumstances might require governments to act as lenders of last resort when domestic banks are in dire need of recapitalization (Gerlach, Schulz and Wolff, 2010). Second, banks' business operations – and more specifically, their adjustments of balance sheets – might have severe implications for the availability of short-term funding in a particular country (Adrian and Shin, 2009), for a shortage of credit can contribute to higher sovereign risk. Third, Brůha and Kočenda (2018) argue for the existence of a corporate credit risk channel. In general, higher dynamics of bank credit is inversely related to sovereign risk as it is a sign of economic expansion. However, the abundance of the bank credit provided might also channel some funding to projects that are destined to fail (Mehrez and Kaufmann, 2000). When the inefficiency of such projects materializes, governments might see their tax revenues declining and unemployment benefits increasing. Firms in charge of failing projects are forced to shrink their workforce and at the same time the banks, which have provided the now non-performing loans, are supposed to utilize loan loss provisions created in case such situations should arise. This development might decrease the fiscal health of a particular country and contribute to an increase in its sovereign risk.



The existing literature on the sovereign risk and banking sectors nexus in the EU is somewhat limited. Gerlach, Schulz and Wolff (2010) report that larger banking sectors are associated with higher sovereign risk. Gómez-Puig, Sosvilla-Rivero and Singh (2015) find that contagion can spread from banking sectors to sovereigns. Brůha and Kočenda (2018) document the existing link between banking sector quality and sovereign risk in the whole of the EU over 1999-2014.

Finally, a sizable strand of literature provides an assessment of the link between sovereign risk and public finances. For the Eurozone, Hallerberg and Wolff (2008) report that public deficits significantly increase risk premia. Bernoth, von Hagen and Schuknecht (2012) find evidence that government debt affects yield spreads. Using a theoretical model, Corsetti et al. (2013) show that sovereign risk may amplify the effects of cyclical shocks to public finances. Finally, for a sample of 22 advanced economies, Poghosyan (2014) determines that an increase in bond yields is positively linked to an increase in the government debt-to-GDP ratio.

Based on the above evidence there are good reasons for the links between sovereign risk, banking sector quality, and public investments.

### 3 RECENT EVIDENCE

Brůha and Kočenda (2018) use data on sovereign risk and banking sector characteristics for 27 EU countries in the sample period from 1999 to 2014. They proxy sovereign risk with four indicators: (i) the government bond yield spread, (ii) sovereign credit default swap (CDS) spread, (iii) expert opinion-based country risk score, and (iv) sovereign credit rating. The state of banking sectors in the EU countries is characterized by three systemic indicators (size, depth and foreign bank penetration) and three indicators related to the performance of banking sectors (efficiency, stability and degree of competition). Their analysis of the sovereign risk and banking sector nexus is performed for the whole of the EU along with various country groups, for the pre-crisis (1999-2007) and the post-crisis (2008-2014) periods. The analysis is based on the Bayesian method for panel data with country fixed effects to minimize time-invariant endogeneity (Wooldridge, 2002; Greene, 2003) to deliver a valid inference under some uncertainty (Daniels and Hogan, 2014; Gelman et al., 2014).

Brůha and Kočenda (2018) do find evidence for the link between the efficiency of banking sectors and sovereign risk in the EU. They show that less efficient and larger banking sectors are linked to higher sovereign risk and the result is robust as it holds irrespective of which sovereign risk measure and which country subgroup is chosen. Other links are specific to a country group or a time period. However, higher foreign bank penetration and higher competition – two signs of diversified banking sector – are associated with greater financial stability of the banking sector as they are linked with lower sovereign risk after the GFC.

#### 4 IMPLICATIONS

The results of Brůha and Kočenda (2018) suggest certain implications related to public investments and public finances in the EU. First, after the GFC, the size of banking sectors of the EU countries was started to be perceived by market participants as an upper bound for potential bailouts. And indeed, several EU countries have been forced to conduct them. The finding provides a direct implication for the fiscal space of the EU governments. Arguably, a bailout might jeopardize public investments as government's indebtedness increases in the case of a bank rescue.

Second, the link between sovereign risk and banking sector is relevant also from the private investment perspective. Investors on stock markets consider countries and their banking sectors interconnected, partly, because of the government guarantees towards domestic banks (Correa et al., 2014). Moreover, when domestic sovereign risk becomes pronounced, foreign creditors first assess the sovereign risk and then they consider the creditworthiness of the firms in the economy (Cooper and Argyris, 1998). From the side of the banking sector, its lower stability implies that fewer funds are available for potential investments.

Finally, the structural break occurring around the onset of the GFC is relevant. The results of Brůha and Kočenda (2018) imply that financial markets reassessed the linkage between banking sector characteristics and sovereign risk. This yields support for the “wake-up call hypothesis” associated with the GFC. The large repricing of the sovereign risk after the GFC quite likely affected public investments via the implementation of austerity policies in the EU countries.

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# Financing public sector investment

MATTHIAS KOLLATZ-AHNEN, Ph.D.\*  
MARKUS J. ROICK, M.A.\*

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Matthias KOLLATZ-AHNEN  
Berlin Senate for Finance, Klosterstraße 59, 10179 Berlin, Germany  
e-mail: [matthias.kollatz-ahnen@senfin.berlin.de](mailto:matthias.kollatz-ahnen@senfin.berlin.de)  
ORCID: 0000-0001-9870-6797

Markus J. ROICK  
Berlin Senate for Finance, Klosterstraße 59, 10179 Berlin, Germany  
e-mail: [markus.roick@senfin.berlin.de](mailto:markus.roick@senfin.berlin.de)  
ORCID: 0000-0001-8189-2271

## 1 INTRODUCTION

Globally, there is a massive shortfall in infrastructure investment. This is the result of a combination of several factors: (i) the continued rise in the global population; (ii) the ongoing process of urbanisation; (iii) a shortage of public spending on infrastructures due to the legacy effects of the Great Recession and the need to consolidate public budgets; and (iv) new challenges such as climate change and the IT revolution that require additional investments. The infrastructure gap is felt in developed countries as much as in emerging market and developing countries. In Europe, public investment at the municipal level has been hit particularly hard. In spite of substantial interest from the private sector, shortages of funding continue to be a major (though not the only) bottleneck on the path towards higher investment volumes. Using the example of Berlin, this article looks at some trends in urban infrastructure policies and discusses alternative sources of financing.

## 2 THE ROLE OF CITIES

Currently, more than 50% of the global population live in urban areas. By 2050, 70% of the global population and 86% of the OECD population will live in cities (OECD, 2012). This is not only an unprecedented development in the history of humankind, but is also a reflection of the extent to which cities are a representation of modern forms of living.

Most large cities are growing fast – they are magnets. Berlin, for example, has gained around 50,000 new citizens annually since 2011. The attractiveness of cities extends to a multitude of different groups. Cities attract internationally mobile knowledge workers as well as economic migrants looking for a better life. Industries that thrive on human network effects – such as advertising, finance, software engineering and consulting – cluster in cities, and so do research and academic institutions that benefit from knowledge spillovers.

Given their importance, cities will inevitably be the locus where the challenges for mankind manifest themselves distinctively and in stark form. At the same time, cities have characteristics that predestine them to providing solutions to these challenges. They are the natural locus for testing new technologies (“smart cities”) and for combating climate change (“green cities”). Similarly, as so often in the past, cities are not only the preferred destination for migrants, but, given their diversity, they are arguably also the best place for the integration of those migrants into society. More generally, cities appear to be better at combatting poverty than rural areas (UN Habitat, 2011:13).

Considering the unabated growth in the global population, cities, with their higher population density, offer unique chances for the optimization of resource use. The challenge here is to make cities more compact without reducing their liveability. The more compact a city lay-out the less degradation of farmland takes place because urban sprawl is reduced, and the less is the environmental burden of commuter traffic. Compact cities also increase the efficiency of network infrastructures, as they offer a higher user density.

Compact, efficient network infrastructures also make it easier to implement new technologies and to finance such changes. This holds true for private as well as public capital. For private capital, cities with their high numbers of potential users facilitate the investment case for large network investments as investment per user shrinks and revenues quickly reach critical mass. For public capital, too, per capita investment costs are lower. In addition, cities usually also have some authority over the financing mechanism associated with such investment projects – which is not only important for the financing of the project per se, but can also be used as a steering mechanism to influence user behaviour: Thus, e.g., toll schemes for city centres simultaneously raise financing and influence road usage. Also, looking beyond finance, cities usually have decisive authority over local infrastructure projects and are therefore well-placed to guide the course on the environmental and sustainable aspects of such projects (Merk et al., 2012:7).

Yet, while cities are the answer to many economic, social, and environmental challenges, they are limited in their capacity to play this role: while cities are often economic powerhouses, they also tend to attract a disproportionally large share of economically and socially weaker citizens. This puts a marked burden on social spending. At the same time, continued migration into the cities requires substantial investment into expanding and upgrading public infrastructure – which, of course, comes on top of the normal requirement to continually renew the existing infrastructure. All of these demands on cities' budgets come at a time, when public sector infrastructure is already strained after the economic impact of the Great Recession after 2008, decades of lean government, and neoliberal thinking.

### 3 REMUNICIPALISATION

As regards the latter, there has been a substantial shift of opinion in recent years in Germany. After a long period during which privatisation of public-sector entities was *de rigueur*, municipalities and cities have rediscovered their interest in owning companies providing public infrastructure.

The driving force for this development has been a substantial disenchantment with the privatisation of these services. Instead of delivering better services and lower prices, privatised general public service companies have often offered low service quality, have neglected investment, and have misused their monopoly positions. The latter has been particularly problematic in the case of network industries such as energy distribution, water supply and sewage, which have the characteristic of a natural monopoly and are therefore particularly prone to the exploitation of monopoly power (Höffler, 2013:72-73). Regulation, which was expected to keep these potential downsides of privatisation in check, has often proved to be too weak or inadequate, or has been captured by private interests.

At the same time, over recent years, regional and municipal governments have often improved their administrative capacity, introduced modern management techniques and increased the efficiency of public service provision. They are hence not only more confident, but also actually more able to match the quality

and efficiency of private sector companies in the supply of such services. In addition, municipal and regional governments have realised that many of the public policy objectives such as fighting climate change can be mastered more effectively if local governments do not only regulate but are actually the owners of the means of production or distribution (Höffler, 2013:76-77).

Against this background, in Berlin, too, the city government has been active on this front:

- The public housing associations are increasing their housing stock – from 300,000 apartments a few years ago to 400,000 in 2025.
- The water supply is state-owned again. We repurchased the “Berliner Wasserbetriebe”, since then running the company each year with a surplus and at the same time increasing investment significantly.
- We founded a new municipal utility for energy, competing for the concession to distribute electricity and gas, and another unit to increase the speed of de-carbonisation.

Even before these moves, Berlin had already been a sizeable economic actor in its own right. The city is the (majority) owner of more than 50 companies with a combined turnover of EUR 8.1bn, an equity of EUR 10.1bn, EUR 54bn in total assets and employing 50,700 people (on an FTE basis). In 2016, these companies turned in a profit of EUR 708m and invested more than EUR 2bn (Senatsverwaltung für Finanzen, 2017). For comparison: investment from the city’s budget directly amounted to EUR 1.7bn. The city government’s objective is to raise both to a level of EUR 2.2bn.<sup>1</sup>

#### 4 FINANCIAL SITUATION OF MUNICIPALITIES IN GERMANY

A precondition for a higher level of economic activity by communities is financial soundness. But the budgetary room for public investments is within tight limits for most cities.

While the financial situation of municipalities has, on the back of a benign overall economic environment and higher employment levels in particular, improved considerably in recent years in line with the improved fiscal situation of the public sector in Germany in general, the financial status of many municipalities continues to be precarious. Overall, Germany’s municipalities have posted a solid financial surplus of more than EUR 4bn in 2016 and EUR 9.7bn in 2017 (Deutscher Städtetag, 2017:5; Destatis, 2018). But many municipalities and even some of the Länder (states) face structural deficits. Problems are concentrated in those municipalities that suffer from high unemployment, negative demographics, and high exposure to social problems with a large share of dependent citizens. Thus, financial constraints and indebtedness of municipalities are concentrated in parts of North Rhine-Westphalia, Rhineland-Palatinate, Hesse, and large parts of Eastern Germany.

<sup>1</sup> This involves some double counting, as part of the investment by firms is re-financed by apportionments from the city’s budget.



Many of these municipalities have resorted to using short-term credit lines to cover structural deficits exposing them to a severe interest risk as well as debt problem. If their finances improve, financially weak municipalities will, therefore, tend to reduce their debt rather than expand investment, even in the full knowledge that this will impede their long-term growth opportunities. Already today, however, the contrast in investment levels between municipalities is indeed stark: In 2016, e.g., physical investment of Bavarian municipalities stood at EUR 517 per capita, whereas those in North Rhine-Westphalia clocked only EUR 196. More generally, municipalities in the former West Germany recorded per capita investment of EUR 327, those in the former East Germany EUR 235 (Deutscher Städtetag, 2017:17; Destatis, 2018). A structurally similar pattern has been evident for at least a decade. This will aggravate the divergence between stronger and weaker municipalities. It is therefore advisable that, when the national or the federal-state (Länder) level advances funds for investment purposes to the municipal level, these funds are being tied to specific purposes ensuring that they actually flow into investments.

Overall, between 1991 and 2013, within 12 years, the proportion of investments in the overall budget of municipalities was halved and totalled only 10% at the end of the period. Closer analysis reveals that this is the result of several factors: first, some reduction is a natural corollary of the phasing-out of the post-unification boom. As the infrastructure in Eastern Germany was gradually brought up to Western standards over the 1990s and early 2000s, investment outlays could be reduced. Second, the steady expansion of social spending, which has expanded in economically good as well as in bad times, has eclipsed investment spending. Thirdly, highly indebted municipalities are legally obliged to bring their finances back into order and are closely supervised on the ensuing consolidation path. As investment spending is a “soft target” in budget consolidation, it is usually hit disproportionately when municipalities try to rebalance their budgets.

While public investment patterns vary across European countries, the financial weakness of the municipalities is particularly grave as most of the investment takes place at that level. According to the EIB, roughly 50% of public infrastructure investment takes place at the municipal level. Against this background it is a matter of concern that more than a third of municipalities report that investment over the last five years has been below needs (EIB, 2017:12).

## 5 CONSTITUTIONAL DEBT BRAKE

In Germany, efforts to push up investment levels quickly are hindered not only by financial and administrative but also by institutional constraints. In 2009, the federal level and the Länder decided to change Germany’s constitution (the Basic Law) by adding a new clause that requires the Federal Republic and the Länder to balance their budgets.<sup>2</sup> In principle, budgets will henceforth have to be balanced

<sup>2</sup> For an overview, see e.g. Bundesfinanzministerium (2015).

without the assumption of new debt. Unlike earlier incarnations of debt brake mechanisms the new debt brake will no longer distinguish between consumption spending and investment spending; both types of expenditures will have to be financed out of current revenues.<sup>3</sup>

After a long transition period, this provision will take full effect in 2020. The debt brake marks a substantial break with the past and will require a fundamentally changed attitude towards and new techniques for budget policies, in general, and the financing of public services and infrastructures, in particular.

Unlike the national and the federal-state (Länder) levels, German municipalities are not covered by the constitutional debt brake. In principle, therefore, they will still be able to finance investment by issuing new debt even after 2020, subject to their creditworthiness still being intact, of course.<sup>4</sup> It should also be noted, though, that municipalities may be affected indirectly by the debt brake if their respective Land is forced, in order to balance its own books, to reduce its financial allocations to the municipal level.

However, the three German city-Länder (Berlin, Hamburg, and Bremen) fully fall under the debt brake provisions. For them, financing investment after 2020 will become more challenging and will inevitably require that all available funding sources will be used. For some time now, this has led to an active search for financing models beyond traditional debt finance.

## 6 ALTERNATIVE FINANCING MODELS

Looking at the possible alternatives, the following options to improve the financial situation of cities are available: increase of tax income, improvement of tax collection, regrouping budget allocations from consumption to investment, use of budget surpluses, user-based financing, mobilising private funding and external funds (inter alia EU funds, such as the European Fund for Strategic Investments – EFSI). They are, of course, not mutually exclusive, but should be used in sensible combinations to increase public-sector investment. When choosing, the choice made by any given city will depend, inter alia, on the overall financial situation of the city, the project to be financed, and the sophistication of financial markets.

### 6.1 INCREASING TAX INCOME

Higher tax revenues are the most obvious choice to finance an increase in the volume of public investment. Higher tax revenues can, of course, be the result of either higher growth and employment or increases in tax rates. Fortunately, in Germany and in Berlin, tax revenues have increased substantially over the recent

<sup>3</sup> Previously, the federal level as well as many Länder had constitutional provisions, which allowed governments to run deficits up to a maximum volume that was equivalent to the volume of investment. However, such rules were frequently evaded by flexible and imprecise definitions of what constitutes public investment.

<sup>4</sup> Incidentally, the fact that municipalities are not covered by the debt-brake provision may actually induce Länder to shift tasks and the corresponding financing obligations to the municipal level. Cf., e.g. Brandt (2015:54).

years on the back of the benign macroeconomic environment without any need to resort to changes in the tax-code.<sup>5</sup> Between 2010 and 2017 total tax revenues at the federal, Länder and municipal level rose from EUR 530.6bn to an estimated EUR 734.5bn (+38%). Total tax revenues are projected to increase to EUR 858bn by 2021 (Bundesfinanzministerium, 2017:21), providing ample fiscal space for public sector investment if funds are allocated accordingly.

However, increased tax revenues are obviously not available exclusively for higher investment. There are other substantial demands for spending on the budget, which must also be met. Apart from the usual drift in spending, which is driven by higher wage demands by public sector employees and inflation in general, social spending in particular is increasing in spite of the benign conditions in labour markets in Germany. The widening of income inequality and the increase in the number of precarious work contracts are probably to blame for this. In addition, additional expenditures for the admission and integration of refugees constitute a considerable demand on public funds, which amounts to roughly EUR 1bn (in 2016, projected to be less in the following years) in the case of Berlin alone.

## 6.2 IMPROVING TAX COLLECTION

The Panama Papers and other leaks have, once again, revealed the extent of international tax avoidance. Zucman (2014:56), e.g., estimates that tax evasion results in lost tax revenues on private wealth of EUR 130bn annually. The publication of such evidence comes at a time, when public opinion towards tax avoidance and tax evasion appears to be changing. They are no longer considered trivial offences, but instead are regarded as unfair behaviour that shows a lack of solidarity with the community at large. Tax intake that the state is denied is money that is missing to finance public services – and this gap is felt by the citizens on a daily basis.

Considerable efforts are being made, especially at the level of the OECD and at EU level, to stamp out the most egregious forms of tax evasion and tax avoidance. The OECD's *Base Erosion and Profit Shifting* (BEPS) aims at reducing the ability of firms to shift profits to low-tax jurisdictions. Similarly, the EU employs a "name and shame" approach to pillory non-cooperative tax havens. While these efforts are laudable as much as overdue, it is obvious that they will not result in a substantial increase in tax revenues in the short-term. They are therefore unlikely to be a major funding source for investments any time soon.

## 6.3 ALTERING COMPOSITION OF BUDGET

The budget consolidation in the past few years – especially at the level of the federal states and municipalities – was to the detriment of investments. As the EIB

<sup>5</sup> Actually, the fact that tax rates were not *lowered* in spite of the strong growth in tax revenues contributed to the strong rise in tax intake, of course. The reluctance to lower taxes probably is a positive side effect of the debt brake as it discourages governments to risk revenues. Even in the ongoing coalition negotiations at the federal level plans for potential tax reductions were and are strictly limited to a volume which would not compromise the objective of a balanced budget. Deficit-enhancing tax reforms such as the one currently designed in the US apparently are anathema under the debt brake regime.

(2017:11) notes: “Infrastructure investment has been hit by fiscal consolidation that has been biased against capital expenditure, with prioritisation given to current expenditure such as social transfers.” The reason is political: scaling back investments is – at least in the short term – easier to pull through politically than social spending, as the effects are not felt immediately by the citizens.

However, if such a strategy is pursued over an extended period (such as in the years of fiscal consolidation following the public debt crisis in Europe, starting in 2011), public infrastructure will start to deteriorate markedly. Today, the public is much more aware that such neglect is harmful. Keeping the state lean may be a desirable objective – starving the state certainly is not, especially not for the poorer members of society that do not have access to privately funded alternatives, such as private schools, gated communities, and helicopters.

Still, there is a limit to shifting funds within budgets in favour of a greater share of investment: consumptive expenditure is to a large extent legally prescribed and, hence, cannot be scaled back without politically difficult legal changes (if at all). Similarly, expenses for personnel cannot be reduced in the short term and with increasing public services this is not even desirable.

#### 6.4 USE OF BUDGET SURPLUSES

The sound condition of public budgets in Germany has sparked an intensive and controversial debate on how the resulting budget surpluses should be used. From an economic point of view, the starting point for any deliberation should be the recognition that unplanned budget surpluses are the result of unexpected higher revenues or lower expenditure than planned. The unexpected nature of these two sources suggests that such surpluses tend to be of a transitory nature. This, in turn, suggests that they should not be used to finance permanent expenditures.

If this logic is accepted, it follows that budget surpluses should, to the extent that they are not used to retire existing debt, be used for discretionary, additional investment purposes rather than for an increase of public consumption.<sup>6</sup> By doing so, the investment level can be re-adjusted should there be no surplus in the following year. Moreover, such a rule is also economically justified in light of the aforementioned fact that investment spending is usually the first victim in times of unexpected budget shortfalls.

Incidentally, Berlin is following such a strategy: in 2014, the city passed a law stipulating that budget surpluses be allocated, at the parliament’s discretion and subject to the obligations Berlin has for consolidating its budget, to additional investments and the retirement of existing debt. In addition, a reserve fund (“sustainability fund”) has been established and filled with a target volume of 1% of

<sup>6</sup> Incidentally, this has also been one of the recommendations by the Expert Group on Strengthening Investment in Germany (the so-called Fratzscher-Group) that was set up by the Federal Ministry for Economic Affairs (Expertenkommission, 2015:38).

total budget volume (currently EUR 290m). This fund is designed to serve as a reserve for the years after 2020 to cover unexpected shortfalls in tax revenues during a recession. To illustrate: in 2016, out of the total budget surplus of ca EUR 1.3bn, EUR 870m was allocated to the investment fund, EUR 137m went into the retirement of legacy debt, and EUR 290m was put into the sustainability fund.

## 6.5 USER-FINANCED MODELS

As yet another financing mechanism, cities can impose user fees on their public services. User fees actually serve two purposes simultaneously: (i) they provide funds to finance those services, (ii) they can be used to steer the behaviour of (potential) users.

Cities have some discretion over the design of user fees. Specifically, these can be fine-tuned to achieve desired policy-outcomes. Thus, e.g., congestion charges, variable parking fees and differentiated property taxes can exert considerable influence over transport modes, user behaviour and land use.

Moreover, user fees and local taxes or charges can be combined effectively to achieve the desired outcomes. User charges on road congestion, for example, are likely to be more effective when combined with attractive public transport services and prices (Hammer, 2011:76). Charges and taxes can then be used either to finance investments in public transport services or to subsidise user fees for such services.

Having said this, a differentiation needs to be made between models in which user fees are cost-covering and those where this is not the case. Full cost recovery can be found in the areas of telecommunication, energy (pipelines, electricity), but also with fairs, water supply and sewage. In those cases, debt financing is often a possibility as a complementary source of funds.

In contrast, user fees only partially cover costs in areas such as urban public transport, theatres, and operas. While coverage rates vary, usually user fees only cover current operating costs, but do not cover depreciation and investments. For instance, Berlin's public transport company, the BVG, had a turnover of EUR 672m, which covered personnel costs (EUR 600m), but did not cover other operating costs (EUR 370m), or interest payments (more than EUR 36m), or depreciation (EUR 212m).

In those cases, cities cover shortfalls either by cross-subsidising public sector services within a holding structure (typically, profits made by water companies are used to subsidise public transport<sup>7</sup>) or allocate funds from the general budget to the transport company (in Berlin's case ca EUR 500m p.a.).

<sup>7</sup> As Höfler (2013:74) argues, such a cross-subsidy can actually be an efficient pricing model according to the Ramsey-Boiteux-rule.

**Case study: Berlin's BVG**

The BVG is facing huge challenges in the coming years. While on the one hand, the number of inhabitants and user numbers are rising markedly, BVG's fleet of underground vehicles is on average 24 to 26 years old. The renewal and expansion of the underground wagon fleet will cost around EUR 3.1bn, an investment that will need to be recouped over the next 35 years. The BVG itself will invest into the fleet, but will leave the financing arrangement to a finance company. This company will be a fully owned subsidiary of BVG. It will be responsible for attracting external capital for the necessary investment.

**6.6 MOBILISING PRIVATE CAPITAL<sup>8</sup>**

Recently, cities have also been highly successful in mobilising private capital. For private investors, investment in cities carry distinct advantages. Risks and opportunities of such investments are easier to predict than in rural areas, a critical mass of users is achieved more easily and contracts can be negotiated with a single administration rather than multiple actors. Cities, especially well-known global cities, also hold the prospect of being well-advertised show-cases where new technologies or financing structures can be put on display for a world-wide audience by technology companies and financiers.

In addition, in times of sustained low interest rates on the financial markets private investors are greatly interested in infrastructure investment. In these circumstances, insurance companies, pension funds, and the like are interested in investments with stable and predictable returns. Infrastructure investments are also attractive as a means of portfolio diversification as the correlation of returns is lower than for other asset classes. Finally, the asset class provides a hedge against inflation, as user fees and/or concession arrangements are usually linked to inflation rates (WEF, 2014:7).

In spite of this, however, privately funded infrastructure remains the exception rather than the rule: on the one hand, many private investors shy away from such investments as the framework conditions are not reliable enough (WEF, 2014:11). Regulations are often changed *ex post*, invalidating any *ex ante* calculation on the viability and profitability of such an investment (Laboul and della Croce, 2014:14).

On the other hand, there are reservations from the public side: as mentioned before, experiences with the privatisation of public infrastructure, especially when it comes to municipal services, are mixed. The public mood is leaning towards remunicipalisation.

<sup>8</sup> For reasons of brevity, "private capital" is used here as a catch-all for a diverse group of private capital, which encompasses, *inter alia* pension funds, insurance companies, family offices, and endowments. All of these have their specific characteristics which leads them to favour different combinations of debt and equity instruments and gives them different risk-return preferences (WEF, 2014:10).

This also holds true for public-private partnerships, or PPPs. In principle, these can be a useful instrument to finance public infrastructures, especially under the conditions of tight budgets. According to Hammer et al. (2011:120), PPPs are mostly used for financing transport infrastructure and to a slightly lesser extent water (30%) and buildings (21%). PPPs can be useful, but only under certain conditions. But as the OECD notes: “There is, however, no indication that PPPs would be better suited to achieve green growth goals than traditional procurement” (Hammer et al., 2011).<sup>9</sup> Specifically, PPPs are critical when they are only chosen because the implicit debt obligation of the state incurred in the context of a PPP project does not appear on the cities’ balance sheet and is therefore irrelevant for debt brake mechanisms.

Even if these reservations were not existent, private financing would not be suitable for all public infrastructure. Many areas, for example schools, are not at all attractive for private investors, and hence, this financing mechanism is not available for such projects.

### 6.7 EXTERNAL FINANCING/EU FUNDS

Funding from the European level has long been an important element in the financing of public infrastructure in EU member states. Two major sources have been the EU structural and cohesion funds for regions with below average p.c. incomes and EIB loans. More recently, the spectrum of potential sources available has been enriched by EFSI, which is part of the so-called Juncker Plan to increase the level of investment in post-crisis Europe.<sup>10</sup> Generally, the Juncker Plan is laudable and it is an important signal on the political priorities of the European Commission.

The Juncker Plan recognises the need of state measures to enhance investments; it is needless to say that recognising the important role that the state has to play has not always been part of the Commission’s philosophy. Furthermore, the Juncker Plan constitutes progress as it is a comprehensive plan; it does not only provide a financing mechanism (EFSI), but also puts emphasis on (i) improving the framework for investments by means of appropriate regulation and structural reforms, (ii) advisory services on how to run complex investment projects, and (iii) developing a project pipeline that not only prioritises projects, but also makes them publicly known so that private investors can express their interest.

The greatest value of EFSI lies in the fact that it aims at closing a gap in the financing spectrum that cannot be covered through the private capital market: EFSI is designed to focus on those kinds of investments that are likely to cover their costs,

<sup>9</sup> There is a heated debate in Germany currently on the use of PPP to finance the building of highways. The National Court of Auditors strongly rejects the use of PPP for this purpose arguing that this form of financing is too expensive.

<sup>10</sup> The Juncker-Plan was first presented by the European Commission (2014) in November 2014, and enacted by Regulation (EU) 2015/1017 of 25 June 2015.



including cost of capital, but which are either too risky or too low-yielding to attract private capital.<sup>11</sup>

It should be noted that by focussing on these kinds of projects, EFSI can lose money on individual projects. However, this is part of its conceptual design and should not be a cause for concern. Conceptually, EFSI is equivalent to a private equity fund and, hence, should not be expected to make a profit out of every investment, but to be profitable over its entire portfolio. Characterising EFSI as a private equity fund also implies, by the way, that the capital of EFSI should be increased regularly to keep its volume relative to the GDP on the same level.

## 7 CONCLUSIONS

The need for investment is not in doubt. Public investments are a catalyst for sustained and sustainable growth. However, to reap the benefits of a strong public sector infrastructure, cities need to invest with a long-term perspective and in a continuous manner. Arguably, continuity in public-sector investment that avoids boom-and-bust cycles is even more important than the actual level of investment.

The answer to the question of how to finance this investment is, however, less clear cut and has so far been given far less weight in discussions. If we compare the needs for investment with the capacity of the potential sources discussed above, one thing becomes clear: a mix of financing sources is needed to provide a steady stream of public sector investment. Each city needs to find its own mix, preferably one with the least negative trade-offs in terms of growth.

The public sector must also meet stronger requirements than the private sector. The conduct of business must be transparent, and a responsible use of taxpayers' money must be at the core of public enterprises. All public enterprises should produce positive returns when subsidies are paid, and the level of these subsidies must, of course, be defined *ex ante* so that companies have an incentive to improve their financial performance and produce positive results. Public enterprises also should not be capitalised with more equity than is needed.

Incidentally, meeting such high standards also protects public enterprises against debates on their privatisation. Providing high quality and efficient services leads to a high level of satisfaction on the part of citizens – and this satisfaction offers the best protection against the provision of such services by public enterprises being questioned.

<sup>11</sup> Incidentally, with respect to public-sector projects, it is a shame that this important group of low return investment projects (a typical example would be projects to increase energy-efficiency) were added to the list of eligible projects only after the intervention of the EU-Parliament and only in a relatively indirect way.



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# Public investment: catalyst for sustainable growth

ZDRAVKO MARIĆ, Ph.D.

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Zdravko MARIĆ  
Ministry of Finance of the Republic of Croatia, Katančičeva 5, 10000 Zagreb, Croatia  
e-mail: Zdravko.Maric@mfin.hr

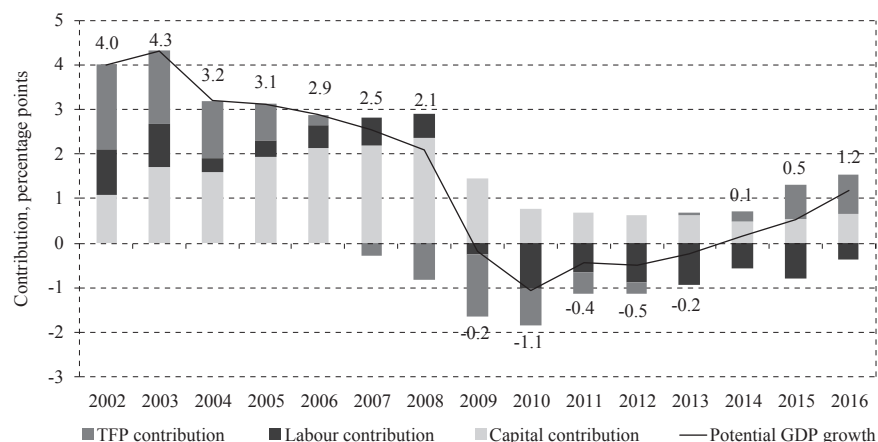
Investment<sup>1</sup> is an important instrument of economic growth. Apart from having a positive effect on aggregate demand, it enables future production growth. Through capital accumulation, investments directly impact a country's potential GDP, i.e. the maximum sustainable level of output achievable by a country without creating inflationary pressure. Furthermore, new technologies can increase productivity and the utilization of factors of production.

Potential GDP growth rate in the EU declined by half after the onset of the 2008 crisis: in the 2002-2008 period, average potential GDP growth rate in the EU was 2%, but dropped to 0.9%<sup>2</sup> in the 2009-2016 period. This decline in growth is a consequence of, primarily, a significant reduction in total factor productivity and, secondarily, poor capital accumulation. The contribution of the labour factor has not been diminished to the same extent.

Croatia has experienced more unfavourable trends than other EU member states, with the pre-crisis potential GDP average growth rate exceeding 3%, then declining or stagnating in the 2009-2014 period, and experiencing modest growth only in 2015. The primary factor contributing to post-crisis potential GDP growth slowdown was the capital factor, as its contribution in the post-crisis period was 2.5 times lower than when compared to the pre-crisis period, which was in line with investment trends in Croatia.

### GRAPH 1

*Factors contributing to potential GDP growth*



Source: Autumn Economic Forecast, European Commission, November 2017.

During the pre-crisis period, the growth of investments in Croatia was strong and was mostly financed by foreign capital and borrowing. A significant part of this growth was generated in the construction sector (primarily through investment into real property and infrastructure projects), while growth in other investment

<sup>1</sup> Investment here means gross fixed capital formation.

