Contributions to Economics

Felix Roth

Intangible Capital and Growth

Essays on Labor Productivity, Monetary Economics, and Political Economy, Vol. 1

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Preface

For several decades now, advanced economies across the globe have been undergoing a process of rapid transformation towards becoming knowledge economies. It is now widely recognized that intangible capital has been a crucial element in the growth performance of these economies and their firms. The term serves as a useful device for capturing those dimensions of capital that are not tangible in nature but are nevertheless fundamentally important for growth. It encompasses investments in education (human capital) and in informal (social capital) and formal (rule of law) institutions by the public sector and households, as well as investments by businesses aimed at enhancing their knowledge base, such as software, innovative property, and economic competencies.

This book is the first of two open-access volumes presenting a selection of my essays on Labor Productivity, Monetary Economics, and Political Economy. They are drawn from the first part of my habilitation in economics on the topic of *Intangible Capital and Labor Productivity Growth and Determinants of Public Support for the Euro*, which I completed in June 2020, at the department of economics at the faculty of Business, Economics, and Social Sciences at the University of Hamburg. This first volume contains 8 chapters, which follow a reverse chronological order starting with my most recent research output in chapter one. The essays in the individual chapters were selected with the aim of providing an overview of my research to date on intangible capital and growth.

Half of the contributions, namely chapters 2, 5, 6, and 7, draw upon works of mine previously published in the *Journal of Intellectual Capital*, *Review of Income and Wealth*, *Intereconomics,* and *Kyklos* respectively. The other four essays, found in chapters 1, 3, 4, and 8, constitute unpublished research based on original project reports prepared for the European Commission and translations of contributions published in edited volumes produced by the Metropolis Publisher and Hamburg University Press.

This volume would not have been possible without the thoughtful mentoring and strong support generously given by Thomas Straubhaar, to whom I am deeply grateful. He acted as a reporting reviewer in my Habilitation Committee and

encouraged me to publish the selected essays in this book. In addition, I would like to thank Mary O'Mahony and Erich Gundlach for acting as reporting reviewers in my Habilitation Committee, Katharina Manderscheid for chairing the Committee, and Elisabeth Allgoewer and Ulrich Fritsche for their participation in its proceedings. I would also like to express gratitude to Marianne Paasi, advisor to the GLOBALINTO project, for her constant support. I gratefully acknowledge the European Commission and German Science Foundation for funding the research that led to the essays presented in this volume. I would also like to thank Aisada Most, Anne Harrington, and Lorraine Klimowich for excellent assistance and support in helping me organize and design the layout of this volume. Finally, I would like to extend warm thanks to my family for their kind and generous encouragement.

Felix Roth
Hamburg, Germany
January 2022

About the Author

Since 2017, Felix Roth has been a Senior Research Fellow and Senior Lecturer with the Chair for International Economics in the Department of Economics at the University of Hamburg. In June 2020, he successfully completed his German Habilitation in economics on the topic of *Intangible Capital and Labour Productivity Growth and Determinants of Public Support for the Euro.* Prior to his appointment at the University of Hamburg, he worked six years as a Research Fellow in the macroeconomic policy unit and as editor of the journal *Intereconomics* at the Centre for European Policy Studies (CEPS) in Brussels. In addition to his ongoing research association with the department of economics at the University of Göttingen, he worked as a Research Fellow, Scientific Expert, and Economic Policy Advisor for the European Commission in Brussels for over three years. He pursued his doctorate in economics on the topic *Social Capital, Trust and Economic Growth—A Cross-Sectional and Panel Analysis* at the University of Göttingen in the framework of a post-graduate program funded by the Deutsche Forschungsgemeinschaft (DFG) and jointly supervised by the University of Göttingen and the London School of Economics and Political Science. He studied economics, sociology and European law at the University of Munich where he received his Diploma in Social Sciences in 2003. Dr. Roth has published his research in monographs and collective volumes produced by internationally renowned academic publishing houses, such as Springer, Routledge and Edward Elgar; in leading international journals in his field, such as *Review of Income and Wealth* and *Journal of Common Market Studies*; and in a wide range of policy contributions, e.g., *VoxEU* and *Intereconomics*. Visit his personal homepage at: https://www.felixroth.net.

Contents

Chapter 1
The Productivity Puzzle: A Critical Assessment and an Outlook on the COVID-19 Crisis

Felix Roth

Abstract This contribution critically assesses the productivity puzzle and gives an outlook on the COVID-19 crisis. It offers two main conclusions. First, it posits that a large fraction of the productivity puzzle can be solved by incorporating intangible capital into the asset boundary of the national accounts. Thus, the productivity puzzle is largely explained as a consequence of fundamental structural changes that are underway, transforming industrial economies into knowledge economies. Secondly, the contribution foresees a post-COVID-19 scenario that is likely to lead to a pronounced increase in labor productivity growth. This depends, however, on whether the current push for digitization will be backed by actual investments in digitization and the necessary complementary investments in (business and public) intangible capital.

Keywords Productivity puzzle · Intangible capital · Labor productivity growth · Structural change · COVID-19 crisis · Remeasurement of GDP

JEL Classifications E22 · F45 · O32 · O34 · O47 · O52

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This contribution is based on the author's Habilitation colloquium lecture entitled "The Productivity Puzzle: A Critical Assessment", which he delivered before the Habilitation Committee of the faculty of Business, Economics, and Social Sciences at the University of Hamburg on June 29, 2020 (Roth, 2020a). A German translation of the contribution appeared as Chap. 3 of an edited volume published by Hamburg University Press in April 2021 (Roth, 2021).

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1 Introduction

Labor productivity growth is a central contributor to an economy's competitiveness (Krugman, 1994) and rising prosperity (Heil, 2018). In most advanced economies, it is of key importance in maintaining the standard of living in societies experiencing population aging (Posen & Zettelmeyer, 2019). Despite its importance, it is widely acknowledged that advanced economies, such as the US and the EU, have suffered a pronounced decline in labor productivity growth rates since the start of the Great Recession in 2007 (Oulton, 2018; Van Ark & O'Mahony, 2016; Van Ark, 2016; Van Ark & Jäger, 2017; Van Ark et al., 2018). In the aftermath of the financial crisis (2008–15/16), these rates have been more than halved compared to the pre-crisis period (1995–2004/07) (Remes et al., 2018; Brynjolfsson et al., 2019; Van Ark et al., 2018).

Although a steady decline in labor productivity growth can be observed in these economies from the 1970s onward (Gordon, 2018; Bergeaud et al., 2016; Brynjolfsson et al., 2019)—despite the exceptional experience of the US in the mid-to-late 1990s—the magnitude of the decline since the start of the Great Recession (2008–2013/16) has posed a conundrum to many scholars (Oulton, 2018; Remes et al., 2018; Van Ark & Jäger, 2017)—principally for two reasons.

First, the decline was puzzling given that real interest rates were close to or below zero (Teulings & Baldwin, 2014; Summers, 2015; Haskel & Westlake, 2018a). Second, the decline was puzzling as it occurred in the midst of ongoing revolutions in both information and communications technology (ICT) and in artificial intelligence (AI) (OECD, 2015). Economists have attempted to capture this conundrum under several multifaceted labels, such as "the Secular Stagnation Puzzle" (Summers, 2014, 2015; Teulings & Baldwin, 2014), "the Modern Productivity Paradox" (Brynjolfsson et al., 2019), or simply "the Productivity Puzzle" (Haskel & Westlake, 2018a). This contribution critically discusses this conundrum by exploring the key role of intangibles in labor productivity growth. It also explores current issues arising from the COVID-19 crisis.

This contribution is organized as follows: it opens by offering some brief introductory remarks and a summary of its main findings and their implications. Second, it sketches an intangible capital-augmented model for labor productivity growth as developed by Roth and Thum in 2013. Third, the contribution reviews salient trends in labor productivity growth from 1950 until 2006. Fourth, it elaborates upon the pronounced decline in productivity experienced from 2007 to 2015, which first prompted the ongoing discussion among economists over this so-called "productivity puzzle". Fifth, the contribution critically discusses this perplexing "puzzle" by elaborating upon the key role of intangibles in labor productivity growth. Sixth, it explores current issues arising from the COVID-19 crisis. And finally, the contribution offers two main conclusions.

2 Determinants of Labor Productivity Growth

This section elaborates the determinants of labor productivity growth by presenting an intangible capital-augmented model specification. This model was first developed by Roth and Thum in 2013 in the context of a European Commission-funded project entitled Intangible Capital and Innovations: Drivers of Growth and Location in the EU (INNODRIVE) (INNODRIVE, 2011; Roth & Thum, 2013). It is currently being used in a subsequent project called GLOBALINTO (GLOBALINTO, 2020), which is devoted to capturing the value of intangible assets in microdata to promote the EU's growth and competitiveness (Roth, 2020b). The model specification follows an approach developed by Benhabib and Spiegel in 1994, which is coined "cross-country growth accounting". The approach differs from the framework of traditional single growth accounting methodology in two ways. First, the output elasticities are estimated rather than imposed. Second, part of the model can be used to explain the international variance in total factor productivity (TFP) growth. Following the theoretical framework of Corrado et al., 2009, Benhabib and Spiegel's model specifications from 1994 are expanded by intangibles. The starting point for the estimation is then an augmented Cobb–Douglas production function. Assuming constant returns to scale, the Cobb–Douglas production function is first rewritten in intensive form. Second, differences in natural logarithms are taken and the TFP term is estimated. This provides the following baseline for the econometric findings to be displayed at a later point in this contribution:

$$\begin{aligned}\left(\ln q_{i,t} - \ln q_{i,t-1}\right) = {} & c + gH_{i,t} + mH_{i,t}\frac{\left(q_{\max,t} - q_{i,t}\right)}{q_{i,t}} + n(1 - ur_{i,t}) \\ & + p\sum_{j=1}^{k} X_{j,i,t} + yd_{i,t} + \alpha(\ln k_{i,t} - \ln k_{i,t-1}) \\ & + \beta(\ln r_{i,t} - \ln r_{i,t-1}) + u_{i,t} \qquad (1.1)\end{aligned}$$

where labor productivity growth ($\ln q_{i,t} - \ln q_{i,t-1}$) [gross value added for the non-farm business sectors, expanded by the investment flows of business intangible capital in country i and period t] can be essentially decomposed into a TFP term and two capital terms: tangible and intangible capital. TFP is represented by a constant term c, which represents exogenous technological progress. The level of human capital ($H_{i,t}$) reflects the capacity of a country to innovate domestically. The term $H_{i,t}\frac{\left(q_{\max,t} - q_{i,t}\right)}{q_{i,t}}$ proxies a catch-up process. The term $(1 - ur_{i,t})$ takes into account the business cycle effect. The term $p\sum_{j=1}^{k} X_{j,i,t}$ is the sum of k extra policy variables which could possibly explain TFP growth. This includes public intangibles, e.g. formal and informal institutions such as the rule of law and trust. They are of central importance for growth. $yd_{i,t}$ are year dummies to control among others for

the economic downturns in 2001 and 2008. Next comes the term for tangible capital services growth ($\ln k_{i,t} - \ln k_{i,t-1}$). Followed by the term intangible capital services growth ($\ln r_{i,t} - \ln r_{i,t-1}$) and the error term. In Sect. 5 we will elaborate upon the β-coefficient for intangibles capital services growth later within this contribution.

3 Labor Productivity Growth, 1950–2006

This section briefly describes the trends in labor productivity growth in the EU and the US from 1950 to 2006. Table 1 from Van Ark et al. (2008), depicts, inter alia, the average annual growth rates of GDP per hour worked in the EU-15 and the US from 1950 to 2006. The empirical evidence demonstrates that the labor productivity growth in the EU from 1950 to 1973, at 5.3%, was twice as high as that in the US, at 2.5%. The same pattern—although with lower numbers—holds for the period 1973–1995, with values of 2.4% for the EU-15 and 1.2% for the US. The literature clearly attributes the labor productivity growth increase in the EU vis-à-vis the US to a catching-up process. This process is built on a strong skill base instilled in upper secondary education and a production process based upon imitation. It is interesting to note that the pattern changes when analyzing the period 1995–2006, with US labor productivity growth increasing to 2.3%, compared to 1.5% in the EU-15.

In analyzing the underlying contributions to labor productivity growth in Table 4 from their article, Van Ark et al. (2008) find that this decline in labor productivity growth in the EU is largely due to a scant contribution from the knowledge economy. A further sectoral decomposition by the authors demonstrates a pronounced decline in TFP growth in the market economy of the EU-15 vis-à-vis the US, particularly in market services. They link the productivity gap in EU market services to deficiencies in ICT and complementary investment in intangible capital as well as rigidities in the EU single market concerning product, labor and services markets.

Similar results in line with this overall argument are presented by a group of economists working with Sapir and Aghion et al., who stress the importance of public intangibles, namely the quantity and quality of higher education for explaining the gap in labor productivity growth (Aghion, 2008; Aghion & Howitt, 2006; Aghion et al., 2007, 2008, 2010; Sapir et al., 2004). Brynjolfsson et al. (2019) stress investment in ICT and AI and lagged complementary intangible capital investments.

4 The Productivity Puzzle, 2007–2015

This brings us directly to the period starting from the Great Recession of 2007 and running up to 2015. Table 1 in Van Ark et al. (2018) illustrates a pronounced decline in labor productivity growth since the start of the Great Recession in 2008. Labor productivity growth rates dropped by half in the euro area (EA) from 1.4% to 0.6% and in the US from 2.5% to 1.3%. As pointed out by Oulton (2018), this decline is

exceptional in its magnitude and not just a continuation of past historical trends, as suggested by the American economic historians Gordon (2018) and Cowen (2011). But what triggered this stark decline in labor productivity growth?

Two channels have been identified in this field of research. First, the decline in labor productivity growth has been linked to a pronounced fall in total factor productivity growth. The long-term evidence produced by Bergeaud et al. (2016) and illustrated with time series findings on labor productivity growth and total factor productivity from 1890 to 2010 support such an assertion.