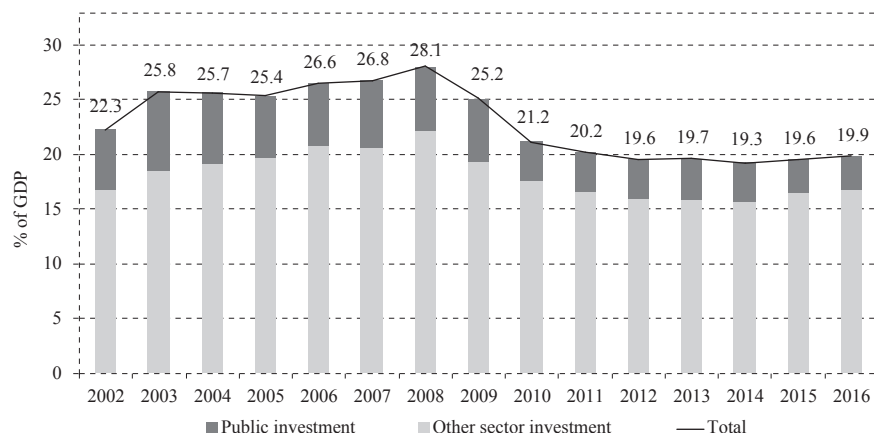
<sup>2</sup> Autumn Economic Forecast, European Commission, November 2017.

categories was somewhat more modest. These trends led to a gradual increase in the investment rate,<sup>3</sup> peaking in 2008 when it exceeded 28% of GDP. When compared with the EU average, investment rate in Croatia was significantly higher in the 2002-2008 period (21.5%, i.e. 25.8% of GDP, respectively). However, investment growth did not result in a strong productivity growth, for the most part because a significant portion of investments was going into nontradable sectors such as trade, financial mediation and construction.

At the onset of the crisis, foreign capital inflow was cut off and both the capital market and the property bubble burst, which led to a shrinkage of investment. In the 2009-2014 period, the investment rate in Croatia was gradually falling, to reach its lowest point at 19.3% of GDP in 2014. The year 2015 saw the beginning of a gradual recovery of investment, even though the share of investment in GDP remains much lower than before the crisis. For instance, the average investment rate in Croatia in the 2009-2016 period was only 20.6%, which was somewhat higher than the average investment rate on EU level, but still lower than in new member states in the same period. One of the key changes when compared to the pre-crisis period is a change in investment structure, primarily in the form of an increase in investment into machinery, equipment and intellectual property, which resulted in an increased potential for productivity growth. Moreover, the higher percentage of investment pertains to the industry sector, while the share of investment in the construction sector has contracted significantly. When we look at investment structure by domestic sectors<sup>4</sup>, the majority of investments (approximately 60%) are made in non-financial enterprises, followed by the general government sector (approximately 20%) and the household sector (with an investment share of approximately 16%), the remaining share relating to financial enterprises.

## GRAPH 2

### *Trends in gross fixed capital formation*



*Note: Public investment means general government investment.*

*Source: Croatian Bureau of Statistics.*

<sup>3</sup> Investment rate is defined as the share of gross fixed capital formation in GDP.

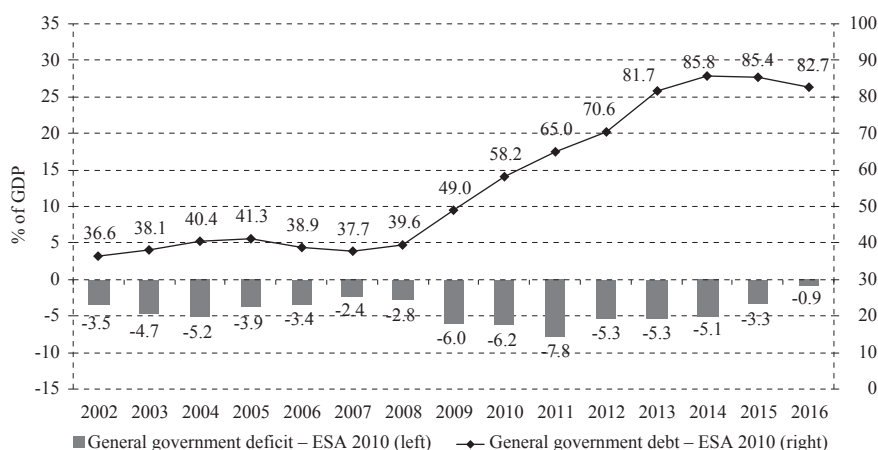
<sup>4</sup> Data is available for the 2002-2012 period. Source: Eurostat.

The share of public investment in the 2002-2009 period was, on an average, 6.1% of GDP, dropping to 3.5% of GDP in 2010-2016. It peaked in 2008 at HRK 20.3bn and diminished continuously since, resulting in HRK 10.3bn, i.e. HRK 10.7bn in 2015 and 2016, respectively. In other words, the impact of the recession on the drop in investment activities was significant, resulting in the current low level of investment.

Such public investment trends were brought about by the necessity of fiscal consolidation and limiting public debt growth. After 2008, when public deficit was at 2.8% of GDP, it started showing an upward trend, resulting in an average 6% of GDP in the 2009-2014 period. At the same time, public debt more than doubled, rising from a stable 40% of GDP average in the 2002-2008 period to a high 85.8% of GDP in 2014. These fiscal trends were a direct consequence of a deep recession and restructuring that affected the Croatian economy, not sparing some state-owned public enterprises that had been the engine of investment activity in the pre-crisis period.

### GRAPH 3

#### *General government deficit and debt*



Source: Ministry of Finance, Croatian Bureau of Statistics.

In this context, in January 2014, the Council of the European Union decided to launch an excessive deficit procedure in order to reduce deficit to below 3% of GDP by the end of 2016 and to have general government debt on a sustainable trajectory to below 60% of GDP. In March 2016, the European Commission concluded that Croatia was experiencing excessive macroeconomic imbalances. In order to meet the Recommendations, fiscal consolidation measures were implemented, which affected most public spending categories, including public investments. Due to high interest rates on the financial markets and limited fiscal options, only necessary investment projects, mostly those dealing with transport and water infrastructure, were greenlighted.

Due to fiscal consolidation and good performance in 2016, Croatia exited the excessive deficit procedure in June 2017. In the course of 2016, the budget deficit dropped to 0.9% of GDP and public debt dropped to 82.7% of GDP, allowing Croatia to rank among EU member states with a most significant annual public debt-to-GDP ratio improvement. 2017 fiscal results exceeded expectations, meaning that budget deficit will fall below 0.6% of GDP. Croatia will have to continue fiscal consolidation in the years to come to ensure that deficit and public debt trends remain in accordance with Stability and Growth Pact provisions.

Public investment will therefore continue to depend on the obligation to pursue a prudent fiscal policy. As a consequence thereof, the Government will focus on EU funds absorption. According to the new Act on the Financing of Units of Local and Regional Self-government, effective as of January 1<sup>st</sup>, 2018, personal income tax will fall under the authority of local units in order to top up their budgets and with the aim to increase investment and better absorb EU funds. Moreover, enterprises majority-owned by the state outside of the general government sector, whose investments, according to Ministry of Finance estimate, account for 6-7% of total investment, play an important role in the increase in investment activity. These are primarily enterprises of strategic interest pertaining to the energy and transport sectors. It is, however, imperative to choose investment projects with highest return on invested capital and which serve the needs of real economy. It would be ideal, therefore, to use EU funds as much as possible for investment financing, particularly in the context of the Investment Plan for Europe (the so-called “Juncker Plan”), which was initiated precisely because of low levels of investment in the EU in comparison with the pre-crisis period.

When it comes to the private sector, significant investments have been made in the tourism sector and an upward trend is clearly visible in the industry sector. However, in spite of much better financing conditions, private sector investment remains hampered by high indebtedness and the need for further deleveraging. Namely, private sector (nonfinancial enterprises and households) debt share at the end of 2016 amounted to 105.9% of GDP, the share of nonfinancial enterprises being 70.6% of GDP. Even though the debt has been reduced when compared with 2010, when it reached its maximum, this amount of debt limits the private sector's options for new investment and makes it vulnerable to changes in financing conditions. Moreover, the banking sector is still burdened with high level of non-performing loans: at the end of September of 2017, 12.5% of total bank loans were irrecoverable or only partially recoverable<sup>5</sup>. The vast majority of nonperforming loans are found in the non-financial enterprise sector (25.9% of total loans), especially in construction, which is probably due to the sharp rise of the construction sector during the pre-crisis period. In 2017, the Government introduced a one-off opportunity to have nonperforming loans, valued as of 31<sup>st</sup> December 2015, considered as tax expenditure as part of a comprehensive tax system reform and

<sup>5</sup> The share of such loans in total loans reached its maximum in 2014 – 17.1%.

pursuant to 2016 Council recommendations, with a view to reduce private sector debt. This move enabled banks to reduce tax liabilities on corporate income tax for the amount of written-off debt.

Another goal of the lowering of the tax burden as part of the tax system reform was to reduce direct personal income and corporate income taxation and in this way encourage personal consumption and investment. The tax burden on all corporate income taxpayers was thus reduced, offering a dedicated incentive to the development of small enterprises and start-ups by reducing the tax rate from 20% to 18%, or to 12% for taxpayers whose annual income does not exceed HRK 3m. In order to enhance tax certainty and remove obstacles for the expansion of foreign and domestic investment, the possibility has been introduced to enter into an advance transfer pricing agreement. Reliefs for assisted regions (PP1 and the city of Vukovar), education, research and development, and reliefs under the Investment Promotion Act remain available. New amendments to the Investment Promotion Act have been presented for debate before Parliament, aimed at enabling small and micro-enterprises and the ICT industry to use incentives in order to increase project realization rates and offering the option to make free of charge use of unused government property for ten years.

The tax burden will be further lowered in 2018. On January 1<sup>st</sup>, measures to increase enterprise liquidity will come into effect. These include the application of the accrual principle (without tax prepayment) on investment equipment imports from third countries and the right to a 50% input VAT deduction for personal vehicles used for business purposes, as well as a rise in the VAT registration threshold from HRK 230,000 to HRK 300,000 to exclude small taxpayers. A further reduction of non-tax payments is also planned in order to reduce enterprise costs by removing obstacles to doing business in particular sectors, and creating a simpler and more efficient regulatory framework.

When it comes to financing conditions, favourable trends will continue and lead to an increase in investment in both the public and the private sector. In the last year, the three leading rating agencies boosted Croatia's credit rating. CDS (credit default swap) spread on five-year bonds has fallen to its lowest level since 2008. All in all, long-term reduction of borrowing costs, lower country risk premiums and a boosted credit rating will allow greater capital availability and lower capital costs for both the public and private sector.



# Importance of public investment for economic growth in the European Union

MANICA HAUPTMAN, MSc

Conference introductory note\*  
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Manica HAUPTMAN  
Economic Counsellor and European Semester Officer, European Commission Representation in the Republic of Croatia, Ulica Augusta Cesarca 4, 10000 Zagreb, Croatia  
e-mail: [Manica.HAUPTMAN@ec.europa.eu](mailto:Manica.HAUPTMAN@ec.europa.eu)

## 1 INTRODUCTION

The economy of the European Union has been recovering steadily from the recent financial crisis, with economic growth returned to all EU member states. Unemployment is at its lowest in nine years, employment rates are growing and long-term and youth unemployment has been declining. Public finances have improved significantly and investment is slowly recovering (European Commission, 2017a:1). Nevertheless, there is some remaining slack in the labour market and, together with slow productivity growth, it obstructs wage dynamics and dampens inflation (European Commission, 2017b:1). Despite the return of more favourable financing conditions, investment has not reached its pre-crisis level and there is still significant potential remaining; the same goes for unemployment.

Some of the EU policy initiatives supporting national and EU public investment have already shown concrete and positive results in terms of increase in investment projects, as well as in terms of the participation of private capital in financial structures also supported by public money. It is important to keep the momentum going and mostly to give enough technical support to every member state to create and manage its own strong project pipeline. The latter together with the supportive regulatory environment remains the key, since the success of any, including of course public, investment depends on the success of the projects it supports.

## 2 PUBLIC INVESTMENT IN THE EU – STATE OF PLAY

Government debt in EU member states has started to decline from the peak of 87% of GDP during the crisis, but it remains well above the level of 58% of GDP in 2007. As a result of pressure on public finances, public investment in the EU fell from 3.4% of GDP in 2008 to 2.7% in 2016. In a number of member states, the reduction in growth-friendly expenditure has been substantial (European Commission, 2017c:XXI).

Although by 2016 government expenditure had returned almost to the pre-crisis average for 2000 to 2007 (to 46.6% of GDP as against 45.5%), the composition of the expenditure had changed. Public investment (i.e. gross fixed capital formation) amounted to 2.7% of GDP as compared with 3.2% in the pre-crisis period, despite total public expenditure being higher, mostly due to an increase in social expenditure of over 1% of GDP in the same period.<sup>1</sup>

The reduction in public investment is more striking in the EU member states that were hit hardest by the economic downturn (such as Ireland, Portugal, Spain and Greece). Many of these countries have had a high level of social expenditure and high cost of debt servicing, while at the same time “growth-friendly” public expenditure, on R&D and education, for instance, has remained low.<sup>2</sup> Persistently low levels of public investment have a negative effect on the convergence process within the EU. At the same time, the exacerbation of disparities and social diver-

<sup>1</sup> Ibid, pp. 165-166.

<sup>2</sup> Ibid, p. 163.

gences among EU countries and regions is preventing convergence of the real economy, especially crucial for the euro area.

There are significant differences in the extent of decentralisation of public investment across the EU and in the share of investment managed at regional and local level. The overall tendency has been for public investment spending to become increasingly centralised, whereas there has been little change in the sub-national share of total government expenditure.<sup>3</sup>

It has been recognised at the political level that the EU needs to remove weaknesses in its investment policy. In April 2017, the Eurogroup (European Commission, 2017i) endorsed a list of common principles intended to guide the member states:

- Structural reforms should promote private investment and facilitate resource allocation;
- Productivity-enhancing public investment should be prioritised to boost growth in the short run as well as potential growth in the long run as well as ensuring Stability and Growth Pact compliance;
- Market-based sources of business financing should be developed to widen the range of available forms of financing, especially non-bank sources of finances (e.g. venture capital, crowdfunding and market based finance).

Structural reforms in member states should reflect these common principles and the European Commission is assessing the progress in the framework of the European Semester, the surveillance process of economic governance in the EU as well as in the euro area.

### 3 INVESTMENT IN HUMAN CAPITAL

One of the most prominent issues in the public investment discourse is the investment in human capital, which is essential for boosting productivity and vital for a resilient economy and economic growth. Investment in quality of education is key to knowledge-intensive and sustainable growth (European Commission, 2017d:1).

Educational attainment in the euro area and the EU has increased over time, but remains heterogeneous across the member states. In terms of quality, Europe is in the midfield rather than a leading world region.<sup>4</sup> Good education systems require appropriate investment. Although the spending on education has been remarkably stable during the years of crisis, its share in government expenditure varies among member states. The EU average share of education within public spending stood at 10.3% in 2015. Education remains the fourth largest government expenditure item after social protection, health and general public services. The ratio of education spending to GDP stood at 4.9% in the EU-28 countries in 2015. In recent years this ratio has stagnated (European Commission, 2017e:11).

<sup>3</sup> Ibid, p. 163.

<sup>4</sup> Ibid, p. 3.

In the context of EU cohesion policy and real convergence, investment in human capital is of the essence. For EU regions to become attractive for investment in higher value-added activities, regions have to improve the quality of their institutions and business ecosystem, become more innovative and improve the skill sets of their labour forces through better education and training. Moving up the value chain requires higher investment per worker than in earlier stages of development, because of the need for a better educated labour force and new business models. Labour-intensive, low-skilled activities need to give way to highly skilled workers to ensure continuous rise in productivity (European Commission, 2017c:25).

Education typically pays off, for both the individual and the society at large. It is mostly funded by public money, which aims to provide equal access to education and lead to more equal income distribution later on (European Commission, 2017d:5).

#### 4 POLICIES AND MECHANISMS AT THE EU LEVEL

The European Commission has been initiating several policy and financial mechanisms to support public investment in its member states.

One of the first initiatives to support jobs and growth was the introduction of the so called “Investment plan for Europe” in 2015, composed of the financial guarantee mechanism “European Fund for Strategic Investment” (EFSI) with backing from European Investment Bank (EIB) own resources and the European Union budget. EFSI has been accompanied by an advisory arm, including technical support for public and private project promoters as well as by a policy pillar, i.e. regulatory reforms, tackling barriers to investment and ensuring a more diverse pool of financing mechanisms in the EU. The main objective of the Investment Plan is to attract private investors, thus participation of the latter in the financing structure of each project or platform is a precondition for applying for EFSI guarantee.

Over the past two years we have seen the launching of hundreds of projects and the macroeconomic impact of EFSI is estimated as increasing EU GDP by 0.7% up to 2020 and providing 700,000 new jobs. In December 2017, the European Parliament and the Council supported the extension of the Investment Plan and therefore EFSI until 2020 (so-called “EFSI 2.0”) with increased transparency, more technical support at the local level, greater focus on smaller projects and a larger proportion of sustainable projects including in new areas of sustainable agriculture, forestry, fisheries and aquaculture (European Commission, 2017f).

There have been more and more investment projects combining EFSI with the use of European Structural and Investment Funds (ESIF, or so-called “EU funds”), which brings a new dimension to the cohesion policy and is leveraging EU funds investment with private capital. Cohesion policy and EU funds have undergone regulatory changes recently and public investment was at the core of the negotia-

tions on the currently applicable legal framework. One of the major objectives was to improve the consistency of the use of the EU funds and European economic governance (European Semester) rules. Thus programmes and projects financed by EU funds have to be aligned with the country-specific recommendations, including budgetary targets and planned structural reforms. This ensures that the EU public investment is underpinned by sound economic policies (European Commission, 2017c:163).

For more efficient implementation of structural reforms in the member states, a separate service has been established within the European Commission, called the Structural Reform Support Service, which has centralised technical support for reforms, including changes in the regulatory environment and removal of investment barriers.

Concerning budgetary discipline and flexibility under the Stability and Growth Pact (SGP) as part of the economic governance process, there is a possibility of activating a so-called investment clause, which is activated *ex ante* upon request from member states in their stability or convergence programmes one year ahead of its application. This means in practice that a member state can temporarily deviate from its mid-term objective (i.e. cyclically-adjusted general government budget position) under the preventive arm of the SGP when investment is aiming at, is ancillary to, and economically equivalent to major structural reforms. Such temporary deviation may be granted for the financing of certain specific investments with positive, direct and verifiable long-term budgetary effects on growth and on the sustainability of public finances under certain conditions. The deviation must be linked to the national expenditure on projects co-funded under the Structural and Investment Funds (ESIF), Trans-European-Network (TEN) or Connecting Europe Facility (CEF) and to national co-financing of EFSI backed investment projects (European Commission, 2017k).

## 5 SOCIAL DIMENSION AND DEEPENING OF THE EU INTEGRATION

The objective of EU and national public investment is not only to increase productivity and achieve sustainable economic growth, but also to support social convergence, with inclusive policies and well-functioning welfare systems in the 21<sup>st</sup> century EU. In December 2017, the European Council endorsed the conclusions of the Social Summit in Gothenburg to further develop the EU social dimension and to promote convergence through efforts at all levels. The European Council called upon the member states to implement the European Pillar of Social Rights, setting out 20 principles, to facilitate a well-functioning social dialogue at all levels, tackle the gender pay gap and deliver further on the new European Skills Agenda, with a particular focus on “Upskilling Pathways”, for people with the greatest skills needs (European Commission, 2017j:2). National public investment in the area of social policies will continue to be supported by the European Social Fund, supporting areas from social inclusion to education and labour markets, as well as efficiency in the public administration and judiciary.

Like equal opportunities, social inclusion and protection, the discourse on the deepening of European integration, especially of the European Monetary Union (EMU), remains among the core issues of the debate on the future of Europe and especially of the European Monetary Union. The European Commission set out a roadmap for EMU deepening in December 2017 with several main initiatives, such as the creation of a European Monetary Fund, new budgetary instruments for a stable euro area, including dedicated convergence facility for member states wanting to join the euro area as well as a proposal for a European minister of economy and finance (European Commission, 2017g). The roadmap also foresees the creation of a stabilisation function, bringing together different EU and euro area level funds and financial instruments, to be used to maintain investment levels in the event of large asymmetric shocks (European Commission, 2017h:8), so as to avoid past scenarios of drastically reduced investment levels during an economic and financial crisis.

## 6 CONCLUSION

Public investment is a crucial part of successful European integration, ensuring sustainable economic growth and economic as well as social convergence. The stimulation of levels of public investment, especially in the current low interest rate environment, remains an EU priority.

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# Sustainability is the issue of human capital investments

ZRINKA ŽIVKOVIĆ MATIJEVIĆ, MSc\*

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Zrinka ŽIVKOVIĆ MATIJEVIĆ  
Head of Research Department, Raiffeisenbank Austria d.d., Magazinska cesta 69, 10000 Zagreb, Croatia  
e-mail: [zrinka.zivkovic-matijevic@rba.hr](mailto:zrinka.zivkovic-matijevic@rba.hr)

## 1 WERE WE INDEED SO SUCCESSFUL?

Even without the official 2017 budget statistics, informally we can say that even in the year 2017 Croatia continued the fiscal consolidation. In the worst case scenario the balance of general government budget landed in a historically low deficit (or, according to the Ministry of Finance, saw a mild surplus), and the public debt proceeded to shrink as compared to the GDP. In addition to the continued economic growth, for the first time since 2004 Croatia was awarded a long-term rating upgrade. However, this year at least, the rating will remain a category below investment grade, clearly recalling the deeply rooted weaknesses and the still high indebtedness. The story of fiscal consolidation in the Republic of Croatia is seemingly rather a nice one, but unquestionably it also raises quite a number of questions. One of the key issues is the extent to which the fiscal consolidation is a consequence of cyclical factors, and the extent to which it resulted from purposefully implemented economic policy measures. Or, in other words, how much did the outer factors impact the recovery, and how much was this a consequence of the structural changes we ourselves implemented in the long-lasting recession in order to raise the potential growth rate, sustainability and resilience of the overall economy?

As regards revenues, the above-expected contribution in the past year was most likely recorded in revenues from indirect taxes (VAT) and social contributions, which was the outcome of growth in economy and employment. Total revenues from direct taxes rose, probably due to an increase in inflows from profit tax, whereas inflows from income tax decreased in keeping with the tax reform.

The discouraging fact, however, is that the growth and the consequential inflow in the government treasury is very much based on tourism, which heightens the sensitivity and vulnerability of the overall economy and budget. In the structure of Croatian services nearly three quarters are linked to tourism. When it is compared to other EU member states with regard to the share of knowledge intensive services exports in overall services exports, Croatia is at the bottom end of the list with a share of less than 20%. The current services structure in the Croatian economy looks more like that of small, island states, and exposes the whole economy to excessive negative risks, should adverse geopolitical events occur. A similar, comparatively unfavourable structure is present in the case of foreign trade in goods. That is, in the exports structure, export of medium and high technology products is relatively modest, at around 38 percent.

This is the consequence of a historically inadequate use of the basic growth sources – of labour, primarily. Amid the conditions of an increasingly faster and more demanding global environment, structural problems of the labour market, linked also to inadequate adjustment of the educational system, have reduced the growth potentials. Furthermore, the very weak and slow progress in technology, partially caused by problems in the educational systems, scientific research, public administration and relatively poor R&D investments, imposes the necessity of stronger,

more resolute and faster structural changes because otherwise Croatia will continue to lag behind most European countries.

As regards the public expenditures, probably we will not witness any material changes structurally. On one hand, the fall in government borrowing costs and the resulting fall in interest costs is heartening, but investment costs are still on the downslide, thus still maintaining the absence of any stronger driving force in this field. Moreover, the government's investment activity in 2017, as compared to 2016, has slowed down. On account of last year's adjustment of pensions, social benefits increased, whereas the wage talks between the Government and the government services unions and their implementation on the public services staff affected growth of budget expenses in the *compensation of employees* item.

## 2 ...AND WHAT ABOUT THE (LONG-TERM) OUTLOOK...

The short-term outlook for economic growth and fiscal consolidation in the sense of reining in deficit and reducing public debt seems favourable. Nevertheless, mid-term to long-term prospects indicate very explicitly that vulnerabilities were not eased, let alone resolved. As said before, the appetites of various interest groups directed mostly at increasing material rights (which usually inflate the current public expenditure whereas future investments remain at the back of the mind) are rising already. Along with exports, investments are the most appreciated source of growth, but when speaking of investments, the 21<sup>st</sup> century stresses a new dimension that has to be considered. All advanced countries have realised that in the modern society, despite the ever increasing automation and digitization of business, human capital is the most valuable resource of any society, and investments in human capital (along with investments in research and development) are one of the key factors in increasing prosperity. What is more, return on human capital investments is rather high, and contrary to the populist viewpoint, return on these investments is materialized only in the long run. Nevertheless, it is evident that human capital accumulation created over time is material for raising productivity, crucial for economic growth and inevitable in creating a more resilient economy. Both in its essence and according to economic theory, human capital represents a major resource that to a substantial extent determines the direction and the dynamics of any country's development. Human capital is shaped and assembled from the early childhood years throughout the educational system and lasts, or should go on, throughout a lifetime. As most education in the phase of formal schooling is financed by public money, the education system should be of special interest to the creators of economic policy also in the financial (short-term) sense. However, much more important than the actual (public) expenditure for education is the issue of efficacy in spending the money because, in the end the efficiency sets the successfulness of return on a particular investment.

In the context of measuring the efficacy of using (public) money on education and achieving public policy goals, various quantitative and qualitative measures are applied, as well as the measures of participation in the labour market and/or in the

system of education and life-long learning. In order to assess the overall performance of (public) money spending policies with regard to education, it is necessary to review all three aspects.

The most common quantitative measure is the level of involvement in tertiary education, whereas pupils' PISA<sup>1</sup> tests are used for quality, or assessment of cognitive abilities. Finally, not less important in measuring the value of spending (public) money on education is the participation of young people in the labour market after finishing their schooling. A higher education level, but also one of better quality, provides individuals with higher employability, faster learning of required knowledge and skills and, in the end, the ability to have higher earnings and better living standard. On the other hand, the society as a whole prospers not only due to a higher long-term growth rate but also due to better resilience to the inevitable downward slides of the economic cycle. Hanushek and Woessmann (2007) confirms the positive correlation of improved results (of cognitive skills) in the PISA tests to real annual GDP growth rate, and raising the success of the young people who are not involved in the education system is considered especially significant.

However, analysis of quantitative and qualitative indicators of investment in human capital and all analyses of labour market participation demonstrate that Croatia belongs to the group of the European Union countries at the bottom of the list. Moreover, European Commission (2017) analyses confirm that the same amount of money could generate a markedly better result.

The importance of investing in human capital gains in relevance especially when exceptionally unfavourable demographic trends and population aging are taken into consideration. Not only do neglecting human capital and ignoring modern demographic trends smother the already low growth potentials, they also put a great deal of pressure on public finances, especially through the health and pension system.

### 3 CONCLUSION

To rewind the story to the beginning, we can only hope that fiscal metrics improvement will not encourage repetition of past expenditure models. A wider and more long-term view warns of suboptimal use of the most valuable resource of our society – its human capital. The numerous reforms directed at improving the educational system and the labour market, besides being implemented slowly, now seem outmoded and inappropriate because they do not develop the skills and knowledge adjusted to the skyrocketing progress of technology. Continuous learning and developing of skills are a prerequisite for strengthening competitiveness, increasing productivity and innovativeness, without which no individual and no society as a whole can expect any increase, as well as any sustainability, in the standard of living.

<sup>1</sup> PISA – Programme for International Students Assessment – assesses the extent to which 15-year-old students, near the end of their compulsory education, have acquired key knowledge and skills that are essential for full participation in modern societies.

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# Contracting arrangements and public private partnerships for sustainable development

EHTISHAM AHMAD, Ph.D.\*

ANNALISA VINELLA, Ph.D.\*

KEZHOU XIAO, Ph.D. candidate\*

Article\*\*

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Ehtisham AHMAD

London School of Economics and Political Science, Houghton Street, London WC2A 2AE, UK

Zhejiang University, 866 Yuhangtang Road, Hangzhou, Zhejiang Province, 310058, P. R. China

e-mail: [s.e.ahmad@lse.ac.uk](mailto:s.e.ahmad@lse.ac.uk)

ORCID: 0000-0002-6054-3336

Annalisa VINELLA

University of Bari “Aldo Moro”, Largo Abbazia Santa Scolastica 53, 70124 Bari, Italy

e-mail: [annalisa.vinella@uniba.it](mailto:annalisa.vinella@uniba.it)

ORCID: 0000-0002-2602-3089

Kezhou XIAO

London School of Economics and Political Science, Houghton Street, London WC2A 2AE, UK

e-mail: [K.Xiao@lse.ac.uk](mailto:K.Xiao@lse.ac.uk)

ORCID: 0000-0002-1687-9043

**Abstract**

*This paper extends the discussion of the investment cycle in Ahmad (2017) (G24 paper), in which the questions concerning “what” to invest in and “where” are addressed. This paper examines the “how” of investment for sustainable development, focusing on options for contracting arrangements, such as PPPs, that would help to involve the private sector, manage risks in the presence of asymmetric information, as well as uncertainty about climate change. It also addresses the strengthening of national and local institutions and the possible role of international financial institutions. In discussing the investment options, the paper also updates a G24 review of the empirical and theoretical literature on involving the private sector involvement in public investments (Ahmad et al., 2018).*

*Keywords: financing infrastructure investments, contracts, sustainable development*

## **1 INTRODUCTION: SETTING THE STAGE FOR PRIVATE PARTICIPATION IN PUBLIC INVESTMENT**

Given the huge infrastructure gaps faced in advanced and developing countries alike, there is growing recognition that the private sector needs to be better involved in public investments for sustainable development, from financing instruments to direct participation with various risk-sharing arrangements (Bhattacharya et al., 2016). A 2015 G24 paper examined the case of public-private partnerships (PPPs), given the high expectations on the part of many governments, as well as bilateral and multilateral donors (Ahmad et al., 2018). In this paper, we review the additional empirical evidence on PPPs that has become available since the 2015 paper. We focus on a data register of private participation in public infrastructure (PPIs) established by the World Bank, and the large body of theoretical literature that has emerged recently on contracts, as well as the applicability of PPPs in the handling of the uncertainty that is a feature in particular of climate change. This paper is a continuation of a discussion of the investment cycle, in which the “what” and the “where” are addressed in companion G24 papers (Ahmad, 2017), and the “how” is taken up below.

Among both theorists and practitioners, two highly topical questions are: (1) whether public agencies, or private firms, or both in cooperation, should develop infrastructure projects; and (2) if so, under what organizational and contractual forms?

Private involvement in public infrastructure is subject to asymmetric information that triggers incentives for cost reduction through cuts in quality, unless quality is contractually well-defined, specified and monitored as argued in G24 (2015). In addition, PPPs create possibilities of game-play across levels of government, and incentives to hide liabilities at lower echelons. This often substitutes for tax reforms and obfuscates accountability as liabilities are pushed onto future generations or to higher levels of government. The reduced linkage between taxation and spending affects “yardstick competition”, and can lead to a buildup of liabilities through poor decision-making. Elections are also often a trigger for reneging on contracts by both the public and private parties, giving rise to a host of political



economy problems, especially pronounced in multilevel states (including those with unitary constitutions, but especially problematic in multiparty federal states). The importance of own-source taxes at lower levels of government to ensure sanctity of contracts, including for PPPs, is typically ignored by policymakers, although there are important exceptions (see Milbradt, 2016; Ahmad, Bordignon and Brosio, 2016).

The failure in the EU to implement requirements of the International Public Sector Accounting Standards Board (IPSAS) to register liabilities in general government balance sheets, also required under the IMF's Government Financial Statistics Manual (GFSM) 2014 framework, contributed to surprises and the depth of the post-2008 crisis. Therefore, contractual (in)completeness, on one hand, and monitoring and control, on the other, are critical issues in the choice of delegation of projects to the private sector. For instance, France, of the few EU countries to do so, has only recently begun to implement the IPSAS/GFSM requirements.

This paper is structured as follows. Section 2 focuses on some preconditions for PPPs. Section 3 presents some stylized facts on PPPs around the world. In Section 4 we examine a range of possible contracts, including the pros and cons of unbundling different stages of the project life-cycle. Section 5 concludes.

## 2 SOME RECENT EVIDENCE ON PRECONDITIONS FOR PPPs

After some "irrational exuberance" concerning PPPs in the international community and different countries, it was recognized that this enthusiasm was often due to the attractiveness of "kicking the fiscal can down the road", including in the EU (see below). McKinsey Global Institute (2016) had a more balanced perspective: "PPPs are often discussed as a solution but they are not a panacea." The main advantages of PPPs are bringing private capital into public infrastructure, through risk-sharing devices, in an innovative manner that helps to close the key infrastructure financing gaps. PPPs also help introduce greater efficiency and market discipline in the management and execution of the project than might in principle be possible in the public sector.

The typical critiques of PPPs are that (1) governments may use off balance-sheet investments to circumvent budget constraints; (2) windfall private-sector profits may accrue; (3) inappropriate risk transfer (with e.g., regulatory changes, land access, and traffic volumes) may increase capital costs; and (4) non-standard or insufficient project size may increase administrative costs (McKinsey Global Institute, 2016).

In addition to these criticisms, our focus is on whether and how asymmetric information generates first, political economy problems across levels of government, and second, game-playing between the public and private partners. The absence of appropriate incentives can also create commitment problems and incentives to renege on contracts (see G24, 2015). Separately, the new literature on climate change and uncertainty suggests that PPPs that focus on risk-sharing may not be the appropriate contracting model in every case.

Despite these criticisms, the case for involving the private sector in public investment projects remains strong, including through the use of PPPs. We examine this issue further in section 4.

## 2.1 LOCAL OWN-SOURCE REVENUES

There is clearly a potential for PPPs in meeting public infrastructure needs, although the preconditions need to be explicitly recognized. National governments and international agencies alike should try to assist lower levels of administration, particularly cities and municipalities, where many of the PPPs are typically to be found.

As discussed in Ahmad (2017), it may not be appropriate to set user charges to cover costs. There may well be implicit tax/subsidies or guarantees involved that affect budget allocations over the short to medium term. Problems typically arise when governments operating under an annual budget framework are unable to meet commitments under future budget scenarios. The problems tend to be magnified when elections result in new administrations that may have different priorities. Also, there is often a tendency for private parties to claim cost escalations prior to, or just after, elections. And if subnational governments are able to either hide costs (a practice common in some Latin American countries with single term limits, thereby enabling administrations to pass on the costs to their successors) or pass them on to higher levels of government, the incentives to renege on contracts are intensified.

A proper system of local own-source revenues is needed before cities can borrow for investment purposes in a sustainable manner. This linkage is important to align incentives. It is important also to recognize that PPPs represent local liabilities, and the repayment schedule needs to be linked to own-source revenue generation. Otherwise, there is a risk of liabilities building up unnoticed until there is a crisis, as was the case in Europe after 2008 (Ahmad, Bordinon and Brosio, 2016).

Unfortunately, international experience with raising revenues at city and local levels leaves much to be desired. Most developing countries generate negligible local revenues – Latin America, which perhaps does better than other regions, manages just 0.3% of GDP – as opposed to advanced countries such as the US, UK, and France that collect over 3% of GDP at the local level. Part of the problem is that countries have adopted the US institutional model based on ownership and valuation, which is exceedingly difficult to administer (the UK under Margaret Thatcher abandoned it), given rapidly changing property rights and prices. Also, the administration of local-level taxes tends to be regarded as separate from other taxes, particularly the VAT and income taxes, and therefore is left to under-staffed and ill-equipped local administrations that rely on direct contact with taxpayers. This contributes to corruption and misses the important interlinkages of information on local assets as a key element in the income tax base. Yet, local-level taxation has significant potential, especially in rapidly growing cities and metropolitan areas within developing countries. The linkage between local own-source

revenue generation and city-level investment and service delivery is critical to meeting the Sustainable Development Goals (SDGs). These issues are discussed in greater detail in Ahmad (2017a) and Ahmad, Brosio and Gerbrandy (2017), and are not pursued further here.

## 2.2 FULL INFORMATION ON LIABILITIES GENERATED

Without full information on the buildup of liabilities, known to the private partner but not the government, it is impossible to properly assign risks or manage the PPP process efficiently. Moreover, if the liabilities are not known to the local governments managing the PPP projects, they will be a black box to the central government that is responsible for overall macroeconomic management and implementation of fiscal rules at the national and sub-national levels. For these reasons, IPSAS 32 requires that PPP liabilities be recorded in the general government balance sheet, the latter being a critical element of the IMF's GFSM framework. The issue of accurate measurement and reporting of liabilities is increasingly important, given the emphasis on PPPs' meeting the UN's sustainable development goals (see Ahmad et al., 2018). For instance, this is now an important issue in China, which is basing its strategy for rebalancing growth toward sustainable and clean sources partly on PPP contracts.

One example of the importance of this precondition comes from the EU. The absence of consistent and full reporting on PPPs within countries and across the EU led to the failure of the practice of relying on the market to discipline local governments during the post-2008 economic crisis (see Ahmad, Brosio and Gerbrandy, 2016). Local governments could hide liabilities by, for instance, bypassing regular payment channels, dealing with local banks, and parking liabilities in PPPs. Additional and largely hidden liabilities have added to the magnitude of the crisis. In Spain, for example, there have been prosecutions of officials and banks, there are fears that funds have been misappropriated in several cases. It is unrealistic that markets would discipline local governments without full information on current and future payment streams, and without the need for standardized reporting of transactions and arrears (such as with the OECD/IMF GFSM standards).

How could the public sector ensure provision of full information on liabilities? It is common for countries to purchase expensive Integrated Financial Management Information Systems (IFMISs), often with IFI support, without thinking through how it might affect the processes and procedures across government entities or the architecture of connection between line agencies and sub-national governments. It is also common for line agencies or local governments to act independently of the Ministry of Finance or Treasury and purchase their own systems, often with charts of accounts that make it virtually impossible to generate data on general government operations – either the economic classification that would also cover the buildup of liabilities, or the functional or program classifications that make it possible to report on the key SDG deliverables, such as spending and outcomes on education or health care, for instance.

Thus, for instance, countries such as Pakistan are only able to report on budgetary central government operations and not on the functional spending or outcomes necessary for their SDGs. These data have to be generated manually, and cannot easily be verified. The absence of treasury single accounts means that the usual cross-checks to facilitate following the flow of funds is missing. This opens the door to rent-seeking and possible game-playing between levels of government.

In a rare admission, the Internal Evaluation Group of the World Bank notes that despite having spent \$3.5 billion in 75 countries, “having a fully functional IFMIS in place alone is not a sufficient condition for it to serve as a good budget management tool” (World Bank, 2016:23). Unfortunately, many of the systems do not track the full GFSM-classified budget with its economic, functional, program, and project classifications in the chart of accounts, which would enable the provision of accurate and timely information, including on liabilities from PPPs. And some countries with high scores in the individual budget management rankings might miss out key elements that affect the ability of and incentives for officials to “cheat”, as is becoming clear for instance with the Panama papers cases, or with ongoing investigations in other countries.

Many IFMISs in emerging market economies, put in at great expense, require mapping tables to generate GFSM-consistent data for inclusion in the GFS Yearbook. In many multilevel countries, only data on central government budgetary transactions were included in the GFS Yearbook. As a result, even functional classification was excluded, and there was no information at all on provincial and local transactions. In the context of increasingly decentralized delivery of the SDG goals, this poses a significant challenge. Even senior IFI staff claim that “it may be simply illusory to expect countries to adopt budget classification and accounting system that are GFSM, if not IPSAS compliant” (Cangiano, Gelb and Goodwin-Groen, 2017:10).

Among the Emerging Market Economies (EMEs), China has made better progress than most countries (except for Russia) in addressing both the GFSM framework and Treasury Single Accounts (TSAs), in that there is a clear goal, and uniform standards are being developed. However, the reforms are not complete, especially with regard to the treatment of liabilities at the lower levels of government including in the more advanced regions of the country (see Ahmad and Zhang, 2018).

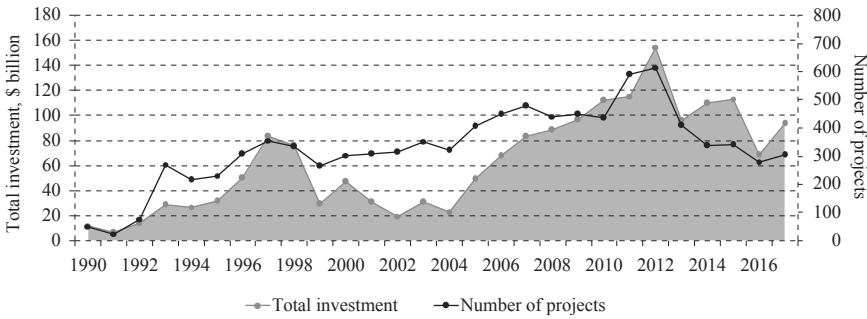
### 3 SOME STYLIZED FACTS ON PPPs

Major stylized information on PPPs is available from the World Bank’s Private Participation in Infrastructure Database (<https://ppi.worldbank.org>). It contains 7,305 projects, recorded since 1990 with a total investment of US\$2.6 trillion. PPPs represent on average 7.5% of infrastructure investment in major EMEs, with much higher shares in some (e.g. Brazil, over 25%), and lower in others (only about 1% in China).<sup>1</sup> The most important sectors for PPPs were electricity, ICT, and

<sup>1</sup> While the share of PPPs in total infrastructure investment in China is very small, it needs to be kept in mind that China invests 8.6% of GDP in public infrastructure, more than North America and Western Europe combined.

roads. There has been a sharp decline in number of projects and total investment since 2012 (figure 1). Some of this is likely related to the growing realization of the incentive problems with PPPs, particularly in multilevel countries such as India.

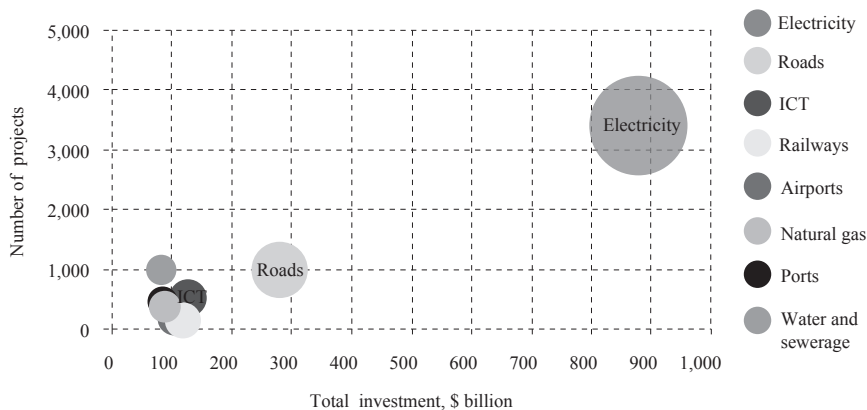
**FIGURE 1**  
*PPP projects in EMEs, 1990-2016*



Source: World Bank, *Private Participation in Infrastructure Database*.

In terms of sectoral distribution (figure 2), the electricity sector has the highest number of PPP projects (with the exception of South Africa) and/or the highest allocation of resources. The ICT sector has a relatively smaller number of PPP projects (with the exception of South Africa) but it accounted for the highest, or near-highest, investment amounts. The importance of the ICT sector for PPPs can be also seen from figure 3, which presents a global perspective.<sup>2</sup>

**FIGURE 2**  
*Sectoral distribution of PPP projects in EMEs*

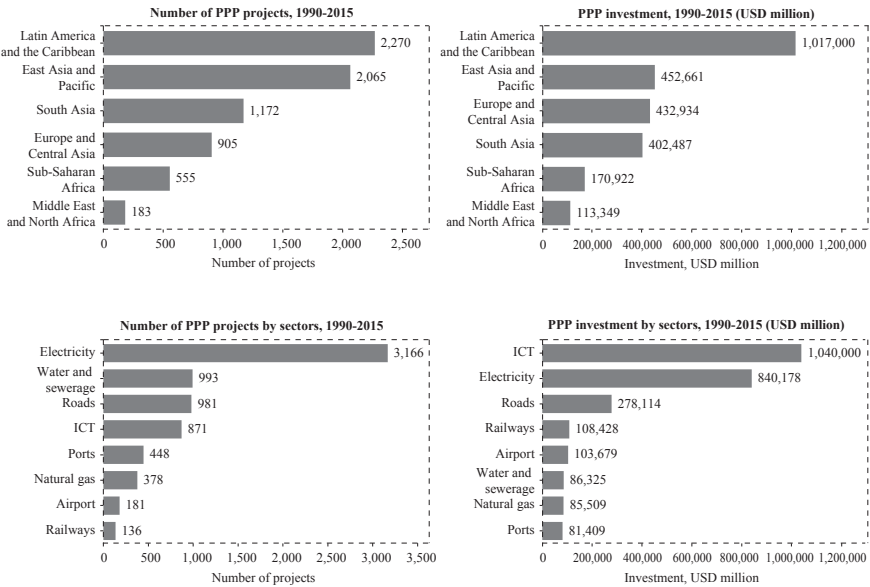


Source: World Bank, *Private Participation in Infrastructure Database*.

<sup>2</sup> The latest World Bank figures suggest a sharp increase in PPPs in roads and ICT in Latin America as well as East Asia and the Pacific after 2015 [see <https://ppi.worldbank.org/snapshots/rankings>].

The World Bank dataset also contains information on cancelled and distressed PPP projects. However, these projects are included without full information from a properly designed monitoring system, so it is hard to disentangle causes of failure. It is important to distinguish whether this is due to management failure, game-playing on the part of the private partner, or failure of the government (at different levels) to provide the requisite budgetary support to cover requisite risks. As pointed out in Ahmad (2018), there are incentives for lower levels of government to pass on liabilities to a higher level, while keeping prices low to benefit local inhabitants.

**FIGURE 3**  
*Global patterns of PPPs*



Source: World Bank, *Private Participation in Infrastructure Database*.

Addressing the increasing resistance of the private sector in many countries to participation in the “riskier” parts of the project life-cycle, especially the preparation and construction stages, Bhattacharya et al. (2016) recommend unbundling projects in such a way that the state undertakes the initial riskier stages, and the private sector is brought in at the operational stage, for example through securitization, when the revenue streams are clearly demarcated (see figure 4). This unbundling may well be particularly justified with respect to the uncertainty associated with climate change, as we discuss in the next section. However, the unbundling misses the efficiency gains and risk-sharing with the private sector at critical stages of the project life cycle, which are at the heart of the PPP-model.

FIGURE 4

*Risk and financing considerations in stages of infrastructure project lifecycle*

	Preparation	Construction	Operation
<b>Description</b>	Developer/government organizes feasibility studies; models cash flows, finances; organizes contracts with utilities, operators and construction firms	Contracted construction company builds the project to specifications	Separate operating company takes over operation and maintenance of the project
<b>Main risks</b>	Macroeconomic and political risks; technical risks to project viability; environmental and planning risks	Macroeconomic and political risks; construction risks (cost overrun, delay)	Macroeconomic and political risks; demand/traffic risks; operating risks; policy risks (e.g. tariff changes)
<b>Cash flows (stylized)</b>			
<b>Financing moments</b>	During project preparation and feasibility studies, the developer seeks “patient capital” or, often, public funds	Once project is “bankable”, the developer will seek equity investors and debt providers to finance the project	Once construction is complete and operation starts, project can be refinanced to reflect the changing risk profile

Source: Bhattacharya et al. (2016).

#### 4 DRAWING PRACTICAL CONCLUSIONS ON PPPs AND CONTRACTUAL ARRANGEMENTS FROM CONTRACT THEORY

In this section we review some of the new literature on alternative contractual options including PPPs. This enables us to address some very relevant policy concerns, such as the need to ensure greater efficiency and risk sharing with the private sector, relieving administrative constraints, and bringing in private sources of financing. PPPs should not be seen as a device for “kicking the fiscal can down the road.” Consequently, for an effective utilization of the opportunities inherent in the PPP model, the multilevel fiscal regime and associated business climate agenda need to be properly delineated, including the incentives associated with own-source taxes and information flows concerning public liabilities.

##### 4.1 TYPES OF CONTRACTS

Williamson (1985) showed that under some conditions a public firm may exactly replicate the performance of a private firm and be equally efficient (i.e., minimize cost). In that case there is no efficiency loss in letting a public firm produce some public good or run some facility.

On the other hand, Sappington and Stiglitz (1987) show that privatization can replicate public provision in terms of productive efficiency, equity, and rent extraction. When this is the case, privatization can be an optimal solution to the delegation problem. But there are two conditions. First, it should be possible to



draw up a complete contract to account for any contingencies, and the government should be able fully to commit to that contract. Second, the government (or policy maker) should be benevolent, i.e., pursue the social interest. The equivalence fails and ownership becomes relevant when one of these requirements is not satisfied. In particular, when contracts are incomplete, ownership matters even with a benevolent government.

Laffont and Tirole (1991, 1993) and Schmidt (1996a, 1996b) show why contractual incompleteness matters in the relationship between the public and private sectors. First, there is an informational asymmetry about the relevant costs and benefits of the project between the (benevolent) policymaker and the delegated manager. Second, the investments made by the manager are non-verifiable and non-contractible. This gives rise to trade-offs between productive and allocative efficiency. Under public ownership, once the cost of investment is sunk, the government cannot refrain from expropriating (part of) the associated benefits from the manager. Then, a hold-up problem arises, which leads to underinvestment. Under private ownership, the government can credibly commit not to expropriate the investment, but informational asymmetries are more costly to address. Then allocative inefficiencies may arise. Hence the first practical conclusion.

### Practical conclusion 1

*In incomplete contracting frameworks where investments made by the project developer are non-contractible, projects should be privatized when hold-up problems are severe (and thus can lead to high productive inefficiencies) and remain public when information problems are costly (and thus can lead to high allocation inefficiencies).*

To summarize, if imperfections only ensue from information problems (moral hazard and adverse selection), but complete contracts can be signed, ownership does not matter. Intuitively, an owner has no special power or rights when all project aspects are specified in a contract. Under contractual incompleteness, the owner, whether public or private, has the “residual control rights”; he therefore makes all the decisions required to develop the project on which the contract is silent (Hart, 2003).

Studies of governments with private agendas that overlap and interfere with social objectives help us understand why such non-benevolent behavior matters for project ownership. Private (regulated) ownership limits policymakers in the pursuit of their private agendas (rent-seeking), subject to institutional arrangements and degree of competition. At the same time, if governments are less informed about the relevant costs and benefits of the projects than private project managers, public ownership helps avoid allocative inefficiencies. Obviously, the desirability of private ownership depends on the balance between these two considerations (Shapiro and Willig, 1990).



## Practical conclusion 2

*When governments are non-benevolent, projects should be privatized if the private agendas of officials induce pronounced rent-seeking. Projects should remain public when it would be too costly for the government to obtain information about the costs and benefits of the private project partner.*

Under some circumstances, the boundaries between public and private firms are difficult to identify. While ownership structures matter when contracts are incomplete, many investment projects are too complex to be analyzed within an incomplete contracts framework. Consistent with this, in public debates, privatization often refers to entrusting private parties with the governing authority and managerial responsibilities that are not necessarily paired with a transfer of asset ownership. Accordingly, contracts on the privatization of infrastructure projects specify not only the transfer of ownership rights, but also attribute responsibilities about design, construction, maintenance and modernization. In this perspective, the choice between public and private ownership is not disjoint from the assignment of investment tasks.

Practical limits to the idea of separating the ownership of infrastructure projects are particularly visible when access to the assets is essential to implement innovations. Two options can be envisaged in such a case, which Hoppe and Schmitz (2010) refer to as two kinds of public-private partnership. Under the first, both parties are assigned veto power on implementation. This is tantamount to joint ownership. Under the second, neither party has veto power. The government has the right to implement quality innovations (which are beneficial to society) and the manager has the right to implement cost innovations (which make the project cheaper).

Within this framework, two conclusions can be drawn. First, given the ownership structure, it is possible to understand what the optimal allocation of investment tasks looks like by considering the pattern of investment induced by that particular structure. Second, it is possible to identify the preferable ownership structure, which will depend on the importance of the cost innovation and side effect on quality; the importance of the quality innovation and its side effect on the cost; and the bargaining power of the public and the private parties.

## Practical conclusion 3

*In incomplete contracting frameworks, where the government and the private manager share the same information, and investments in quality and cost innovations are contractible control actions, the optimal allocation of investment tasks depends on whether ownership is private or public, or a partnership is formed. Under private ownership, the manager should be entrusted with the investment in cost innovation; which party should be in charge of the investment in quality innovation depends on the parties' bargaining powers. Under public ownership, the government should maintain the responsibility for the investment in quality*

*innovation; which party should be in charge of the investment in cost innovation depends on the parties' bargaining powers. In a partnership, there should be no veto power. The government should maintain the responsibility for the investment in quality innovation; the manager should be entrusted with the investment in cost innovation.*

This conclusion can be explained as follows. Private ownership strengthens the incentives to engage in cost-reduction activities, because the benefits of those activities can be fully appropriated while attaining an efficient level of investment.<sup>3</sup> By contrast, private ownership reduces the incentives to engage in quality improvements and gives rise to underinvestment. In turn, public ownership strengthens the incentives to engage in quality-enhancing activities, in which the efficient level of investment is attained, and reduces the incentives to engage in cost innovations, which gives rise to underinvestment.<sup>4</sup> A partnership without veto power warrants implementation of both cost-reduction and quality-enhancing innovations, replicating the incentives for cost innovations under private ownership and the incentives for quality innovation under public ownership. However, it is unlikely that the two investments occur with efficient size. In fact, one should expect overinvestment to arise in one dimension and underinvestment in the other.<sup>5</sup>

#### **Practical conclusion 4**

*In an incomplete contracting framework, where the government and the private manager share the same information and investments in quality and cost innovations are contractible control actions, a partnership with no veto power is preferred to a single ownership when (1) the parties' bargaining powers are not very different, and (2) the side-effects of the quality and cost innovations are relatively less important. A single ownership is preferred when (1) the parties' bargaining powers are unbalanced, and (2) the side-effect of one innovation is important relative to that of the other. Private ownership is preferred when the side-effect induced by the quality innovation on cost is relatively strong. Public ownership is preferred when the side-effect induced by the cost innovation on quality is relatively strong.*

<sup>3</sup> This outcome arises when, as considered by Hoppe and Schmitz (2010), the parties agree on setting the quantity (not excessively) below the efficient level in the contracting stage. That quantity can then be upgraded to the efficient level in a later renegotiation. This possibility looks highly plausible as, in practice, it is often the case that the scope of the project is revised and scaled up during its development. If the quantity is set to the efficient level already in the initial contract, then overinvestment in cost innovations arises under private ownership, because, as found in Hart, Shleifer and Vishny (1997), the side effect of the cost-reducing activities on quality is not internalized. On the other hand, too small a quantity leads to underinvestment, because the manager does not fully appropriate the benefits generated by the investment in the renegotiation stage. An important lesson arises from these results. Extending the scope of public projects during their development and, hence, letting the projects become less cheap than initially planned, may be a deliberate choice to address the overinvestment problems that would arise if a bigger size were fixed up-front.

<sup>4</sup> The same observation on the choice of the quantity level applies in this case.

<sup>5</sup> Again, this is related to the quantity choice made by the parties in the initial contract. In this case, the quantity is a single incentive tool to be used to pursue two goals, namely induce an efficient investment in cost reduction and quality enhancement. In general, the quantity that secures the former goal differs from the quantity that secures the latter, and none of the two goals is achieved as a result of the bargaining process between the parties.

This conclusion is intuitive. When one party has strong bargaining power, the critical limit of the single ownership, namely the issue of underinvestment, is less important. What matters is to attain the efficient level of investment in the innovation that is deemed to be important. A partnership is thus less appropriate. When the bargaining power is equal between the parties, the issue of underinvestment in one task – either cost reduction or quality enhancement – is more important. This makes a partnership a more appropriate solution. Of course, the reach and implications of this conclusion cannot be fully understood without identifying what determines the bargaining power of the public and the private party. As Hoppe and Schmitz (2010) suggest, this might be related to the degree of competition.

#### 4.2 BUNDLING OR UNBUNDLING?

In drawing up practical conclusions 3 and 4, we have followed Hoppe and Schmitz (2010) and referred to “partnerships” as arrangements under which either the public and the private party both have veto power on the implementation of innovations, or neither has veto power but each is in charge of a single innovation. PPPs are essentially meant to be contractual arrangements for the development of infrastructure projects with the following key characteristics: first, the construction of the infrastructure and its subsequent management for the provision of a service are bundled and assigned either to a single private contractor or to a consortium of private firms. Second, sometimes the bundle includes also other phases of the project, such as design and finance.

Bundling places PPPs in sharp contrast with traditional procurement, under which the private sector is also involved, but the responsibilities for the different phases of the project are assigned to different private contractors. Therefore, PPPs are intrinsically longer-term than procurement relationships.

There is also a second feature that differentiates PPPs from traditional procurement. Under a PPP, the government specifies the *outputs*, namely the service to be delivered and the essential standards to be complied with, whereas the control rights over the ways of accomplishing tasks are transferred to the private contractor. Throughout the duration of the PPP, the private contractor is responsible for the infrastructure, may implement innovative systems for service supply, and may even use the infrastructure for other income-generating activities (provided that the standards specified in the PPP contract are not diminished). At the end of the contract, either the infrastructure returns to the public sector or it remains with the private sector, depending on the specific contractual arrangement.

By contrast, under traditional procurement, the government specifies the *inputs* and preserves the ownership of the infrastructure during the contractual period and thereafter. Accordingly, one may consider a PPP as being tantamount to *private ownership with bundling of subsequent activities*, and traditional procurement as being tantamount to *public ownership with unbundling and delegation of subsequent activities to different private contractors* (Bennett and Iossa, 2006).

There are various criteria to be used and aspects to be considered to establish when the PPP-type institutional arrangement in infrastructure projects is preferable to the unbundled. These criteria depend on the terms of residual value and optimal ownership of the infrastructure after the contracts end. This is a major concern for public infrastructure projects with long-term private investments.

The first aspect that matters and, hence, can be used as a criterion to establish a preference between PPPs and traditional procurement, pertains to the nature of the links (if any) between the subsequent phases of the project. To examine this aspect, Bennett and Iossa (2006) use an incomplete contracting model with two subsequent project stages, namely construction of the infrastructure and management and provision of the public service. They represent situations in which investments are non-contractible – as is the case with the delivery of innovations – but ex-post verifiable, because once innovations have been discovered their implementation can be verified. Accordingly, the owner of the infrastructure during the execution of the project is allocated the right to decide on the implementation of the innovations. The implication is that under private ownership (PPP) the contractor decides freely whether to implement an innovation or disregard it. Under public ownership (procurement) any innovation requires a new negotiation with the contractor, the implementation of innovation can then be either permitted or not.

### Practical conclusion 5

*Bundling is preferable when there are positive externalities between the subsequent phases of the project. The case for bundling is weakened when there are negative externalities between the subsequent phases of the project. Unbundling is preferable with weak externalities, especially if the provision of the service is long-term.*

For instance, a positive externality (or synergy) arises when building a high-quality infrastructure reduces the cost of management in the operation stage. When the high quality of the infrastructure, while enhancing the social benefit of the project, increases the cost of management, the externality is negative, instead.

Intuitively, PPPs perform better in the presence of positive externalities because the latter are optimally internalized when project phases are bundled. Bundling strengthens both incentives to innovate and reduce the costs over the lifecycle of the project. Traditional procurement performs better with weak negative externalities, as internalization is then either irrelevant or less desirable. On the other hand, internalization of negative externalities exacerbates the issue of underinvestment. The same issue arises in the hold-up problem under incomplete contracting noted above. If externalities are weak and the operation phase is long, then project bundling restricts competition without providing positive incentives to reduce costs or improve quality.

**Practical conclusion 6**

*In the presence of positive externalities, control rights on the innovations should be assigned to the private contractor, if the effects in terms of cost and residual value of the infrastructure are strong relative to those on the social benefit. In the converse case, control rights should be assigned to the government. In the presence of negative externalities, control rights should be assigned to the private builder of the infrastructure, if the effects in terms of residual value of the infrastructure are relatively strong. If the effects in terms of social benefit are relatively strong, control rights should be assigned to the government.*

The intuition behind this conclusion is not very different from that underlying practical conclusion 2. We will rather turn to considering the ownership in the post-contractual period.

**Practical conclusion 7**

*With positive externalities between project phases, bundling is desirable regardless of whether the infrastructure returns to the public sector or remains with the private contractor after the end of the contract.*

If the infrastructure becomes public after the end of the contract, a concern arises with the incentives to invest in innovations by the private partner. The impact on incentives will depend on how and under what conditions the return to public ownership takes place. Innovation incentives are reduced if an automatic transfer clause is introduced in the PPP contract. Hence, clauses of this kind are to be avoided. Innovation incentives are reinforced if the choice is made through a voluntary negotiation and the partners reach an agreement on a compensation payment to the private contractor. This is obviously a better strategy to follow in terms of innovation incentives. The negotiation strategy also strengthens the case for PPPs relative to traditional procurement, especially for projects/services that do not attract strong political or social opposition to the long-term private ownership of infrastructure.

A more nuanced view becomes possible when one goes beyond the externalities case and considers interdependence of the different project tasks. As Chen and Chiu (2010) point out, interdependence of tasks may lead to substitutability: making more of one investment decreases the benefits of making more of another investment. For instance, constructing a high-quality hospital reduces the operational cost once the hospital is finished, but makes it less likely that further improvements in the quality of the hospital facility will be made, or that it will be used for alternative purposes. Interdependence of tasks may also lead to complementarity: making more of one investment increases the benefits of making more of another investment. For instance, installing higher-quality but more expensive glass in the windows of a school reduces the operational cost; in addition, it may be worthwhile to install a surveillance system to protect windows from vandalism.

This classification of tasks helps us to understand a circumstance in which the exact terms under which the service will be provided in the operation stage are not defined until after the infrastructure is built, even though operation by the private contractor is accounted for in the contract. It is also useful for thinking about greenfield projects, in which preserving flexibility in the contracting stage helps arrangements to be modified at a later stage, when the project becomes more mature and the initial uncertainty dissipates.<sup>6</sup>

### Practical conclusion 8

*In a framework with interdependence of investment tasks and interim contractibility of the task to be accomplished in the operation stage, substitutability favors bundling. Under private ownership, it also favors the PPP consortium for the entire life-cycle of the project, arranged through a separate direct contract with the builder during the construction stage.<sup>7</sup> Complementarity favors unbundling and, under private ownership, a separate builder's contract for the construction stage. Under public ownership, for instance by state-owned enterprises, integration and separation of tasks are equivalent.*

When the tasks are separated (unbundled), complementarity is helpful in lessening the incentives to underinvest in the construction stage, which result from the usual hold-up problem. As mentioned above, complementarity involves more investment in the construction stage triggering more investment in the operation stage. Thus, with complementary tasks, the private builder will be more motivated to invest, anticipating that this will induce the manager to invest more and that more surplus will be generated. As the operating task can be negotiated at interim, the builder can negotiate with the manager how they will share the benefits of the operating investment. The sharing will depend on the size of the investment initially made by the builder, whereas the cost of the operating investment will remain with the manager only. This explains why complementarity favors the builder's ownership/full PPP contract. On the contrary, when the tasks are bundled, complementarity weakens the incentives to invest in the construction stage because the private contractor internalizes the impact on the later investment not only in terms of benefits but also in terms of costs.

Under public ownership, integration and separation are equivalent because, on the one hand, the operating investment can be contracted upon at interim and, on the other, the government can veto the implementation of the building innovation after the investment has been made.

<sup>6</sup> Projects are said to be greenfield when they are totally new. They require designing, financing and building in the early stages; and operating and maintaining in the late stages (these tasks can, of course, be accomplished under different possible institutional arrangements). By contrast, brownfield projects rest on previously existing assets so that such tasks as design and construction are of a more limited importance. As developing countries are very poorly endowed with existing infrastructure they are much in need of greenfield projects. The conclusions presented in the text are therefore potentially very relevant for developing countries.

<sup>7</sup> Recall that in PPPs the private partner is often a consortium of private firms (rather than a single firm), and that it is in charge of all the phases of the project (rather than solely the construction phase).



It is useful to relate this to practical conclusion 5. According to the latter, negative externalities between tasks weaken the case for bundling relative to separation. It has sometimes been argued that negative externalities are almost negligible in practice. This would mean that bundling should be observed in nearly all projects. However, that conclusion should be refined in light of practical conclusion 8. Unbundling is a desirable option even in the presence of (not-too-pronounced) synergies, when the project tasks display sufficiently strong complementarity. Chen and Chiu (2010) discuss this point in light of projects of a different nature (e.g. schools and information technology projects as cases of complementarity, prisons and transport as cases of substitutability).

### Practical conclusion 9

*In a framework with interdependence of investment tasks and interim contractibility of the task to be accomplished in the operation stage, private ownership is preferable when the residual value of the infrastructure is high and the social value of the project is low. Public ownership is preferable in the converse case.*

So far, we have identified several features of the projects and the contractual environments under which bundling (hence, PPP) is preferable to an institutional arrangement that separates and assigns tasks to different contractors. As the relationship between public and private agents is of a longer-term nature under bundling, innovation incentives that arise to project developer have to be contrasted with a potential drawback of bundling, i.e. the scope for informational asymmetries to develop over time. This implies that a PPP may or may not perform better than traditional procurement over the long term, depending on the incentives of the private contractor to gather information for strategic reasons.

Hoppe and Schmitz (2013) develop a model in which the initial contract details only the basic features of the project, whereas additional specifications can be agreed upon later, when the operation phase is to begin and it is then apparent how to improve the project to match the social needs. Again, the interim contractibility of subsequent (ex-post verifiable) investments is meant to capture the necessity of preserving flexibility for future adaptation, as also accounted for in Bennett and Iossa (2006), and Chen and Chiu (2010). Of course, the second-stage improvements are costly. Hoppe and Schmitz (2013) focus on situations in which the cost is not known in the construction stage, but the private builder can devote some resources to gather information about it. Information gathering is socially wasteful in that the cost will become known without exerting any effort in the operation stage. The contractor can nonetheless decide to acquire information in order to appropriate more surplus in a later stage of relationship with the government (a rent-seeking strategy). Whereas the institutional arrangement would be irrelevant in the absence of informational asymmetries between the public agency and the private contractor, it does matter when the latter enjoys an informational advantage.

### Practical conclusion 10

*In a framework with early design innovation, interim contractibility of the operating investments, and strategic gathering of information on the cost of those investments, traditional procurement is preferable when the government can rely on some precise signal of the effort exerted in innovation, information gathering is cheap, and great importance is attached to the surplus accruing to the private contractor. PPPs are preferable otherwise.*

Under traditional procurement, the government must provide a reward to motivate the contractor to come up with an innovative design in the early stage of the project. The reward is typically based on some signal of the effort exerted to attain the agreed-upon outcome. For the contractor protected by limited liability, this involves granting a rent.

Under a PPP, there is less need of a direct reward. The contractor will be motivated to innovate early in the project, anticipating that she will enjoy a rent if she makes that effort and then gathers information (not available to the government) on the future cost. The perspective of attaining that rent permits a reduction in the rent to be conceded due to limited liability. The PPP thus provides a useful tool to motivate the private contractor to develop a design that is flexible enough to respond to the future social preferences in a cost-effective manner. However, the rent in the form of strategic information gathering is not socially desirable, and the PPP project in this case will actually be less cheap than it might have been if resources had not been disbursed for strategic purposes.<sup>8</sup>

In several cases, especially involving climate change, the investments made in the early stages of the project do not simply affect the environment in which later investments will be made. When irreversible, the early investments may represent a constraint to the later investments. For instance, if high-quality investments are made in the water, transport, or electricity systems early in the projects, the contractor is committed thereafter to make high operation and maintenance expenditures to maintain the viability of the project. This is potentially problematic when future conditions are uncertain in the early stage of the project. Indeed, irreversibility leads to rigidities, i.e. it makes it difficult to adapt the project to the environmental conditions that will be discovered only at a later stage. It is thus not surprising that irreversibility will affect the incentives and the decisions of the

<sup>8</sup> Hoppe and Schmitz (2013) point out that these results are robust to the possibility that the government does not observe information gathering. However, in that case ex-post inefficiencies may arise under PPP. Che, Iossa and Rey (2017) also conclude that rents matter. They consider an environment where the procurer pursues two goals: incentivizing research effort to create a new idea, and implementing the new idea in a least costly manner. Provided that the research effort is unverifiable and that the cost of implementing the innovation is privately known, the procurer faces moral hazard ex ante and adverse selection ex post. The implementation of the idea should be assigned to the innovator (that is, the follow-up should be bundled with the initial contractor) when the value of the innovation is sufficiently high. In that case, the rents accruing to the innovator represent a powerful incentive tool. By contrast, the implementation of the idea should be assigned to a contractor other than the innovator (that is, the follow-up should be separated with a new contractor) when the value of the innovation is low. In that case, the rents accruing to the innovator are greater than incentives to innovate, raising the opportunity cost of favouring the innovator.



contractor in the subsequent stages. These considerations have implications for the desirability of different institutional arrangements and bundling at subsequent stages relative to a sequence of shorter-term contracts with different contractors.