Second, the decline in labor productivity growth has been attributed to a drop in investment. Such claims are supported by analyses of investments in tangible capital, which have significantly declined over the period 2008–2013. The decline in tangible investment across EU economies is displayed in Fig. 1.1 as illustrated in the work by Roth (2020b). In particular, one detects the most pronounced decline in tangible capital investment in the periphery countries of the EA that implemented intensive austerity measures.

This decline in labor productivity growth and investment has puzzled many scholars for several reasons (Oulton, 2018; Remes et al., 2018; Van Ark & Jäger, 2017). In the first instance, the decline was puzzling, given that real interest rates were close to or below zero (Teulings & Baldwin, 2014; Summers, 2015; Haskel & Westlake, 2018a).

Secondly, the decline was puzzling as it occurred in the midst of ongoing revolutions in ICT and AI (OECD, 2015). As pointed out by Nakamura (2019), the intensity of technological innovations since the beginning of the 1990s points to a "dramatically dynamic economy!" As can be discerned from Fig. 5.4 in Haskel and Westlake (2018a, p. 95), frontier firms actually saw a huge increase in their labor productivity growth. Furthermore, the available empirical evidence points to the increasing importance of intangibles among the S&P 500 companies and notes the fact that the ten leading firms are almost entirely based on intangibles (Ross, 2020). They all give evidence in support of Nakamura's claim from 2019.

Several scholars, such as Lawrence Summers, identified a lack of aggregate demand as the main culprit behind declining labor productivity growth and investment (Draghi, 2014; Krugman, 2014; Summers, 2014, 2015). Applying their recommendations for stimulating aggregate demand to the EA implied two sets of strategies. First, on the condition that member states would adopt a structural reform agenda aimed at laying the basis for pro-growth support, the European Central Bank committed to implement a quantitative easing (QE) program. Secondly, the European Commission undertook to initiate an EU-wide European Investment Plan (Fichtner et al., 2014). However, a fiscal stimulus package proposed on behalf of the core economies, such as Germany, and favored by some prominent economists such as De Grauwe (2015) and Fratzscher (2014), was never launched.

Nevertheless, the policies initiated at the EU level have already been successful in stimulating demand support. They have thereby succeeded in initiating an economic recovery since 2014 and initiating investment in the EA, as shown in Fig. 1.1. Triggering aggregate demand support, however, is only the first step towards solving the productivity puzzle. Another essential step is linked to the incorporation of intangible capital investments into the asset boundary of the national accounts.

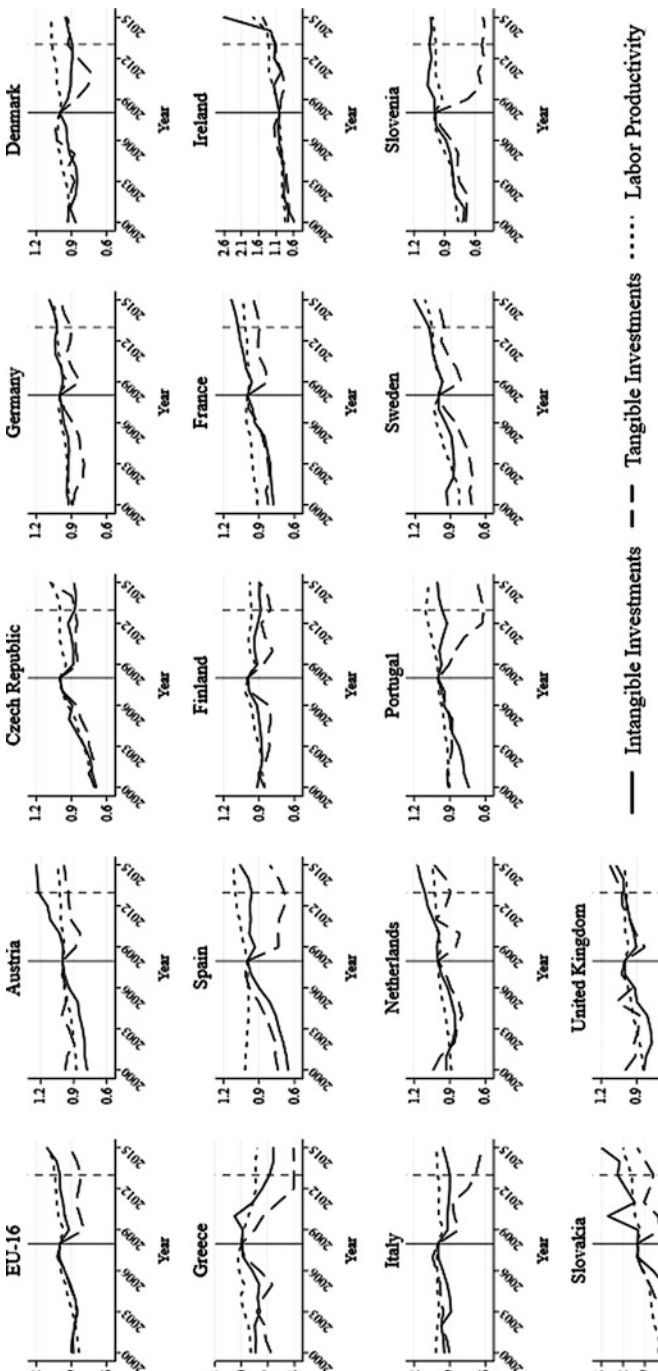

Fig. 1.1 Intangible and tangible capital and Labor productivity growth, EU-16, 2000–2015
Notes: Investment in Intangibles, Tangibles, and Labor Productivity are given in millions of national currencies and are standardized to 1 in the year 2008. The continuous line indicates the start of the financial crisis in September 2008. The dashed line indicates the start of the economic recovery at the end of 2013. Adopted y-scales are applied to Greece, Ireland, and Slovakia.
Data source: INTAN-Invest (NACE2) data (Corrado et al., 2018).
Source: Fig. 4 in Roth, 2020b, p. 680.

5 Intangible Capital and the Productivity Puzzle

But which investments in intangible capital should be incorporated into the asset boundary of national accounts? In their seminal paper published in 2005 and as shown in Table 1.1, Corrado, Hulten, and Sichel (CHS) categorize three dimensions of intangible assets (Corrado et al., 2005).

First, computerized information, which CHS define as "knowledge embedded in computer programs and computerized databases." Second, innovative property, which CHS define as "scientific knowledge embedded in patents, licenses and general know-how". Third, economic competencies, which CHS define as "the value of brand names and other knowledge embedded in firm-specific human and structural resources."

To what extent are these assets relevant for stimulating labor productivity growth? Let us consider two examples drawn from a chain of arguments developed by Brynjolfsson and Hitt (2000) and Brynjolfsson et al. (2002) over the last two decades. He and his team find that for every euro invested in software, a firm needs to spend an additional 10 euros in developing economic competencies if they want to reap the full potential of labor productivity growth. This includes the retraining of staff to use the software effectively, along with the necessary restructuring of organizational procedures. Similar results have been found for investments in AI.

And what economic contributions can be expected once these intangibles are incorporated into the asset boundary of national accounts? Table 1.2, taken from the

Table 1.1 Overview of business intangible assets employed in CHS (2005)

Category of intangible assets	Definition by CHS (2005)	Business intangible item	Included in NA
Computerized information	"Knowledge embedded in computer programs and computerized databases" (p.23)	Computer software	Yes
		Computerized database	Yes
Innovative property	"Not only the scientific knowledge embedded in patents, licenses and general know-how (not patented) but also the innovative and artistic content in commercial copyrights, licenses and designs" (p.26)	Science and engineering R&D	Yes
		Mineral exploration	Yes
		Copyright and license costs	Yes
		Other product development, design, and research expenses	No (new intangible)
Economic competencies	"The value of brand names and other knowledge embedded in firm-specific human and structural resources" (p.28)	Brand equity	No (new intangible)
		Firm-specific human capital	No (new intangible)
		Organizational structure	No (new intangible)

Note: NA = national account.
Source: Own adaption of CHS (2005) as published in Table 1 in Roth, 2019, p. 6.

Table 1.2 Contributions to the economy from incorporating intangibles into the asset boundary of national accounts: Overview of the empirical literature, 2009–2018

Authors	Country	Investment (in GDP) in %	Contribution to LPG in %[a]	Growth acceleration in %	Article	Harmonized cross-country dataset	Methodology
Corrado et al. (2009)	US	~ 13* (03)	27 (95–03)	11.2 (95–03)	RoIW	–	GA
Fukao et al. (2009)	JAP	11.1 (00–05)	27; 16 (95–00); (00–05)	17.3, −1.4 (95–00), (00–05)	RoIW	–	GA
Marrano et al. (2009)	UK	13** (04)	20 (95–03)	13.1 (95–03)	RoIW	–	GA
Nakamura (2010)	US	Intangible = Tangible (00–07)	/	/	RoIW	–	GA
Edquist (2011)	SE	10/~16*** (04)	41; 24 (95–00); (00–06)	16, −2.3 (95–00), (00–06)	RoIW	–	GA
Roth and Thum (2013)	EU-13	9.9**** (98–05)	50 (98–05)	4.4 (98–05)	RoIW	INNODRIVE	CCGA
Corrado et al. (2013)	EU-15	6.6 (95–09)	24 (95–07)	/	OREP	INTAN-invest (NACE1)	GA
Corrado et al. (2018)	EU-14, NMS-4	7.2, 6.4 (00–13)	30, 10; 19, 8; 43‡,17 (00–13);(00–07); (07–13)	/	JIPD	INTAN-invest (NACE2)	GA

Notes: [a]LPG = labor productivty growth. *The measure here is non-farm business output. **The measure here is adjusted market sector gross value added (MGVA). ***The measure here is gross value added (GVA). ****The measure is GVA (c-k+o excluding k70). ‡Capital share. US = United States, UK = United Kingdom, JAP = Japan, SE = Sweden, EU = European Union, NMS = New Member States, RoIW = Review of Income and Wealth, OREP = Oxford Review of Economic Policy, JIPD = Journal of Infrastructure, Policy and Development, GA = Growth Accounting, CCGA = Cross Country Growth Accounting. The numbers in brackets refer to the relevant time periods.
Source: Table 1 in Roth (2020b, p. 675).

work by Roth (2020b), summarizes three sets of main findings as reported in the literature.

First, investment as a percentage of GDP increases significantly and approaches levels comparable to those of tangible capital once intangibles are incorporated. Second, intangibles constitute a significant contribution to labor productivity growth. For example, the work by Roth and Thum (2013) shows that growth in intangible capital services is able to explain 50% of the international variance in labor productivity growth in the EU. It becomes, in fact, its dominant driver. Third, the rate of labor productivity growth accelerates. As reported by Edquist (2011), e.g., once accounting for intangibles, labor productivity growth accelerates by 16% in Sweden.

What are the implications of these findings for the productivity puzzle? Four points can be elaborated. First, the "puzzling" decline in investment is largely due to a mismeasurement in most advanced economies of the actual ongoing investment rates by firms. Contemporary national accounting classifications have not yet been fully revised to account for the ongoing transition towards the knowledge economy of the twenty-first century. Although selective elements of intangibles have already been accounted for, such as software and scientific R&D, investments in economic competencies, such as firm-specific human and organizational capital, are still excluded.

Figure 1.2, taken from the work by Roth (2020b, p. 680), illustrates that once intangibles are included in the national accounts, overall business investments in an EU-16 country sample are almost twice as high and represent 25% of the total sum. Moreover, it is interesting to observe that in seven out of the 16 countries surveyed, business investments in intangible capital are already larger than those in tangible capital.

Figure 1.1 also shows that despite a steady decline in tangible investments, particularly in the aftermath of the financial crisis, investments in intangible capital have swiftly recovered and are on a steadily upward trend. These results are consistent with the latest evidence from the INNODRIVE follow-up INTAN-Invest dataset, referenced in a speech given early in 2020 by Jonathan Haskel, British economist and Member of the Monetary Policy Committee at the Bank of England. This evidence illustrates a steady decline in tangible capital and a solid increase in intangible capital in the post-financial crisis era in advanced economies. The above findings demonstrate that the use of tangible investment flows as the sole basis of analysis leads to erroneous empirics and ultimately to the design of misguided policy measures.

Second, incorporating intangibles into the asset boundary of national accounts leads to an increase in labor productivity growth. This has already been shown by Edquist (2011) for the case of Sweden. His results differ from claims published by Haskel and Westlake (2018a) and Syverson (2017). The results by Roth (2020b) from the GLOBALINTO project in 2020 support Edquist's (2011) findings. Other analyses of economic recovery show that labor productivity growth has accelerated by 0.4% points (or 22%), from 1.8% to 2.2%. In this context, Nakamura (2019) even suggests that the mismeasurement of labor productivity growth will most likely give an annual growth rate of 2%.

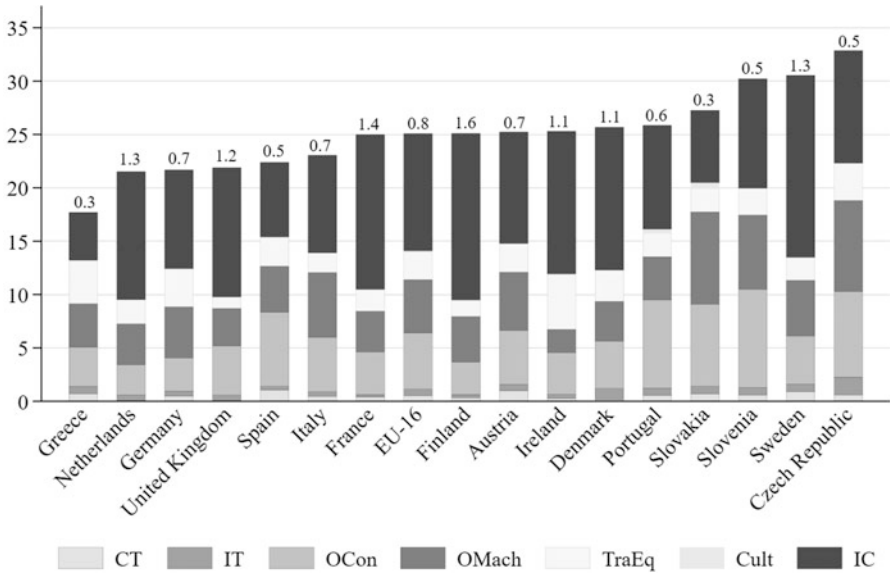

Fig. 1.2 Business tangible and intangible capital investments (as a percentage of GVA), EU16, 2000–2015
Notes: CT = communications technology; IT = information technology; OCon = total nonresidential capital investment; OMach = other machinery and equipment; TraEq = transport equipment; Cult = cultivated assets; IC = intangible capital. Residential Structure has been excluded. Values on top of the bars depict the intangible/tangible capital investment ratio.
Data sources: INTAN-Invest (NACE2) data (Corrado et al., 2018) and EUKLEMS data (Jäger, 2017).
Source: Fig. 3 in Roth, 2020b, p. 680.