Martimort and Straub (2016) examine bundling in a two-period model with uncertainty, in which a non-verifiable and costly effort (investment) is exerted in each period. Higher effort makes it more likely that the social return to the project will be above its basic social value. Non-verifiability and irreversibility influence the incentives to invest early in the project. A dynamic moral hazard problem arises and rents are generated under limited liability.<sup>9</sup>

### Practical conclusion 11

*In an incomplete contracting framework with uncertainty, unverifiable irreversible investments, and limited liability, bundling tasks in a long-term contract is desirable when commitment concerns prevail. Unbundling and providing for a sequence of shorter-term contracts with different contractors is desirable when flexibility concerns prevail.*

The government agency can structure the intertemporal profile of rewards to the contractor in charge of the project in such a way that the contractor will find it convenient to raise the early investment, thus also creating a commitment to high investment at a later stage. However, the contractor's reaction will also depend on how he or she values the preservation of flexibility. A responsive contractor will make large investments in both early and later stages due to the commitment effect induced by the initial investment. A less responsive contractor will invest little in the early stage and, hence, will be free to choose any convenient level of investment later in the project, when uncertainty will be resolved. To understand why the issue of underinvestment is mitigated if the second stage of the project is separated from the first and delegated to a different contractor, it is useful to consider that irreversibility works as a negative externality between investments. We recall from practical conclusion 5 that negative externalities weaken the case for bundling tasks. Separation mitigates the issue of underinvestment because, following the early irreversible investment, the second contractor will enjoy less flexibility and be committed to investing.

As usual, the most appropriate organizational form is not a one-for-all solution. It depends on several elements, as Martimort and Straub (2016) show, including:

<sup>9</sup> The authors point out that what they refer to are investments intended to raise the efficiency (or quality) of the project, in addition to any well-defined investment related to, say, the contractually specified size of the physical assets. This latter kind of investment is verifiable and, hence, could be disciplined through the contract. One might expect the moral hazard problem associated with non-contractible investments to be especially severe when the physical assets to which the contractible investments pertain are network infrastructures (such as rail and road systems) rather than stand-alone facilities (such as schools and hospitals) and point-to-point infrastructures (such as ports and airports). This is because the former are more complex systems, require higher sunk costs, and are exposed to less competition. Considerations of this kind lead Albalade, Bel and Geddes (2015) to suggest that jurisdictions inexperienced in contracting out infrastructure projects begin with stand-alone facilities and point-to-point infrastructures, and move to network infrastructures only after acquiring sufficient expertise.

(1) the presence of rents associated with the moral hazard problem and the availability of instruments to contain them; (2) the sector concerned or kind of project and the environmental specificities; and (3) the likelihood of future technological improvements in a given sector/kind of project.

### Practical conclusion 12

*In an incomplete contracting framework with uncertainty, unverifiable irreversible investments, and limited liability, the case for bundling tasks in a long-term contract is stronger when: (1) there are instruments to contain limited liability rents; (2) the sector/kind of project concerned is less exposed to the adverse consequences of unpredictable events; and (3) technological improvements are expected to enhance flexibility.*

In practice, conceding rents is necessary to address moral hazard, because contractors are generally protected by limited liability (or are risk averse). Moral hazard is more easily addressed if there are ways to reduce the rents (i.e. the stake for opportunistic behavior). This could be achieved, among other ways, by tightening competition in the tendering stage, boosting diversification through the acquisition of financial bonds (so as to reduce the need for insurance within the contractual relationship), and/or introducing risk- and revenue-sharing mechanisms.<sup>10</sup>

Local public goods provide a good example of sectors and projects with prominent commitment concerns that are less exposed to the potential consequences of unpredictable events, particularly those associated with climate change. Water and sanitation networks and power production projects belong to the category of sectors and projects that are heavily exposed to flexibility concerns. However, Borenstein (2012) emphasizes that even generation plants with similar technologies will not have the same exposure, as they are highly heterogeneous in location, architecture, and other elements.

Sometimes technological improvements may grant technological flexibility, which may work as a substitute for contractual flexibility. When this is the case, it becomes less important to preserve flexibility by reducing investments early in the project. If so, the case for unbundling is weakened. However, technological improvements cannot be taken for granted (Biglaiser and Riordan, 2000). For instance, they are less likely in water and sanitation systems, and highly plausible in energy projects, favoring bundling in the former case, and making the choice less clear-cut in the latter.

### 4.3 MULTILEVEL CONSIDERATIONS

Multilevel governance conditions are important. In general, central governments, which are typically in charge of water and energy policy, should be well prepared to design and follow up short-term contracts, while local governments, which are

<sup>10</sup> Mechanisms of this kind are already in use in many utilities and projects such as greenfield concessions for toll highways, as reported in Iossa (2015). Of course, this calls for fine-tuning complementary institutional mechanisms and raises potential concerns related to social equality considerations.

typically in charge of local public goods, should be well prepared to design and follow up PPPs. However, this conclusion may be problematic on several grounds.

PPP contracts may be too complex for many local governments to implement, so they should ideally receive technical support from a central PPP-management body, perhaps supported by international agencies. The liabilities associated with PPP contracts should be recorded in the local government balance sheets. This requires both the GFSM and IPSAS standards to be implemented. Not doing so proved problematic in EU countries (see Ahmad, Bordignon and Brosio, 2016). For instance, France has just required local administrations to begin doing so. In particular, it is essential for local governments to have access to local own-source revenues in order to limit the creation of liabilities within a medium-term budget framework and lessen the incentives to engage in strategic game-play with the central government. This issue is critical in the context of the SDGs (see Ahmad, Brosio and Gerbrandy, 2017).

When the bundling solution is preferable, an additional conclusion can be drawn concerning the preferable form of PPP to be used. As Martimort and Straub (2016) highlight, this also raises the question whether the infrastructure should return to the public sector or be privatized after the contract ends.

## 5 CONCLUDING REMARKS

This paper highlights the interactions of sustainable investment decisions with tax policy options and institutional arrangements and information flows that influence incentives facing firms, households and governments at different levels.

Equally important are the interlinkages between information flows and governance institutions, including public finance management prerequisites such as recording public liabilities (including subnational governments and state-owned enterprises) in general government balance sheets. Despite the pessimism of some senior staff of international financial institutions (e.g. Cangiano, Gelb and Goodwin-Groen, 2017), both the GFSM and IPSAS standards are needed, not to report to the IMF but as tools of active macro-management and accountability at different levels of government. Without full information on the nature, generation and time-profile of liabilities, PPPs can easily become opportunities to “kick the fiscal can down the road”, and create opportunities for “game-play” between different levels of government and between the private and public partners. As highlighted in Ahmad and Zhang (2018), full information is needed also with respect to state-owned enterprises, particularly at the local level.

The choice between alternative contractual arrangements at different stages of the project life-cycle turns on the need to bring in private expertise, risk-sharing, and private finance. The contractual options range from traditional public procurement to PPPs of various types. Asymmetric information makes it possible for the private partner to extract extra rents, and for local governments to hide liabilities. But the

private sector may just not be interested in earlier and riskier stages of the project life cycle due, perhaps, to lack of credibility of contracts or rent-seeking. This is where multilateral agencies able to guarantee that contracts will be respected come into play.

Bhattacharya et al. (2016) argue that different stages should be “unbundled” or treated separately, so that the private sector is brought in when there is a steady stream of income. However, entering into PPPs at the operational stage may be tantamount to privatizing the benefits but socializing the risks. Bhattacharya et al. (2016) refer to “securitization” rather than PPPs at the operational stage. This may well be the appropriate option, particularly with respect to uncertainty associated with climate change (Martimort and Straub, 2016). In this vein, Arezki and Sy (2016), suggest with reference to African countries that development banks should provide financing in the early phases of the infrastructure projects when risks are particularly high.

But there are distinct advantages with “bundling” and full risk sharing with the private sector in all stages of the project life cycle, especially where there is interdependence between activities at the different stages. This may be critical to innovation, efficiency, and overall cost.

The contract choices can be quite complex. A national office dealing with the operational, legal, and regulatory arrangements, as well as dispute-resolution may be needed. Technical support from countries (including the EU as well as major Asian countries) with experience in designing and managing infrastructure programs may be quite helpful in this regard. Multilateral development banks have considerable expertise in this area, with repositories of case studies. They could usefully reorient their traditional activities concerning and support to developing and emerging market economies so as to support sustainable development. The options include better articulation of the overall growth strategy and parameters for project selection; interactions with the tax regime at the national and local levels, particularly the role of local property taxes to anchor local investments and service delivery and generate accountability; identification of local growth hubs; improved formulation and implementation of support for IFMISs to focus on the tracking of liabilities at all levels of government, particularly the GFSM framework and IPSAS standards; support for contracting arrangements at national or local levels so as to prevent egregious rents; exchange of information on successful as well as problematic implementation cases; and ensuring that contracts are respected.

Together, the options presented here represent a formidable research and policy agenda for designing and implementing sustainable growth strategies and programs.

### Disclosure statement

No potential conflict of interest was reported by the authors.

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# Public investment and corporate productivity in Croatia

SANJA BORKOVIC, M.A.\*  
PETER TABAK, M.A., MBA\*

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Sanja BORKOVIC

Analyst, European Bank for Reconstruction and Development, Španskih boraca 3, 11000 Belgrade, Serbia

e-mail: [BorkoviS@ebrd.com](mailto:BorkoviS@ebrd.com)

ORCID: 0000-0003-4602-2021

Peter TABAK

Lead Regional Economist, European Bank for Reconstruction and Development, Španskih boraca 3, 11000 Belgrade, Serbia

e-mail: [TabakP@ebrd.com](mailto:TabakP@ebrd.com)

ORCID: 0000-0001-5745-9988

## Abstract

*Motivated by the weak productivity growth, low investments and unfavourable demographic dynamics in Croatia, the paper investigates the relationship between public investment and the productivity of Croatian firms. Our results suggest that government investments in general have a significant and positive effect on total factor productivity (TFP) at firm level. The positive effect can be established only for private sector companies though, while state-owned enterprises do not seem to benefit significantly from these investments. The latter may be due to the relatively small sample of public firms. However, not every type of public investment is significant for Croatian companies. While investments in transport and R&D tend to enhance productivity throughout the economy, investments in human capital work only at the sectoral level by supporting the productivity of enterprises operating in tourism. Sector-level analysis confirms that all the sectors examined benefit from public investment in transport but also reveals that investments in R&D tend to increase the productivity of manufacturing companies only.*

*Keywords:* total factor productivity, productivity drivers, public investment, Croatia

## 1 INTRODUCTION

As a consequence of the global financial crisis, the region of Central, Eastern and South-Eastern Europe (CESEE) has experienced a large drop in investment since 2008, though with significant cross-country variances. While Bulgaria recorded a drop in investment-to-GDP ratios of around 15 percentage points between 2008 and 2015, the decline was less than 5 percentage points in the Czech Republic. Over the same period, some countries managed to increase public investment (e.g. Hungary, Slovakia). Croatia, however, has undergone the largest decline in public investment among the new EU member states – from 6 per cent of GDP in 2008 to 3 per cent in 2015 – due in part to its limited capacity to absorb EU structural and cohesion funds and the completion of a number of large public infrastructural projects. The fall was driven by investment in transport, one of the main investment categories, which fell from 2.7 to 0.5 per cent of GDP between 2008 and 2015. Public investment in human capital (i.e. education, health, and housing and community amenities) also declined, but to a lesser degree, from 1.2 to 1.0 per cent of GDP. On the other hand, investment in research and development (R&D) has increased, but only in 2015, and at 0.1 per cent of GDP in 2015 remains rather negligible.<sup>1</sup>

In light of the large volatility in public investment in Croatia in the recent past, the question arises how much the changes (especially those in transport infrastructure) have affected the total factor productivity (TFP) of Croatian firms since 2008. In order to answer this question, the paper examines the main productivity drivers of Croatian enterprises, including public investment, and also differentiates between public and private sector companies. Furthermore, the paper assesses

<sup>1</sup> Source: EUROSTAT.

whether different types of public investment are equally relevant for all sectors (e.g. public investment in R&D might be important for the productivity of manufacturing companies, but less so for that of construction firms).

The focus on the productivity, and specifically TFP, is justified by three main reasons. First, TFP contributed negatively to the potential growth of the Croatian economy after the global financial crisis and has started to contribute positively only recently (European Commission, 2017). Second, UN (2017) forecasts show that Croatia, like many other European countries, might face a significant decline in population in the coming decades (of more than 17 per cent between 2017 and 2050), which highlights the need for productivity enhancements in order to sustain economic growth. Third, unlike labour or capital productivity, which measure the productivity of a single factor of production, TFP is a comprehensive concept, showing the portion of output not explained by the amount of inputs used in production and thus indicating the efficiency of combining factors of production. As a result, gains in TFP are usually related to technological progress or innovation.

The remainder of the paper is organised as follows. Section 2 reviews related literature. Section 3 outlines the methodology, while section 4 describes the data used. Section 5 reports the results from the econometric analysis. Conclusions are presented in the final section.

## 2 LITERATURE REVIEW

Because it is such an important issue for public policy, the link between public investment and economic growth has been thoroughly researched. In terms of theory, the relationship is ambiguous. On the one hand, public investment can positively affect growth through raising aggregate demand, potentially crowding in private investment and contributing to the economy's productive capacity. On the other hand, it can also crowd out private investment. In addition, this theoretical seems to translate into an empirical ambiguity, as indicated by the richness of results in the empirical literature (see, e.g. Barro, 1991; Devarajan, Swaroop and Zou, 1996; Cavallo and Daude, 2011; Warner, 2014; Bom and Ligthart, 2014). However, some specific public investments, such as investment in infrastructure or innovation, and productive expenditure, like those in education and health, seem to impact long-term economic growth positively (see Fournier, 2016; Acosta-Ormaechea and Morozumi, 2013; Barbiero and Cournède, 2013).

But how important is public investment for productivity? The question is particularly interesting given the expected population decline and potential labour shortages many developed countries will face. The starting point of this line of research was Aschauer (1989), who found that public investment is a significant predictor of productivity growth. Despite some critical reviews (Aaron, 1990; Gramlich, 1994), Aschauer's findings were often confirmed (Munnell, 1990; Fernald, 1999; Mamatzakis, 2003; Bronzini and Piselli, 2009), with some authors focusing specifically on private sector productivity (Heintz, 2010; Pineda and Rodriguez,

2006). Still, all these approaches generally relied on aggregate data at the country, regional or industry level; thus, specific channels through which public investments affect productivity at firm level were not revealed.

Mechanisms translating public investment into higher firm productivity could be direct or indirect. For example, public investment in (better quality) roads might reduce transport-related costs for companies. Or, as Kneller and Misch (2014) observe, labour productivity may be affected by health-related public services (e.g. through increased availability of drugs against common diseases), while investment in infrastructure can improve firm productivity through, e.g. potentially lower inventory levels and easier access to a larger number of suppliers. Using a sample of South African firms, the authors find that capital intensity of firms is an important factor in the transmission mechanism, i.e. shifts in public expenditure mix towards more productive ones positively affect productivity of firms that have lower ratio of capital to labour than other firms in their industry and province.

Studies that examine the relationship between public investment and firm-level productivity are rather scarce. To the best of our knowledge, besides Kneller and Misch (2014), there are only two other studies that try to establish similar micro-economic linkages, although their focus was not strictly on firm productivity. Chatterjee and Narayananz (2016) examined the output elasticities of Indian firms in the formal and informal sectors to government investment in infrastructure, while Iimi, Humphrey and Melibaeva (2015) studied the impact of improving the quality of public infrastructure in five East African countries, associating output elasticities of firms with different infrastructure costs, including transport.

Hence, by pursuing a micro-level approach we are trying to fill the gap in the literature, which would be the main contribution of this paper. Furthermore, we are adding to productivity studies on Croatia, which also appear to be limited. One of them (Anos-Casero and Udomsaph, 2009) revealed positive influence of the quality of infrastructure on the TFP of Croatian enterprises, while the other one (Iootty et al., 2014) examined the contribution of firm dynamics to productivity growth over the period 2008-2012.

### 3 METHODOLOGY<sup>2</sup>

Following the vast empirical literature, the TFP determinants were estimated by a two-step approach (see, e.g. Escribano and Pena, 2009; Coricelli et al., 2012; Añón-Higón et al., 2014; Fons-Rosen et. al., 2014; Damijan, 2016).

**First, in order to calculate the TFP, a production function was estimated on a panel of firms.** We assumed that the production function followed the Cobb-Douglas form with endogenous capital and labour:

$$Y_{it} = A_{it} L_{it}^{\beta_l} K_{it}^{\beta_k} M_{it}^{\beta_m} \quad (1)$$

<sup>2</sup> This section draws from Zildzovic et al. (2016:89-90).

where  $Y_{it}$  represents output (sales) of firm  $i$  in period  $t$ ,  $A_{it}$  represents the TFP, and  $L_{it}$ ,  $K_{it}$  and  $M_{it}$  are inputs of labour (measured as number of employees), capital (measured as book value of fixed assets) and intermediate (material) inputs, respectively, while  $\beta_y$ ,  $\beta_k$  and  $\beta_m$  represent output elasticities of these three inputs. Taking natural logs, we get the linear representation:

$$y_{it} = \ln A_{it} + \beta_l l_{it} + \beta_k k_{it} + \beta_m m_{it} \quad (2)$$

where lower-case letters refer to natural logarithms of the variables and  $\ln A_{it} = \beta_0 + \varepsilon_{it}$ , with  $\beta_0$  being the average level of productivity of the firm and  $\varepsilon_{it}$  the deviation from that average. Furthermore,  $\varepsilon_{it}$  can be decomposed into  $\omega_{it}$  (the observable component of the TFP, i.e. shock in productivity that a firm can predict when deciding on inputs) and  $e_{it}$  (unobservable component of the TFP, which represents measurement error or unexpected productivity shocks).

Under the assumption that  $\omega_{it} = g(k_{it}, m_{it})$  is a three-degree polynomial of the capital stock ( $k_{it}$ ) and intermediate inputs ( $m_{it}$ ) and that  $E(e_{it} | l_{it}, k_{it}, m_{it}) = 0$  (where  $t = 1, 2, \dots, T$ ), Eq. (2) becomes:

$$E(y_{it} | l_{it}, k_{it}, m_{it}) = \beta_0 + \beta_l l_{it} + \beta_k k_{it} + \beta_m m_{it} + g(k_{it}, m_{it}) = \beta_l l_{it} + h(k_{it}, m_{it}) \quad (3)$$

where  $h(k_{it}, m_{it}) \equiv \beta_0 + \beta_k k_{it} + \beta_m m_{it} + g(k_{it}, m_{it})$ .

Early research estimated Eq. (3) using the ordinary least squares (OLS) method. However, OLS estimates of the unobservable TFP can be correlated with the error term as firms change their factor inputs in anticipation of TFP change.<sup>3</sup> This endogeneity renders OLS estimates inconsistent. The seminal works of Olley and Pakes (1996) (henceforth OP) and Levinsohn and Petrin (2003) (henceforth LP) suggested possible alternatives. However, OP's approach rests only on the subset of firms with positive investments, while relying heavily on proper measurement of the capital variable. LP's approach potentially suffers from an identification problem in the first estimation stage due to collinearity. In order to overcome these issues, Wooldridge (2009) proposes using a single set of moments, built upon the LP method (see also, e.g. Petrin, White and Reiter, 2011; Gal, 2013; Sung and Sang, 2014).

Following Wooldridge (2009), we estimate the industry specific production functions in the following form Eq. (3):

$$y_{it} = \beta_0 + \beta_l l_{it} + \beta_k k_{it} + \beta_m m_{it} + g(k_{it}, m_{it}) + e_{it}, t = 1, \dots, T \quad (3.1)$$

and

$$y_{it} = \beta_0 + \beta_l l_{it} + \beta_k k_{it} + \beta_m m_{it} + f(g(k_{it-1}, m_{it-1})) + \eta_{it}, t = 1, \dots, T \quad (3.2)$$

<sup>3</sup> In other words the error term is expected to influence the decision on factor inputs (labour and capital).

where  $\eta_{it}$  represents the sum of innovations in productivity ( $a_{it}$ , where  $a_{it} \equiv \omega_{it} - E(\omega_{it} | \omega_{it-1})$ ) and unobserved TFP ( $e_{it}$ ), whereas the function  $f(\cdot)$  is approximated by a three-degree polynomial in  $g$ . Under the assumption that  $\omega_{it}$  follows a random walk, identification is made by just current values and one lag in the conditioning set. In order to identify Eqs. (3.1) and (3.2) in the generalised method of moments (GMM) estimation, two groups of instruments are used – in the first equation the polynomials of  $\ln k_{it}$  and  $\ln m_{it}$  and their one-period lags, and in the second equation lagged  $\ln l_{it}$ , lagged  $\ln k_{it}$  and the lagged polynomials of  $\ln k_{it}$  and  $\ln m_{it}$ .

Once the coefficients on labour, capital and intermediate inputs are estimated, the firm-level TFP is calculated as:

$$tfp_{it} = y_{it} - \beta_l l_{it} - \beta_k k_{it} - \beta_m m_{it} \quad (4)$$

**Second, we estimate the impact of the key prospective determinants on TFP growth.** In particular, the following panel regression was estimated:

$$tfp_{it} = \alpha + \beta tfp_{i,t-1} + \sum_j \gamma_j X_{jit} + u_i + v_{it} \quad (5)$$

where  $X_{jit}$  is a set of TFP determinants (a variety of firm-specific, macroeconomic, institutional and business environment determinants, including public investment),  $u_i$  captures firm-specific unobserved effects and  $v_{it}$  is the error term. The estimates were obtained by using the first-differenced GMM regression to deal with potential endogeneity.

#### 4 DATA

For the analysis of productivity drivers, the paper uses a panel of 48,129 companies in Croatia, in the period 2007–2015. Firm-level data were obtained from the BvD ORBIS database. Observations with negative values for any of the variables entering the production function (revenues, fixed assets, material costs) were excluded from the sample. Sector- and country-level data come from the EURO-STAT, the Croatian National Bank, and the World Economic Forum (WEF) Global Competitiveness Report. Sectors were defined in line with NACE Rev. 2 classification of economic activities. For data on public investment we used EURO-STAT's functional classification of government expenditure (COFOG), which classifies government expenditure into ten main categories: general public services; defence; public order and safety; economic affairs; environmental protection; housing and community affairs; health; recreation, culture and religion; education; social protection. Details on variables used are given in the table 1.

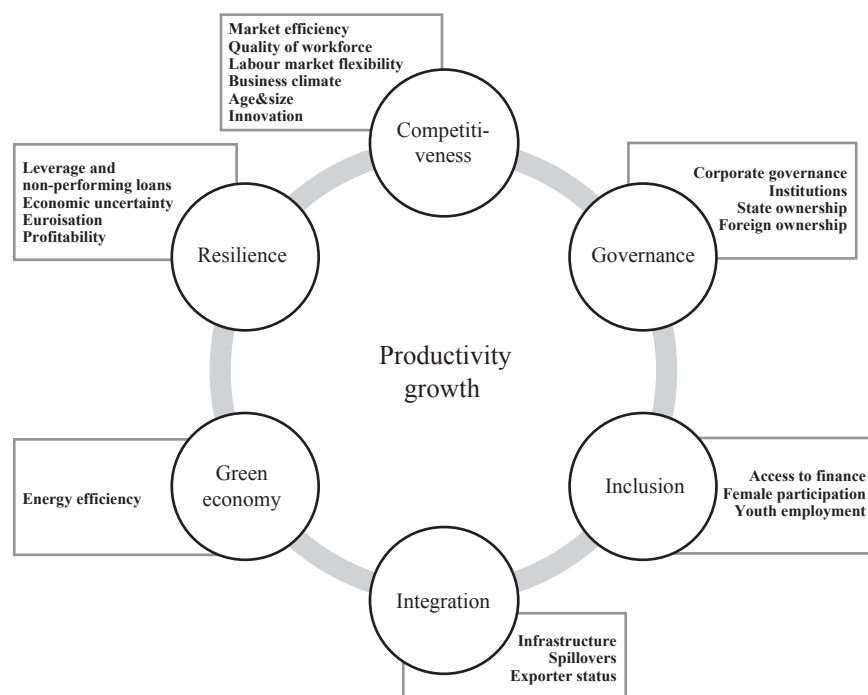
TABLE 1

*Variable definitions and sources*

Variable	Description	Level	Source
Private investment	The firm's fixed assets, adjusted for depreciation and amortization (log, change)	Firm	ORBIS
Total government investment	Gross fixed capital formation within the total general government expenditure (log change)	Country	EUROSTAT
Government investment in human capital	Gross fixed capital formation in education, health and housing and community amenities (log, change)	Country	EUROSTAT
Government investment in transport	Gross fixed capital formation in transport within general government expenditure on economic affairs (log, change)	Country	EUROSTAT
Government investment in R&D	Gross fixed capital formation in research and development within general government expenditure on economic affairs (log, change)	Country	EUROSTAT
Efficacy of corporate boards	Efficacy of corporate boards score in the WEF's Global Competitiveness Index (value 1-7, change)	Country	World Economic Forum
Flexibility of wages	Flexibility of wage determination score in the WEF's Global Competitiveness Index (value 1-7, change)	Country	World Economic Forum
GHG emissions	Ratio of greenhouse gas emissions to gross value added (GVA) by sector (tonne/EUR)	Sector	EUROSTAT
Goods market efficiency	Goods market efficiency score in the WEF's Global Competitiveness Index, assessing the quality of supply-and-demand conditions (value 1-7, change)	Country	World Economic Forum
Hiring and firing practices	Hiring and firing practices score in the WEF's Global Competitiveness Index (value 1-7, change)	Country	World Economic Forum
Institutions	Institutions score in the WEF's Global Competitiveness Index, assessing the quality of public and private institutions (value 1-7, change)	Country	World Economic Forum
Intangible in total assets	Share of intangible in total assets (per cent)	Firm	ORBIS
Market concentration	Herfindahl-Hirschman index, defined as the sum of the squares of market shares of the firms within a sector of economy (log, change), except in the specification for the sector of tourism in which it is the share of the top 5 companies in the sector in total revenues (per cent, change)	Sector	ORBIS
NPLs	Ratio of non-performing to total gross corporate loans, by sector (per cent, change)	Sector	Croatian National Bank
Professional management	Reliance on professional management score in the WEF's Global Competitiveness Index (value 1-7, change)	Country	World Economic Forum
Youth employment	Share of the youth population (age 15-24) in total employment, by sector (per cent, change)	Sector	EUROSTAT

The potential TFP determinants were identified on the base of extensive empirical literature. Except for public investment, other variables can be connected to one of the six transition qualities (competitiveness, governance, resilience, integration, green economy and inclusion)<sup>4</sup>, associated with a well-functioning market economy (figure 1).

**FIGURE 1**  
*Key productivity determinants*



Source: Authors' elaboration.

## 5 RESULTS

In line with expectations, we find that the TFP of the Croatian corporate sector declined significantly after the global financial crisis, but has started to recover (chart 1). All sectors, except for tourism, experienced a fall in TFP over the period 2010-2012, which was most pronounced in construction, the sector that also saw the fastest recovery later.

In the second step we investigated the TFP drivers, first at the aggregate (total economy) and then at the sector level. Our results indicate that TFP of Croatian firms in general benefits from increasing public investment and closing the transition gaps in the “competitive”, “resilient”, “inclusive” and “well-governed” qualities (table 2). Higher public investment, a larger share of youth in employment,

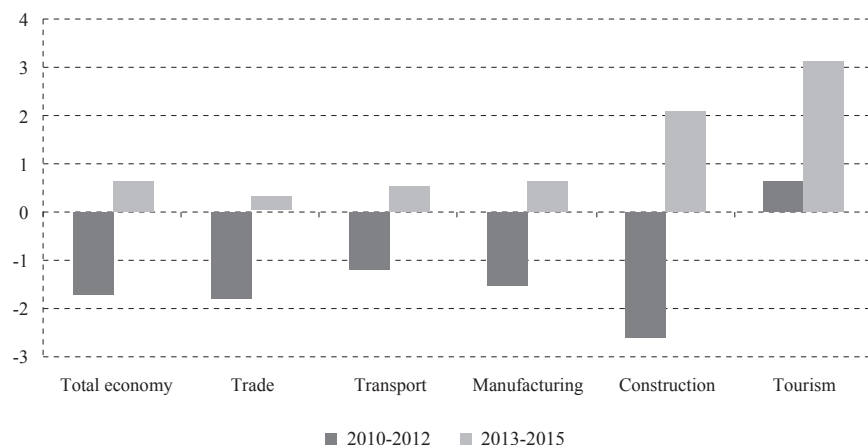
<sup>4</sup> This is new concept of the European Bank for Reconstruction and Development (EBRD) for measuring the transition to a market economy. For more detail please visit [<http://www.ebrd.com/our-values/transition.html>] or see EBRD (2018:105-115).



better institutions, higher ratio of intangible to total assets (a proxy for firm-level innovation), as well as more flexible hiring and firing practices seem to improve corporate productivity, while an increase in the share of non-performing loans (NPLs) and market concentration act in the opposite direction.

# CHART 1

*Estimated three-year average TFP growth rate, total economy and by sector (in %)*



Except for concentration, which impacts productivity instantly, other determinants act with a lag of one or two years. Public investment as a whole affects productivity with a 4-year lag. This seems reasonable: while the implementation of public investment projects can boost (construction) employment in the short term, it may take a long time until the projects are finished and the benefits felt by businesses. As expected, investments made by a firm did not prove to be a significant driver of TFP given that they increase capital, i.e. one of the production inputs, which is by definition out of scope of the TFP concept. That is why in the following stages we left out this variable. At the same time, our sample increased threefold as many firms appear not to report the figure on their own investment.

In order to understand better the relative significance of the identified TFP determinants we used standardized coefficients.<sup>5</sup> Government investment and flexibility in hiring and firing workers seem to be of greatest importance for productivity improvements, followed by the quality of institutions and NPLs, and then by youth employment and market concentration. The results suggest that the share of intangible in total assets enhances productivity the least.

In the following stage, we checked if state- and privately-owned enterprises have different productivity drivers. However, since the vast majority (99.5%) of enterprises in the sample have private owners, there is almost no difference between results for the subsample of private companies and the whole sample. Unfortun-

<sup>5</sup> Calculated by multiplying the estimated coefficient by the ratio between the standard deviations of the independent and the dependent variables.

nately, results for the subsample of the remaining 218 state-owned enterprises did not prove to be meaningful, which is why we do not report them.<sup>6</sup>

**TABLE 2**  
*TFP determinants in Croatian corporate sector*

Variables	Total economy (1)	Total economy (2)	Private sector
Lagged dep. variable	0.2638*** (0.0266)	0.2385*** (0.0043)	0.2394*** (0.0150)
Private investment (-1)	0.0005 (0.0009)		
Total government investment (-4)	0.0520*** (0.0101)		0.0445*** (0.0046)
Government investment in human capital (-3)		0.0067 (0.0125)	
Government investment in transport (-4)		0.0251*** (0.0036)	
Government investment in R&D (-2)		0.0326*** (0.0091)	
NPLs (-1)	-0.0022** (0.0008)	-0.0014*** (0.0003)	-0.0013*** (0.0003)
Youth employment (-2)	0.0063*** (0.0018)	0.0054*** (0.0009)	0.0057*** (0.0009)
Market concentration	-0.1013** (0.0379)	-0.0860*** (0.0174)	-0.0908*** (0.0178)
Institutions (-1)	0.1033** (0.0336)	0.0735*** (0.0141)	0.0531*** (0.0149)
Intangible in total assets (-1)	0.3430** (0.1119)	0.1551*** (0.0307)	0.1510*** (0.0417)
Hiring and firing practices (-2)	0.0661*** (0.0132)	0.0397*** (0.0070)	0.0637*** (0.0055)
Constant	0.0207** (0.0097)	0.0160*** (0.0028)	0.0180*** (0.0029)
Number of observations	33,107	176,887	175,899
Number of enterprises	15,529	48,129	47,911
Number of instruments	29	30	28

*Notes: The dependent variable is the log of TFP. Robust standard errors are in parentheses. For the specification tests, p-values are reported.*

*\*, \*\* and \*\*\* indicate that the coefficients are significant at the 10, 5, and 1 per cent level, respectively.*

Given the possibility that not all government investments are equally important, we next examined the significance of three different government investments that are usually considered productive – investment in transport, human capital (a sum of investment in health, education, and housing and community amenities, the latter including water supply, street lighting and suchlike) and research and development (R&D). Government spending on salaries in sectors of health and educa-

<sup>6</sup> Some of the variables that were statistically significant previously, now seem not to be and/or have wrong signs. Public investment is significant at 10 per cent level.

tion was not included, although they might be considered investments too since a large part of the productive benefits come from the human input (number and quality of teachers or doctors) and not just from the physical infrastructure. The exercise suggests that two out of these three types of public investment contribute positively to the productivity of Croatian enterprises, i.e. investment in transport and investment in R&D, while investment in human capital does not seem to matter for the corporate sector as a whole. The lag is twice as short in the case of investment in R&D (two years) but investments in transport seem to have twice as big an impact on productivity as investment in R&D.

Finally, TFP determinants were estimated for several sectors to allow for the possibility that individual sectors can have different, sector-specific productivity drivers, and check whether there is a difference in importance of various types of public investment across sectors. For example, public investment in R&D would be expected to be more significant in manufacturing than in tourism. We looked at five sectors for which we thought government investment might matter the most: transport, trade, tourism, construction and manufacturing. The number of enterprises per sector varied between 2,175 in transport and 13,699 in trade.

Tourism has been one of the key sectors in Croatia, supporting the economic recovery after the global crisis with its share in the gross value added increasing the most between 2008 and 2015 (from 4.0 to 5.5 per cent). Our productivity exercise indicates that this sector benefits not only from investment in transport but, as expected in the case of a highly labour-intensive industry, also in human capital. While the former seem to impact productivity much more than the latter, in both cases the identified lags are rather long (four and five years, respectively).<sup>7</sup> However, this is understandable given the long implementation period of transport projects and the several years of training needed for future employees.

The other sector that also benefits from more than one type of public investment is manufacturing. Besides transport, government investment in R&D also tends to enhance the productivity of the enterprises, and the impact of the two investments on the TFP seems to be equally strong. Again, the time lags are rather long – four and three years, respectively.

The productivity of companies in the remaining sectors of trade, transport and construction also increases with an increase of government investment in transport. In addition, this investment appears to be the most important productivity driver in the first two sectors, while coming second in the construction sector, after professional management. Time lags are similar to those previously reported.





Overall, our exercise indicates that public investments, in particular in transport, have a large and statistically significant effect on the productivity of Croatian enterprises in all five sectors. Besides these, two other variables also seem to affect the TFP in all sectors examined – NPLs and youth employment. An increas-

<sup>7</sup> More detailed sectoral results are available on request.

ing sectoral NPL ratio tends to be associated with falling productivity of the enterprises operating in the sector, while higher youth employment in the sector acts in the opposite direction. The latter is an important finding given the high youth unemployment rates in the country. Market concentration also matters for the majority of sectors – a higher degree of concentration in the sector leads to lower productivity, which is probably due to less incentive to innovate.