Third, several prominent contributions have highlighted the role of a decline in TFP in relation to the level of business investments in intangibles. Van Ark (2016), Van Ark and O'Mahony (2016), Van Ark and Jäger (2017), as well as Bounfour and Miyagawa (2015) attribute the decline in labor productivity and TFP growth primarily to a slower diffusion of technology and innovation, which is due to low growth rates of investments in ICT and complementary intangibles. Haskel and Westlake (2018b) also highlight a reduction in the spill-over effects of intangibles on TFP due to the widening gap of intangible investment between leader and laggard firms. Moreover, Brynjolfsson et al. (2019) argue that more investment in complementary intangibles is necessary to reap the full benefits of AI to labor productivity growth.

Fourth, as can be seen in Table 1.3 as taken from Roth (2020b), the econometric results point towards the importance of intangible capital services growth for labor productivity growth at the macro-level. The work by Roth from 2020 uses a cross-country growth accounting estimation approach for an EU-16 country sample over the period 2000–2015. It is based on the intangible augmented model specification as

Table 1.3 Intangibles and labor productivity growth, 2000–2015, PP-PCSE estimation

Estimation method	PP-PCSE	PP-PCSE	PP-PCSE	PP-PCSE	PP-PCSE	2SLS
Time sample	2000–2015	2000–2015	2000–2015	2008–2015	2000–2015	2000–2015
Equation	(1)	(2)	(3)	(4)	(5)	(6)
Tangible services growth	0.31***	0.19**	0.28***	−0.13	0.18**	0.58
	(0.08)	(0.08)	(0.08)	(0.15)	(0.07)	(0.42)
Tangible services growth*crisis	–	–	−0.32**	–	–	–
			(0.13)			
Tangible services growth*recovery	–	–	–	0.47	–	–
				(0.30)		
Intangible services growth	–	0.38***	0.48***	0.32***	–	0.50***
		(0.07)	(0.09)	(0.11)		(0.16)
Intangible services growth*crisis	–	–	−0.28**	–	–	–
			(0.13)			
Intangible services growth*recovery	–	–	–	0.42*	–	–
				(0.23)		
Innovative property services growth	–	–	–	–	0.37***	–
					(0.07)	
Computerized information services growth	–	–	–	–	−0.01	–
					(0.04)	
Economic competencies services growth	–	–	–	–	0.02	–
					(0.06)	
Upper secondary education 15+	0.07***	0.05***	0.05***	0.02	0.06***	0.07***
	(0.02)	(0.01)	(0.01)	(0.02)	(0.01)	(0.02)
Catch-up	−0.02**	−0.02***	−0.02***	−0.01	−0.02**	−0.02*
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Business cycle	−0.11*	−0.12*	−0.13**	−0.13*	−0.12*	−0.11**
	(0.06)	(0.06)	(0.06)	(0.07)	(0.06)	(0.05)
R-squared	0.40	0.50	0.54	0.63	0.54	0.46
Observations	256	256	256	128	256	208
Number of countries	16	16	16	16	16	16

Notes: PP-PCSE = Pooled Panel - Panel-Corrected Standard Error. In regression (1), tangible services growth, labor productivity growth, and the catch-up term exclude software, R&D, and entertainment, artistic and literary originals, and mineral exploration. In regressions, (2–6) labor productivity growth and the catch-up term are expanded with intangible capital. Tangible capital excludes residential capital. Labor productivity growth was calculated based on the GVA of the non-farm business sectors b − n + r − s (excluding real estate activities). ***p < 0.01, **p < 0.05, *p < 0.1.
Source: Table 2 in Roth, 2020b, p. 682.

introduced in the beginning of this contribution. It provides evidence that growth in intangible capital services can explain the largest share of labor productivity growth—up to 66%. This is demonstrated by the size of the beta coefficient of 0.38. Equally significant, but less pronounced results are found at the meso and micro-levels (Niebel et al., 2017; Marrocu et al., 2011).

6 An Outlook on the COVID-19 Crisis and Labor Productivity Growth

How will the present COVID-19 crisis affect labor productivity growth? In order to answer this question, we should distinguish between a short-term and a medium- to long-term perspective.

To understand the short-term impact, it helps to examine the pattern that emerged in the aftermath of the 2008 financial crisis. Table 6, taken from Mas (2012), presents evidence from the EU and the US in the period 2007–2010, which shows that whereas the US saw an actual increase in labor productivity growth from 1.93% to 2.02%, the EU-15 experienced a pronounced decline in labor productivity growth from 1.41% to 0.07%. This difference can be attributed to differences in labor market arrangements between the two economies. Whereas EU welfare states have intensively utilized short-term working schemes to dampen the threat of large layoffs in the aftermath of the financial crisis, the US refrained from such policies.

And indeed, as can be observed in the data from the spring 2020 projections by DG ECFIN, labor productivity growth in the EA will decline by 3.2% points, with a peak in Germany of 5.6% points (European Commission, 2020a). Conversely, the decline in US labor productivity growth will be marginal, estimated at only 0.2% points. Much like the experience following the financial crisis in 2009, the short-term working schemes adopted to dampen the threat of large layoffs will lead to a pronounced decline in labor productivity growth in the euro area and in Germany vis-á-vis the US. But how large is the economic impact caused by the COVID-19 pandemic from a historical perspective?

Recent evidence generated from empirical time series performed by Bergeaud et al. (2020) over the period 1875–2025 shows that, although the impact on GDP growth is more pronounced than that from the financial crisis in 2008, it is only a fraction of the decline suffered during the Great Depression in 1929. Furthermore, there will be a swift recovery in 2021 beyond the previous level. Also, a similar decline in investment in 2020 due to the COVID-19 crisis, with a strong recovery in 2021, is projected by ECFIN (European Commission, 2020a). Whether this holds also for intangible capital investment remains an open question. We hope to arrive at an answer by means of a customized COVID-19 survey to be administered by the GLOBALINTO project (GLOBALINTO, 2020) on business intangible capital investment in seven EU countries.

To understand the mid- and long-term impact, we must first analyze the policy measures adopted to address the COVID-19 crisis. In response to the pandemic, historically large stimulus packages of up to 200 billion euro were agreed at the member state level among selective core countries of the EA (Greive, 2020). At the federal level of the EU, the agreed overall fiscal capacity is 750 billion euro (European Commission, 2020b). These fiscal policies are flanked by the ECB's Pandemic Emergency Purchase Programme (PEPP), with a total volume of 1350 billion euro. The novelty of PEPP is the role being assumed by the ECB to act as lender of last resort in the government bond market, with no restrictions placed on

single-country purchases (Schnabel, 2020). For the European Commission to borrow 750 billion euro in its capacity as a multinational actor within its multiannual financial framework is equally historic. This is most likely a significant step forward towards establishing a stronger fiscal union. As pointed out in my latest work, given the large public support shown for the euro during its first two decades, it is likely that the presidents of both the ECB and the European Commission enjoy the necessary political legitimacy to enact these decisive measures (Roth, 2020c).

But will these investment plans help to stimulate a recovery in the EA? As we learned from the arguments presented above, these stimuli will surely help the euro area to recover in the short-term, especially given that it is a three-fold program this time round: fiscal stimuli at the member state and EU levels, paired with monetary stimuli.

In a medium- to long-term perspective, two issues are relevant for a full recovery of labor productivity growth. First, the current push for digitization needs to be backed by investments from the recovery packages into digitization and the necessary complementary (business and public) intangible capital. If the funds are used in such a manner, we can expect to see labor productivity growth accelerate in the post-COVID-19 era. Second, the ongoing investments in ICT and in intangibles must be flanked by pro-growth supply-side reforms within the labor, product, and services markets in the larger EA economies, such as Italy. This should achieve the necessary convergence in unit labor costs vis-á-vis Germany.

A post-COVID-19-scenario will likely lead to a pronounced increase in labor productivity growth. This depends, however, on whether the current push for digitization will be backed by actual investments in digitization and the necessary complementary investments in (business and public) intangible capital.

7 Conclusion

We now come to the main conclusion of this contribution, which has attempted to critically assess the productivity puzzle and give an outlook on the COVID-19 crisis. It offers two main conclusions.

First, it posits that a large fraction of the productivity puzzle can be solved by incorporating intangible capital into the asset boundary of the national accounts. Thus, the productivity puzzle is largely explained as a consequence of fundamental structural changes that are underway, transforming industrial economies into knowledge economies. And it is precisely this radical transformation that yet needs to be statistically validated by the national accounts.

Secondly, the contribution foresees a post-COVID-19 scenario that will likely lead to a pronounced increase in labor productivity growth. This depends, however, on whether the current push for digitization will be backed by actual investments in digitization and the necessary complementary investments in (business and public) intangible capital.

References

Aghion, P. (2008). Higher education and innovation. *Perspektiven der Wirtschaftspolitik, 9*, 28–45.

Aghion, P., & Howitt, P. (2006). Joseph Schumpeter lecture appropriate growth policy: A unifying framework. *Journal of the European Economic Association, 4*, 269–314.

Aghion, P., Dewatripont, M., Hoxby, C., Mas-Colell, A., & Sapir, A. (2007). *Why reform Europe's universities?*. Bruegel Policy Brief 4. Brussels, Bruegel.

Aghion, P., Dewatripont, M., Hoxby, C., Mas-Colell, A., & Sapir, A. (2008). *Higher aspirations: An agenda for reforming European universities*. Bruegel Blueprint Series 5. Brussels, Bruegel.

Aghion, P., Dewatripont, M., Hoxby, C., Mas-Colell, A., & Sapir, A. (2010). The governance and performance of universities: Evidence from Europe and the US. *Economic Policy, 1*, 7–59.

Benhabib, J., & Spiegel, M. M. (1994). The role of human capital in Economic Development—Evidence from aggregate cross-country data. *Journal of Monetary Economics, 34*, 143–173.

Bergeaud, A., Cette, G., & Lecat, R. (2016). Productivity trends in advanced countries between 1890 and 2012. *Review of Income and Wealth, 62*, 420–444.

Bergeaud, A., Cette, G., & Lecat, R. (2020). Current and past recessions: A long-term perspective. *ECO note pad Banque de France* 159, 27 April.

Bounfour, A., & Miyagawa, T. (2015). *Intangibles, market failure and innovation growth* (pp. 1–10). Springer Verlag.

Brynjolfsson, E., & Hitt, L. M. (2000). Beyond computation: Information technology, organizational transformation and business performance. *Journal of Economic Perspectives, 14*, 23–48.

Brynjolfsson, E., Hitt, L. M., & Yang, S. (2002). Intangible assets: Computers and organizational capital. *Brookings Papers on Economic Activity, 1*, 137–198.

Brynjolfsson, E., Rock, D. and Syverson, C. (2019). Artificial intelligence and the modern productivity paradox: A clash of expectations and statistics. In: A. Agrawal, J. Gans, and A. Goldfarb (eds.) (2019): The economics of artificial intelligence: An agenda, University of Chicago Press, pp. 23–57.

Corrado, C., Hulten, C., & Sichel, D. (2005). Measuring capital and technology: An expanded framework. In C. Corrado, J. Haltiwanger, & D. Sichel (Eds.), *Measuring capital in the new economy* (pp. 11–46). University of Chicago Press.

Corrado, C., Hulten, C., & Sichel, D. (2009). Intangible capital and U.S. Economic growth. *Review of Income and Wealth, 55*, 661–685.

Corrado, C., Haskel, J., Jona-Lasinio, C., & Iommi, M. (2013). Innovation and intangible investment in Europe, Japan, and the United States. *Oxford Review of Economic Policy, 29*, 261–286.

Corrado, C., Haskel, J., Jona-Lasinio, C., & Iommi, M. (2018). Intangible investment in the EU and US before and since the great recession and its contribution to productivity growth. *Journal of Infrastructure, Policy and Development, 2*, 11–36.

Cowen, T. (2011). *The great stagnation: How America ate all the low-hanging fruit of modern history, got sick, and will (eventually) feel better*. Dutton.

De Grauwe, P. (2015). Secular stagnation in the eurozone. *VoxEU*. 30 January.

Draghi, M. (2014). Unemployment in the Euro Area, Speech at the Annual Central Bank Symposium in Jackson Hole, 22 August, Wyoming.

Edquist, H. (2011). Can Investment in Intangibles Explain the Swedish productivity boom in the 1990s? *The Review of Income and Wealth, 57*, 658–682.

European Commission. (2020a). *European Economic Forecast, European Economy Institutional Paper 125*. European Union.

European Commission. (2020b). Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the regions: The EU budget powering the recovery plan for Europe COM/2020/442 final, Brussels.

Fichtner, F., Fratzscher, M., & Gornig, M. (2014). Eine Investitionsagenda für Europa. *DIW Wochenbericht, 27*, 631–635.