TABLE 3  
*Key TFP determinates by sector*

Sector	Public investment	Well-governed	Resilient	Competitive	Inclusive	Green
<b>Tourism</b> (2,817 firms)	Government investment in transport (-4)		NPLs	Market concentration	Youth employment	
	Government investment in human capital (-5)			Hiring and firing practices		
<b>Manufacturing</b> (7,594 firms)	Government investment in transport (-4)		NPLs	Goods market efficiency	Youth employment	
	Government investment in R&D (-3)					
<b>Trade</b> (13,699 firms)	Government investment in transport (-4)	Efficacy of corporate boards	NPLs	Market concentration	Youth employment	
<b>Transport</b> (2,175 firms)	Government investment in transport (-4)		NPLs	Intangible in total assets		GHG emissions
<b>Construction</b> (5,467 firms)	Government investment in transport (-3)	Professional management	NPLs	Market concentration	Youth employment	

Standardised coefficient:  >|3.0|  |2.0-3.0|  |1.0-2.0|  <|1.0|

\* Darker shades indicate higher relative importance of the variables, i.e. higher standardized coefficient (showing the impact of one standard deviation change in the variable on productivity).

There are also several sector-specific TFP determinants. They range from hiring and firing practices in tourism to greenhouse gas emissions in the transport sector. In the case of manufacturing, goods market efficiency also matters, while in trade and transport the same is true for the quality of corporate governance. The significance of the share of intangible in total assets in the transport sector is somewhat less intuitive, but given that standardized coefficient equals zero, economically speaking this variable is of little, if any, importance.

Results across sectors are summarised in table 3. The TFP determinants are grouped according to the transition quality they represent, while cells are shaded according to the economic relevance of TFP determinants within a sector.

## 6 CONCLUSION

Our results show that public investments, especially in transport and human capital, have a positive and significant effect on corporate productivity in Croatia. These effects are, however, different for various sectors. While investments in transport seem to affect the productivity of all sectors, human capital has a significant effect only in the (most) labour intensive sector, i.e. tourism.

Another important finding is that public investments, as expected, take effect with a considerable lag. This can be up to 4-5 years, e.g. in transport or human capital.

Besides public investments, the productivity of Croatian firms might also benefit from the closing of the transition gaps in the qualities defined as competitive, resilient, inclusive and well-governed. This suggests that improving the transport networks, as well as resolving the corporate over-indebtedness issue and trying to get as many young people employed as possible, should be high on the agenda of Croatian authorities as all these factors tend to increase firms' productivity.

However, in order to have more precise policy recommendations some further research may be warranted. It could be done along several lines. One potential issue that is worth checking is if the effects of public investment are (non)linear. For example, in the case of motorways (where Croatia invested heavily in previous years), the productivity-enhancing effects may reach their peak at a certain level of investment in transport, which is when other investments (e.g. in human capital) may take the lead.

A cross-country comparison of productivity drivers may also be useful in order to check whether results hold when accounting for the countries' income levels, as this can also influence productivity drivers. For example, less developed countries may experience larger productivity improvements from investments in physical infrastructure, given its low quantity and quality, but at a later stage investment in human capital might become the most relevant factor. Including the quality of public investment as a variable can be also justified as higher quantity of investment does not necessarily translate into their higher quality, i.e. better services for economic agents.

As an immediate next step, one could investigate if adding wages and salaries to human capital investments would make a difference in the results. One can argue that in the case of human capital (e.g. health or education) most of the value comes from the employees (e.g. doctors or teachers) who work in the institutions (hospitals or schools) and much less from the institutions themselves; thus capturing only the investments might not be enough.

### Disclosure statement

No potential conflict of interest was reported by the authors.

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# Composition of public investment and economic growth: evidence from Turkish provinces, 1975-2001

GÖKÇEN YILMAZ, Ph.D.\*

Article\*\*

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Gökçen YILMAZ

Sinop University, School of Economics, 57200 Boyabat/Sinop, Turkey

e-mail: [gyilmaz@sinop.edu.tr](mailto:gyilmaz@sinop.edu.tr)

ORCID: 0000-0002-6187-9130

## Abstract

*The relationship between public expenditure and economic growth is one of the central topics in economics literature, and an extensive body of knowledge has accumulated around it. The current consensus is that infrastructure, education and health are the types of public services that are likely to contribute to economic growth. Still, the question of how public resources should be allocated among them remains unanswered. This paper, benefiting from an endogenous growth model that is useful in the identification of the optimal allocation of public resources, analyses the growth effect of the composition of public investment in Turkey using a dataset for the years between 1975 and 2001. Results indicate that, between these years, the government overinvested in transportation and communication services and underinvested in energy infrastructure, education, health, and city infrastructure and security services. There is further evidence that public policy led to an underinvestment in energy infrastructure in these years. The scope of the analysis is confined by the limitations of the economic model. Additionally, the robustness of the results depends on the assumption that public policy is exogenous in the model.*

*Keywords: public investment, health, education, infrastructure, economic growth, optimal allocation, Turkey*

## 1 INTRODUCTION

Investigation of the relationship between public expenditure and economic growth is a research topic that stems from the origins of the economics discipline itself. Adam Smith's *invisible hand* is invoked to oppose government intervention in the economy. Since Smith's time, the role of public policy in economic growth has been analysed from various perspectives that include the Keynesian and Latin American Structuralist schools, which heavily influenced state-led economic policies in the 1950s and 1960s. However, the debt and financial crises of the 1970s and 1980s led to the Washington Consensus in 1989, which limited the role of government to the provision of infrastructure, education and health. The shift in economic policy was accompanied by empirical studies that linked public infrastructure expenditure to growth, and by the introduction of the endogenous growth theory, which provided arguments in favour of government intervention in the education sector. These developments in economics literature generated the most current consensus: that public expenditure on education, health and infrastructure is likely to contribute to growth as it helps in the creation of human capital and complements private sector investment.

The second point of discussion regarding the link between public expenditure and economic growth is about the composition of public expenditure. How should the resources be allocated among education, health and infrastructure? This aspect of the topic became a focus of attention relatively recently and remains under-researched.

One of the earliest studies on the composition of public expenditure and economic growth was carried out by Devarajan, Swaroop and Zou (1996), who provide a model of endogenous growth theory that helps to determine whether the government underspends or overspends in a particular type of public service. Although many other scholars (Lee, 1992; Turnovsky and Fisher, 1995; Agénor and Moreno-Dodson, 2006; Chen, 2006; Agénor, 2009; Agénor and Neanidis, 2011) proposed models to analyse the relationship between the allocation of public expenditure and economic growth, the model in Devarajan, Swaroop and Zou (1996) has the advantage of having a general framework. It is also the one that imposes the fewest restrictions in the analysis regarding the relationship between the composition of public expenditure and economic growth.

This paper contributes to the literature by applying the model in Devarajan, Swaroop and Zou (1996) to a panel dataset of Turkish provinces for the years between 1975 and 2001. It complements the aforementioned study by proposing a regression model to test the theory in question. Additionally, this study differs from Devarajan, Swaroop and Zou (1996) in terms of public spending data; while they carry out their analyses using public current and capital expenditure, this study applies this method to the latter.

Turkey is chosen as the subject of the research because of its characteristics. Turkish provinces vary significantly in terms of economic performance. The provinces in the west are considerably more developed than those in the east. To foster the economy in underdeveloped areas, Turkish governments have aimed to increase the accessibility of infrastructure facilities and improve human capital. This policy has been pursued by implementing public investment projects in infrastructure, health and education facilities using the central government budget. Thus, Turkish provinces constitute a sample suitable for use in the analysis of the relationship between the composition of public expenditure and economic growth. As the public policy in question uses public investment projects to promote development, the analysis in this paper concentrates on the link between the composition of public investment and economic growth<sup>1</sup>.

The time range of the dataset is narrowed to 1975 and 2001 as the economic growth rates for the provinces are available only for these years. To address reverse causality between public investment variables and the economic growth, the dependent variable is specified as the five-year forward-moving geometric average of the per-worker real GDP growth rate<sup>2</sup>. This is also to capture the lagged impact of public investment on the output growth rate. For empirical analysis, the random-effects and the pooled OLS techniques are used. The standard errors are

<sup>1</sup> Public investment corresponds to public capital expenditure. This paper adopts the former term whenever it refers to its sample. This is because the State Planning Organisation (now, a section of the Ministry of Development) reports these data under the title “public investment”.

<sup>2</sup> Note that, with the real GDP data for the years between 1975 and 2001, the dependent variable can be calculated for the years between 1975 and 1996.

corrected for heteroscedasticity, and serial correlation within and between panels. Post-estimation diagnostics provide evidence for the robustness of the results<sup>3</sup>.

The results in this paper show that, for the years between 1975 and 2001, there was an overinvestment in transportation and communication. The policy implication of this study is that, for the investigated time period, Turkish public policy should have shifted resources from this public layout to the provision of energy infrastructure, education, health, and city infrastructure and security services. Results provide additional evidence that the governments between the years 1975 and 2001 underinvested in energy infrastructure.

## 2 LITERATURE REVIEW

Literature regarding the relationship between government expenditure and economic growth focuses on particular types of spending, namely, infrastructure, education and health. The origin of the link between public expenditure on infrastructure and economic growth is an empirical study carried out by Aschauer (1989), who demonstrated that public expenditure on roads and highways has considerable growth effects. This initiated discussions about whether it is the government consumption expenditure that might have growth-reducing effects, and that public policy should favour capital spending, which is understood to be expenditure on infrastructure.

The relationship between public expenditure on human capital and economic growth builds on the endogenous growth theory, which identifies the source of economic growth as technological progress, which is a function of human capital. Endogenous growth models are derived on the assumption that social returns to public expenditure on human capital are higher than private returns to it, and so the equilibrium growth rate in a free-market economy is sub-optimal (Barro and Sala-I-Martin, 1992).

The combination of the two streams of the literature provided above led to the current consensus that public expenditure on education, health and infrastructure is likely to have a positive impact on economic growth. The arguments in favour of government intervention in these sectors can be listed as: market failure in the provision of services in these areas, their high positive externalities, their impact on human capital and thus on research and technology, their positive impact on private sector productivity, and their welfare benefits. However, it is also acknowledged that public investment might crowd-out private investment. Additionally, public investment is considered less efficient than private investment due to factors such as rent-seeking, corruption and congestion.

The literature that analyses the relationship between the composition of government expenditure and economic growth is divided in accordance with the streams

<sup>3</sup> Available on request.

of the literature that focus on the link between public expenditure and economic development. While some investigate the composition of public expenditure by disaggregating it as capital and consumption spending (Lee, 1992; Turnovsky and Fisher, 1995), others focus on the functional composition of public expenditure as health, education and infrastructure (Agénor and Moreno-Dodson, 2006; Chen, 2006; Agénor and Neanidis, 2011; Agénor, 2009).

Correspondingly, in the relevant empirical literature, the majority of studies focus on the relationship between public capital expenditure and economic growth (Haque, 2004; Gupta et al., 2005; Ghosh and Gregoriou, 2008; Afonso and Furceri, 2010; Chamorro-Narvaez, 2012). Few studies further investigate the growth effect of public expenditure on infrastructure services such as transportation facilities (Shioji, 2001; León-González and Montolio, 2004; Pereira and Andrzej, 2005). There are relatively few studies that include public health and education spending in empirical analysis (Easterly and Rebelo, 1993; Odedokun, 2001; Ramirez and Nazmi, 2003; Bose, Haque and Osborn, 2007). Although the results regarding the impact of public capital on economic growth are mixed, overall findings in the literature appear to support the hypothesis that public expenditure on transportation is positively related to growth. The literature also provides evidence that public education expenditure is positively associated with economic progress.

In this literature, Devarajan, Swaroop and Zou (1996) provide a model that encompasses all others as it can be used to analyse the composition of any type of public expenditure. The authors relate the productivity of a type of public expenditure to its share in total public expenditure, and the productivity of other types of public expenditure in the model. Despite the strength of their model, the results in Devarajan, Swaroop and Zou (1996) are unconventional and their robustness is debatable. The authors find a positive relationship between public consumption expenditure and economic growth, which contradicts the implications of economic theory. Their results also indicate a negative growth effect for public expenditure on education. Haque (2004) observes that Devarajan, Swaroop and Zou (1996) do not account for unit roots in the data, which may have biased their results.

This paper contributes to the literature by applying the model provided by Devarajan, Swaroop and Zou (1996) to public investment (i.e. public capital expenditure) for a panel dataset of Turkish provinces for the years between 1975 and 2001. This study also proposes a regression model to test the theory in question to obtain robust results. The shortcomings of the regression model used in Devarajan, Swaroop and Zou (1996) are discussed in more detail in the relevant section.

### 3 ECONOMIC MODEL

The economic theory adopted in this paper is provided by Devarajan, Swaroop and Zou (1996). For the purposes of this paper, this section presents a brief summary of that model, together with a conclusion that relates the composition of public expenditure to economic growth.

Devarajan, Swaroop and Zou (1996) use an endogenous growth model, in which the household intertemporal utility function,  $U$ , equals:

$$U = \int_0^{\infty} u(c_t) e^{-\rho t} dt$$

where  $\rho$  is rate of time preference,  $\rho > 0$ , and the utility function is:

$$u(c) = \frac{c^{1-\sigma} - 1}{1-\sigma}$$

In the utility function,  $\sigma$  is the elasticity of intertemporal substitution, and is assumed to be constant.

The authors use a production function that has the constant elasticity of substitution property:

$$y = [ak^{-r} + bg_1^{-r} + \delta g_2^{-r}]^{-1/r}$$

$$a > 0$$

$$b \geq 0$$

$$\delta \geq 0$$

$$a + b + \delta = 1$$

$$1 \geq -r$$

where  $y$  is total output per capita, and  $g_1$  and  $g_2$  are the components of public expenditure per capita, respectively. The terms  $a$ ,  $b$  and  $\delta$  are productivity parameters, while  $r$  is a function of elasticity of substitution,  $\pi = \frac{1}{1+r}$ .

In the model, the income tax rate ( $\tau$ ) and hence the share of total public expenditure in output  $\left(\frac{g}{y}\right)$  are considered given. The government's budget constraint is defined as:

$$\tau y = g_1 + g_2$$

where

$$g_1 = \theta \tau y, (0 \leq \theta \leq 1), \text{ and so } g_2 = (1 - \theta) \tau y$$

The constraint for capital accumulation is specified as:

$$\dot{k} = (1 - \tau)y - c_t$$

which shows the amount of income per capita after taxation and consumption.

Devarajan, Swaroop and Zou (1996) find the condition for an increase in the share of  $g_1$  in total public expenditure to have a positive impact on economic growth as in:

$$\frac{\theta}{1-\theta} < \left(\frac{b}{\delta}\right)^{1/(1+r)}$$

which simplifies to:

$$\frac{\theta}{1-\theta} < \frac{b}{\delta}$$

if the value of  $r$  equals 0 (i.e. the elasticity of substitution equals 1), in which case, the production function corresponds to the Cobb-Douglas production function.

The inequality indicates that an increase in the share of  $g_1$  in total public expenditure,  $\theta$ , will result in higher growth only if the ratio of the output elasticity of  $g_1$  to  $g_2$ ,  $\left(\frac{b}{\delta}\right)$ , is higher than the ratio of  $\theta$ , the share of  $g_1$  in total public expenditure, to  $(1-\theta)$ , the share of  $g_2$  in total public expenditure,  $\left(\frac{\theta}{1-\theta}\right)$ .

This suggests that, even though the output elasticity of  $g_1$  was higher than the output elasticity of  $g_2$  – that is, a 1% percent increase in  $g_1$  created a higher increase in output than a 1% increase in  $g_2$  did – if an increase in the share of  $g_1$  in total public expenditure results in the violation of the inequality condition above, then an increase in the share of  $g_1$  in total public expenditure will not have a positive effect on economic growth.

It can be seen that the model does not depend on any initial assumption regarding the productivity of  $g_1$  and  $g_2$ . Any component of public expenditure can be productive if its share relative to other components satisfies the condition above. Productivity of public expenditure is not a matter of the sector in which it would be expected to have a positive impact on growth. Thus, the productivity of public expenditure in this model is in relative terms, which implies that public expenditure in some sectors that would be considered to contribute to growth may turn out to be detrimental to it if the composition of public expenditure is taken into account.

As this paper uses public investment data, in its context of analysis,  $g_1$  and  $g_2$  correspond to the components of public investment. Then, Devarajan, Swaroop and Zou's (1996) model shows that, for a given budget, if increasing the share of  $g_1$  in  $g$  is negatively associated with economic growth, then there is an overinvestment in the first type of public investment. Similarly, for a given budget, if increasing the share of  $g_1$  in  $g$  is positively associated with economic growth, then there must be an underinvestment in the first type of public investment. Thus, the model provides a tool for assessing Turkish public policy regarding the implementation of public investment projects in different sectors and balancing the shares of public investment accordingly for the years between 1975 and 2001.

This section discusses possible regression models that can be used to apply the theoretical model to data. The theoretical model in Devarajan, Swaroop and Zou (1996) assumes that there are two types of public expenditure. Type 1 is denoted by  $g_1$ , and type 2, by  $g_2$ . The model shows the conditions for a change in the share of a type of public expenditure, for a given share of public expenditure in GDP ( $g/y$ ), to have a positive impact on economic growth,  $\gamma$ . Thus, the growth effect of a type of public expenditure depends on: (1) its share in total public expenditure, (2) its productivity, and (3) the productivity of the other type of public expenditure.

Devarajan, Swaroop and Zou (1996) assume a linear regression model for empirical analysis, and include the shares of each component in total public expenditure and the share of total public expenditure in GDP as explanatory variables (in addition to other control variables in their paper). In this paper, too, empirical analysis assumes that the relationship between explanatory variables and the dependent variable is linear. Post-estimation diagnostics provide evidence that this assumption holds.

For a model with two types of public expenditure, variables can be defined as follows:

Public expenditure type 1:  $g_1$

Public expenditure type 2:  $g_2$

Total public expenditure:  $g = g_1 + g_2$

Additionally,

$$g_1 = \theta_1 g,$$

$$g_2 = \theta_2 g,$$

and,

$$\theta_1 + \theta_2 = 1, \text{ which means } \theta_2 = 1 - \theta_1$$

Then, the regression model can be expressed as follows:

$$\gamma = z_0 + x_0 \frac{g}{y} + x_1 \theta_1 + \sum_1^s z_s m_s \quad (1)$$

In which  $m_s$  represents the other control variables, which are explained at the end of the section.  $x_0$  is the coefficient that shows the effect of a change in the share of total public expenditure on output. A change in  $\frac{g}{y}$  would change the level of both types of public expenditure, as  $g = g_1 + g_2$ . Thus,  $x_0$  is interpreted as the effect of a change in the level of  $g_1$  and  $g_2$ .



In equation (1), only  $\theta_1$ , the share of  $g_1$  in total public expenditure, is included, because including  $\theta_2$ , the share of  $g_2$  in total public expenditure, would lead to perfect collinearity, as  $\theta_1 + \theta_2 = 1$ . This also means that the coefficient of the share of  $g_1$  in total public expenditure shows the effect of a change in  $\theta_1$  with respect to a change in  $\theta_2$ , because an increase (or a decrease) in  $\theta_1$  entails a reduction (or a rise) in  $\theta_2$ .

The specification of the regression model becomes slightly more complicated if there are more than two types of public expenditure. If there are  $n$  types of public expenditure, then the components of public expenditure could be expressed as:

The first type of public expenditure:  $g_1 = \theta_1 g$

The second type of public expenditure:  $g_2 = \theta_2 g$

...

The  $n^{th}$  type of public expenditure:  $g_n = \theta_n g$

$$g = g_1 + g_2 + \dots + g_n \text{ and } \theta_1 + \theta_2 + \dots + \theta_n = 1$$

In this case, the regression model could be specified in two ways. The first way is to adopt equation (1), which would indirectly reduce the number of types of public expenditure to two, as  $x_1$  would reflect the effect of a change in  $\theta_1$  with respect to a change in the share of the remaining types of public expenditure ( $\theta_2 + \theta_3 + \dots + \theta_n$ ). In this paper, the regression model is specified as in equation (1) for robustness of results, and simplicity in interpretation.

The alternative approach would be to include  $n - 1$  types of public expenditure in the regression model, and to exclude the  $n^{th}$  type of public expenditure to avoid perfect collinearity, as in equation (2).

$$\gamma = z_0 + x_0 \frac{g}{y} + x_1 \theta_1 + x_2 \theta_2 + \dots + x_{n-1} \theta_{n-1} + \sum_1^s z_s m_s \quad (2)$$

However, specifying the regression model as in equation (2), firstly, complicates the analysis, and, secondly, reduces the reliability of the results. In this case, including the shares of  $g_2, g_3, \dots, g_{n-1}$  imposes the assumption that a change in  $\theta_1$  impacts  $\gamma$ , for given values of  $\theta_2, \theta_3, \dots, \theta_{n-1}$ , (and  $\frac{g}{y}$ ). Thus, the coefficient of the share of  $g_1$  in total public expenditure shows the effect of a change in  $\theta_1$  with respect to a change in  $\theta_n$ . For the same reason, the coefficients of the share of  $g_2$  (or  $g_3, \dots$ , or  $g_{n-1}$ ) also reflect the effect of a change in  $\theta_2$  (or  $\theta_3, \dots$ , or  $\theta_{n-1}$ ) with respect to a change in  $\theta_n$ .

It can be seen that specifying the regression model as in equation (2) puts emphasis on the  $n^{th}$  type of public expenditure that is left out of the equation. This complicates

the analyses as the coefficient of a type of public expenditure depends on the type of public expenditure that is excluded from the model. If, for example, the regression model was specified as in equation (3), in which the share of  $g_1$  in total public expenditure is excluded, and the share of  $g_n$  in total public expenditure is included in the model, the values of  $x_2, x_3, \dots, x_{n-1}$  would differ from equation (2), as the coefficients would reflect the effect of a change in  $\theta_2, \theta_3, \dots, \theta_{n-1}$  with respect to a change in  $\theta_1$ , not in  $\theta_n$ . Considering there are  $n$  types of public expenditure, one would have to choose a regression model among  $n - 1$  versions of equation (2). This would reduce the robustness of the results because, as the number of types of public expenditure increased, the results between equations would be more volatile, and choosing the appropriate model would be more difficult.

$$\gamma = z_0 + x_0 \frac{g}{y} + x_2 \theta_2 + \dots + x_{n-1} \theta_{n-1} + x_n \theta_n + \sum_1^s z_s m_s \quad (3)$$

In Devarajan, Swaroop and Zou (1996), the regression models are specified as in equation (2). The authors include the shares of education, health, transportation and communication, and defence in total public expenditure in their regression models. However, they do not explain what type of public expenditure they exclude from the regression models, and, hence, it is actually not possible to interpret the full meaning of the coefficients in their paper.

In this paper, the estimated equation is defined according to equation (1) for robust analyses. Thus, the estimated model in this paper is specified as in equations (4) and (5):

$$\gamma_{i0} = z_{i0} + x_{i0} \frac{g}{y} + x_{ii} \theta_i + z_{ii} \frac{k}{y} + z_{i2} \eta + \sum_3^s z_{is} T_j + u_{i0} \quad (4)$$

where

$$\begin{bmatrix} \gamma_{00} \\ \gamma_{10} \\ \gamma_{20} \\ \gamma_{30} \\ \gamma_{40} \\ \gamma_{50} \end{bmatrix} = \begin{bmatrix} x_{00} & x_{01} & x_{02} & x_{03} & x_{04} & x_{05} \\ x_{10} & x_{11} & x_{12} & x_{13} & x_{14} & x_{15} \\ x_{20} & x_{21} & x_{22} & x_{23} & x_{24} & x_{25} \\ x_{30} & x_{31} & x_{32} & x_{33} & x_{34} & x_{35} \\ x_{40} & x_{41} & x_{42} & x_{43} & x_{44} & x_{45} \\ x_{50} & x_{51} & x_{52} & x_{53} & x_{54} & x_{55} \end{bmatrix} \begin{bmatrix} \left(\frac{g}{y}\right) \left(\frac{g}{y}\right) \left(\frac{g}{y}\right) \left(\frac{g}{y}\right) \left(\frac{g}{y}\right) \left(\frac{g}{y}\right) \\ 0 \quad \theta_{en} \quad 0 \quad 0 \quad 0 \quad 0 \\ 0 \quad 0 \quad \theta_{t\&c} \quad 0 \quad 0 \quad 0 \\ 0 \quad 0 \quad 0 \quad \theta_{ed} \quad 0 \quad 0 \\ 0 \quad 0 \quad 0 \quad 0 \quad \theta_{he} \quad 0 \\ 0 \quad 0 \quad 0 \quad 0 \quad 0 \quad \theta_{c\&s} \end{bmatrix} + \begin{bmatrix} z_{00} \dots z_{0s} \\ z_{10} \dots z_{1s} \\ z_{20} \dots z_{2s} \\ z_{30} \dots z_{3s} \\ z_{40} \dots z_{4s} \\ z_{50} \dots z_{5s} \end{bmatrix} \begin{bmatrix} 1 \\ (k/y) \\ \eta \\ T_0 \\ \dots \\ T_j \end{bmatrix} + \begin{bmatrix} u_{00} \\ u_{10} \\ u_{20} \\ u_{30} \\ u_{40} \\ u_{50} \end{bmatrix} \quad (5)$$

and

$$\theta_{en} + \theta_{t\&c} + \theta_{ed} + \theta_{he} + \theta_{c\&s} = 1$$

This paper applies the model in Devarajan, Swaroop and Zou (1996) to public investment data. Thus, in the matrix expression in equation (5),  $\theta_{en}$  represents the share of energy infrastructure,  $\theta_{t\&c}$ , transportation and communication,  $\theta_{ed}$ , education,  $\theta_{he}$ , health,  $\theta_{c\&s}$ , city infrastructure and security, in total public investment.

The other variables in the regression model in this paper are:  $\frac{g}{y}$ , the share of total public investment in GDP, to control for the change in the sum of all components of public investment;  $\frac{k}{y}$ , the share of private capital in GDP in the manufacturing sector, to control for private sector investment;  $\eta$ , population growth rate, to control for the change in the population size in the provinces; and  $T_j$ , a dummy variable for each year in the dataset, to control for the cross-sectional fixed-effects.  $\gamma$  is the dependent variable, which is the five-year forward-moving geometric average of per-worker real GDP growth rate.  $z_{i0}$  is the constant term and  $u_{i0}$  is the error term.

## 5 DATA AND METHOD

### 5.1 DATA SOURCE

The range of the dataset in this paper is limited by the available data for GDP per province. Although data for public investment are provided for provinces up to 2017, GDP series are available for provinces only for the years 1975-2001. The data for GDP were not reported for provinces for the years before 1975 and after 2001.

Public investment data used in this paper are taken from the State Planning Organisation (now, a section of the Ministry of Development) and reflect the amount of public capital expenditure financed by the central government budget. Data used in this paper exclude types of public investment that are made to multiple provinces, as they are not reported in a way that allows one to determine the proportion of public investment received by each province. The State Planning Organisation groups these types of public investment under the title “various provinces”.

The State Planning Organisation disaggregates public investment functionally as energy infrastructure (e.g. energy plants and electricity grids), transportation and communication (e.g. roads, railways, airports, postal service, telephone grids), education (e.g. schools, universities and student dormitories), health (e.g. health centres and hospitals), and city infrastructure and security services (e.g. piped water networks, sewage systems and security stations). Data are deflated for the base year 1987 using public investment deflators provided by the DPT (2001).

Data for GDP, for the years between 1987 and 2001, are provided by the Turkish Statistical Institute. For the years between 1975 and 1986, they are available in Karaca (2004). Both periods of GDP data are provided as deflated series for the base year 1987. Note that Karaca (2004) obtains GDP data for the provinces for the years between 1979 and 1986 from Özötün (1988), and, for the years between 1975 and 1978, from Özötün (1980), the latter of which is published by the State Statistical Institute (which later became the Turkish Statistical Institute). Karaca, given that the series before and after 1986 are calculated differently, adjusts the data for the years between 1975 and 1986. He does this by assuming that, for any given calculation method with fixed prices, the output shares of provinces should be the same. Thus, he derives the output shares of the provinces from Özötün (1988) and (1980), and multiplies them by the national GDP reported by the State Statistical Institute for the years between 1975 and 1986.

Nevertheless, the consistency of the series provided by Karaca (2004), for the years between 1975 and 1986, and the Turkish Statistical Institute, for the years between 1987 and 2001, are checked, firstly, by calculating GDP growth rate for Turkey for the years between 1975 and 2001. Then, they are plotted against data for Turkey's GDP growth rate obtained from the World Bank (2017) for the years between 1975 and 2001. The annual growth rates calculated from data series used in this paper do not differ from those provided by the World Bank, which is an indication that the GDP series taken from Karaca (2004) and the Turkish Statistical Institute are consistent<sup>4</sup>.

Data for private capital include gross investments in fixed capital in the manufacturing sector. The data are collected by annual manufacturing sector surveys carried out by the Turkish Statistical Institute. This indicator is included in the regression to capture the impact of private capital on economic growth. As it measures private investment only in the manufacturing sector, it also reflects the level of industrialisation in the provinces. Data for private capital are deflated for the year 1987 using the deflator series for the manufacturing sector in DPT (2001).

The population growth rate is included in the regressions because it is one of the determinants of the size of the workforce, which has an effect on the denominator of GDP per worker. The population growth rate is calculated using the census statistics. Census statistics were collected in 1975, 1980, 1985, 1990 and 2000 by the Turkish Statistical Institute. The population growth rate reflects the annual growth in the number of people between census years. It is computed by the formula,  $\sqrt[h]{\frac{N_{t+h}}{N_t}} - 1$ , in which  $N_t$  is the size of population in census year  $t$  and  $N_{t+h}$  is the size of population in census year  $t+h$ . For example, for 1978, the population growth rate equals  $\sqrt[5]{\frac{N_{1980}}{N_{1975}}} - 1$ , while for 1998, the population growth rate is  $\sqrt[10]{\frac{N_{2000}}{N_{1990}}} - 1$ .

It must be noted that the data for the population growth rate are problematic by construction as they remain fixed between census years. Nevertheless, the variable is retained in the regressions for two reasons: firstly, the population growth rate is a key demographic indicator, the exclusion of which could lead to omitted variable bias. Secondly, the Hausman test for model specification in the post-estimation diagnostics suggests using the random-effects and the pooled OLS techniques, both of which render the population growth rate a useful indicator as it changes considerably from province to province due to domestic migration, despite its shortcomings in terms of reflecting the change in population within panels.

In this paper, the economic growth rate is calculated using data for real GDP per worker. For the denominator, the data for the number of workers are also taken

<sup>4</sup> The figure is provided as part of the post-estimation diagnostics on request.

from census data collected in 1975, 1980, 1985, 1990 and 2000. The number of workers for in-between census years is calculated by assuming the size of the workforce would increase at a fixed annual growth rate. Thus, the number of workers for year  $t + 1$  is obtained using the formula,  $L_{t+1} = L_t \sqrt[j]{\frac{L_{t+j}}{L_t}}$ , ( $1 < j$ ), in which  $L_t$  is the number of workers in census year  $t$ , and  $L_{t+j}$  is the number of workers in census year  $t+j$ . The intervals in census data and the computation of the size of the workforce impose disadvantages on the denominator of GDP per worker similar to those discussed in relation to the population growth rate.

In the empirical analysis, public investment in year  $t$  is expected to impact the growth rates between years  $t + 1$  and  $t + 5$ . Thus, the dependent variable is defined as the five-year forward-moving geometric average of per-worker real GDP growth rate using the formula,  $\left( \sqrt[5]{\frac{GDP \text{ per worker}_{t+5}}{GDP \text{ per worker}_t}} - 1 \right)$ . The reason for using the five-year forward-moving geometric average of per-worker real GDP growth rate is discussed in more detail in the next section.

## 5.2 ECONOMETRIC METHOD

For the econometric analysis of the relationship between the composition of public investment and economic growth, this paper benefits from the empirical practices applied in the research regarding the link between public expenditure and economic growth. One of the major problems in estimating the effect of public expenditure on economic growth is reverse causality, which implies that public expenditure might be endogenous as an explanatory variable in regressions. Reverse causality arises due to the difficulty of identifying whether economic growth is a consequence of a change in public expenditure or is the cause of that change in public expenditure. In a case in which the model is static, the effect of public expenditure on economic growth rate might be a result of an increase or a decrease in output rather than a factor that explains the change in it. That is, it might be the case that, as higher economic growth is achieved, a government will spend more. The other possibility is that, as a public policy, the government, in order to promote growth, might spend more in some sectors, and the effect of this spending might not be observed if the income per capita and the relevant spending are contemporaneous. These are issues that might affect the robustness of results in this paper too.

The econometric problem is that if public expenditure were endogenous to the system, ordinary least squares (OLS) estimates would be biased and inconsistent, because the assumption that the error term and explanatory variables are uncorrelated would be violated. In the literature, there are two common methods to address the problem of simultaneous endogeneity of public expenditure. Some researchers (Bose, Haque and Osborn, 2007; Chamorro-Narvaez, 2012; Ghosh and Gregoriou, 2008) prefer to apply dynamic panel data estimation techniques that are derived from the generalised method of moments (GMM), which allows them to use the lagged values of dependent or explanatory variables as instruments.

Others (Devarajan, Swaroop and Zou, 1996; Haque, 2004; Odedokun, 2001) specify the dependent variable as the five-year forward-moving average of per-capita GDP growth rate to address the possibility of reverse causality. Both of these approaches are applicable in the empirical analysis of the relationship between public investment and economic growth.

The advantage of the GMM is that it is a technique developed specifically for the problem of endogeneity. The method introduced by Arellano and Bond (1991) has small sample bias; in other words, the technique requires the time dimension of the dataset to be sufficiently large. Later, this weakness was addressed by Arellano and Bover (1995), and Blundell and Bond (1998), and the system GMM estimator was proposed. However, these techniques require error terms to be uncorrelated between panels (Stata, 2017a; 2017b). Because this paper uses a dataset that consists of provinces and, as the workforce and capital are more fluid between provinces than between countries, the error terms are likely to be correlated between provinces, which violates this assumption<sup>5</sup>.

Thus, in this paper, to address endogenous simultaneity, the second approach is preferred. It requires calculating the dependent variable as the  $n$ -year forward-moving average of the growth rate. This introduces serial correlation to standard errors within panels which can be corrected using relevant statistical methods<sup>6</sup>. The problem of reverse causality is addressed by avoiding using the contemporaneous values of public expenditure and economic growth rate in the regression. While, as the explanatory variable, the value of public expenditure in year  $t$  is used, as the dependent variable, the growth rate in year  $t + 1$  is taken into consideration. To account for the impact of public expenditure on future growth rates, the dependent variable is calculated as the  $n$ -year forward-moving average of the growth rate, which is the average of the growth rates between  $t + 1$  and  $t + n$ . This paper adopts this approach for public investment.

Following the empirical literature (Devarajan, Swaroop and Zou, 1996; Haque, 2004; Odedokun, 2001), this paper uses the five-year forward-moving average of the growth rate as the dependent variable. However, this paper differs from the cited papers in two aspects. Instead of computing the dependent variable as the

<sup>5</sup> The post-estimation diagnostics show the presence of serial correlation in residuals both within and between panels.

<sup>6</sup> Devarajan, Swaroop and Zou (1996), and Haque (2004) correct the standard errors using the methodology in Hansen and Hodrick (1980). This paper uses the built-in commands in the statistical software (Stata) used for the empirical analysis of the data. For panel data, the command “xtreg” offers the “robust” option which corrects the standard errors to heteroscedasticity and serial correlation, while the command “xtscc” allows for correcting the standard errors to heteroscedasticity and serial correlation between panels, and within panels up to a specific number of lags. In this paper, the standard errors obtained from the “xtscc” command are corrected for serial correlation within panels up to five lags, as the five-year forward-moving geometric average of per-worker real GDP growth rate introduces correlation to error terms between years  $t$  and  $t + 5$  (Devarajan, Swaroop and Zou, 1996). Note that, while the command “xtreg” offers the random-effects and fixed-effects techniques, the command “xtscc” offers pooled OLS and fixed-effects techniques as econometric methods. In accordance with the results of the Hausman test for model specification in the post-estimation diagnostics, table 3 uses the random-effects technique, while table 4 uses the pooled OLS technique.

arithmetic average, this study computes it as the geometric average of the economic growth rate. This is because the geometric average is more reliable than the arithmetic average, as the growth rate is a variable that fluctuates considerably. Secondly, this paper prefers using data for real GDP per worker instead of real GDP per capita, to account for the changes in the size of the workforce in output production<sup>7</sup>.

In this paper, the results obtained from the random-effects and pooled OLS techniques are reported. In panel data analysis, there are two main causes of concern: spatial and temporal dependence. If these lead to dependence between error terms, the inferential statistics become biased. If they are common factors that are correlated with the explanatory variables, their omission leads to biased coefficients. To address temporal dependence, the within-estimator that subtracts the individual effects that are fixed over time is used, while, to address spatial dependence, the between-effects estimator that eliminates the individual effects that are constant across the cross-sections (space) is required. The random-effects estimator is the equally weighted average of the within and between estimators. It allows for spatial dependence between error terms but assumes that it is not a common factor that is correlated with the explanatory variables. Meanwhile, the pooled OLS estimator assumes the observations are independent.

To choose between the econometric techniques, two diagnostic tests are commonly used as indicators. To check whether spatial or temporal dependence is a common factor that is correlated with the explanatory variables, the Hausman test for model specification is applied. To control for the spatial dependence between error terms, the Breusch and Pagan Lagrangian multiplier test is used. In this paper, the post-estimation diagnostics show that the Hausman test for model specification fails to reject the null hypothesis that there is not a systematic difference between the coefficients produced by the fixed-effects and random-effects techniques, or the fixed-effects and pooled OLS techniques. This also means that the between-effects and fixed-effects estimators are equivalent, in other words, the results would not differ between the spatial and temporal panel data techniques<sup>8</sup>. In the lack of spatial and temporal dependence, the random-effects and pooled OLS techniques are considered more efficient. Thus, in this paper, these techniques are preferred over the fixed-effects (or the between-effects) technique.

Breusch and Pagan Lagrangian multiplier test indicates spatial dependence in error terms, which leads to serial correlation in residuals between panels and, thus, biased inferential statistics. This requires choosing the random-effects estimator over the pooled OLS estimator because the former is derived from the generalised least squares technique which allows for spatial dependence in error terms. How-

<sup>7</sup> Robustness of the results to alternative specification of the dependent variable is discussed in the end of the results section.

<sup>8</sup> This, indeed, appears to be the case, as the results remain similar if one uses the between-effects estimator provided by the statistical software Stata.



ever, this problem can also be addressed by using a correction technique for standard errors that clusters the observations. Therefore, for the results obtained from the pooled OLS technique, standard errors robust to heteroscedasticity, and serial correlation within panels (temporal autocorrelation) and between panels (spatial autocorrelation) are reported, while, for the results estimated by the random-effects technique, standard errors robust to heteroscedasticity and serial correlation within panels are presented.

As a final note, it must be added that, although the Hausman test for model specification provides evidence regarding the robustness of the coefficients, and despite correcting the standard errors to address the presence of cross-sectional autocorrelation in residuals as indicated by the Breusch and Pagan Lagrangian multiplier test, spatial dependence remains an issue that can affect the robustness of the results in this paper.

## 6 RESULTS AND DISCUSSIONS

### 6.1 DESCRIPTIVE STATISTICS

Summary statistics are provided in table 1. The number of observations (N) in the sample is 1407. The sample is divided into 67 panels (n) that contain 22 years (T). The number of observations in the original dataset for public investment indicators is 1809. The dataset consists of 67 panels (n) and 27 (T) years. However, the size of the dataset reduces when the dependent variable is calculated as the five-year forward-moving geometric average of per-worker real GDP growth rate. This is because real GDP per worker is available only for the years between 1975 and 2001. Thus, calculating the value of the dependent variable for 1997, 1998, 1999, 2000 and 2001 is not possible, as this requires the values of real GDP per worker for 2002 and onwards. Nevertheless, the length of the dataset is considered to be the years between 1975 and 2001, as the five-year forward-moving geometric average of per-worker real GDP growth rate, even if indirectly, reflects the changes in output per worker between these years.

Turkey experienced many economic crises between the years 1975 and 2001; thus, on average, the five-year forward-moving geometric average of per-worker real GDP growth rate is low (1.8%) for a developing country. For the same reason, the size of the standard deviation of the dependent variable within panels is rather high. The value of an observation deviates from the sample mean by 3.2%, which is nearly twice as high as the sample mean. The size of the standard deviation between panels indicates that the five-year forward-moving geometric average of per-worker real GDP growth rate varies significantly across the provinces as well. This is due to the disparity in the level of economic development across the provinces in Turkey.

The minimum and maximum values of the dependent variable across observations, between panels and within panels, provide examples of extreme cases. The highest value of the five-year forward-moving geometric average of per-worker



real GDP growth rate is observed in Adiyaman in 1986, which is 17.8%.<sup>9</sup> The minimum value of the dependent variable across observations is -9.1%, which is observed in Mus in 1982. This is likely to be related to the economic crisis between 1978 and 1981, which may have affected the growth rates reported in Mus in the following years.

Average shares of the components of public investment for the estimated sample can be ordered by magnitude of the values from highest to lowest as city infrastructure and security services (30.0%), energy infrastructure (26.7%), education (21.6%), transportation and communication (14.8%), and health (6.9%). Overall minimum values show that the shares of transportation and communication, education and health in total public investment are zero. This is because some provinces do not receive public investment in some sectors. Similarly, overall maximum values of the shares in total public investment are over 90%. This is because some provinces in the sample receive public investment only in one sector, such as in energy, or transportation and communication. The values of the overall standard deviations of the components of public investment are very high with respect to the mean of the variables. This indicates high variation in public investment across regions and time.

The summary statistics for the share of total public investment in GDP are in accordance with the summary statistics for the components of public investment. The share of total public investment in GDP is 3.7% on average. The maximum value for the overall observations is 87.3%. This is due to provinces (such as Bingöl, Kahramanmaraş and Sanliurfa) that are underdeveloped. Their economies are so minuscule that the level of their GDP is hardly above the value of the public investment they receive.

The average of the population growth rate in the dataset is 1.6%. The statistics show that the value of population growth rate is negative for some provinces, and it can be as low as -3.5%. This is a result of domestic migration, which leads to negative population growth rates for the provinces from which people emigrate. Migration also makes the rate of population growth considerably higher in those provinces that receive domestic migrants. The maximum value of the overall sample is 10.1%. The minimum value of the panel means shows that some provinces consistently had a negative population growth rate in the sample.

Summary statistics show that the average share of private capital in GDP for Turkey in the estimated sample is 1.3%. The values of standard deviation show that it varies both between and within provinces by 1.9%. This is further evidence for disparity in the level of development across provinces. Its value is negative for some provinces (Diyarbakır, Isparta, Niğde and Sinop) for the years that coincide with the economic crises the country experienced (such as between 1984 and

<sup>9</sup> The dataset has been examined for errors in data entry and the calculation of the dependent variable but neither of these appears to be the case.

1986, and between 1994 and 1996). Additionally, its value is zero for some provinces (such as Adiyaman, Agri and Hakkari) that are underdeveloped and rural.

The pairwise correlation matrix for the variables can be found in table 2. Overall statistics show that the values of correlation coefficients are below 20%. However, the public investment indicators appear to be correlated with each other. It should be added that they are included in the regressions separately; thus, multicollinearity is unlikely to be an issue in the results. Nevertheless, the values of the correlation coefficients between the share of total public investment in GDP and the shares of energy infrastructure, education, and city infrastructure and security in total public investment are over 30%, which is a factor that reduces the reliability of the results. Considering this, in the next section, the values of the variance inflation factors are also reported to establish the robustness of the results to collinearity between the variables.

TABLE 1  
*Descriptive statistics*

Variable		Mean	Std. dev.	Min.	Max.	Obs. <sup>†</sup>
$\gamma$	overall	0.018	0.032	-0.091	0.178	N=1474
	between		0.012	-0.019	0.049	n=67
	within		0.030	-0.080	0.161	T=22
$\theta_{it\&c}$	overall	0.148	0.161	0.000	0.929	N=1474
	between		0.086	0.022	0.427	n=67
	within		0.137	-0.183	0.874	T=22
$\theta_{en}$	overall	0.267	0.278	0.000	0.987	N=1474
	between		0.200	0.044	0.830	n=67
	within		0.195	-0.563	1.005	T=22
$\theta_{ed}$	overall	0.216	0.144	0.000	0.887	N=1474
	between		0.078	0.023	0.357	n=67
	within		0.122	-0.077	0.790	T=22
$\theta_{c\&s}$	overall	0.300	0.184	0.004	0.915	N=1474
	between		0.109	0.068	0.511	n=67
	within		0.148	-0.139	1.072	T=22
$\theta_{he}$	overall	0.069	0.085	0.000	0.891	N=1474
	between		0.044	0.011	0.259	n=67
	within		0.073	-0.147	0.867	T=22
$g/y$	overall	0.037	0.063	0.002	0.873	N=1474
	between		0.040	0.009	0.204	n=67
	within		0.048	-0.159	0.735	T=22
$\eta$	overall	0.016	0.015	-0.035	0.101	N=1474
	between		0.012	-0.019	0.046	n=67
	within		0.008	-0.026	0.071	T=22
$k/y$	overall	0.013	0.027	-0.005	0.377	N=1474
	between		0.019	0.000	0.092	n=67
	within		0.019	-0.078	0.371	T=22

<sup>†</sup> The summary statistics are expressed in decimal numbers. Thus, “0.018” should be read as “1.8%”.

<sup>‡</sup> Obs.: The number of observations; N: the number of observations in the sample; n: the number of panels (provinces) in the sample; T: the number of time periods (years) in the sample.

TABLE 2

*Pairwise correlation matrix for the variables*

	$\gamma$	$\theta_{en}$	$\theta_{t\&c}$	$\theta_{ed}$	$\theta_{he}$	$\theta_{c\&s}$	$g/y$	$\eta$	$k/y$
$\gamma$	1.000								
$\theta_{en}$	0.118	1.000							
$\theta_{t\&c}$	-0.206	-0.381	1.000						
$\theta_{ed}$	-0.099	-0.584	-0.061	1.000					
$\theta_{he}$	0.014	-0.291	-0.093	0.108	1.000				
$\theta_{c\&s}$	0.073	-0.585	-0.209	0.103	-0.028	1.000			
$g/y$	0.086	0.510	-0.094	-0.310	-0.170	-0.367	1.000		
$\eta$	-0.024	0.095	-0.009	-0.149	-0.020	-0.010	0.061	1.000	
$k/y$	0.116	-0.077	-0.004	-0.006	0.022	0.115	-0.149	0.166	1.000

## 6.2 REGRESSION ANALYSIS

The results are reported in tables 3 and 4. In table 3, the results are obtained from the random-effects technique with standard errors robust to heteroscedasticity and serial correlation within panels. In table 4, the results obtained from the pooled OLS with standard errors robust to heteroscedasticity, serial correlation within and between panels are reported.

The results in table 3, firstly show that the coefficients of the shares of energy infrastructure, health, education, and city infrastructure and security services in total public investment are not statistically significant. It appears that the coefficient of the share of transportation and communication in total public investment is negative and statistically significant in the third column. The share of total public investment in GDP has a positive and statistically significant coefficient in all columns. The coefficient of the population growth rate is not statistically significant in any of the regressions. The share of private capital (in the manufacturing sector) in GDP has a positive and statistically significant coefficient in the overall results. In table 4, the results remain similar to those in table 3, except for the coefficient of the share of energy infrastructure in total public investment, which becomes statistically significant with a positive sign.

In tables 3 and 4, Wald  $\chi^2$  and F statistics indicate the coefficients of the variables in the regressions are jointly statistically significant. The values of  $R^2$  show that the variables explain 17 to 18% of the change in the dependent variable. The average values of the variance inflation factors (mean VIF) for the regressions in tables 3 and 4 provide evidence that the results are robust to multicollinearity.

Overall results suggest that, if the share of total public investment in GDP and other factors are held constant, shifting the public investment from transportation and communication to other sectors contributes positively to the five-year forward-moving geometric average of per-worker real GDP growth rate. Shifting 1% of the public investment from transportation and communication to other sectors is associated with an increase that is between 0.016% and 0.019% in the depend-

ent variable. Devarajan, Swaroop and Zou's (1996) model above indicates that public policy overinvested in transportation and communication services in the years between 1975 and 2001. The results in table 4 appear to indicate that, among public investment in education, health, city infrastructure and security, and energy infrastructure, it is the latter in which there has been underinvestment.

It must be noted that, given the economic model discussed in the previous section, the results do not provide information as to whether a particular type of public investment is more or less productive than another. They simply indicate the allocation of public investment between transportation and communication, energy infrastructure, education, health, and city infrastructure and security is not optimum. Although investment in transportation and communication might be productive per se, results indicate that other public investment layouts would yield higher output for a unit increase in the amount of resources.

According to Devarajan, Swaroop and Zou's (1996) model, the government does not need to increase the level of overall public investment to increase the growth rate. Public policy can achieve a higher growth rate simply by shifting resources from transportation and communication layout to other types of public investment. The results in table 4 imply that, ideally, this should be public energy infrastructure.

The results also indicate that the level of public investment is positively related to the five-year forward-moving geometric average of per-worker real GDP growth rate. For a given public investment composition, increasing the share of total public investment in GDP is associated with higher values of the dependent variable. Findings regarding the coefficient of the level of public investment are consistent with the implication of the economic model presented in this paper. The Devarajan, Swaroop and Zou (1996) model suggests that, even though the coefficient of the share of transportation and communication in total public investment is negative, this does not mean that investment in this layout is unproductive per se. The positive coefficient of the level of public investment supports this point and suggests that, even though the resources are misallocated among the public investment layouts, if there were no budget constraints, increasing their amount would have a positive growth effect.

Statistical evidence in this paper indicates that returns to public capital are slightly lower than the returns to private capital. While a 1% increase in the share of total public investment in GDP is associated with a 0.05 to 0.09% increase in the five-year forward-moving geometric average of per-worker real GDP growth rate, a 1% increase in the share of private capital in GDP in the manufacturing sector is related to a 0.10 to 0.16% increase in the dependent variable. The results are in agreement with Khan and Kumar (1997), who find that the rate of return for public capital is 0.29%, while the rate of return to private investment is 0.4% for the years 1970-1990 for a cross-section of developing countries. Their results also indicate that the productivity of private capital is higher than that of public capital.

The population growth rate does not appear to be related to the five-year forward-moving geometric average of per-worker real GDP growth rate. Becker, Glaeser and Murphy (1999) show that, although the effect of population becomes negative as land and other natural resources have diminishing returns, it can also be a source of growth through its positive impact on human capital. The results appear to imply that the negative and positive effects of population movements between provinces cancel each other out.

It should be added that the statistical significance of the coefficient of the share of transportation and communication in total public investment in table 4 is robust to alternative specification of the dependent variable, such as the ten-year or the fifteen-year forward-moving geometric average of per-worker real GDP growth rate. This is the case if the dependent variable is calculated as the five-year forward-moving arithmetic average of per-capita or per-worker real GDP growth rate, or geometric average of per-capita real GDP growth rate. The statistical significance of the share of transportation and communication in total public investment in table 3, although robust to using wider time spans in computation of the dependent variable, is sensitive to the specification of the dependent variable in per capita terms or calculating it as an arithmetic average<sup>10</sup>.

For the five-year forward-moving geometric average of per-worker real GDP growth rate, the coefficient of the share of transportation and communication in total public investment in tables 3 and 4 becomes statistically insignificant when the fixed-effects technique is used. However, for wider time spans of the dependent variable, its coefficient becomes statistically significant according to the fixed-effects technique too.

The statistical significance of the share of total public investment in GDP in tables 3 and 4 is robust to both alternative specifications of the dependent variable and using the fixed-effects as the econometric technique. However, the statistical significance of the coefficient of the share of private capital in GDP depends on the computation of the dependent variable and the chosen econometric technique. This appears to be the case for the population growth rate too, which becomes statistically significant for the ten-year or the fifteen-year forward-moving geometric average of per-worker real GDP growth rate<sup>11</sup>.

<sup>10</sup> Between tables 3 and 4, the statistical significance of the coefficient of the share of energy infrastructure in total public investment is sensitive to the treatment of residuals for heteroscedasticity, and serial correlation between and within panels. For this reason, the robustness analysis regarding alternative specifications of the dependent variable focuses on the share of transportation and communication in total public investment, which is the only public investment component that has a statistically significant coefficient in both tables 3 and 4.

<sup>11</sup> All the results are available on request.

TABLE 3  
*Composition of public investment and economic growth: random-effects technique-  
standard errors corrected for heteroscedasticity and serial correlation*

	(1)	(2)	(3)	(4)	(5)	(6)
$\theta_{en}$		0.004 (0.006)				
$\theta_{t\&c}$			-0.016 <sup>†</sup> (0.007)*			
$\theta_{ed}$				-0.004 (0.010)		
$\theta_{he}$					0.011 (0.016)	
$\theta_{c\&s}$						0.006 (0.008)
$g/y$	0.089 (0.016)**	0.080 (0.020)**	0.084 (0.016)**	0.085 (0.017)**	0.091 (0.017)**	0.092 (0.018)**
$\eta$	-0.082 (0.129)	-0.083 (0.127)	-0.088 (0.127)	-0.083 (0.125)	-0.085 (0.129)	-0.084 (0.129)
$k/y$	0.102 (0.032)**	0.105 (0.033)**	0.105 (0.032)**	0.106 (0.033)**	0.103 (0.032)**	0.100 (0.032)**
<b>Year dummies</b>						
$(T_j)^{\dagger\dagger}$						
<b>Constant</b>	0.004 (0.003)	0.004 (0.003)	0.006 (0.003)	0.005 (0.005)	0.003 (0.004)	0.002 (0.005)
<b>Observations</b>	1474	1474	1474	1474	1474	1474
<b>Number of panels</b>	67	67	67	67	67	67
<b>Wald <math>\chi^2</math></b>	771.65	832.68	829.83	773.86	829.34	797.86
<b>Prob &gt; Wald <math>\chi^2</math></b>	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
<b>R<sup>2</sup></b>	0.17	0.17	0.18	0.17	0.17	0.17
<b>Mean VIF<sup>†††</sup></b>	1.15	1.29	1.24	1.33	1.20	1.40

Standard errors in parentheses, \* significant at 5%; \*\* significant at 1%.  
<sup>†</sup> The coefficients show the effect of a one-unit change in the value of an indicator on the dependent variable. The values of the variables are expressed in decimal numbers in table 1. This means that a unit change in table 3 corresponds to a 100% change in the shares of public investment.  
<sup>††</sup> The results for year dummies are not reported in the table for conciseness.  
<sup>†††</sup> VIF: Variance Inflation Factor.

**TABLE 4**  
*Composition of public investment and economic growth: pooled OLS technique-  
standard errors corrected for heteroscedasticity, and serial correlation both within  
and between panels*

	(1)	(2)	(3)	(4)	(5)	(6)
$\theta_{en}$		0.009 <sup>†</sup> (0.004)*				
$\theta_{t\&c}$			-0.019 (0.008)*			
$\theta_{ed}$				-0.015 (0.011)		
$\theta_{he}$					0.013 (0.010)	
$\theta_{c\&s}$						0.005 (0.006)
$g/y$	0.074 (0.008)**	0.054 (0.008)**	0.068 (0.007)**	0.064 (0.007)**	0.077 (0.009)**	0.079 (0.013)**
$\eta$	-0.091 (0.098)	-0.093 (0.097)	-0.095 (0.101)	-0.104 (0.101)	-0.091 (0.099)	-0.095 (0.101)
$k/y$	0.167 (0.060)**	0.165 (0.057)**	0.166 (0.055)**	0.163 (0.057)**	0.168 (0.059)**	0.166 (0.060)**
<b>Year dummies</b>						
$(T_j)^{**}$						
<b>Constant</b>	0.003 (0.002)	0.003 (0.002)	0.006 (0.002)**	0.009 (0.003)**	0.002 (0.002)	0.001 (0.004)
<b>Observations</b>	1474	1474	1474	1474	1474	1474
<b>Number of panels</b>	67	67	67	67	67	67
<b>F</b>	35.98	26.60	41.45	30.92	32.05	55.26
<b>Prob &gt; F</b>	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
<b>R<sup>2</sup></b>	0.17	0.18	0.18	0.18	0.17	0.17
<b>Mean VIF<sup>†††</sup></b>	1.15	1.29	1.24	1.33	1.20	1.40

Standard errors in parentheses, \* significant at 5%; \*\* significant at 1%.  
<sup>†</sup> The coefficients show the effect of a one-unit change in the value of an indicator on the depend-  
ent variable. The values of the variables are expressed in decimal numbers in table 1. This means  
that a unit change in table 4 corresponds to a 100% change in the shares of public investment.  
<sup>††</sup> The results for year dummies are not reported in the table for conciseness.  
<sup>†††</sup> VIF: Variance Inflation Factor.

7 CONCLUSION AND LIMITATIONS

In this paper, the relationship between the composition of public investment and economic growth has been analysed. According to the model used in the paper, results indicate that, for the years between 1975 and 2001, public policy led to an overinvestment in transportation and communication services. As the GDP data for the provinces after 2001 are not reported by the Turkish Statistical Institute, it is not possible to draw a policy implication regarding the country’s more current economic climate. Results in this paper only indicate that the misallocation of public resources is likely to have led to sub-optimum growth rates between 1975 and 2001. Nevertheless, this paper provides an approach to the assessment of public policy that could be applied to data for the years after 2001 if the GDP series for the provinces were made available by the Turkish Statistical Institute.

Devarajan, Swaroop and Zou (1996) provide a useful analytical tool that helps to identify whether the distribution of public resources between infrastructure, education and health is optimum. The strength of their model is the lack of restrictions regarding the productivity of public investment layouts. However, this is also the model’s weakness, as it does not provide any insight into the reasons for the misallocation of resources. Thus, the model does not explain why it is the transportation and communication services that are overinvested in. Is it because investment in this sector is less productive in general or because the amount of spending in this layout too high? It is not possible to answer these questions using the economic model presented in this paper.

The second limitation of this paper is the assumption that there is no reverse causality between the dependent variable and public investment indicators. To reduce the possibility of the endogeneity of the public policy in determining the amount of public investment, the dependent variable is calculated as the five-year forward-moving geometric average of per-worker real GDP growth rate. Nevertheless, public policy might be impacted by the expected future growth rates, which would lead to biased results.

Disclosure statement

No potential conflict of interest was reported by the author.



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# Returns to schooling in the Portuguese economy: a reassessment

MARIA MANUEL CAMPOS, MSc\*

HUGO REIS, Ph.D.\*

Article\*\*

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Maria Manuel CAMPOS

Banco de Portugal, Av. Almirante Reis, 71, 1150-012 Lisbon, Portugal

e-mail: [mmcampos@bportugal.pt](mailto:mmcampos@bportugal.pt)

ORCID: 0000-0003-1699-4102

Hugo REIS

Banco de Portugal, Av. Almirante Reis, 71, 1150-012 Lisbon, Portugal

Universidade Católica Portuguesa, Palma de Cima, 1649-023 Lisbon, Portugal

e-mail: [hfreis@bportugal.pt](mailto:hfreis@bportugal.pt)

ORCID: 0000-0002-6366-3421

**Abstract**

*This paper provides an overview of the evolution of private returns to schooling in the Portuguese economy along the 1986-2013 period. We estimate the returns separately for men and women, at the mean and along the conditional wage distribution. Returns to schooling are found to be high, particularly for women, and to increase along the distribution. The magnitude of the returns increased throughout the 1986-2013 period, but particularly in the 1990s. We also provide estimates of the relative wage premium associated with specific levels of educational attainment and find that they are highest for tertiary education. In the first decades under analysis, relative wage premia associated with the 9<sup>th</sup> grade stand above those estimated for secondary education, whereas in the most recent period these differences are negligible.*

*Keywords: returns to schooling, quantile regression, education*

**1 INTRODUCTION**

As formalized in Becker (1962), assessment of the private returns to schooling provides a key piece of information for an individual decision determining the optimal level of investment in formal education.

Regardless of the potential social returns to education, information on private returns is also relevant for policymakers, guiding them in the design of programs and incentive schemes to promote individual investment in education. There is a wide strand of empirical literature shedding light on the magnitudes and explanatory factors of returns to schooling in both advanced and emerging economies. Card (1999) provides a comprehensive review of existing literature on returns to schooling.

Cross-country estimates presented in Psacharopoulos (1994), Martins and Pereira (2004), Psacharopoulos and Patrinos (2004), and Montenegro and Patrinos (2014), show that returns to schooling in Portugal rank high among European Union countries. Vieira (1999), using data for the 1982-1992 period, found evidence of returns to schooling of approximately 7 per cent at the mean of the wage distribution. Acknowledging that conventional estimates based on Mincerian equations are hampered by the so-called “ability bias”, Vieira (1999) attempts to circumvent this by estimating the returns to schooling using instrumental variables (IV). Specifically, the author uses changes to compulsory schooling legislation as an exogenous source of variation in educational attainment. This results in lower – albeit still positive – returns to education. Sousa, Portela and Sá (2015) also focus only on returns at the mean of the distribution. Using *Quadros de Pessoal* data (QP henceforth) spanning the 1986-2009 period and a standard Mincer equation, they found returns of 10.0 per cent in the case of men and close to 10.5 per cent for women in the last year under analysis. Sousa, Portela and Sá (2015) also use IV, presenting results based on three different instruments: changes to compulsory education, quarter of birth and the average education by region in the year the

individual first entered school. In this case estimates of returns to schooling are higher than those obtained using OLS, but show a similar evolution over time.

There are other studies that assess the returns at different points of the conditional wage distribution – not only at the mean. Machado and Mata (1998), using QP data for the 1982-1994 period, found returns ranging from 4 to 11 per cent, respectively, at the lower and upper parts of the distribution (and around 7-8 per cent at the mean). Similar evidence is provided in Hartog, Pereira and Vieira (2001). In the latter case, however, the authors consider a richer set of covariates in the regressions, which yields slightly lower returns than in Machado and Mata (1998). Martins and Pereira (2004) also provide estimates of returns to schooling at different points of the distribution. Using the 1995 wave of QP, they find increasing returns along the distribution (of 6.5 and 14.5 per cent, respectively, at the bottom and at the top of the distribution).

Alves, Venteno and Novo (2010), and Portugal (2004) provide estimates of the returns to tertiary education. In both cases, the authors find positive and significant returns benefiting individuals with university degrees (relative to non-university educated counterparts). Alves, Venteno and Novo (2010) provide estimates of the tertiary education wage premium at different points of the distribution and on the basis of QP data for 1982, 1995 and 2006. In the latter year they find returns ranging from approximately 45 per cent to almost 100 per cent, respectively, at the lower and upper quantiles of the distribution.

The recent evolution of returns to schooling in Portugal may however have changed, reflecting important reshufflings in the educational composition of the labor force that may have affected the way the market values education and specific schooling levels. This paper aims to complement the existing evidence on returns to schooling in the Portuguese economy and provide an overview of how they have changed since the late 1980s. In particular, we use QP data spanning the 1986-2013 period to estimate the returns to schooling separately for men and women, at the mean and along the conditional wage distribution. We also provide estimates of the relative wage premium associated with specific levels of educational attainment. The main goal of this paper is to provide a comprehensive description of the evolution of returns to schooling in this period, without claiming a causal relationship between schooling and earnings.

In broad terms, our results may be summarized as follows: the returns to schooling are found to be high, particularly in the case of women, and to increase along the distribution. The returns are highest for tertiary education. In the first decades under analysis, relative returns to the 9<sup>th</sup> grade stand above those estimated for secondary education. In the most recent period these differences are negligible, in line with the typical evolution in advanced economies (Montenegro and Patrinos, 2014). The detailed analysis undertaken in this paper allows the pinpointing of exceptions to these general findings.

It is worth highlighting that we do not resort to IV or control function methods for estimating the private returns to schooling. Estimates based on these methods are highly dependent on the sub-sample whose schooling attainment is affected by the change in the instrument chosen for the analysis. Different instruments yield different estimates of the returns to schooling and lead to different interpretations (Imbens and Angrist, 1994). Moreover, we are interested in providing a broad picture of how returns have changed along the 1986-2013 period and, as shown in Sousa, Portela and Sá (2015), relying on IV estimates does not change the overall evolution. Finally, note also that our paper focuses only on the *private* (or individual) returns to education and does not address the *social* returns to education.

The paper is organized as follows: section 2 presents the data source, also providing a comprehensive analysis of descriptive statistics. Section 3 describes the theoretical framework underlying the estimations presented in the article, whereas section 4 sheds light on the strategy used to implement the analysis. Section 5 lists the key results of the article. Finally, section 6 presents the main conclusions and discusses topics relevant in terms of education policy.

## 2 DATA DESCRIPTION

Data are drawn from *Quadros de Pessoal*, a matched employer-employee dataset including a personal identification number that allows the tracing of individuals across time. The information is based on a compulsory survey conducted annually by the Ministry of Social Security. Data cover every establishment paying wages in the Portuguese private sector: general government, military staff, self-employed and household employees are thus excluded. The questionnaire covers attributes of workers and firms. Regarding the former, it includes information on gender, age, education, occupation, industry, tenure and earnings, among other dimensions. For the purpose of our analysis, we use data covering the 1986-2013 period (except 1990 and 2001, for which data are not available). We focus on a sub-sample made of full- and part-time employees aged between 16 and 65 years.

We define wages as the sum of every work-related category of income (including base salary, overtime pay, and other regular payments). Hourly wages are adjusted for both normal and supplementary working hours. Real wages are computed on the basis of each year's Consumer Price Index (taking 1986 as the base-year). In QP, individual educational attainment corresponds to a categorical variable reporting the highest level completed.<sup>1</sup> An additional variable providing information on the minimum number of school years required to complete the highest educational level reported was also created.

<sup>1</sup> More precisely, we consider the mode of the highest level of education reported throughout the panel. The difference between the mode and the actual level reported is negligible and does not change either the magnitude of the estimates or their evolution over time.



Table 1 briefly describes selected QP waves used for the analysis. It provides evidence of a remarkable increase in the average length of schooling, from 5.6 to 9.9 years, respectively in 1986 and 2013. This is consistent with a significant drop in the share of employees reporting lower educational levels and a strong increase in the percentage with either secondary or tertiary education (figure 1).

This evolution was particularly noticeable in the case of female employees. They are, on average, more educated than men throughout the entire period under analysis and this disparity widened in the last decade. In particular, the percentage of female employees with a university degree increased from 2.3 per cent in the 1986 wave of QP to 22.0 per cent in 2013 (panel D of figure 1).