Fratzscher, M. (2014). *Die Deutschland-Illusion: Warum wir unsere Wirtschaft überschätzen und Europa brauchen*. Carl Hanser Verlag.
Fukao, K., Miyagawa, T., Mukai, K., Shinoda, Y., & Tonogi, K. (2009). Intangible investment in Japan: Measurement and contribution to economic growth. *Review of Income and Wealth, 55*, 717–736.
GLOBALINTO (2020): *Capturing the value of intangible assets in micro data to promote the EU's growth and competitiveness*. https://globalinto.eu/.
Gordon, R. J. (2018). Declining American growth despite ongoing innovation. *Explorations in Economic History, 69*, 1–12.
Greive, M. (2020). Bund macht fast 220 Milliarden Euro neue Schulden. *Handelsblatt*. 15 June.
Haskel, J. & Westlake, S. (2018a). *Capitalism without capital*. Princeton University Press.
Haskel, J. & Westlake, S. (2018b). Productivity and secular stagnation in the intangible economy. *Vox.EU*. 31 May.
Haskel, J. (2020). *Monetary policy in the intangible economy*. Bank of England Speech given at the University of Nottingham. 11 February.
Heil, M. (2018). Finance and productivity: A literature review. *Journal of Economic Surveys, 32*, 1355–1383.
INNODRIVE. (2011). INNODRIVE intangibles database. (https://cordis.europa.eu/project/id/214576/reporting/de).
Jäger, K. (2017). *EU KLEMS growth and productivity accounts 2017 release - description of methodology and general notes*. Available at: http://www.euklems.net/TCB/2017/Metholology_EU%20KLEMS_2017.pdf.
Krugman, P. (1994). Competitiveness: A dangerous obsession. *Foreign Affairs, 73*, 28–44.
Krugman, P. (2014). Depression are different. In R. M. Solow & J. Murray (Eds.), *Economics of the curious* (pp. 7–18). Palgrave Macmillan.
Marrano, M., Haskel, J., & Wallis, G. (2009). What happened to the knowledge economy? ICT, intangible investment, and Britain's productivity record revisited. *Review of Income and Wealth, 55*, 686–716.
Marrocu, E., Raffaele, P., & Pontis, M. (2011). Intangible capital and firms' productivity. *Industrial and Corporate Change, 21*, 377–402.
Mas, M. (2012). Productivity in the advanced countries: From expansion to crisis. In M. Mas & R. Stehrer (Eds.), *Industrial productivity in Europe* (pp. 11–34). Edward Elgar.
Nakamura, L. (2010). Intangible assets and national income accounting. *Review of Income and Wealth, 56*, 135–155.
Nakamura, L. (2019). *Economic growth--too slow or too fast? Measuring the value of intangibles and AI, presentation at the 15th world conference on intellectual Capital for Communities on the 11th and 12th July*. UNESCO.
Niebel, T., O'Mahony, M., & Saam, M. (2017). The contribution of intangible assets to sectoral productivity growth in the EU. *The Review of Income and Wealth, 63*, 49–67.
OECD (2015). *The future of productivity*. OECD.
Oulton, N. (2018). Productivity and the great recession. *Intereconomics, 53*, 63–68.
Posen, A. S. & Zettelmeyer, J. (2019). Facing up to low productivity growth: Introduction. In A. S. Posen & J. Zettelmeyer (Eds.), *Facing up to low productivity growth* (pp. 1–11). Columbia University Press.
Remes, J., Mischke, J., & Krishnan, M. (2018). Solving the productivity puzzle: The role of demand and the promise of digitization. *International productivity Monitor, 35*, 28–51.
Ross, M. (2020). *Intangible assets: A hidden but crucial driver of company value*. Downloadable at: https://www.visualcapitalist.com/intangible-assets-driver-company-value/.
Roth, F. (2019*). Intangible capital and labour productivity growth: A literature review*. Hamburg discussion papers in international economics 4. Hamburg, Germany.
Roth, F. (2020a). The productivity puzzle – A critical assessment, Habilitation Colloquium Lecture delivered before the Habilitation Committee of the Faculty of Business, Economics and Social Sciences at the University of Hamburg on June 29.

Roth, F. (2020b). Revisiting intangible capital and labour productivity growth, 2000-2015: Accounting for the crisis and economic recovery in the EU. *Journal of Intellectual Capital, 21*, 671–690.
Roth, F. (2020c). Economic recovery strengthens public support for the euro, JCMS-blog, 9. January.
Roth, F. (2021). Das Produktivitätspuzzle – Eine kritische Bewertung. In: T. Straubhaar (Hg.): *Datenwirtschaft: was ist neu und anders?,* (pp. 61–82). Hamburg University Press.
Roth, F., & Thum, A.-E. (2013). Intangible capital and labour productivity growth. *Review of Income and Wealth, 59*, 486–508.
Sapir, A., Aghion, P., Bertola, G., Hellwig, M., Pisani-Ferry, J., Rosati, D., Vinals, J., & Wallace, H. (2004). *An agenda for growing Europe*. Oxford University Press.
Schnabel, I. (2020). The ECB's policy in the COVID-19 crisis – A medium-term perspective, European Central Bank speech, 10 June 2020, Frankfurt am Main. ECB.
Summers, L. (2014). Reflections on the "new secular stagnation hypothesis". *VOXEU*. 15 August.
Summers, L. (2015). Demand side secular stagnation. *American Economic Review, 105*, 60–65.
Syverson, C. (2017). Challenges to mismeasurement explanations for the US productivity slowdown. *Journal of Economic Perspectives, 31*, 165–186.
Teulings, C., & Baldwin, R. (2014). Secular stagnation: Facts, causes and cures. *VOXEU*. 15 August.
Van Ark, B., O'Mahony, M., & Timmer, M. (2008). The productivity gap between Europe and the United States: Trends and causes. *Journal of Economic Perspectives, 22*, 25–44.
Van Ark, B. (2016). Europe's productivity slowdown revisited: A comparative perspective to the United States. In P. Askenazy, L. Bellmann, A. Bryson, & E. Moreno Galbis (Eds.), *Productivity puzzles across Europe* (pp. 26–48). Oxford University Press.
Van Ark, B., & O'Mahony, M. (2016). Productivity growth in Europe before and since the 2008/2009 economic and financial crisis. In D. Jorgensen, K. Fukao, & M. P. Timmer (Eds.), *The world economy: Growth stagnation* (pp. 111–152). Cambridge University Press.
Van Ark, B., & Jäger, K. (2017). Recent trends in Europe's output and productivity growth performance at the sector level, 2002-2015. *International Productivity Monitor, 33*, 8–23.
Van Ark, B., de Vries, K., & Jäger, K. (2018). Is Europe's productivity glass half full or half empty? *Intereconomics, 53*, 53–58.

Chapter 2
Revisiting Intangible Capital and Labor Productivity Growth, 2000–2015: Accounting for the Crisis and Economic Recovery in the EU

Felix Roth

Abstract

Purpose—This contribution aims to revisit the relationship between intangible capital and labor productivity growth using the largest, up-to-date macro database (2000–2015) available to corroborate the econometric findings of earlier work and to generate novel econometric evidence by accounting for times of crisis (2008–2013) and economic recovery (2014–2015).

Design/methodology/approach—To achieve these aims, the study employs a cross-country growth-accounting econometric estimation approach using the largest, up-to-date database available encompassing 16 EU countries over the period 2000–2015. It accounts for times of crisis (2008–2013) and of economic recovery (2014–2015). It separately estimates the contribution of three distinct dimensions of intangible capital: 1) computerized information, 2) innovative property, and 3) economic competencies.

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Findings—First, when accounting for intangibles, this contribution finds that these intangibles have become the dominant source of labor productivity growth in the EU, explaining up to 66% of growth. Second, when accounting for times of crisis (2008–2013), in contrast to tangible capital, it detects a solid positive relationship between intangibles and labor productivity growth. Third, when accounting for the economic recovery (2014–2015), it finds a highly significant and remarkably strong relationship between intangible capital and labor productivity growth.

Originality/value—The study corroborates the importance of intangibles for labor productivity growth and thereby underlines the necessity to incorporate intangibles into today's national accounting frameworks in order to correctly depict the levels of capital investment being made in European economies. These levels are significantly higher than those currently reflected in the official statistics.

Keywords Intangible capital · Labor productivity growth · Crisis · Recovery · European Union

1 Introduction

Recent research has reported a disappointing performance in labor productivity growth among European Union (EU) and euro area (EA) countries since the start of the crisis from 2008 to 2015 (Van Ark & Jäger, 2017). According to this literature, this performance stems largely from a slower diffusion of technology and innovation due to low growth rates of information and communication technology (ICT) and complementary intangible capital investment (Van Ark & Jäger, 2017, p. 15; Van Ark, 2016, pp. 37–41; Van Ark & O'Mahony, 2016, pp. 132–138).

Indeed, a recent growth-accounting study at the macro-level over the period 2000–2013 identifies the deepening of intangible capital as a main driver of labor productivity growth (Corrado et al., 2018, p. 11). Such findings are in line with existing growth-accounting studies for the US (Corrado et al., 2009), the UK (Marrano et al., 2009), Japan (Fukao et al., 2009), Sweden (Edquist, 2011), and the EU-15 (Corrado et al., 2013).

Within this substantial body of growth-accounting evidence, however, there exists only scarce econometric evidence at the macro-level of the impact of intangible capital investment on labor productivity growth. The only existing econometric study analyses an EU-13 country sample for pre-crisis times from 1998 to 2005 (Roth & Thum, 2013). This scarcity of growth econometric studies is remarkable in light of their general advantages in comparison to growth-accounting studies (Temple, 1999, pp. 120–121). To help close this gap in the research, this study conducts an econometric analysis using a cross-country growth-accounting approach covering 16 EU countries over the period 2000–2015. This approach goes beyond earlier

work in two ways. First, it enables us to corroborate earlier econometric findings (Roth & Thum, 2013) with the help of a greatly extended dataset containing more than two and half times the number of overall observations (256 versus 98). Second, by covering a period until 2015, we are able to generate novel econometric findings on the impact of intangible capital deepening on labor productivity growth by accounting for times of crisis (2008–2013) and times of economic recovery (2014–2015).

By matching the most recent release of the INTAN-Invest (NACE2)[1] dataset (Corrado et al., 2018) with the latest figures from the EU KLEMS[2] dataset (Jäger, 2017), in combination with a wide range of growth-relevant policy variables from Eurostat, the OECD and the World Bank, this contribution provides the largest up-to-date intangible capital panel dataset at the macro-level containing an overall number of 256 country observations. Estimating a slightly modified model specification as developed within the existing literature (Roth & Thum, 2013, p. 495), with the help of a cross-country growth-accounting econometric approach, this contribution reaches three major findings. First, in line with the previous growth econometric literature (Roth & Thum, 2013), it confirms that once intangibles are accounted for, they become the dominant source of labor productivity growth in the EU, explaining up to 66% of this growth. Second, when accounting for times of crisis (2008–2013), it finds that even when the relationship between tangible capital and labor productivity turned negative, the impact of intangibles on growth remained solidly positive. Third, when accounting for the economic recovery (2014–2015), it reports a highly significant and remarkably strong relationship between intangible capital and labor productivity growth.

2 Theoretical Linkages between Intangible Capital and Labor Productivity Growth

The earliest work highlighting the importance of intangible capital for labor productivity dates back to the 1960s (Haskel & Westlake, 2018, p. 38). Based on research by Brynjolfsson et al. (2002) and Nakamura (2001), among others, Corrado et al. (2005) developed a methodological framework for the US of how to account for business intangibles in the "new economy". The authors used an intertemporal framework for investment and grouped the various business intangibles into three broad dimensions: 1) computerized information, namely software, 2) innovative property, namely research & development (R&D) and 3) economic competencies, namely brand names, firm-specific human capital and organizational capital. Conducting a growth-accounting analysis alongside their methodological framework, Corrado et al. (2009) showed that business intangibles were able to explain

[1] Accessible at www.intaninvest.net (Corrado et al., 2018).

[2] Accessible at www.euklems.net (Jäger, 2017).

a significant share of labor productivity growth. Using growth-accounting studies, similar results were found for the UK (Marrano et al., 2009), Japan (Fukao et al., 2009), Sweden (Edquist, 2011) and the EU (Corrado et al., 2013, 2018). Econometric cross-country growth-accounting studies for the EU (Roth & Thum, 2013) find an even stronger impact of intangibles on labor productivity growth. In addition, the positive relationship between intangible capital and labor productivity was prominently discussed and established in the work of Bounfour (Bounfour & Miyagawa, 2015; Delbecque et al., 2015); Piekkola (2016, 2018) and Miyagawa (Miyagawa & Hisa, 2013; Bounfour & Miyagawa, 2015).

The positive relationship between computerized information and labor productivity growth—particularly the interaction between software and organizational capital (Brynjolfsson et al., 2002)—and R&D and labor productivity growth (Guellec & van Pottelsberghe de la Potterie, 2001) has already been well established in the literature. Consequently, the intangible assets—software, R&D and entertainment, artistic and literary originals, and mineral exploration—were already included in the asset boundary of the national accounts. Given that economic competencies, in particular, were not yet included in the national accounts, it seems necessary to once more elaborate their positive role in labor productivity growth. Concerning *brand names*, Cañibano et al. (2000) argue that the ownership of an attractive brand permits a seller to retain a higher margin for goods or services compared to his competitors. Since the consumer is driven by his perceptions in choosing among the products of competing firms, the development of an appealing image or brand is crucial in producing future benefits. Concerning training or *firm-specific human capital*, the same authors stress that a firm with higher-skilled employees is likely to attain higher profits than competitors whose workers are less competent. This observation is in line with Abowd et al. (2005), who argue that the value of a firm will increase if the quality of its firm-specific human capital resources improves. Concerning *organizational capital*, Lev and Radhakrishnan (2005, p. 75) define organizational capital as "an agglomeration of technologies (. . .) business practices, processes and designs and incentive and compensation systems—that together enable some firms to consistently and efficiently extract from a given level of physical and human resources a higher value of product than other firms find possible to attain." The authors classify this as the only competitive asset truly possessed by a firm, whereas the others are exchangeable and thus can be obtained by any company prepared to make the necessary investment.

3 Estimates on Intangible Capital

A methodological framework originally developed by Corrado et al. (2005) for measuring business intangibles in the US has become widely used internationally. The framework was adopted in individual country-case studies for the UK (Marrano

et al., 2009), Japan (Fukao et al., 2009), and Sweden (Edquist, 2011). Adapting this methodological framework to the EU, the FP7 INNODRIVE project[3] constructed the first harmonized dataset for an EU-27 country sample (plus Norway), alongside the three dimensions mentioned above. It contained two "old" national account intangibles and eight "new" intangibles over the time period 1980–2005 (INNODRIVE, 2011; Jona-Lasinio et al., 2011; Gros & Roth, 2012; Roth & Thum, 2013). The INNODRIVE macro database was used as the base for the EU-27 countries within the first version of the INTAN-Invest (NACE1) dataset[4]—a harmonized and updated intangible dataset covering the EU and the US over the time period 1980–2010 (Corrado et al., 2013). In developing the second version of the INTAN-Invest (NACE2) dataset, Corrado et al. (2016, 2018) significantly altered their methodology to provide information on intangible capital on single-digit NACE2 economic sectors and updated their dataset in the latest January 2019 release until the year 2015.

The INTAN-Invest (NACE2) covers 19 EU countries plus the US over the period 1995–2015. The dataset measures three "old" national account intangibles and five "new" intangibles. The dataset groups business intangibles under three dimensions: 1) computerized information, 2) innovative property and 3) economic competencies. The first dimension, i.e. computerized information, contains computer software and databases. The second dimension, i.e. innovative property, contains 1) entertainment, artistic and literary originals, and mineral exploration, 2) R&D, 3) design and 4) new product development in the financial industry. The third dimension, i.e. economic competencies, contains 1) brand, 2) firm-specific human capital and 3) organizational capital. A detailed explanation of the altered methodology of the INTAN-Invest (NACE2) dataset is provided in Corrado et al. (2016), pp. 42–47.

4 Previous Empirical Results

Table 2.1 gives an overview of the existing empirical results of the growth-accounting and cross-country growth econometric literature analyzing the relationship between business intangible capital and labor productivity growth by businesses at the macro-level. The table displays three distinct effects once intangible capital has been incorporated into the asset boundary of the national accounts.

In the first instance, the table clarifies that investments in intangible capital reach significant levels, once they are fully accounted for. Analyzing the business investment level for the US in pre-crisis times, Corrado et al. (2009) find a business investment level of 13% of non-farm business output, whereas Nakamura (2010) finds equal shares of intangible and tangible capital investments. Similar investment

[3] Accessible at https://cordis.europa.eu/project/id/214576/reporting/de (INNODRIVE, 2011).

[4] Accessible at www.intaninvest.net (Corrado et al., 2013).

Table 2.1 Overview of existing empirical studies, 2009–2018

Authors	Country	Investment (in GDP) in %	Contribution to LPG in %†	Growth acceleration in %	Article	Harmonized cross-country dataset	Methodology
Corrado et al. (2009)	US	~ 13* (03)	27 (95–03)	11.2 (95–03)	RoIW	–	GA
Fukao et al. (2009)	JAP	11.1 (00–05)	27; 16 (95–00); (00–05)	17.3, −1.4 (95–00), (00–05)	RoIW	–	GA
Marrano et al. (2009)	UK	13** (04)	20 (95–03)	13.1 (95–03)	RoIW	–	GA
Nakamura (2010)	US	Intangible = Tangible (00–07)	/	/	RoIW	–	GA
Edquist (2011)	SE	10/~16*** (04)	41; 24 (95–00); (00–06)	16, −2.3 (95–00), (00–06)	RoIW	–	GA
Roth and Thum (2013)	EU-13	9.9**** (98–05)	50 (98–05)	4.4 (98–05)	RoIW	INNODRIVE	CCGA
Corrado et al. (2013)	EU-15	6.6 (95–09)	24 (95–07)	/	OEP	INTAN-invest (NACE1)	GA
Corrado et al. (2018)	EU-14, NMS-4	7.2, 6.4 (00–13)	30, 10; 19, 8; 43‡, 17 (00–13); (00–07); (07–13)	/	JIPD	INTAN-invest (NACE2)	GA

Notes: †LPG = labor productivty growth. *The measure here is non-farm business output. **The measure here is adjusted market sector gross value added (MGVA). ***The measure here is gross value added (GVA). ****The measure is GVA (c-k+o excluding k70). ‡Capital share. US = United States, UK = United Kingdom, JAP = Japan, SE = Sweden, EU = European Union, NMS = New Member States, RoIW = Review of Income and Wealth, OREP = Oxford Review of Economic Policy, JIPD = Journal of Infrastructure, Policy and Development, GA = Growth Accounting, CCGA = Cross Country Growth Accounting. The numbers in brackets refer to the relevant time periods.

rates for precrisis times are found for Japan (Fukao et al., 2009) and the UK (Marrano et al., 2009) with 11.1% of GDP and 13% of adjusted MGVA (market sector gross value added), respectively. With a value of 16% of GVA(gross value added), higher business investment rates are found in Sweden (Edquist, 2011). Utilizing INNODRIVE data, Roth and Thum (2013) find an average business investment rate for precrisis times (1998–2005) for 13 EU countries of 9.9% of GVA. Utilizing the first version (NACE1) of the INTAN-Invest dataset, Corrado et al. (2013) find an average business investment rate of 6.6% of GDP for an EU-15 country sample from 1995 to 2009. Utilizing the second version of the INTAN-Invest (NACE Rev.2) dataset, Corrado et al. (2018) find an average investment rate for business intangibles for the EU-14 and NMS-4 of 7.2% and 6.4% of GDP, respectively, from 2000 to 2013.

Second, the contribution from intangible capital services to labor productivity growth is significant. Once business intangible capital is accounted for, 27% and 20% of labor productivity growth were explained in the US and the UK, respectively. The same and higher values of up to 41% hold for Japan and Sweden (Fukao et al., 2009; Edquist, 2011). Utilizing INNODRIVE data and analyzing 13 EU countries with the help of an econometric cross-country growth-accounting methodological approach, Roth and Thum (2013) find that 50% of labor productivity can be explained. Using INTAN-Invest (NACE1) data for an EU-15 country sample over the time period 1995–2009, Corrado et al. (2013) find a value of 24%. In their most recent study, using INTAN-Invest data (NACE2), Corrado et al. (2018) differentiate between a precrisis and a crisis period. They find that intangible capital contributes 30% over the time period 2000–2013, and 19% and 43% in times of precrisis and crisis respectively, for an EU-14 country sample.

Third, the capitalization of intangibles accelerates productivity growth.

5 Model Specification, Research Design and Data

5.1 Model Specification

We estimate a slightly revised model specification as developed in the existing econometric literature (Roth & Thum, 2013, p. 495). Following this literature, the slightly revised model specification takes the following form:

$$\begin{aligned}\left(\ln q_{i,t} - \ln q_{i,t-1}\right) = {} & c + gH_{i,t} + mH_{i,t}\frac{\left(q_{\max,t} - q_{i,t}\right)}{q_{i,t}} + n(1 - ur_{i,t}) \\ & + p\sum_{j=1}^{k} X_{j,i,t} + yd_{i,t} + \alpha(\ln k_{i,t} - \ln k_{i,t-1}) \\ & + \beta(\ln r_{i,t} - \ln r_{i,t-1}) + u_{i,t} \qquad (2.1)\end{aligned}$$

where $(\ln q_{i,t} - \ln q_{i,t-1})$ is labor productivity growth (GVA expanded by intangibles and divided by total hours worked) for the non-farm business sectors $b - n + r - s$ excluding real estate activities expanded by the investment flows of business intangible capital in country i and period t. The constant term c represents exogenous technological progress; the level of human capital $(H_{i,t})$ reflects the capacity of a country to innovate domestically; and the term $H_{i,t}(q_{\max,t} - q_{i,t})/q_{i,t}$ proxies a catch-up process, with $q_{\max,t}$ using a purchasing power parity-weighted GVA measure divided by total hours worked and representing the country with the highest level of labor productivity at period t. The term $(1 - ur_{i,t})$ takes into account the business cycle effect proxied by 1 minus the unemployment rate (ur); the term $\sum_{j=1}^{k} X_{j,i,t}$ is the sum of k extra policy variables, which could possibly explain TFP (total factor productivity) growth and $yd_{i,t}$ are year dummies to control among others for the economic downturn in 2001, in the wake of the bursting of the information technology bubble in the previous year and the 9/11 attack in 2001, as well as the pronounced economic downturn since 2008. $(\ln k_{i,t} - \ln k_{i,t-1})$ and $(\ln r_{i,t} - \ln r_{i,t-1})$ represent the growth of tangible and intangible capital services, and $u_{i,t}$ represents the error term.

5.2 Research Design

The econometric analysis covers 16 out of 27 EU countries from 2000 to 2015. The countries included are Austria, Czech Republic, Denmark, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal, Spain, Slovakia, Slovenia, Sweden, and the United Kingdom.[5] With 16 EU countries and 16 time periods from 2000 to 2015, this leaves the econometric analysis with an overall number of 256 observations. Following the approach by Roth and Thum (2013, p. 496), annual growth rates from 2000 to 2015 were estimated. The econometric analysis was restricted to a period of 2000–2015, due to the valid calculation of capital stock data. Equation (2.1) is estimated with the help of an econometric cross-country growth accounting approach. This approach differs from traditional single-growth accounting in two ways. First, the output elasticities are estimated rather than imposed. And second, the model can be designed to explain the international variance in TFP (total factor productivity) growth. The whole research design applies to non-farm business sectors $b - n + r - s$ excluding real estate activities. For Greece, Ireland, and Portugal, measures for the total economy were adjusted to the non-farm business sectors. For Greece, disproportionately high levels of organizational capital investment were adjusted to an average EU-16 level. Measurement errors and missing values in the latest releases of the EU KLEMS (Jäger, 2017) and

[5] The cases for Belgium and Hungary were excluded due to missing data in the EU KLEMS dataset. Luxembourg was excluded due to significant inconsistencies in the intangible capital data.

the INTAN-Invest (NACE2) dataset (Corrado et al., 2018) were dealt with when necessary.[6]

5.3 Data Sources

The data were retrieved from the sources specified below:

1. Data on the single components of intangible capital were taken from the INTAN-Invest (NACE2) dataset (Corrado et al., 2018), which provides information on gross fixed capital formation (GFCF) and intangibles adjusted GVA. The data cover 19 EU countries + the US over the period 1995–2015, for 21 NACE2 economic sectors. The INTAN-Invest (NACE2) dataset does not provide intangible capital stocks.
2. Data on the single components of tangible capital were taken from the EU KLEMS database (Jäger, 2017). The database provides data on GFCF, tangible capital stocks, GVA, labor compensation, capital compensation, and number of hours worked per employee. The data cover the EU-28 countries and the US, over the period 1995–2015, for 21 NACE2 economic sectors.
3. Human capital is measured as the percentage of the population aged 15+ that has attained at least upper-secondary education, which is taken as a proxy for the stock of human capital. The data were obtained from Eurostat.
4. Data on unemployment, power purchasing parity (PPP), inflation (HICP), government expenditures on education (percent of GDP), total government expenditures (percent of GDP), social expenditure (percent of GDP), and stock of foreign direct investment (FDI) (percent of GDP) were obtained from Eurostat.
5. Data on income tax (as a percent of GDP) were obtained from the OECD. The variables rule of law (Kaufmann et al., 2010), data on market capitalization (percent of GDP), and openness to trade were retrieved from the World Bank.

5.4 A Note on the Construction of Intangible Capital Stocks

In line with the literature (Niebel et al., 2017, p. 55; Roth & Thum, 2013, p. 497; Timmer et al., 2007, pp. 32 and 39), intangible capital stocks for the selected 16 EU-27 countries for the time period 2000–2015 were constructed by applying the perpetual inventory method (PIM) to a series of intangible capital investment going back to 1995 and using the depreciation rates (δ_R) as suggested by Corrado et al. (2009): 20% for R&D, design, and new product development in the financial services industry; 35% for software; 40% for organizational capital and firm-specific

[6] Details on the exact procedure followed for each country and asset type can be obtained from the author upon request.

human capital; 60% for brand names; and 13.75% for entertainment, artistic and literary originals, and mineral exploration. For the calculation of the intangible capital stock R_t, the PIM takes the following form:

$$R_t = N_t + (1 - \delta_R)R_{t-1} \tag{2.2}$$

which assumes that (1) geometric depreciation, (2) constant depreciation rates over time, and (3) depreciation rates for each type of asset are the same for all countries. The real investment series for (N_t) uses a GVA price deflator which is the same for all intangibles.

5.5 *A Note on the Construction of Intangible and Tangible Capital Services*

Data on intangible capital service services were generated according to the work by Oulton and Srinivasan (2003) and Marrano et al. (2009) and are consistent with the EU KLEMS approach (Timmer et al., 2007). This work contends that rather than using a wealth measure (such as the capital stock), it is vital to ascertain the flow of services a capital stock can provide to production. The technical steps of the construction of intangible and tangible capital services are in line with Roth and Thum (2013) and are explained in detail in Appendix 1.