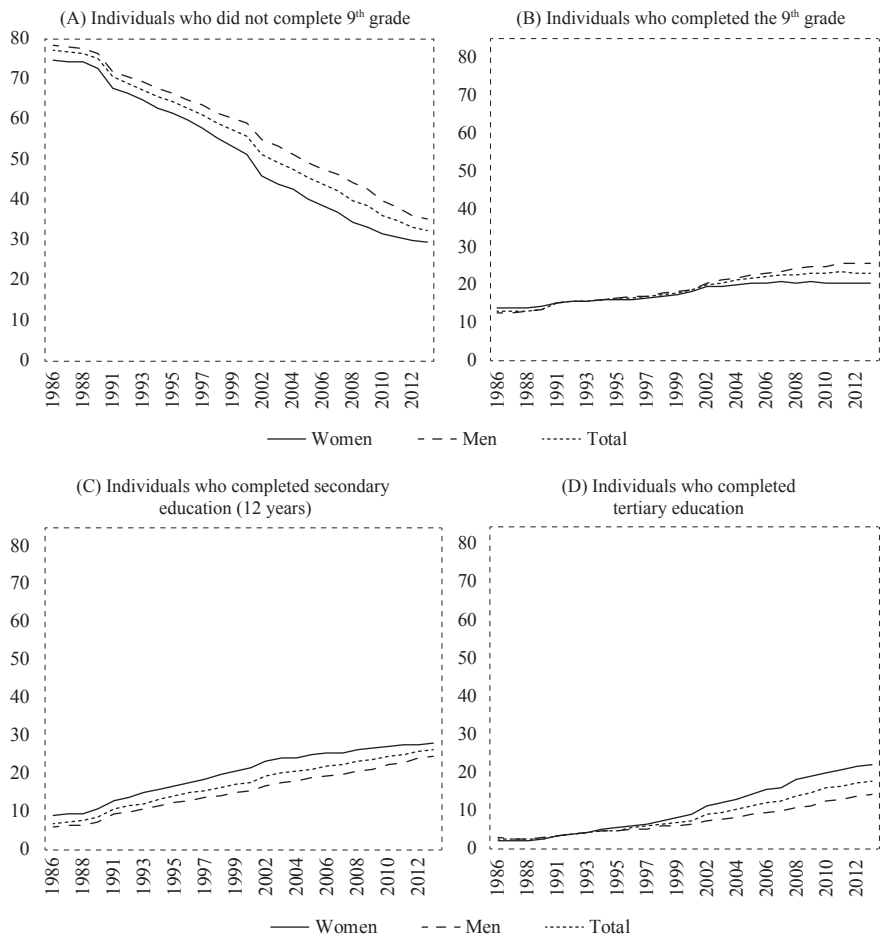
**TABLE 1**  
*Descriptive statistics*

		1986	1991	1996	2000	2005	2010	2013
Women	Education	5.73	6.54	7.37	8.16	9.17	10.09	10.39
	(years)	[3.42]	[3.57]	[3.84]	[4.05]	[4.26]	[4.38]	[4.38]
	Age	32.34	32.24	34.18	35.08	36.56	38.06	39.37
	(years)	[10.2]	[10.26]	[10.15]	[10.15]	[10.17]	[10.31]	[10.21]
	Tenure	8.55	7.34	7.77	7.21	7.21	7.61	8.53
	(years)	[7.15]	[7.83]	[7.98]	[7.97]	[7.66]	[7.92]	[8.2]
	No. obs.	327,634	467,428	584,109	714,836	836,568	923,898	901,793
	% of total	33.1	36.7	39.9	41.5	42.2	45.2	47.3
Men	Education	5.50	6.17	6.89	7.40	8.18	9.03	9.45
	(years)	[3.33]	[3.5]	[3.7]	[3.81]	[3.96]	[4.08]	[4.08]
	Age	36.30	36.35	36.88	37.27	37.79	39.01	39.92
	(years)	[11.65]	[11.74]	[11.32]	[11.16]	[10.84]	[10.68]	[10.5]
	Tenure	9.56	8.93	8.84	8.11	7.73	8.14	8.89
	(years)	[8.05]	[8.71]	[8.62]	[8.52]	[8.07]	[8.27]	[8.54]
	No. obs.	662,723	806,480	880,628	1,009,561	1,144,560	1,118,236	1,003,012
	% of total	66.9	63.3	60.1	58.5	57.8	54.8	52.7
Total	Education	5.6	6.31	7.08	7.71	8.60	9.51	9.9
	(years)	[3.36]	[3.53]	[3.76]	[3.93]	[4.12]	[4.25]	[4.25]
	Age	34.99	34.84	35.80	36.36	37.27	38.58	39.66
	(years)	[11.35]	[11.39]	[10.95]	[10.8]	[10.58]	[10.53]	[10.37]
	Tenure	9.23	8.34	8.42	7.73	7.51	7.90	8.72
	(years)	[3.36]	[3.53]	[3.76]	[3.93]	[4.12]	[4.25]	[4.25]
	No. obs.	990,357	1,273,908	1,464,737	1,724,397	1,981,128	2,042,134	1,904,805

*Notes:* Unless otherwise specified, the table reports averages (and standard-deviations in brackets). Variable “tenure” corresponds to the number of years working in the current firm.

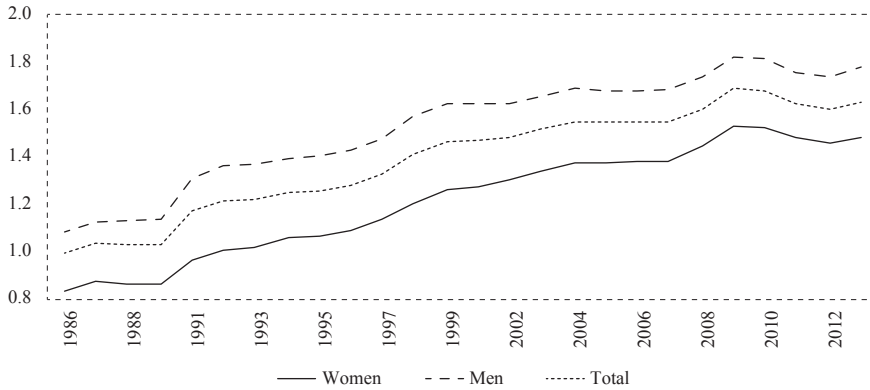
*Source:* Authors’ calculations based on Quadros de Pessoa.

**FIGURE 1**  
*Employees by level of educational attainment (percentage)*



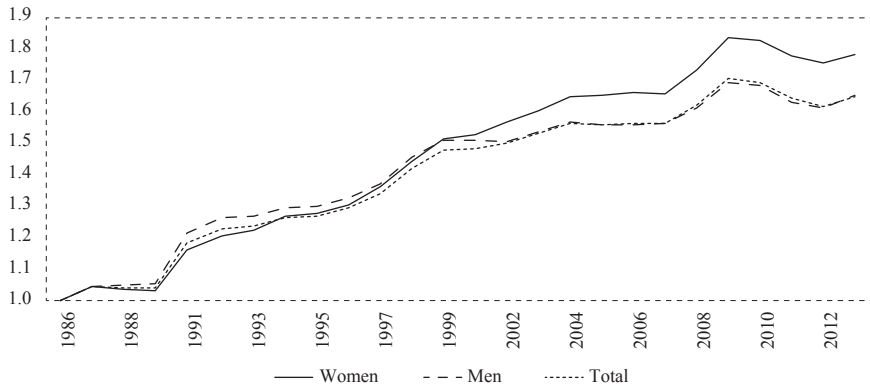
Source: Authors' calculations based on Quadros de Pessoa.

In spite of their better educational endowments, QP data show that, on average, women earn consistently lower wages than male employees over the whole period (figure 2). Nonetheless, although the two genders have experienced similar real wage increases in the first part of the 1986-2013 period, women's earnings have been growing more sharply than men's since 2000 (figure 3). As emphasized in Cardoso et al. (2016), this evolution may be explained by a composition effect stemming from the higher educational level of the women joining the labor market. Indeed, on average, wages for university-educated women, who represent an increasing share of our sample, grew more than wages of males with the same educational level (figure 4).

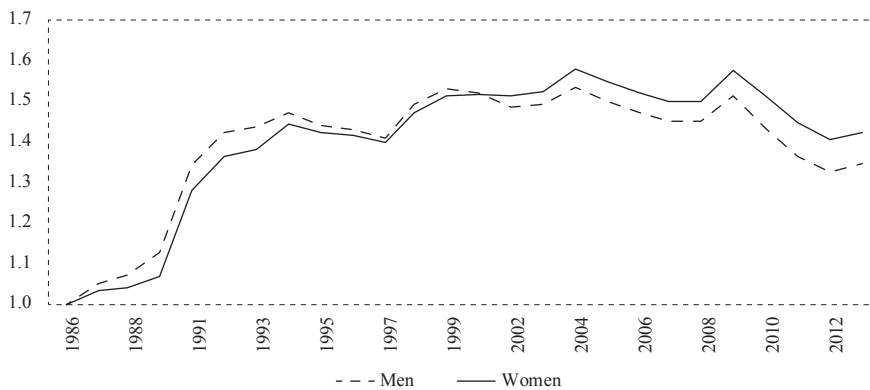
**FIGURE 2***Average real wage per hour (in euro)*

*Note: The chart depicts the average real wage per hour worked in each wave of QP (deflated using CPI, 1986 base year).*

*Source: Authors' calculations based on Quadros de Pessoa.*

**FIGURE 3***Real wage growth (index 1986=1)*

*Source: Authors' calculations based on Quadros de Pessoa.*

**FIGURE 4***Real wage growth for workers with tertiary education (index 1986=1)*

*Source: Authors' calculations based on Quadros de Pessoa.*

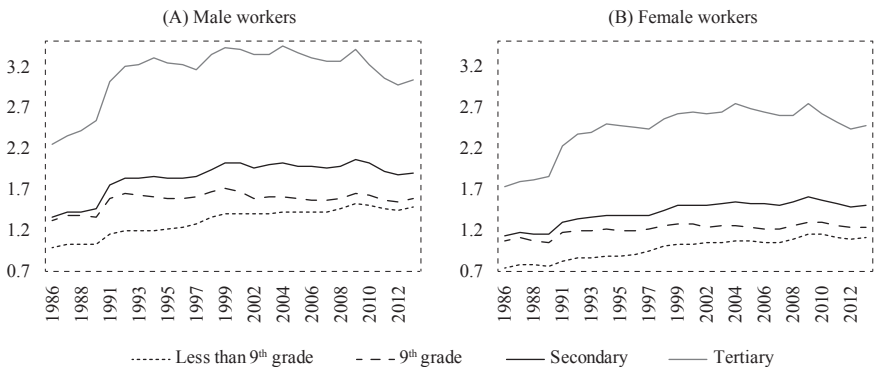
Figure 5 depicts the average real wage by educational level along the 1986-2013 period. As expected, wages increase with education but differences between workers with tertiary education and their less educated counterparts are particularly significant. This differential widened up to 1995, remained relatively constant up to the mid-2000s and, more recently, it has been shrinking.

Focusing on workers with lower educational levels, figure 5 also points out that while in the late 1980s wages of individuals who did not complete the 9<sup>th</sup> grade were considerably below those of workers who did, this difference almost disappears in more recent QP waves. Conversely, whereas in the beginning of the period average real wages were similar among workers with 9<sup>th</sup> grade education and those who have completed secondary schooling, the gap between the two groups has been widening since the 1990s.

For both genders the distribution of wages has shifted to the right and become slightly less compressed than in the late 1980s (details depicted in appendix). This increase in wage inequality was particularly noticeable at the upper tail of the distribution, and only up to the mid-1990s, having remained stable since then. The wage distribution is more compressed in the case of less educated individuals.

**FIGURE 5**

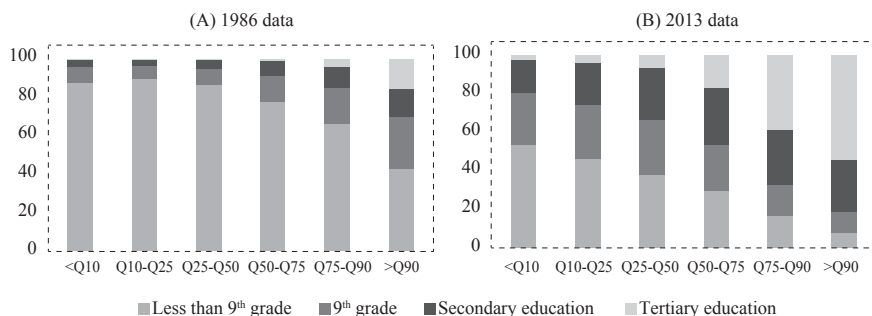
*Average hourly wage by educational level*



Source: Authors' calculations based on Quadros de Pessôal.

The educational *composition* of individuals across the distribution changed considerably along the 1986-2013 period. While in 1986 the share of workers with tertiary (or even secondary) educational attainment with below-median wages was low, it increases when focusing on the 2013 wave of QP (figure 6). Although this may reflect a wide range of aspects and changes in the composition of private employment or in the productive structure of the economy, it can also be interpreted as a symptom of over-education (a phenomenon that warrants further analysis but which is out of the scope of this paper).

FIGURE 6

*Educational composition of the wage distribution*

Source: Authors' calculations based on Quadros de Pessoa.

### 3 THEORETICAL FRAMEWORK

Becker (1962) pioneered in applying utility theory to investment in education. In his framework the proportional pecuniary returns associated with educational attainment are a key component of the individual decision on whether and by how much to invest in human capital. In particular, individuals select the optimal number of years of schooling so as to maximise the discounted present value of future earnings net of the cost of schooling. This corresponds to an optimization problem whose solution is such that individuals would continue to invest in additional education up to the point where marginal benefits match marginal costs.

Mincer (1974) provided an empirical approximation to the marginal benefits' side of the individuals' optimization problem. In particular, the so-called traditional Mincerian wage equation corresponds to:

$$\ln y_i = \alpha + \beta S_i + \lambda_1 \text{Exp}_i + \lambda_2 \text{Exp}_i^2 + \varepsilon_i \quad (1)$$

where  $\beta$  corresponds to the pecuniary return from an additional year of formal education and  $\text{Exp}$  refers to individuals' experience in the labor market. Like most writers on the relationship between education and earnings, we rely on Mincer's framework for the estimation of the returns to schooling.

Card (1999) made it clear that the decision on how much to invest in schooling is very much conditional on individual preferences and that it is subject to individual heterogeneity, both in terms of the marginal returns to schooling (determined by, for instance, differences in individual ability) and in terms of its costs (accounting for differences in rates of substitution between schooling and future earnings on the basis of, e.g., access to funds or personal taste). This implies a heterogeneous effects framework in which the way covariates affect wages varies across individuals.

#### 4 EMPIRICAL STRATEGY

To estimate the returns to schooling in the Portuguese economy we adopt the standard approach relying on Mincerian wage regressions such as the one in equation (1). The regressions are run separately for each wave of QP, assuming a cross-sectional set-up. We adopt a homogeneous effect framework, in the sense that we assume that the impact of schooling on wages is the same for all individuals:  $\beta_i = \beta_1 = \dots = \beta_N$ , for all  $i = 1, \dots, N$ .

Since our dataset does not include information on individuals' labor market experience, we take *age* (as a second order polynomial) as a proxy. It should be noted that this is not an accurate measure because it fails to take into account, for instance, the years spent at school or university or in unemployment, yielding an overestimation of the amount of labor market experience. Our regressions include a set of other covariates: the individual's tenure in the current firm (also as a second order polynomial), the logarithm of the current firm's size and, when pooling data jointly for men and women, gender dummies (equal to one for male employees). We allow for additional flexibility by running the wage regressions separately for men and women using the same set of covariates, except for the gender dummy.<sup>2</sup>

It should be noted that, as pointed out by Card (2001), estimates of returns to schooling based on Mincerian wage equations may be hampered by sources of bias. In the first place, there may be mismeasurements in terms of the individual schooling, in which case estimates of  $\beta$  would be downward biased. Although the possibility of measurement errors cannot be ruled-out, as we are using an administrative data source we are confident that erroneous cases are negligible in our sample.

An additional source of bias arises from the fact that we are not controlling for the whole set of individual-specific attributes that affect wages ("ability bias"). These factors – some of which are not observable – are included in error term. If they are also correlated with schooling attainment, generating endogeneity, the estimator would also be inconsistent. Since the standard Mincerian equation does not account for the impact of individual innate ability (or other unobservables) on wages and educational level,  $\hat{\beta}$  would be upward biased. There are several possible solutions to circumvent these issues, based on finding appropriate proxies for the unobserved factors or by applying specific econometric methods (such as IV or control function).

However, in this paper we do not resort to these solutions because no suitable proxy variables are available in the dataset and estimates based on the aforementioned methods would be highly dependent on the subsample whose schooling attainment is affected by the change in the elected instruments (Imbens and Angrist, 1994). Moreover, we are interested in providing a broad overview of

<sup>2</sup> For the purpose of assessing robustness of the estimates, we also ran regressions including controls for industry and region. This brings down the magnitude of the coefficients associated with educational attainment, but the evolution of returns over time is unchanged.

returns to schooling along the 1986-2013 period and not on analyzing causal relationships; since the unobserved factors that may be biasing our results are unlikely to change over time, they do not affect the *evolution* of the returns – only their magnitude. This is confirmed by results presented in Sousa, Portela and Sá (2015), which show that controlling for endogeneity does not change the way the returns evolved over time.

Finally, one should bear in mind that estimates of returns to education based on Mincerian regressions do not take into account the effect of costs and taxes that individuals incur by investing in education. Therefore, as thoroughly discussed in Heckman, Lochner and Todd (2006), Mincer-based returns such as those we present in this paper fail to provide an accurate depiction of the *actual* internal rate of return to schooling and shall not be interpreted as such.

#### 4.1 RETURNS TO AN ADDITIONAL YEAR OF SCHOOLING

Our baseline specification corresponds to

$$\ln y_i = \alpha + \beta S_i + \lambda_1 age_i + \lambda_2 age_i^2 + x_i^T \gamma + \varepsilon_i \quad (2)$$

where  $y_i$  corresponds to individuals' real hourly wage and  $S_i$  represents the minimum number of schooling years required to complete the highest level reported by the individual. As such, coefficient  $\beta$ , our parameter of interest, represents the per cent increase in hourly wage resulting from an additional year of schooling estimated using Ordinary Least Squares (OLS). Vector  $x_i$  groups the set of observable characteristics aforementioned and estimates for the parameters in vector  $\gamma$  measure the respective marginal impact on  $y_i$ .

Finally, the marginal impact of age is given by  $\lambda_1 + 2 * \lambda_2 age_i$ , where  $age_i$  refers to the worker's age.

In spite of adopting a homogeneous effect set-up, we allow for some heterogeneity in the returns by letting them change depending on the individuals' placement along the conditional distribution of wages. In particular, we also run our baseline specification within the Quantile Regression (QR) framework proposed in Koenker and Bassett (1978). This allows our covariates to affect the shape and tail behavior of the conditional wage distribution and implies assuming

$$\ln y_i = \alpha_\theta + \beta_\theta S_i + \lambda_{1,\theta} age_i + \lambda_{2,\theta} age_i^2 + x_i^T \gamma_\theta + \varepsilon_{\theta,i}, \quad (3)$$

where  $\theta$  represents different quantiles of the conditional distribution of hourly wages:  $\theta = \{0.1, 0.25, 0.5, 0.75, 0.9\}$ . Therefore,  $\beta_\theta$  corresponds to the return to an additional year of schooling at the  $\theta$ -th quantile of distribution of the logarithm of hourly wages conditional on the individuals' observed attributes. By assessing the returns to schooling at these different quantiles, we complement the evidence provided by OLS, which refers to the mean of the wage distribution.

4.2 RETURNS TO SPECIFIC EDUCATION LEVELS

In addition to the baseline specification, we also consider an alternative specification in which the highest completed level of schooling is included on the basis of dummy variables:

$$\ln y_i = \alpha + \sum_{j=2}^4 \beta_j E_{j,i} + \lambda_1 age_i + \lambda_2 age_i^2 + x_i^T \gamma + \varepsilon_i, \tag{4}$$

where  $E_j, j = \{1,2,3,4\}$ , are indicator variables that equal one for individuals reporting each of the following levels of schooling attainment: (1) less than the 9<sup>th</sup> grade; (2) 9<sup>th</sup> grade; (3) secondary education; and (4) tertiary education. The first category is omitted in the regressions. In this case each  $\beta_j > 1$  corresponds to the wage premium benefiting individuals holding schooling level  $j$  vis-à-vis comparable counterparts with less than the 9<sup>th</sup> grade ( $j=1$ ). We also implement this alternative specification within a QR framework:

$$\ln y_i = \alpha_\theta + \sum_{j=2}^4 \beta_{\theta,j} E_{j,i} + \lambda_{1,\theta} age_i + \lambda_{2,\theta} age_i^2 + x_i^T \gamma_\theta + \varepsilon_{\theta,i}, \tag{5}$$

5 FINDINGS

5.1 RETURNS TO AN ADDITIONAL YEAR OF SCHOOLING

Figure 7 presents the estimates of returns to schooling obtained from OLS regressions with specification (2) in each available wave of QP. Table 2 presents the full set of results of non-gender-specific regressions for selected years, including the results of the estimation of specification (2) controlling for industry and region effects. The introduction of these additional covariates does yield a decrease in the magnitude of the returns to schooling, but the overall picture does not change.

FIGURE 7  
*OLS-based returns to an additional year of schooling*



Note: The chart depicts the coefficient of  $S_i$  estimated on the basis of specification (2) using OLS. Coefficients are significant at the 1% level.

Source: Authors' calculations based on Quadros de Pessoa.



The results provide evidence of positive returns to an additional year of schooling in the case of both men and women. In the latter, the estimated returns are slightly higher, over the whole period under analysis: in 2013, an additional year of schooling is estimated to yield, on average, a 7.6 per cent increase in females' hourly wage, whereas for men the estimated increment stands at 6.4 per cent. The gender gap in the returns is statistically significant along the entire period and has remained relatively stable since 1986. Over time, there has been a slight increase in the returns for both genders. This was particularly marked along the 1990s and in more recent decades the returns remained relatively constant, albeit with a minor drop as of 2009.<sup>3</sup>

Results presented in figure 7 refer to the estimates of returns to an additional year of schooling *at the mean* of the conditional wage distribution. Such evidence may hide important differences at different points of the distribution. By relying on the QR framework we are able to estimate the returns to schooling at different quantiles. Results obtained with this methodology are summarized in figure 8 and table 3.

**FIGURE 8**

*Returns to schooling across the wage distribution (per cent)*



*Note: The charts depict the per cent wage increment from an additional year of schooling, obtained on the basis of specification (3).*

*Source: Authors' calculations based on Quadros de Pessoa.*

These results indeed show that the magnitude of the estimates for the returns to schooling changes considerably along the distribution. For instance, estimates obtained on the basis of OLS using the 2013 wave of QP and pooling data for both men and women point that an additional year of schooling implies a mean 7.1 per cent increase on wages (table 2). This figure masks the fact that, applying the same procedure to the same data but using the QR framework, one additional year of schooling yields a 3.1 per cent wage increase at the 1<sup>st</sup> decile of the distribution and an 8.8 per cent impact at the 9<sup>th</sup> (table 3).

<sup>3</sup> Significance tests show that this drop, although small, is statistically significant.

TABLE 2  
*Wage regressions – OLS*

	Baseline specification (2)					Specification (2) with additional controls				
	1986	1996	2005	2010	2013	1986	1996	2005	2010	2013
Educ. (years)	0.0608*** (0.0001)	0.0719*** (0.0001)	0.0730*** (0.0001)	0.0715*** (0.0001)	0.0706*** (0.0001)	0.0478*** (0.0001)	0.0580*** (0.0001)	0.0640*** (0.0001)	0.0638*** (0.0001)	0.0637*** (0.0001)
Age	0.0580*** (0.0002)	0.0458*** (0.0002)	0.0413*** (0.0002)	0.0404*** (0.0002)	0.0423*** (0.0002)	0.0489*** (0.0002)	0.0406*** (0.0002)	0.0382*** (0.0002)	0.0363*** (0.0002)	0.0374*** (0.0002)
Age sqrd.	-0.0006*** (0.0000)	-0.0004*** (0.0000)	-0.0004*** (0.0000)	-0.0004*** (0.0000)	-0.0004*** (0.0000)	-0.0005*** (0.0000)	-0.0004*** (0.0000)	-0.0003*** (0.0000)	-0.0003*** (0.0000)	-0.0003*** (0.0000)
Sex (male=1)	0.1858*** (0.0007)	0.2526*** (0.0006)	0.2567*** (0.0006)	0.2449*** (0.0005)	0.2477*** (0.0006)	0.1530*** (0.0007)	0.1957*** (0.0007)	0.2154*** (0.0006)	0.2036*** (0.0006)	0.1992*** (0.0006)
Firm size (log)	0.0778*** (0.0002)	0.0832*** (0.0002)	0.0715*** (0.0001)	0.0497*** (0.0001)	0.0446*** (0.0001)	0.0590*** (0.0002)	0.0621*** (0.0002)	0.0539*** (0.0001)	0.0335*** (0.0001)	0.0303*** (0.0001)
Tenure	0.0078*** (0.0001)	0.0117*** (0.0001)	0.0166*** (0.0001)	0.0165*** (0.0001)	0.0164*** (0.0001)	0.0097*** (0.0001)	0.0122*** (0.0001)	0.0174*** (0.0001)	0.0162*** (0.0001)	0.0159*** (0.0001)
Tenure sqrd.	-0.0000*** (0.0000)	-0.0002*** (0.0000)	-0.0002*** (0.0000)	-0.0002*** (0.0000)	-0.0001*** (0.0000)	-0.0001*** (0.0000)	-0.0002*** (0.0000)	-0.0003*** (0.0000)	-0.0002*** (0.0000)	-0.0002*** (0.0000)
Intercept	-2.1323*** (0.0033)	-1.9018*** (0.0035)	-1.7187*** (0.0034)	-1.6105*** (0.0035)	-1.7051*** (0.0039)	-2.0086*** (0.0042)	-1.6877*** (0.0043)	-1.5613*** (0.0043)	-1.4275*** (0.0043)	-1.5136*** (0.0046)
Region controls	N	N	N	N	N	Y	Y	Y	Y	Y
Industry controls	N	N	N	N	N	Y	Y	Y	Y	Y
R-squared	0.54	0.53	0.49	0.45	0.45	0.63	0.59	0.53	0.5	0.49
N	990215	1464732	1981128	2042134	1904805	990215	1464732	1981128	2042134	1904805

Notes: Coefficients obtained from OLS regressions using specification (2) pooling data for men and women. Standard errors in parentheses.  
\*  $p<0.05$ ; \*\*  $p<0.01$ ; \*\*\*  $p<0.001$ .

Source: Authors' calculations based on Quadros de Pessoa.

**TABLE 3**  
*Wage regressions – Quantile regressions*

	1986			1996			2005			2010			2013		
	P10	P50	P90	P10	P50	P90	P10	P50	P90	P10	P50	P90	P10	P50	P90
Educ. (years)	0.0385*** (0.0001)	0.0611*** (0.0002)	0.0762*** (0.0002)	0.0394*** (0.0001)	0.0719*** (0.0001)	0.0887*** (0.0002)	0.0371*** (0.0001)	0.0732*** (0.0001)	0.0902*** (0.0002)	0.0326*** (0.0001)	0.0716*** (0.0001)	0.0885*** (0.0002)	0.0309*** (0.0001)	0.0709*** (0.0001)	0.0881*** (0.0002)
Age	0.0503*** (0.0002)	0.0530*** (0.0002)	0.0705*** (0.0004)	0.0235*** (0.0001)	0.0405*** (0.0002)	0.0655*** (0.0004)	0.0188*** (0.0001)	0.0386*** (0.0002)	0.0599*** (0.0004)	0.0147*** (0.0001)	0.0368*** (0.0002)	0.0600*** (0.0004)	0.0135*** (0.0001)	0.0387*** (0.0002)	0.0646*** (0.0004)
Age sqrd.	-0.0006*** (0.0000)	-0.0006*** (0.0000)	-0.0007*** (0.0000)	-0.0002*** (0.0000)	-0.0004*** (0.0000)	-0.0006*** (0.0000)	-0.0002*** (0.0000)	-0.0003*** (0.0000)	-0.0005*** (0.0000)	-0.0001*** (0.0000)	-0.0003*** (0.0000)	-0.0005*** (0.0000)	-0.0001*** (0.0000)	-0.0003*** (0.0000)	-0.0006*** (0.0000)
Sex (male=1)	0.1522*** (0.0008)	0.1906*** (0.0008)	0.2174*** (0.0015)	0.1710*** (0.0005)	0.2575*** (0.0007)	0.3158*** (0.0014)	0.1533*** (0.0004)	0.2568*** (0.0006)	0.3393*** (0.0012)	0.1244*** (0.0003)	0.2407*** (0.0006)	0.3268*** (0.0012)	0.1206*** (0.0003)	0.2391*** (0.0006)	0.3379*** (0.0012)
Firm size (log)	0.0667*** (0.0002)	0.0766*** (0.0002)	0.0813*** (0.0004)	0.0711*** (0.0001)	0.0829*** (0.0002)	0.0801*** (0.0003)	0.0537*** (0.0001)	0.0716*** (0.0002)	0.0735*** (0.0003)	0.0287*** (0.0001)	0.0488*** (0.0001)	0.0529*** (0.0003)	0.0257*** (0.0001)	0.0429*** (0.0001)	0.0506*** (0.0003)
Tenure	0.0073*** (0.0001)	0.0074*** (0.0001)	0.0084*** (0.0003)	0.0116*** (0.0001)	0.0136*** (0.0001)	0.0038*** (0.0003)	0.0129*** (0.0001)	0.0167*** (0.0001)	0.0106*** (0.0002)	0.0112*** (0.0001)	0.0167*** (0.0001)	0.0112*** (0.0002)	0.0128*** (0.0001)	0.0170*** (0.0001)	0.0088*** (0.0002)
Tenure sqrd.	-0.0001*** (0.0000)	-0.0000*** (0.0000)	0 (0.0000)	-0.0002*** (0.0000)	-0.0002*** (0.0000)	0.0001*** (0.0000)	-0.0002*** (0.0000)	-0.0002*** (0.0000)	-0.0001*** (0.0000)	-0.0002*** (0.0000)	-0.0002*** (0.0000)	-0.0000*** (0.0000)	-0.0002*** (0.0000)	-0.0001*** (0.0000)	0.0001*** (0.0000)
Intercept	-2.1000*** (0.0041)	-2.0584*** (0.0035)	-2.1252*** (0.0066)	-1.4851*** (0.0019)	-1.8398*** (0.0035)	-1.9750*** (0.0073)	-1.1600*** (0.0016)	-1.6994*** (0.0035)	-1.8373*** (0.0073)	-0.8478*** (0.0015)	-1.5666*** (0.0032)	-1.7899*** (0.0077)	-0.8485*** (0.0015)	-1.6566*** (0.0033)	-1.9629*** (0.0085)
N	990215	990215	990215	1464732	1464732	1464732	1981128	1981128	1981128	2042134	2042134	2042134	1904805	1904805	1904805

*Notes: Coefficients obtained from QR regressions using specification (3) pooling data for men and women. Standard errors in parentheses.*

*\*  $p < 0.05$ ; \*\*  $p < 0.01$ ; \*\*\*  $p < 0.001$ .*

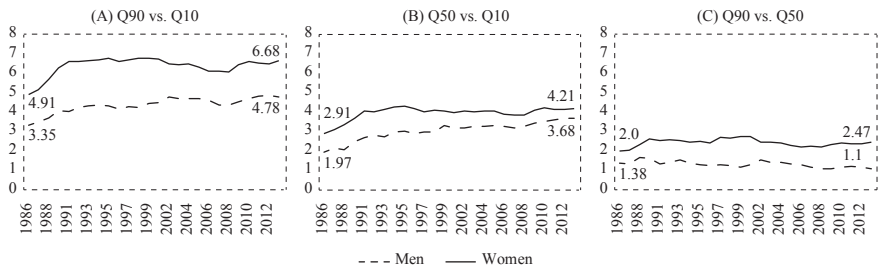
*Source: Authors' calculations based on Quadros de Pessoa.*

In fact, estimates of returns to schooling increase along the wage distribution. This feature holds for both genders, but it is particularly noticeable in the case of women. Evidence presented in figure 8 also makes it clear that the increase in returns to schooling along 1986-2013 period holds only for individuals placed above the 25<sup>th</sup> quantile of the wage distribution. Returns estimated at its lower tail using the 2013 QP wave stand below those obtained using the 1986 data. Moreover, up to 2003, evidence of higher returns for women also holds only above the 1<sup>st</sup> decile of the distribution.<sup>4</sup>

The comparison between returns to schooling estimated at different points of the distribution provides a measure of their dispersion. Such a comparison, illustrated in figure 9, shows in the first place that, across the whole distribution, returns are more dispersed among women than among men. In both cases, inequality in returns widened along the 1986-2013 period, but it was particularly noticeable in the case of female employees and in the early 1990s. This evolution seems to be largely driven by developments at the lower part of the conditional wage distribution, since at the upper quantiles inequality in returns has remained relatively stable. Moreover, among high earners variability in the returns is lower than at the lower part of the wage distribution.

**FIGURE 9**

*Dispersion in returns to schooling (percentage points)*



*Note:* The charts depict the difference between the returns to schooling estimated for different points of the distribution.

*Source:* Authors' calculations based on Quadros de Pessoa.

## 5.2 RETURNS TO SPECIFIC EDUCATION LEVELS

On the basis of specifications (4) and (5) it is possible to assess the average wage premium associated with specific levels of education. In this case, coefficients  $\beta_j, j = \{2, 3, 4\}$ , represent the wage gain from completing schooling level  $j$  relative to individuals who have not completed the 9<sup>th</sup> grade (corresponding to education level  $j=1$ , the omitted category). Table 4 provides detailed results for selected years.

<sup>4</sup> Note that the differences in returns estimated on the basis of QR for the 1986 and 2013 waves of QP are found to be statistically significant.

As we are interested in the wage gain relative to the schooling level immediately before, we plot in figure 10 the difference in the coefficients estimated using specification (4) as follows:

$$r_{9^{\text{th}}} = \beta_2$$

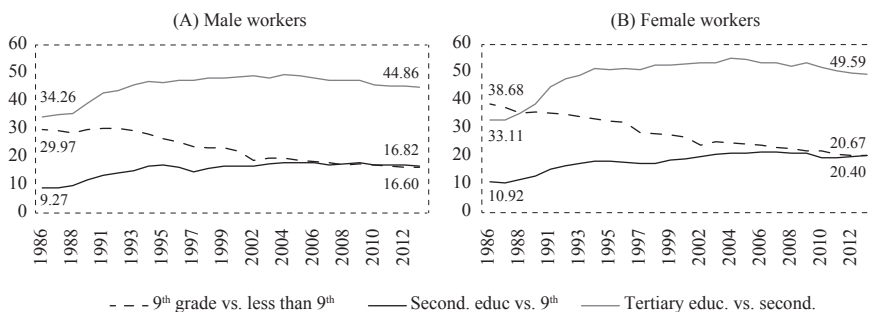
$$r_{\text{secondary}} = \beta_3 - \beta_2$$

$$r_{\text{tertiary}} = \beta_4 - \beta_3$$

In the first place, figure 10 confirms that women benefit from larger returns to education than men, except as regards the relative premium associated with tertiary education in the first years of the sample. It also shows that the increase over time in overall returns to schooling documented in the previous subsection is largely driven by the evolution of the premium associated with tertiary education. Indeed, in the beginning of the 1986-2013 period, completing a university degree is estimated to yield male workers a 34.3 per cent premium vis-à-vis completing secondary education, while for women such figure stands at 33.1 per cent. Results obtained using the 2013 wave of QP imply that men holding a university degree enjoy a 44.9 per cent wage premium relative to comparable workers who complete only secondary education. For women, the comparable figure stands at 49.6 per cent.

**FIGURE 10**

*Returns to schooling at the mean of the wage distribution by educational attainment (per cent)*



*Note: The charts depict the per cent wage premium associated with each educational level relative to level immediately before.*

*Source: Authors' calculations based on Quadros de Pessoa.*

Regarding secondary education, there is evidence that the gain relative to completing only the 9<sup>th</sup> grade increased along the 1986-2013 period, but it is still considerably below that referring to tertiary education: 16.8 per cent for men and 20.4 per cent for women. The increase in the premia estimated for secondary and tertiary education occurred against a background of an expansion in the pool of workers holding these schooling levels, suggesting that it may have been demand-driven.

TABLE 4

Wage regressions – OLS

	Baseline specification (4)					Specification (4) with additional controls				
	1986	1996	2005	2010	2013	1986	1996	2005	2010	2013
9 <sup>th</sup> grade	0.3309*** (0.0011)	0.2824*** (0.0009)	0.2127*** (0.0007)	0.1936*** (0.0007)	0.1832*** (0.0008)	0.2360*** (0.0009)	0.1966*** (0.0008)	0.1663*** (0.0007)	0.1577*** (0.0007)	0.1508*** (0.0008)
Second. educ.	0.4365*** (0.0016)	0.4604*** (0.0010)	0.4138*** (0.0008)	0.3839*** (0.0008)	0.3720*** (0.0008)	0.3156*** (0.0012)	0.3304*** (0.0009)	0.3278*** (0.0008)	0.3117*** (0.0008)	0.3058*** (0.0008)
Tertiary educ.	0.7643*** (0.0026)	0.9508*** (0.0017)	0.9356*** (0.0011)	0.8767*** (0.0010)	0.8496*** (0.0010)	0.6521*** (0.0019)	0.8005*** (0.0014)	0.8321*** (0.0010)	0.7883*** (0.0009)	0.7697*** (0.0009)
Age	0.0569*** (0.0002)	0.0437*** (0.0002)	0.0397*** (0.0002)	0.0401*** (0.0002)	0.0425*** (0.0002)	0.0471*** (0.0002)	0.0381*** (0.0002)	0.0360*** (0.0002)	0.0356*** (0.0002)	0.0370*** (0.0002)
Age sqrd.	-0.0006*** (0.0000)	-0.0004*** (0.0000)	-0.0004*** (0.0000)	-0.0004*** (0.0000)	-0.0004*** (0.0000)	-0.0005*** (0.0000)	-0.0004*** (0.0000)	-0.0004*** (0.0000)	-0.0003*** (0.0000)	-0.0004*** (0.0000)
Sex (male=1)	0.1947*** (0.0007)	0.2543*** (0.0006)	0.2581*** (0.0005)	0.2484*** (0.0005)	0.2525*** (0.0006)	0.1606*** (0.0007)	0.1964*** (0.0007)	0.2167*** (0.0006)	0.2068*** (0.0006)	0.2030*** (0.0006)
Firm size (log)	0.0784*** (0.0002)	0.0841*** (0.0002)	0.0713*** (0.0001)	0.0500*** (0.0001)	0.0450*** (0.0001)	0.0584*** (0.0002)	0.0620*** (0.0002)	0.0532*** (0.0001)	0.0333*** (0.0001)	0.0303*** (0.0001)
Tenure	0.0068*** (0.0001)	0.0123*** (0.0001)	0.0179*** (0.0001)	0.0173*** (0.0001)	0.0169*** (0.0001)	0.0087*** (0.0001)	0.0127*** (0.0001)	0.0187*** (0.0001)	0.0170*** (0.0001)	0.0164*** (0.0001)
Tenure sqrd.	0 (0.0000)	-0.0002*** (0.0000)	-0.0003*** (0.0000)	-0.0002*** (0.0000)	-0.0001*** (0.0000)	-0.0001*** (0.0000)	-0.0002*** (0.0000)	-0.0003*** (0.0000)	-0.0002*** (0.0000)	-0.0002*** (0.0000)
Intercept	-1.8229*** (0.0033)	-1.4761*** (0.0035)	-1.2544*** (0.0034)	-1.1626*** (0.0035)	-1.2639*** (0.0039)	-1.7812*** (0.0042)	-1.3597*** (0.0043)	-1.1697*** (0.0042)	-1.0422*** (0.0043)	-1.1261*** (0.0046)
Region controls	N	N	N	N	N	Y	Y	Y	Y	Y
Industry controls	N	N	N	N	N	Y	Y	Y	Y	Y
R-squared	0.52	0.52	0.49	0.46	0.46	0.61	0.59	0.54	0.51	0.5
N	990215	1464732	1981128	2042134	1904805	990215	1464732	1981128	2042134	1904805

Notes: Coefficients obtained from OLS regressions using specification (4) pooling data for men and women. Standard errors in parentheses.  
\*  $p<0.05$ ; \*\*  $p<0.01$ ; \*\*\*  $p<0.001$ .

Source: Authors' calculations based on Quadros de Pessoa.

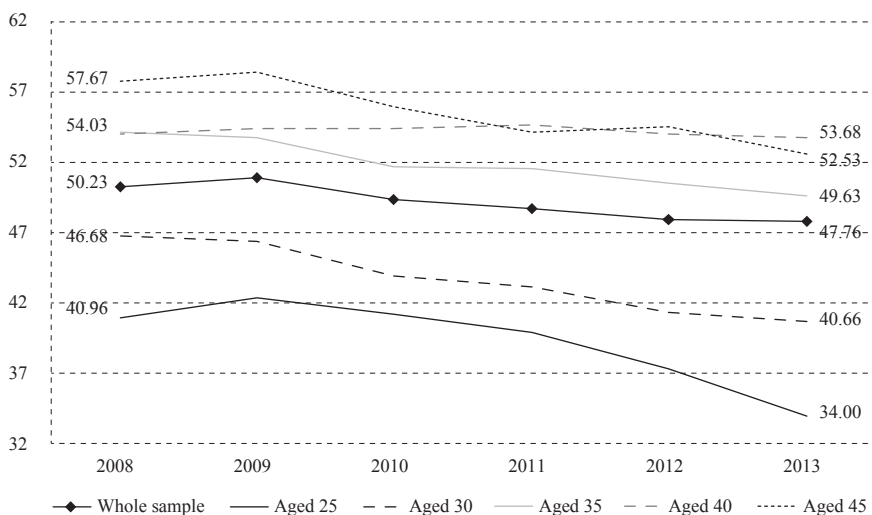
The premium for tertiary education increased markedly in the first half of the 1990s – especially in the case of women – and then remained stable up to 2009, when there is a minor decline in its magnitude. Evidence from regressions focusing specifically on university-educated individuals aged between 25 and 45 suggests that the younger workers benefit from lower returns to schooling and have experienced a slightly larger drop in returns than the overall sample (figure 11).

Finally, it is worth highlighting the sharp decline in the premium associated with completing the 9<sup>th</sup> grade. In the late 1980s, it was very close to the relative wage gain enjoyed by individuals holding a university degree (in the case of women it was in fact higher). Since then, our estimates suggest a decline and the magnitude estimated on the basis of 2013 data corresponds to approximately half the figure obtained with the 1986 QP wave. This evolution is in line with the pattern typically found for advanced economies (Montenegro and Patrinos, 2014).

The drop in returns to the 9<sup>th</sup> grade has been accompanied by an increase in the share of employees reporting it as the highest level completed (and a sharp decline in those holding less than the 9<sup>th</sup> grade). This evolution, plotted in figure 12, may be related to the fact that compulsory schooling was extended to the 9<sup>th</sup> grade in 1986. The measure applied only to individuals born as of 1980, which would be showing up in QP data as of 1996.

**FIGURE 11**

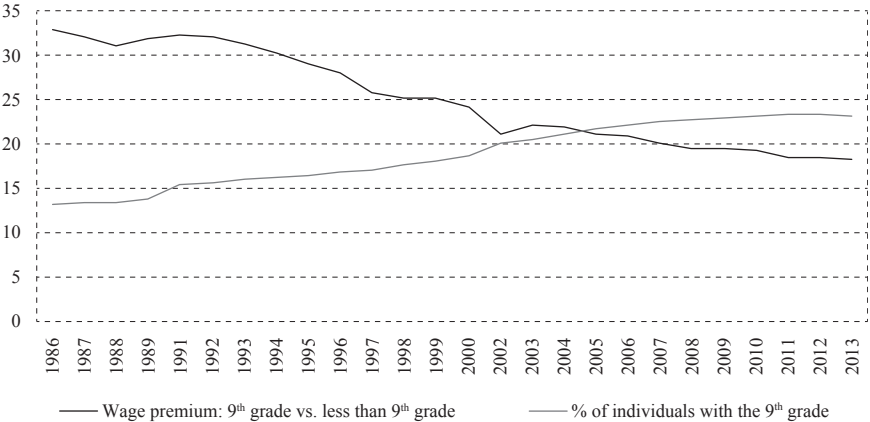
*Returns to tertiary education in the post-2009 period for younger cohorts (per cent)*



*Note: The chart depicts the relative wage increment from obtaining a university degree vis-à-vis completing only secondary education. Figures are obtained pooling data for both men and women.*

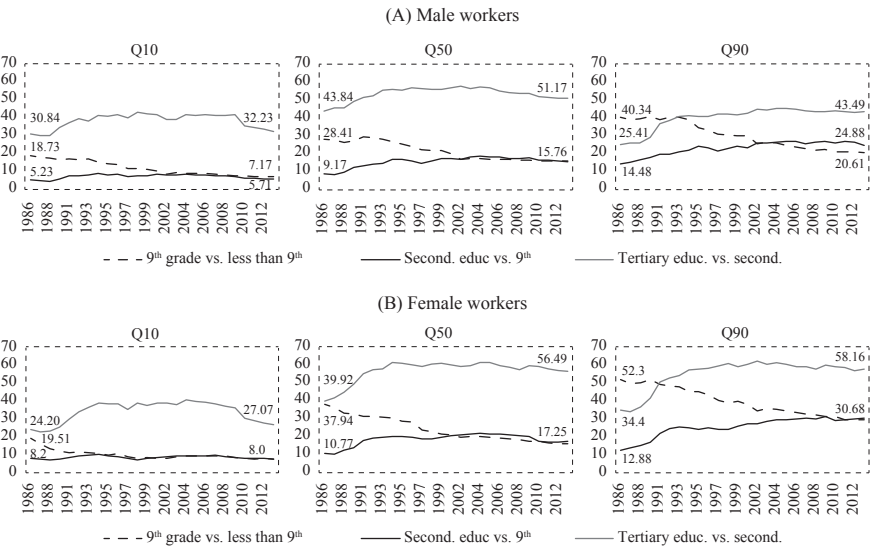
*Source: Authors' calculations based on Quadros de Pessoa.*

**FIGURE 12**  
*Returns to completing the 9<sup>th</sup> grade vs. share of individuals with the 9<sup>th</sup> grade*



Source: Authors' calculations based on Quadros de Pessoa.

**FIGURE 13**  
*Returns to schooling across the wage distribution by educational attainment (per cent)*



Source: Authors' calculations based on Quadros de Pessoa.



**TABLE 5**  
*Wage regressions – Quantile Regressions*

	1986			1996			2005			2010			2013		
	P10	P50	P90	P10	P50	P90	P10	P50	P90	P10	P50	P90	P10	P50	P90
9 <sup>th</sup> grade	0.1995*** (0.0013)	0.3219*** (0.0014)	0.4409*** (0.0022)	0.1359*** (0.0009)	0.2636*** (0.0011)	0.3751*** (0.0019)	0.0996*** (0.0006)	0.1904*** (0.0008)	0.2861*** (0.0016)	0.0862*** (0.0004)	0.1747*** (0.0007)	0.2580*** (0.0017)	0.0813*** (0.0004)	0.1653*** (0.0007)	0.2534*** (0.0018)
Second. educ.	0.2628*** (0.0017)	0.4312*** (0.0020)	0.5866*** (0.0027)	0.2364*** (0.0011)	0.4497*** (0.0012)	0.6192*** (0.0021)	0.1955*** (0.0007)	0.3962*** (0.0009)	0.5699*** (0.0017)	0.1635*** (0.0005)	0.3548*** (0.0008)	0.5357*** (0.0018)	0.1530*** (0.0005)	0.3418*** (0.0008)	0.5285*** (0.0018)
Tertiary educ.	0.5473*** (0.0054)	0.8431*** (0.0029)	0.8663*** (0.0035)	0.6331*** (0.0038)	1.0206*** (0.0021)	1.1082*** (0.0024)	0.6006*** (0.0020)	0.9837*** (0.0013)	1.1092*** (0.0018)	0.4940*** (0.0016)	0.9108*** (0.0011)	1.0676*** (0.0018)	0.4502*** (0.0014)	0.8800*** (0.0010)	1.0503*** (0.0019)
Age	0.0499*** (0.0002)	0.0508*** (0.0002)	0.0709*** (0.0004)	0.0221*** (0.0001)	0.0371*** (0.0002)	0.0626*** (0.0004)	0.0174*** (0.0001)	0.0347*** (0.0002)	0.0573*** (0.0004)	0.0141*** (0.0001)	0.0343*** (0.0002)	0.0587*** (0.0004)	0.0139*** (0.0001)	0.0366*** (0.0002)	0.0632*** (0.0004)
Age sqrd.	-0.0006*** (0.0000)	-0.0006*** (0.0000)	-0.0008*** (0.0000)	-0.0002*** (0.0000)	-0.0004*** (0.0000)	-0.0006*** (0.0000)	-0.0002*** (0.0000)	-0.0003*** (0.0000)	-0.0005*** (0.0000)	-0.0001*** (0.0000)	-0.0003*** (0.0000)	-0.0005*** (0.0000)	-0.0001*** (0.0000)	-0.0004*** (0.0000)	-0.0006*** (0.0000)
Sex (male=1)	0.1610*** (0.0008)	0.1981*** (0.0008)	0.2189*** (0.0015)	0.1697*** (0.0005)	0.2576*** (0.0007)	0.3154*** (0.0014)	0.1517*** (0.0005)	0.2550*** (0.0006)	0.3411*** (0.0012)	0.1264*** (0.0004)	0.2415*** (0.0006)	0.3327*** (0.0012)	0.1248*** (0.0004)	0.2418*** (0.0006)	0.3459*** (0.0012)
Firm size (log.)	0.0653*** (0.0002)	0.0768*** (0.0002)	0.0811*** (0.0004)	0.0697*** (0.0001)	0.0834*** (0.0002)	0.0818*** (0.0003)	0.0525*** (0.0001)	0.0699*** (0.0002)	0.0749*** (0.0003)	0.0279*** (0.0001)	0.0467*** (0.0001)	0.0544*** (0.0003)	0.0255*** (0.0001)	0.0403*** (0.0001)	0.0515*** (0.0003)
Tenure	0.0067*** (0.0002)	0.0062*** (0.0001)	0.0076*** (0.0003)	0.0112*** (0.0001)	0.0145*** (0.0001)	0.0047*** (0.0001)	0.0132*** (0.0001)	0.0182*** (0.0001)	0.0121*** (0.0002)	0.0116*** (0.0001)	0.0173*** (0.0001)	0.0122*** (0.0002)	0.0136*** (0.0001)	0.0166*** (0.0001)	0.0094*** (0.0002)
Tenure sqrd.	-0.0001*** (0.0000)	0.0000*** (0.0000)	0.0000*** (0.0000)	-0.0003*** (0.0000)	-0.0002*** (0.0000)	0.0001*** (0.0000)	-0.0002*** (0.0000)	-0.0002*** (0.0000)	-0.0001*** (0.0000)	-0.0002*** (0.0000)	-0.0002*** (0.0000)	-0.0000*** (0.0000)	-0.0002*** (0.0000)	-0.0001*** (0.0000)	0.0001*** (0.0000)
Intercept	-1.8962*** (0.0039)	-1.7218*** (0.0034)	-1.7707*** (0.0067)	-1.2250*** (0.0018)	-1.3824*** (0.0035)	-1.4688*** (0.0071)	-0.8965*** (0.0021)	-1.1694*** (0.0034)	-1.2918*** (0.0076)	-0.6226*** (0.0016)	-1.0440*** (0.0028)	-1.2513*** (0.0079)	-0.6578*** (0.0018)	-1.1268*** (0.0030)	-1.4207*** (0.0085)
N	990215	990215	990215	1464732	1464732	1464732	1981128	1981128	1981128	2042134	2042134	2042134	1904805	1904805	1904805

*Notes: Coefficients obtained from QR regressions using specification (5) pooling data for men and women. Standard errors in parentheses.*

*\*  $p < 0.05$ ; \*\*  $p < 0.01$ ; \*\*\*  $p < 0.001$ .*

*Source: Authors' calculations based on Quadros de Pessoa.*

However, even older individuals who were still attending school in 1986 may have anticipated that the market would start valuing completion of the 9<sup>th</sup> grade and decided to study longer – either to complete just the 9<sup>th</sup> grade or further levels to obtain a differentiation factor. This would result in a decline in the share of individuals with less than the 9<sup>th</sup> grade even before the first cohorts affected by the legal change joined the labor force. Although it is not possible to establish a causal link between this decline and the drop in returns to the 9<sup>th</sup> grade, *ceteris paribus*, an expansion in the pool of workers who have completed the latter level would in principle result in such an evolution. This suggests that the drop in the premium for completing the 9<sup>th</sup> grade was supply-driven. Additionally, this evolution may have been reinforced by selection effects. In particular, it is arguable that the individuals who drop out after completing the 9<sup>th</sup> grade in the recent period differ from those who did it some years or decades ago, in terms of characteristics that may result in lower returns to schooling (for example, younger 9<sup>th</sup> grade drop-outs may be expected to have, on average, poorer innate ability endowments, or less favorable family backgrounds).

Evidence obtained from QR estimates of specification (5), presented in figure 13 and in greater detail in table 5, shows that, for women, the relative premium from completing tertiary education increases along the wage distribution. In the case of male employees, such evidence holds only below the 9<sup>th</sup> decile. Figure 13 also suggests that the rise in the relative return to university degrees occurred throughout the wage distribution, but it is more noticeable at the upper quantiles and in the case of women. Regarding the already mentioned drop in the magnitude of returns as of 2009, it appears to result from developments at the lower tail of the conditional distribution. Finally, regarding the premia estimated for completing secondary education and the 9<sup>th</sup> grade, their average evolutions are driven by results in the upper quantiles, as below the median of the wage distribution they have remained broadly constant.

## 6 DISCUSSION AND CONCLUDING REMARKS

This paper sheds light on the recent evolution of private returns to schooling in the Portuguese economy. The returns increased in the late 1980s and the 1990s, especially as regards tertiary education. This occurred in parallel with an expansion of the pool of workers holding university degrees, suggesting it was surpassed by a rise in the demand for skilled labor. During the late 1990s and early 2000s, returns remained relatively constant, largely reflecting the stabilization of the wage premium for tertiary education. In the post-2009 period, however, our results point to a minor decrease in the magnitude of the returns, in the case of both tertiary and secondary education.

In spite of these changes along the 1986-2013 period, the overall picture does not change: the returns to schooling are found to be higher in the case of women and to increase along the wage distribution and with educational attainment: formal education appears to be more valued for women and highly paid and highly skilled

jobs. Several factors may be put forward as possible explanations for the evolution of returns to schooling just described.

The phenomenon of over-education could be one of the drivers: over-education, measured as a non-negligible share of highly-educated workers in blue-collar occupations, results in their placement in the bottom quantiles of the wage distribution. This translates into low returns to schooling for these individuals and increases dispersion within the same educational level, thus contributing to explain the pattern of increasing returns along the distribution.

The effects of over-education may be a reflection of qualitative aspects of schooling: while the estimation of returns only takes into account the *quantity* of educational attainment, it disregards factors such as school quality or the different valuation attributed to different areas of study. Attending poor quality schools or investing in a field of study that receives low valuation in the labor market would, in principle, result in low-paid jobs and in positions requiring low skills.

We cannot rule out the possibility that the developments described are affected by the fact that individual differences in ability (or other unobserved attributes) are not being controlled for. In particular, it is expectable that differences in individual ability play a bigger role in explaining the dispersion in returns among more skilled workers. For low educated individuals, by contrast, the differences should be relatively smaller. Not controlling for these differences would result in an over-estimation of returns to schooling in the upper quantiles of the distribution and reinforce the effects of over-education and low school quality.

In spite of focusing only on the *private* returns to education, our results unveil important messages for individuals and policymakers alike: in Portugal, education remains a profitable investment for individual agents and policymakers must take this into account when designing policies and incentive schemes.

The returns are highest for tertiary education and it is likely that individuals will continue to invest in education and, in particular, in university degrees. Compulsory schooling has recently been extended to 12 years, encompassing secondary education. This may also provide incentives for individuals that would otherwise leave school to go further and complete a tertiary educational level to differentiate themselves from the holders of secondary schooling. These factors would in principle result in the expansion of the student population in the next decades but are likely to be counteracted by demographic trends.

Against a background of tight budgetary constraints, the challenge for policymakers is to ensure the quality of the public school system while providing low-income households the conditions to access tertiary level education. Moreover, this cannot be done at the expense of low quality preschool or elementary education,

as investments in lower schooling levels increase the returns to subsequent ones<sup>5</sup>. These tensions may require a reshuffling in terms of the funding sources of public expenditure on education policy. A common suggestion is to increase the share of costs supported by the individuals in tertiary education. This line of reasoning is based on the idea that *social* returns to schooling are relatively lower for tertiary levels, whereas *private* returns are high – a piece of evidence supported by our empirical findings. Examples of measures aimed at increasing individual participation in financing include mere increases in tuition or the recently higher education reform in the UK encompassing the setting-up of a loan scheme that is contingent on graduates' future earnings. Resorting to this sort of measures may create additional leeway to reinforce support to low-income households.

### Disclosure statement

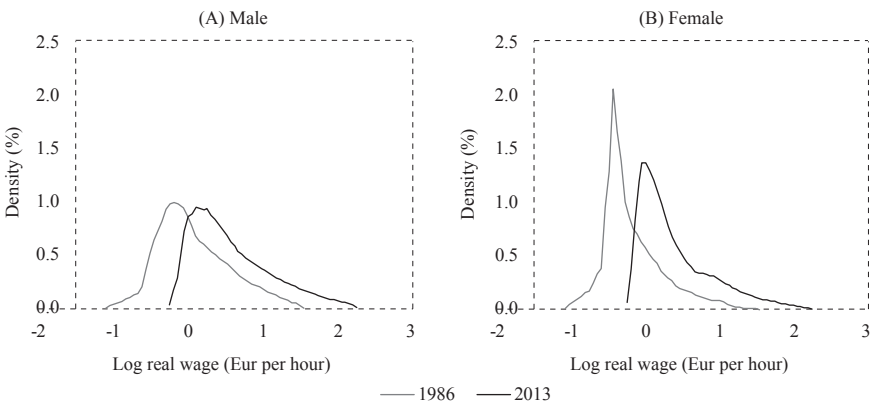
No potential conflict of interest was reported by the authors.

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<sup>5</sup> Refer to Heckman and Cunha (2007).

DETAILS ON THE EMPIRICAL DISTRIBUTION OF THE LOGARITHM OF  
HOURLY WAGES

**FIGURE A1**  
*Distribution of real wages in 1986 and 2013*



Source: Authors' calculations based on Quadros de Pessoa.

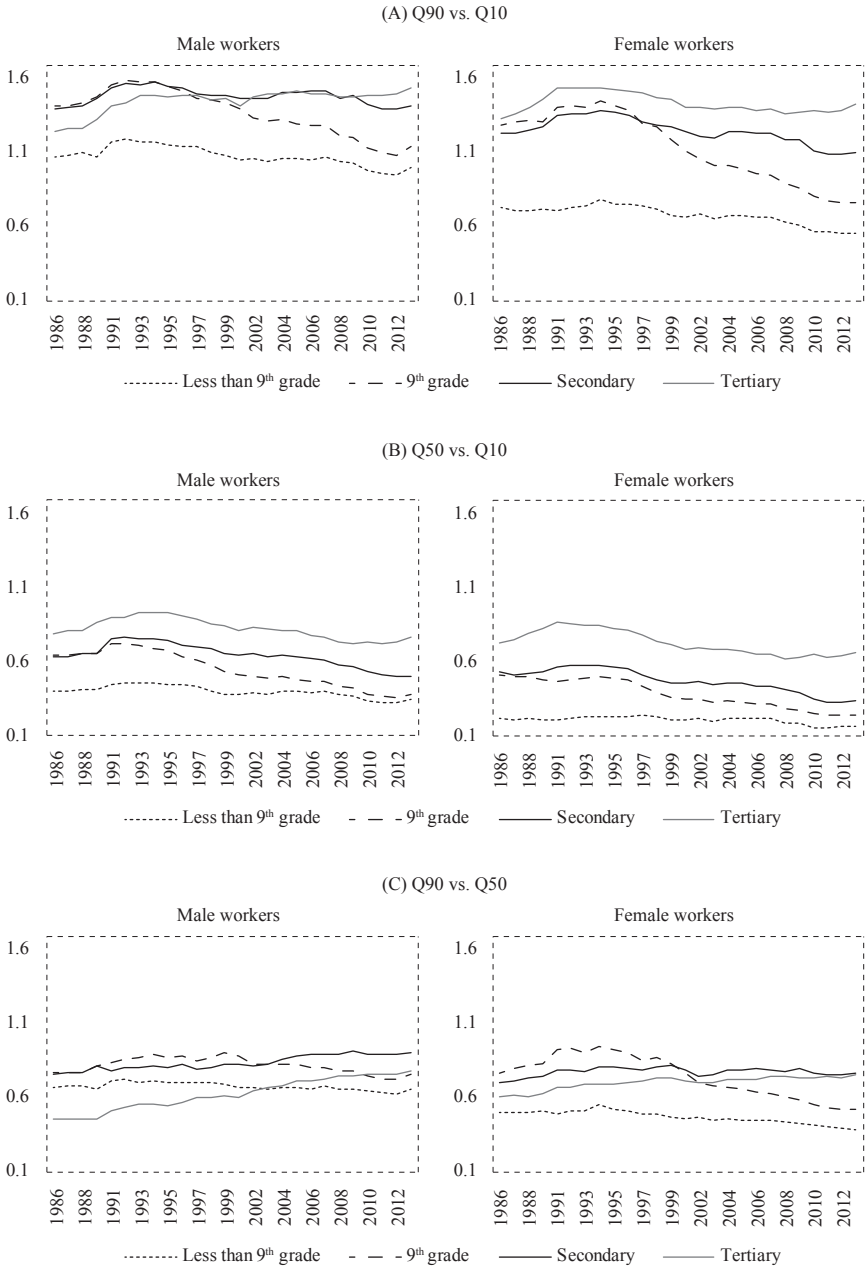
**FIGURE A2**  
*Real wage dispersion*



Note: Charts depict the difference in the logarithm of real hourly wages at different points of the distribution.

Source: Authors' calculations based on Quadros de Pessoa.

**FIGURE A3**  
*Real wage dispersion by educational attainment*



*Note:* Charts depict the difference in the logarithm of real hourly wages at different points of the distribution.

*Source:* Authors' calculations based on Quadros de Pessoa.

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# Economics for the Common Good

JEAN TIROLE (translated by Steven Rendall)

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Predrag BEJAKOVIĆ, Ph.D.

Institute of Public Finance, Smičiklasova 21, 10000 Zagreb, Croatia

e-mail: [predrag@ijf.hr](mailto:predrag@ijf.hr)

ORCID: 0000-0002-4164-8220

Economists are often deemed incapable of and uninterested in lessening the most important human problems, such as poverty and inequality. They are blamed for neglecting the issues of morality and for not predicting serious economic crises and financial turmoil. They mostly provide contradictory opinions, while some burden their readers with incomprehensible mathematical formulas and econometric calculations. In his recently published “Economics for the Common Good,” Jean Tirole, a French economist and Nobel prize-winner, chairman of the Toulouse School of Economics and the Institute for Advanced Study in Toulouse, tries to defend and protect economists’ reputation. His transformation from academic economist to public intellectual motivated him to analyse the role economists and their discipline play in society.

In the *Introduction* as well in the further text, Tirole admits that some of these criticisms are justified. Leading economists are more willing to create knowledge than to explain to and disseminate it among the broader public. Although mathematical formulas and models are needed because they enable clarity and rigour, they could well disregard the questions asked and be wrongly taken as the goal of the studies rather than as necessary scientific tools. Furthermore, quite often, what the public expects from economists is unrealistic. It is unfair to accuse economists for failing to see and predict events concerning which even the most competent financial supervisors have only limited understanding and knowledge. Crises in most cases cannot be forecast, while it is completely impossible to foresee the future relations between states.

Tirole describes economists as ill-trained and inadequately equipped to deal with the murky reality of everyday politics. Tirole warns possible future stars of TV discussions and articles in popular newspapers that academic economists will be soon put into political boxes, and their statements will be praised or criticised according to the political prejudices and preferences of the observers and readers. Briefly, Tirole is the economists’ guardian, but not their saviour.

Apart from the *Introduction* and the short *Epilogue*, the book consists of five parts divided in seventeen chapters. In the *Introduction*, Tirole writes on institutions and sends the most important but often forgotten message of his book: there is no conflict between the state regulation and the market. *The state and the market are complementary, not mutually exclusive. The market needs regulation, the state needs competition and incentives* (page 10). To be competitive, a market economy requires an efficient state to correct its failures, although sometimes the state does not work for the achievement of the common good. Furthermore, a market economy is not an end in itself, but it is an instrument for the alignment of the private interests of individuals, social groups and nations with the common interest.

In Part I, *Economics and society*, Tirole dedicates much of his attention to explanations of the role of economics. As a social activity, it should elucidate complex phenomena, help in distinguishing the differences between intended and final

realised goals of the various public policies and aid in achieving the economic efficiency and financial sustainability of measures related to the public good. Tirole stresses that despite the many pitfalls (primarily insufficient information) and limited number of safeguards, economists should be capable of understanding and explaining the issues of morality. *The best response to the claims of moral superiority is not necessarily another moral claim* because opposing one's morality to somebody else's leads to confrontation, *making problems impossible to resolve* (page 35). It is much better to begin with the question: "Who is the victim?" and "Can the infringement of the other be justified?" Tirole explains that having in mind the final outcome, the instinctive moral repugnance to the trade in human organs or blood should not be the reason for the cancelling of such a market. Trade in human organs can increase the supply of donated kidneys and thus save lives.

In Part II, *The economist's profession*, Tirole analyses various old and new challenges ranging from environmental protection and carbon taxes to industrial policy, from market competition to artificial intelligence and digital economy. He presents two basic rules of personal ethics for economists in their search for the overt and hidden rules of individual and group behaviour: (a) discuss ideas, never persons, and (b) never state anything that you are not ready to defend before your peers (page 76). In the further text, he elucidates the importance of debates and peer-reviews by anonymous referees in journals and *although the academic community agrees that questioning theory is essential, criticism is only truly useful if it is constructive* (page 87). Economists should behave like policy inspectors searching out with scientific methods the possible abuses of market power in the hope that, in that way, the efficiency of the provision of public good can be enhanced. In such activities, *economists have much to learn from other disciplines, and in turn their work can open new lines of research into individual behaviour and social phenomena* (page 123).

The institutions of state and market forms are the subject of the third theme, where Tirole situates these institutions in their economic environment. In their activities, public policy decision makers should propose and implement measures according to the Rawls principle that they should be "behind the veil of ignorance". Law-makers should not know anything about the future, whether any one person, including the policymakers themselves, will benefit or lose from a particular decision. The idea is to incentivize citizens to create wealth for society, but also to provide the preconditions for them to have a relatively decent life even if they are among the most unfortunate. For achieving such a demanding and complex task, *an independent authority should be trusted with the general mandate within which it can evaluate options and find technical solutions, a mandate that guarantees coherence in that authority's policies and its independence with regards to pressure groups* (page 164). However, Tirole is fully aware that this is only an ideal situation because the independent authorities (the governments) for various reasons are never fully independent. Although the implementation of reforms is a task with questionable results, the positive examples of Germany, the Netherlands

and the Scandinavian countries in changing their social welfare systems and labour markets clearly show that adequate preparation, optimal time scale and packaging together of various measures can achieve results that are better than expected.

To demonstrate how economics can be useful in the realisation of the common good, Part IV deals with the great macroeconomic challenges of everyday lives and the future of humanity. They include climate change and global warming, problems of the labour market, primarily of long-term unemployment, the problems of Europe at the crossroads, finance and the euro crisis. Fully aware of the danger of the degradation of the human environment, he supports tradable emissions permits and carbon taxes as an efficient means for the prevention of pollution, but reminds us also of different types of “command and control” and supports renewable energy resources approaches, which are sometimes too expensive and not particularly efficient. Such measures often lead to *a lack of consistency that substantially increases the costs of reducing emissions* (page 206). Germany, for example, spent a huge amount of resources on first generation solar panels regardless of the fact that the country does not have a lot of sunshine. Results comparable to those produced by reduction of CO<sub>2</sub> emissions can be achieved with other methods with significantly lower costs. In other words, emissions could have been reduced for the same costs, by one hundred tons rather than one ton. Particularly interesting is a part dedicated to the labour market, where France is characterised by strict and complex labour law regarding dismissal, obsolete institutions and strong trade unions that resist changes. All these factors lead to the polarisation of the labour market into permanently well-off insiders employed on permanent labour contracts and unemployed outsiders that can find only temporary or short-term badly paid jobs. *This polarisation is a dirty trick played on employees in general, and especially on the young* (page 239).

The final, fifth, section of the book turns to the importance and impact of the digital revolution, innovation, and the proper equilibrium between the free market and regulation. Tirole applies his macroeconomic insight to microeconomic questions like digital platforms and their influence on employment, intellectual property, competition laws and policy and finally, the regulation of network industries. Tirole correctly underlines the importance of new technology explaining that *digitalisation has an impact on intellectual property rights, competition law, labour law, taxation and regulation in general. The digital economy is bringing extraordinary technological progress that is giving us better health, as well as more time and purchasing power, but it also creates dangers we cannot ignore* (page 378). In the economic analysis and clarification of rules in these areas, he uses the principal-agent approach, applies asymmetric information and underlines the role and significance of incentives. Writing about digitisation in health care, he reminds us that there are huge opportunities in the collection and analysis of very large data sets. This technology enables more precise and less costly diagnoses and may help us to ensure equal access of the population to health care. Equal access is now under pressure from the combination of higher treatment costs and weak

possibilities of public finance to cover them. Finally, he believes that the right question is not whether due to artificial intelligence and digitisation there will be employment possibilities for people, but whether there will be enough jobs paying decent wages. Without doubt, in comparison to knowledge regarding the economic aspects of the digital technology available hitherto from other economists, Tirole takes a huge step forward in our understanding of the digital economy and society.

Providing an abundant explanation of how economics can benefit everyone, Tirole in *Economics for the Common Good* defines a new agenda for the role and impact of economists and economics in economy and society. His ability to explain complicated themes clearly and understandably is unfortunately a very rare skill among economists. The book is non-technical and without complicated mathematical formulas, aimed at the general and not particularly knowledgeable reader, and is full of examples from daily life. It should perhaps be required reading for any economist that wants to understand many issues and to learn how to write comprehensibly in a field that is more art than science, because in real life it is very difficult or impossible to collect all the data needed to assess precisely the effects predicted by theory.



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