6 Descriptive Analysis

Table 2.A1 in Appendix 2 shows the descriptive statistics of the analyzed dataset. Labor productivity growth increased by 0.1% points (from 1.5 to 1.6), or by 6.7%, a slightly higher value than the value of 4.4% detected in previous work (Roth & Thum, 2013, p. 498). Figure 2.1 shows the business intangible capital investment over GVA for the eight intangible capital indicators for the 16 EU countries over the 16-year average time period 2000–2015. The figure shows that overall business intangible capital investments vary considerably across the 16 EU countries. Sweden ranks first with an investment of 17.1%. This is similar to the findings by Edquist (2011), who reports an investment rate of 16, but higher than the findings by Roth and Thum (2013), who report an investment rate of 13.6% over business GVA. Sweden is followed by Finland, France, Denmark, and Ireland with investment rates of 15.6%, 14.5%, 13.4%, and 13.4% over GVA, respectively. Such values are again higher than those found by Roth and Thum (2013). In particular, the Irish case seems noteworthy, given its low values in the literature (Roth & Thum, 2013, p. 498). Most countries' investment rates are positioned between 9% and 12%, and therefore fall near the EU-16 average investment rate of 11%. This is in the range of the value of 9.9%, as

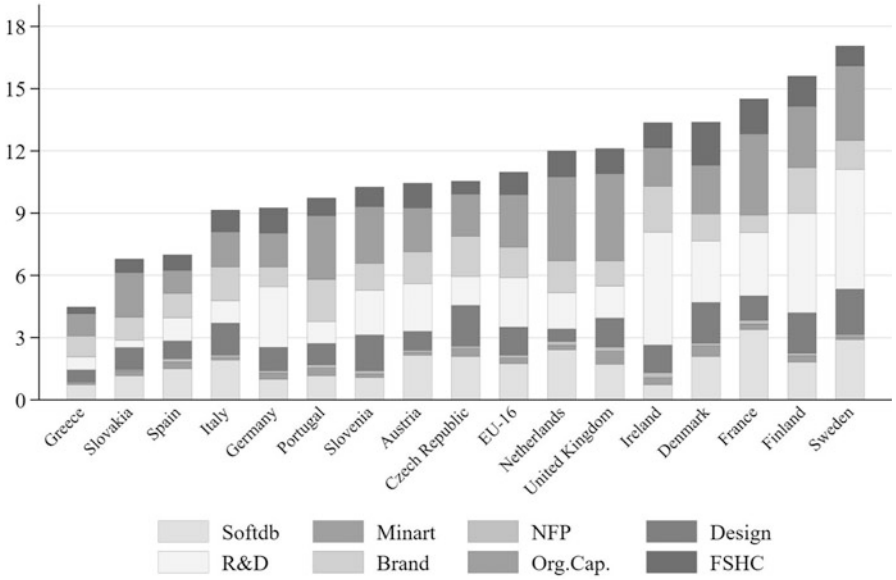

Fig. 2.1 Business intangible investment (as a percentage of GVA) in 16 EU countries, 2000–2015
Notes: Investments are compared to GVA (non-farm business sector b-n + r-s excluding real estate activity). Softdb = software and databases; Minart = entertainment, artistic and literary originals, and mineral exploration; NFP = new product development costs in the financial industry; Design = design; R&D = research and development; Brand = brand names; Org.Cap. = organizational capital; FSHC = firm-specific human capital.
Sources: INTAN-Invest (NACE2) data (Corrado et al., 2018).

reported in earlier econometric work (Roth & Thum, 2013, p. 498). The lowest investment levels can be detected in Spain, Slovakia, and Greece, with values of 7.0, 6.8, and 4.5, respectively. Overall, it is noteworthy that the equal investment levels for Germany and Italy—with values of 9.3% and 9.2%—as well as the pronounced difference between Germany and France by 5.2% points, were not detected in the earlier literature using INNODRIVE data (Roth & Thum, 2013, p. 498).[7]

In order to analyze the distribution of the three intangible dimensions, Fig. 2.2 displays a scatterplot between the innovative property and economic competencies. The five countries located in the upper-right corner—Sweden, Ireland, Finland, Denmark, and France—can be classified as highly innovative and strong investors in economic competencies. In addition, four out of these five countries score high on computerized information. There are some economies, however, that are highly

[7] A first comparison of the time series patterns of the INNODRIVE and INTAN-Invest (NACE2 rev.) in Fig. 2.A1 in Appendix 3 reveals that total intangible capital investment has strongly increased in the case of Italy, moderately increased in the case of France, and has not increased at all in the case of Germany, compared to the original INNODRIVE data. Future research should analyze these differences in more detail, by country and asset type.

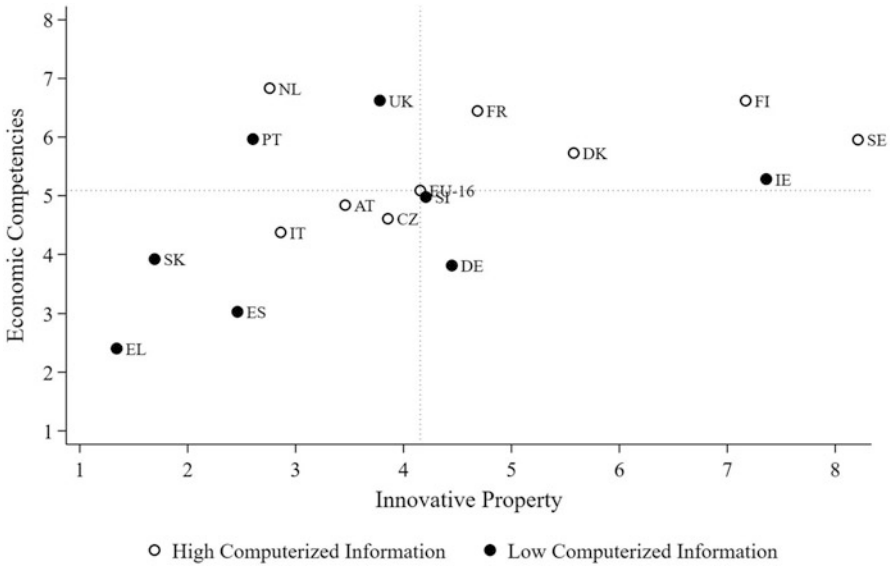

Fig. 2.2 Scatterplot between innovative property and economic competencies (as a percentage of GVA), 2000–2015
Notes: The dashed lines indicate the EU16 average values. AT = Austria; CZ = Czech Republic; DE = Germany; DK = Denmark; EL = Greece; ES = Spain; FI = Finland; FR = France; IE = Ireland; IT = Italy; NL = the Netherlands; PT = Portugal; SE = Sweden; SI= Slovenia; SK = Slovakia; UK = United Kingdom.
Sources: INTAN-Invest (NACE2) data (Corrado et al., 2018).

innovative, but which invest less in economic competencies and computerized information, such as Germany.[8] The third category includes countries that score low on innovative property but high on economic competencies, namely the UK, the Netherlands, and Portugal, of which only the Netherlands scores high on promoting computerized information. The fourth category contains countries that score low on both dimensions: Italy, Spain, Slovakia, and Greece. Three out of these four countries also score low on computerized information.

Figure 2.3 compares business investments in intangible and tangible capital as used in the econometric estimation. Once intangibles are included in the asset boundary of the national accounts, the average level of investment of the 16 EU countries is 25.1%. This value is significantly higher than the value produced if one only considers tangible capital investment, which would be at 14.1%. Among the 16 EU countries, seven countries (Finland, France, Sweden, the Netherlands, the United Kingdom, Ireland, and Denmark) invest more in intangibles than in tangibles—their share of intangible/tangible investment is already greater than 1%. This is in line with the finding by Nakamura (2010), who detected this pattern for the US as early as the year 2000, but contrasts with an earlier analysis for the time period

[8] Germany's position might be related to the altered methodology in the INTAN-Invest (NACE2) dataset (Corrado et al., 2018) (see Fig. 2.A1 in Appendix 3).

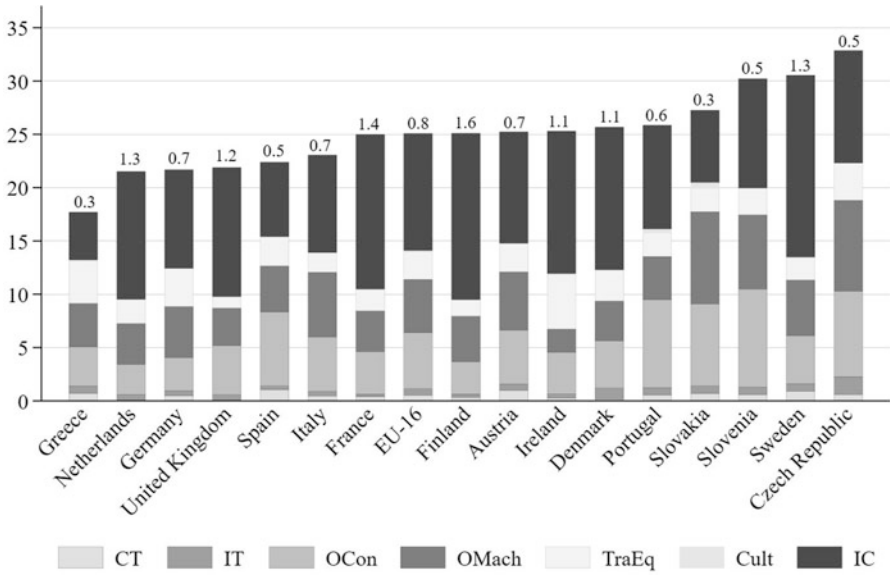

Fig. 2.3 Business tangible and intangible capital investments (as a percentage of GVA), EU16, 2000–2015
Notes: CT = communications technology; IT = information technology; OCon = total non-residential capital investment; OMach = other machinery and equipment; TraEq = transport equipment; Cult = cultivated assets; IC = intangible capital. Residential Structure has been excluded. Values on top of the bars depict the intangible/tangible capital investment ratio.
Sources: INTAN-Invest (NACE2) data (Corrado et al., 2018) and EUKLEMS data (Jäger, 2017).

1998–2005 (Roth & Thum, 2013, p. 500), which did not find such a pronounced pattern.[9]

Figure 2.4 shows the time series pattern for intangible and tangible capital investment and labor productivity growth for the 16 individual EU countries and the average EU-16 pattern. Three findings are especially noteworthy. First, in line with earlier literature (Corrado et al., 2018), when analyzing an average EU-16 time series pattern, the crisis has led to a slight decline in intangible capital investment but a more pronounced decline in tangible capital. Whereas intangible capital investments have swiftly recovered, tangible capital investments have not yet recovered to pre-crisis levels. Second, the decline in investment in tangible capital has been pronounced in EA countries due to the sovereign debt crisis, particularly in Greece, Spain, Italy, Portugal, and Slovenia. Conversely, with the exception of Greece, intangible capital investment has even increased in these countries in times of crisis and economic recovery. Third, the Irish case is exceptional. In times of economic recovery, Ireland has managed to more than double its intangible capital investments—largely due to significant investments in R&D.

[9] Such contrasting findings might be related to the overall increase in total intangible capital investment in the INTAN-Invest dataset (NACE2), as displayed in Fig. 2.A1 in Appendix 3.

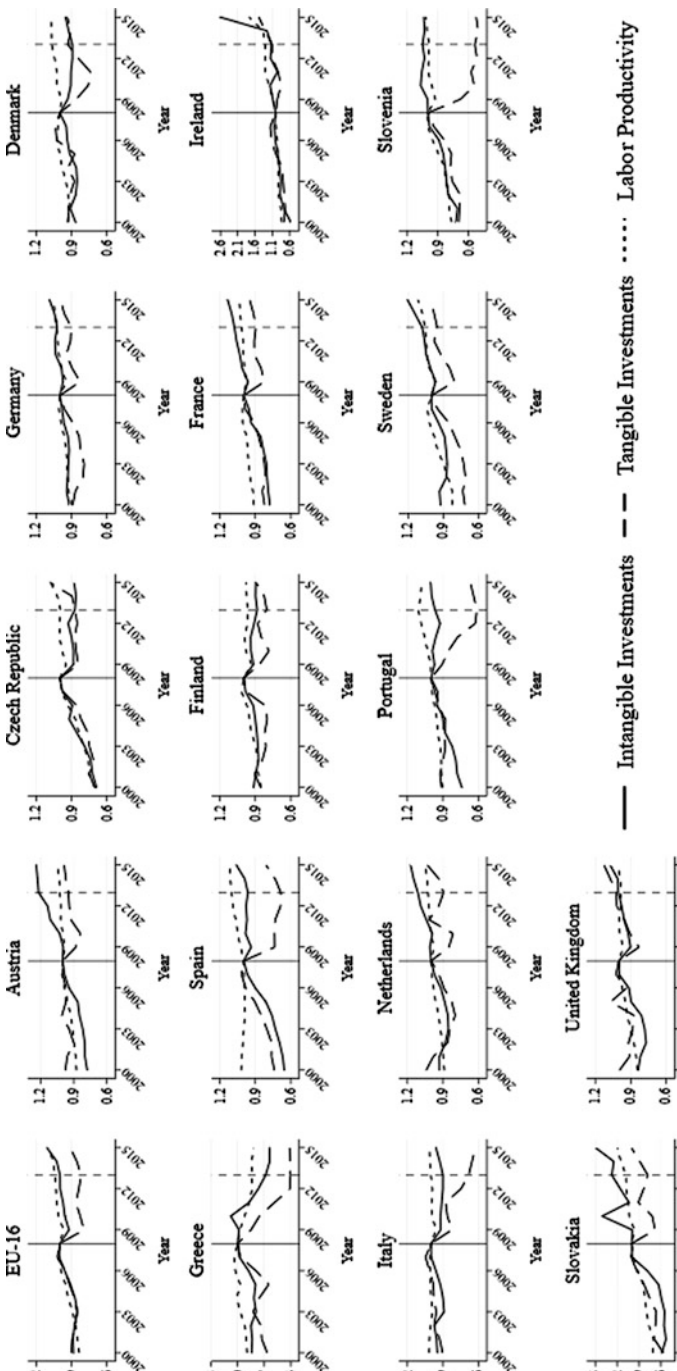

Fig. 2.4 Investments in intangibles and tangibles and labor productivity in the 16 EU countries (2000–2015)
Notes: Investment in intangibles, tangibles, and labor productivity are given in millions of national currencies and are standardized to 1 in the year 2008. The continuous line indicates the start of the financial crisis in September 2008. The dashed line indicates the start of the economic recovery at the end of 2013. Adapted y-scales are applied to Greece, Ireland, and Slovakia. EU-16 average is based on PPP-adjusted values.
Sources: INTAN-Invest (NACE2) data (Corrado et al., 2018).

7 Econometric Estimation

We estimate eq. (2.1) with the help of a pooled panel (PP) estimation approach.[10] To control for panel heteroscedasticity, a panel-corrected standard error estimation procedure (PCSE) was used.[11] It should be noted that the PP-PCSE estimation yields the same coefficients as a random-effects estimator (see row 27 in Table 2.3). This property permits us to compare our results directly with the econometric findings of the existing literature (Roth & Thum, 2013, pp. 501–505). Regression 2.1 in Table 2.2 shows the results when estimating a traditional production function without the inclusion of intangibles (excluding software, R&D, and entertainment, artistic and literary originals, and mineral exploration from the tangible capital investment). Growth in tangible capital services is positively associated with labor productivity growth and has a coefficient of 0.31, which explains a 64% share of labor productivity growth.[12] Regression 2.2 includes intangibles. Growth in intangible capital services positively relates to labor productivity growth with a coefficient of a magnitude of 0.38, explaining 66% of labor productivity growth. As can be inferred from Table 2.1, this value is higher than the figure of 50% reported in earlier work (Roth & Thum, 2013, p. 502). Once intangibles are included, the impact of tangible capital diminishes to 34%, which is a slightly lower value than previously reported in the literature (Roth & Thum, 2013, p. 503).[13] This finding clarifies that intangible capital investments have become the dominant source of growth in EU countries.

Regression 3 in Table 2.2 analyzes the relationship between intangible capital and labor productivity during times of crisis by adding a crisis (2008–2013) interaction effect to the specification of regression 2. Regression 3 clarifies that while the relationship between tangible capital services growth and labor productivity growth actually turns negative in times of crisis, with a coefficient of 0.04 (0.28–0.32), the relationship between intangible capital services growth and labor productivity growth remains positive with a coefficient of 0.20 (0.48–0.28). To analyze this novel finding in more detail, regression 4 adds a recovery interaction effect

[10] Without a lagged initial income term on the left-hand side, the baseline model specification in eq. (2.1) may be estimated without the complexities of a dynamic panel analysis. When replicating the random-effects estimation by Roth and Thum (2013, pp. 501–505), a Breusch and Pagan LM test for random effects was performed via the post-estimation command "xttest0" (Stata Corporation, 2017). With a χ^2 value of 0, the rejection of the null hypothesis fails. This validates the usage of a pooled panel estimation approach.

[11] The PCSE calculation was performed via the "xtpcse" command (Stata Corporation, 2017).

[12] Taking eq. (2.1) as our reference, with the mean value of $(\ln q_{i,\,t} - \ln q_{i,\,t-1})$ being 1.5, the mean value of $(\ln k_{i,\,t} - \ln k_{i,\,t-1})$ being 3.1, and α being 0.31, the calculation can be set up as follows: $(0.31*3.1)/1.5 = 0.64$.

[13] When controlling for Ireland in 2015 (see row 2 in Table 2.3 and Fig. 2.4), intangible capital services explain 46% of labor productivity growth. This value is closer to the 50% finding by Roth and Thum (2013, p. 502). Growth in tangible capital services and TFP then explains 31% and 23%, respectively.

Table 2.2 Intangibles and labor productivity growth, 2000–2015, PP-PCSE estimation

Estimation method	PP-PCSE	PP-PCSE	PP-PCSE	PP-PCSE	PP-PCSE	2SLS
Time sample	2000–2015	2000–2015	2000–2015	2008–2015	2000–2015	2000–2015
Equation	(1)	(2)	(3)	(4)	(5)	(6)
Tangible services growth	0.31***	0.19**	0.28***	−0.13	0.18**	0.58
	(0.08)	(0.08)	(0.08)	(0.15)	(0.07)	(0.42)
Tangible services growth*crisis	–	–	−0.32**	–	–	–
			(0.13)			
Tangible services growth*recovery	–	–	–	0.47	–	–
				(0.30)		
Intangible services growth	–	0.38***	0.48***	0.32***	–	0.50***
		(0.07)	(0.09)	(0.11)		(0.16)
Intangible services growth*crisis	–	–	−0.28**	–	–	–
			(0.13)			
Intangible services growth*recovery	–	–	–	0.42*	–	–
				(0.23)		
Innovative property services growth	–	–	–	–	0.37***	–
					(0.07)	
Computerized information services growth	–	–	–	–	−0.01	–
					(0.04)	
Economic competencies services growth	–	–	–	–	0.02	–
					(0.06)	
Upper secondary education 15+	0.07***	0.05***	0.05***	0.02	0.06***	0.07***
	(0.02)	(0.01)	(0.01)	(0.02)	(0.01)	(0.02)
Catch-up	−0.02**	−0.02***	−0.02***	−0.01	−0.02**	−0.02*
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Business cycle	−0.11*	−0.12*	−0.13**	−0.13*	−0.12*	−0.11**
	(0.06)	(0.06)	(0.06)	(0.07)	(0.06)	(0.05)
R-squared	0.40	0.50	0.54	0.63	0.54	0.46
Observations	256	256	256	128	256	208
Number of countries	16	16	16	16	16	16

Notes: In regression (2.1), tangible services growth, labor productivity growth, and the catch-up term exclude software, R&D, and entertainment, artistic and literary originals, and mineral exploration. In regressions, (2–6) labor productivity growth and the catch-up term are expanded with intangible capital. Tangible capital excludes residential capital. Labor productivity growth was calculated based on the GVA of the non-farm business sectors $b - n + r - s$ (excluding real estate activities). ***p < 0.01, **p < 0,05, *p < 0.1.

(2014–2015) to a crisis-recovery sub-sample (2008–2015). Regression 4 clarifies that in times of economic recovery, intangible capital services growth has a strong positive relationship to labor productivity growth. This finding is particularly evident in Ireland in 2015, where a large intangible service growth (20%) is related to a large labor productivity growth of (25.8%) (see rows 2 and 3 in Table 2.3 and Fig. 2.4).

Table 2.3 Sensitivity analysis for the baseline PP-PCSE estimator

Row	Specification change	Coefficient on intangibles	Countries	Obs.	R-squared
Baseline regression					
(1)	Baseline—regression	0.38***	16	256	0.50
Influential cases					
(2)	Including Irish 2015 Dummy	0.26***	16	256	0.59
(3)	Excluding Ireland	0.24***	15	240	0.48
(4)	Excluding Greece	0.44***	15	240	0.56
(5)	Excluding Greece and Ireland	0.28***	14	224	0.56
(6)	Excluding New Member States	0.37***	13	208	0.53
Restructuring of country sample					
(7)	13 EU countries, 2000–2015	0.52***	13	208	0.65
(8)	Dummy for coordinated economies	0.37***	16	256	0.51
(9)	Dummy for Mediterranean countries	0.37***	16	256	0.50
(10)	Dummy for New Member States	0.33***	16	256	0.53
(11)	Dummy for Scandinavian countries	0.37***	16	256	0.50
(12)	Dummy for liberal economies	0.37***	16	256	0.50
Specifications					
(13)	Rule of Law	0.37***	16	240	0.51
(14)	Openness to Trade	0.33***	16	256	0.53
(15)	FDI	0.39***	16	241	0.54
(16)	Government Expenditures	0.35***	16	256	0.52
(17)	Social Expenditures	0.31***	16	256	0.54
(18)	Education Expenditures	0.41***	16	241	0.57
(19)	Inflation	0.38***	16	256	0.53
(20)	Income Tax	0.36***	16	256	0.50
(21)	Stock Market Capitalization	0.38***	16	204	0.50
(22)	Alternative Business cycle	0.38***	16	256	0.50
Other independent variables					
(23)	Without Ireland (Inno. Prop.)	0.11	16	240	0.50
(24)	Without Ireland (Computerized Information)	−0.01			
(25)	Without Ireland (Economic Competencies)	0.17***			
Methods					
(26)	Panel Autocorrelation—Order 1	0.40***	16	256	0.58
(27)	Random-Effects	0.38***	16	256	0.51

Notes: The random-effects estimator depicts an overall R-Square value. ***p < 0.01, **p < 0,05, *p < 0.1. Obs. = Observations.

Regression 5 assesses which dimensions of intangible capital services are the key drivers for the positive relationship between intangible capital and labor productivity growth. It includes 1) computerized information, 2) innovative property, and 3) economic competencies. In contrast to earlier work (Roth & Thum, 2013, p. 503), which finds economic competencies to be the main driver, we now find innovative property to be a strong driver (0.37) of labor productivity growth. This relationship describes the evidence in the Irish case in 2015, in which a large share of innovative property services growth is related to a large labor productivity growth. Excluding Ireland in rows 23–25 in Table 2.3 renders innovative property insignificant and re-establishes economic competencies with a coefficient of 0.17 as the main driver. In order to control for potential endogeneity, regression 6 estimates eq. (2.1) with the help of a 2SLS estimation approach and 208 overall observations. Following earlier econometric work by Roth and Thum (2013, p. 503), lagged levels of intangible and tangible capital as instruments were chosen.[14] The results clarify that while the relationship between tangible capital and labor productivity growth is rendered insignificant after controlling for endogeneity, the coefficient for intangible capital services growth remains highly significant, yielding a further increase in magnitude (0.50). The sensitivity analysis in Table 2.3 further explores the robustness of the coefficient of intangible capital on labor productivity growth, from regression 2, permitting us to conduct an analysis with a maximum of 256 observations.

Table 2.3 displays a sensitivity analysis of regression 2 in Table 2.2. The first row shows the coefficient for the Baseline regression, regression 2 in Table 2.2. Rows 2–6 analyze the sensitivity due to influential cases.[15] When controlling for Ireland in 2015, as expected, the intangible capital coefficient declines (0.26), explaining a 46% share of labor productivity growth. A similar decline in magnitude (0.24 and 0.28) is found when excluding Ireland or Ireland and Greece from the country sample in rows 3 and 5. Excluding Greece in row 4 yields a higher coefficient (0.44). Excluding the three new member states in row 6 yields a slight reduction of the coefficient (0.37). Rows 7–12 restructure the country sample and analyze five distinct European regime dummies. When analyzing the 13 EU countries from 2000 to 2015 from earlier work (Roth & Thum, 2013), the relationship remains highly significant and reveals an increase in magnitude (0.52). Neither controlling for the five European regime dummies in rows 8–12, nor altering the model specifications in rows 13–22, nor using alternative estimation approaches in rows 26–27 alters the significance of the relationship between intangible capital and labor productivity in any appreciable manner, although the magnitude of the relationship varies slightly.

[14] To be precise, the first two lagged levels were used. A Wooldridge robust score test of overidentifying restrictions was performed via the 2SLS post-estimation command "estat overid" (Stata Corporation, 2017). With a χ^2 (2) value of 0.4, the rejection of the null hypothesis fails. This indicates that the instruments used are valid.

[15] The influential cases of Ireland and Greece have been detected via the "avplot" command (Stata Corporation, 2017), as well as from Fig. 2.4.

8 Conclusions

This contribution analyzes the relationship between intangible capital investment by businesses and labor productivity growth by analyzing an EU-16 country sample over the time period 2000–2015, with the help of a cross-country growth-accounting estimation approach. By matching the most recent release of the INTAN-Invest (NACE2) dataset (Corrado et al., 2018) with the latest data available from the EU KLEMS dataset (Jäger, 2017) alongside a wide range of growth-relevant policy variables from Eurostat, the OECD, and the World Bank, this contribution generates the largest and most up-to-date panel dataset developed on intangible capital at the macro-level, based on a total of 256 country observations.

This contribution reaches three major findings. First, in line with previous growth econometric literature (Roth & Thum, 2013), this contribution confirms that once intangibles are factored into the calculations, they become the dominant source—up to 66%—of labor productivity growth in the EU. Second, when focussing on times of crisis (2008–2013), this contribution finds that whereas the relationship between tangible capital and labor productivity turned negative, the impact of intangibles on growth remained solidly positive throughout this period. Thirdly, when accounting for the economic recovery (2014–2015), this contribution establishes a highly significant and remarkably strong relationship between intangible capital and labor productivity growth.

In light of these novel empirical results, four main policy conclusions can be drawn from our analysis of European economies. First, given the paucity of econometric findings in the literature analyzing the relationship between intangible capital and labor productivity growth at the macro-level, additional research should be devoted in the future to further econometrically corroborate the positive relationship between intangible capital and labor productivity. This future research should examine in more detail the evolutionary changes in existing cross-country intangible capital datasets, by country and by asset type. Second, as developed economies transition into knowledge societies, it is essential to incorporate a complete set of intangibles—including branding, firm-specific human capital, and organizational capital—into today's national accounting framework in order to acknowledge the pronounced shift in investment patterns from tangible to intangible investment in contemporary national accounting frameworks. The current frameworks are inadequate, as they under-represent actual levels of capital investment in European economies. Their reported levels of capital investment would undoubtedly be greater once the full range of investment in intangible capital is incorporated into the accounting framework.

Third, the incorporation of a broader dimension of innovation investment seems to be an important first step in revising today's national accounting framework, particularly when focusing on the business sector. Moreover, a follow-up step consists of broadly adapting the national accounting framework to reflect environmental, health, and public intangible capital investment. Fourth, government policies that actively support the accumulation of business intangibles should be designed

and implemented as soon as possible. This will foremost require government investment in public intangibles, such as enhancing the quantity and quality of a highly skilled labor force, well-functioning formal and informal institutions, and a well-designed policy framework that includes credible financial conditions and an effective scheme offering intangible tax incentives at the member state and EU level.[16]

Appendix 1 Construction of Intangible and Tangible Capital Services Growth

Following Oulton and Srinivasan (2003), Marrano et al. (2009) and the EU KLEMS approach (Timmer et al., 2007) and consistent with Roth and Thum (2013), tangible and intangible capital services growth ($\ln k_{i,t} - \ln k_{i,t-1}$) and ($\ln r_{i,t} - \ln r_{i,t-1}$) or respectively $\Delta \ln k_{i,t}$ and $\Delta \ln r_{i,t}$ are defined as:

$$\Delta \ln k_{i,t} = \sum_{i=1}^{m} \overline{v}_{i,t} \Delta \ln a_{i,t} \tag{2.A1}$$

$$\Delta \ln r_{i,t} = \sum_{i=m+1}^{n} \overline{v}_{i,t} \Delta \ln a_{i,t} \tag{2.A2}$$

where $a_{i,t}$ is the asset-specific capital stock, as calculated with the PIM, assets from 1 to m are tangible assets, and assets from $m + 1$ to n are intangible. Lower case $k_{i,t}$, $r_{i,t}$ and $a_{i,t}$ indicate that the variables are scaled on hours worked. $\overline{v}_{i,t}$ is a 2-year average weighting term defined as:

$$\overline{v}_{i,t} = \frac{1}{2}[v_{i,t} + v_{i,t-1}] \tag{2.A3}$$

The term $v_{i,t}$ is computed as:

$$v_{i,t} = \left(\frac{p^a_{i,t} a_{i,t}}{\sum_{i=1}^{n} p^a_{i,t} a_{i,t}} \right) \tag{2.A4}$$

[16] See here Gros and Roth (2012); Haskel and Westlake (2018); Roth (2019); and Thum-Thysen et al. (2019).

From (2.A4), $a_{i,t}$ is the asset-specific capital stock and $p^a_{i,t}$ is the asset-specific (tangible or intangible) user cost. The latter user cost is defined as:

$$p^a_{i,t} = p^I_{i,t-1} i_t + \delta_{i,t} p^I_{i,t} - \left[p^I_{i,t} - p^I_{i,t-1}\right] \tag{2.A5}$$

where $p^I_{i,t-1}$ is the investment price, constructed from the price index of the GFCF series at chained prices, i_t is the time-specific rate of return (common to all tangible and intangible assets) and $\delta_{i,\,t}$ is the time variant and asset-specific depreciation rate. The depreciation rate that varies over time reflects the varying contribution over time of industries to the total non-farm business sector (b-n + r-s excluding real estate activities). The time-varying depreciation rate used here is defined as:

$$\delta_{i,t} = \frac{A_{i,t-1} + I_{i,t} - A_{i,t}}{A_{i,t-1}} \tag{2.A6}$$

The last term in (A5) is the capital gain term $\left[p^I_{i,t} - p^I_{i,t-1}\right]$; following Niebel and Saam (2011), it is computed considering the price indices of three consecutive periods using the formula:

$$\left[p^I_{i,t} - p^I_{i,t-1}\right] = \frac{1}{2}\left(\ln\left(p_{i,t}\right) - ln\left(p_{i,t-2}\right)\right) p_{i,t-1} \tag{2.A7}$$

The rate of return i_t is common to all the tangible and intangible assets and represents the overall return on the investment under the profit maximization assumption, as explained in Oulton and Srinivasan (2003). Following Timmer et al. (2007), the common rate of return is computed here using an ex-post approach that accounts for the rental payments of each asset:

$$i_t = \frac{p^a_t a_t + \sum_i \left[p^I_{i,t} - p^I_{i,t-1}\right] a_{i,t} - \sum_i p^I_{i,t} \delta_{i,t} a_{i,t}}{\sum_i p^I_{i,t-1} a_{i,t}} \tag{2.A8}$$

where $p^a_t a_t$ is the total nominal capital compensation, obtained by subtracting the labor compensation from the GVA.

Appendix 2 Descriptive Statistics

Table 2.A1 Descriptive statistics, EU16, 2000–2015

	Obs.	Mean	Standard deviation	Min.	Max.
LPG—expanded by intangibles (in %)	256	1.6	3.1	−7.6	25.8
LPG–excluding all intangibles (in %)	256	1.5	3.0	−8.7	16.7
Intangible services growth (in %)	256	2.8	3.4	−7.9	20
Tangible services growth (in %)	256	3.1	2.9	−4.4	13.8
Tangible services growth-expanded by intangibles (in %)	256	2.9	3.0	−5.8	13.3
Innovative property services growth (in %)	256	4.0	4.3	−8.2	33.5
Economic competencies services growth (in %)	256	1.4	3.8	−13.0	17
Computerized information services growth (in %)	256	3.9	6.4	−18.4	40.1
Upper-secondary education 15+ (in %)	256	67.8	14.2	21	87.6
Interaction education and catch-up—expanded by intangibles	256	34.7	35.0	0	197.2
Interaction education and catch-up—excluding all intangibles	256	31.8	30.4	0	158.1
Business cycle (in %)	256	91.2	4.5	72.5	96.9
Rule of law	240	1.4	0.5	0.3	2.1
Openness (in %)	256	92.3	39	45.6	215.4
FDI (main balance of payments as a % of GDP)	241	−0.4	5.2	−15.2	10.2
Government expenditure (as a % of GDP)	256	47.1	5.9	29	65.1
Social expenditure (as a % of GDP)	256	25.3	4.7	14.8	34.5
Education expenditure (as a % of GDP)	241	5.3	1.2	3	8.8
Inflation (in %)	256	2.2	1.7	−1.7	12.2
Income tax (as a % of GDP)	256	8.9	5.0	2.6	26.3
Stock market capitalization (as a % of GDP)	204	52.8	36.2	1.5	233.9

Notes: LPG = Labor Productivity Growth; Obs. = Observations; Min. = Minimum; Max. = Maximum.

Appendix 3 A Comparison of INNODRIVE and INTAN-Invest datasets

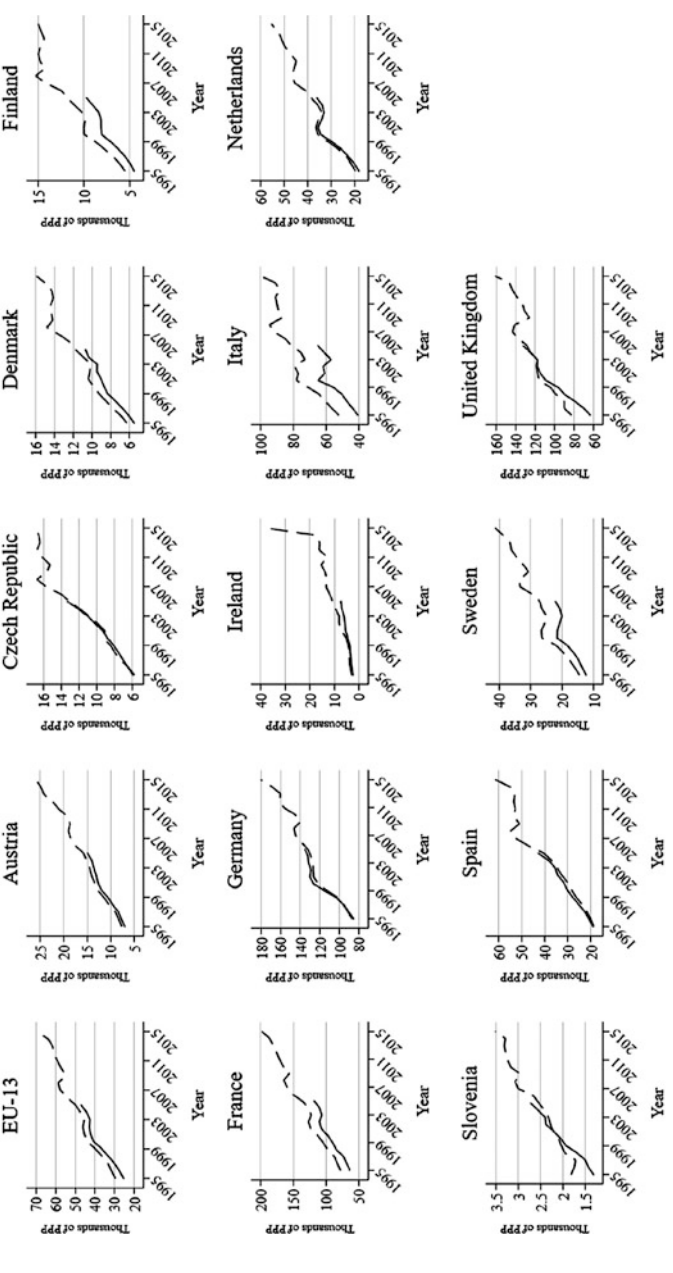

Fig. 2.A1 Intangible investments in 13 EU countries, 1995–2015: a comparison of INNODRIVE and INTAN-Invest (NACE2) datasets
Notes: PPP-Adjusted time series were used. The 13 EU countries are: Austria, Czech Republic, Denmark, Finland, France, Germany, Ireland, Italy, the Netherlands, Slovenia, Spain, Sweden, and the United Kingdom. "Total Intangible Investments" is the sum of Computerized Information, Innovative Properties, and Economic Competencies. Economic sectors for INNODRIVE (NACE1) dataset include c-k + o (excluding k70) and for INTAN-Invest (NACE2) dataset include b-n + r-s (excluding l).
Sources: INNODRIVE data (INNODRIVE, 2011) and INTAN-Invest (NACE2) dataset (Corrado et al., 2018).

References

Abowd, J. M., Haltiwanger, J., Jarmin, R., Lane, J., Lengermann, P., McCue, K., McKinney, K., & Sandusky, K. (2005). The relationship among human capital, productivity and market value. In C. Corrado, J. Haltiwanger, & D. Sichel (Eds.), *Measuring capital in the new economy* (pp. 153–204). University of Chicago Press.

Bounfour, A., & Miyagawa, T. (2015). *Intangibles, market failure and innovation growth* (pp. 1–10). Springer Verlag.

Brynjolfsson, E., Hitt, L. M., & Yang, S. (2002). Intangible assets: Computers and organizational capital. *Brookings Papers on Economic Activity,* (1), 137–198.

Cañibano, L., Garcia-Ayuso, M., & Sánchez, P. (2000). Accounting for intangibles: A literature review. *Journal of Accounting Literature, 19*, 102–130.

Corrado, C., Hulten, C., & Sichel, D. (2005). Measuring capital and technology: An expanded framework. In C. Corrado, J. Haltiwanger, & D. Sichel (Eds.), *Measuring capital in the new economy* (pp. 11–46). University of Chicago Press.

Corrado, C., Hulten, C., & Sichel, D. (2009). Intangible capital and U.S. economic growth. *Review of Income and Wealth, 55*(3), 661–685.

Corrado, C., Haskel, J., Jona-Lasinio, C., & Iommi, M. (2013). Innovation and intangible investment in Europe, Japan, and the United States. *Oxford Review of Economic Policy, 29*(2), 261–286.

Corrado, C., Haskel, J., Jona-Lasinio, C., & Iommi, M. (2016). Intangible investment in the EU and US before and since the great recession and its contribution to productivity growth. EIB Working Papers No. 2016/08. European Investment Bank, Luxembourg. Available at: http://hdl.handle.net/10419/149979.

Corrado, C., Haskel, J., Jona-Lasinio, C., & Iommi, M. (2018). Intangible investment in the EU and US before and since the great recession and its contribution to productivity growth. *Journal of Infrastructure Policy and Development, 2*(1), 11–36.

Delbecque, V., Bounfour, A., & Barreneche, A. (2015). Intangibles and value creation at the industrial level: Delineating their complementarities. In A. Bounfour & T. Miyagawa (Eds.), *Intangibles, market failure and innovation growth* (pp. 27–56). Springer Verlag.

Edquist, H. (2011). Can investment in intangibles explain the Swedish productivity boom in the 1990s? *Review of Income and Wealth, 57*(4), 658–682.

Fukao, K., Miyagawa, T., Mukai, K., Shinoda, Y., & Tonogi, K. (2009). Intangible investment in Japan: Measurement and contribution to economic growth. *Review of Income and Wealth, 55*(3), 717–736.

Gros, D., & Roth, F. (2012). *The Europe 2020 strategy: Is it capable of maintaining the EU's competitiveness in the world?* Centre for European Policy Studies.

Guellec, D., & van Pottelsberghe de la Potterie, B. (2001). R&D and productivity growth: Panel data analysis of 16 OECD countries. *OECD Economic Studies, 33*, 103–126.

Haskel, J., & Westlake, S. (2018). *Capitalism without capital*. Princeton University Press.

INNODRIVE. (2011). *INNODRIVE intangibles database*. Available at: https://cordis.europa.eu/project/id/214576/reporting/de.

Jäger, K. (2017). *EU KLEMS growth and productivity accounts 2017 release - description of methodology and general notes*. Available at: http://www.euklems.net/TCB/2017/Methology_EU%20KLEMS_2017.pdf.

Jona-Lasinio, C., Massimiliano, I., & Roth, F. (2011). National measures of intangible capital in the EU-27. In H. Piekkola (Ed.), Intangible capital—Driver of growth in Europe, Proceedings of the University of Vaasa Reports 167 (pp. 20–62). University of Vaasa.

Kaufmann, D., Kraay, A., & Mastruzzi, M. (2010). "The worldwide governance indicators: A summary of methodology, data and analytical issues", World Bank Policy Research Working Paper No. 5430. World Bank.

Lev, B., & Radhakrishnan, S. (2005). The valuation of organizational capital. In C. Corrado, J. Haltiwanger, & D. Sichel (Eds.), *Measuring capital in the new economy* (pp. 73–110). University Chicago Press.

Marrano, M., Haskel, J., & Wallis, G. (2009). What happened to the knowledge economy? ICT, intangible investment, and Britain's productivity record revisited. *Review of Income and Wealth, 55*(3), 686–716.

Miyagawa, T., & Hisa, S. (2013). Estimates of intangible investment by industry and productivity growth in Japan. *Japanese Economic Review, 64*(1), 42–72.

Nakamura, L. (2001). "What is the U.S. gross investment in intangibles? (at least) one trillion dollars a year!", Working Papers 01-15. Federal Reserve Bank of Philadelphia.

Nakamura, L. (2010). Intangible assets and national income accounting. *Review of Income and Wealth, 56*(1), S135–S155.

Niebel, T., & Saam, M. (2011). "Productivity of ICT and non-ICT capital: The role of rates of return and capital prices", ZEW Discussion Papers, no, 11–083. Mannheim.

Niebel, T., O'Mahony, M., & Saam, M. (2017). "The contribution of intangible assets to sectoral productivity growth in the EU". *Review of Income and Wealth Series, 63*, S49–S67.

Oulton, N., & Srinivasan, S. (2003). "Capital stocks, capital services, and depreciation: An integrated framework", Bank of England working paper no. 192. Bank of England.

Piekkola, H. (2016). Intangible investment and market valuation. *Review of Income and Wealth, 62*(1), 28–51.

Piekkola, H. (2018). Broad-based intangibles as generators of growth in Europe. *Economics of Innovation and New Technology, 27*(4), 377–400.

Roth, F. (2019). *"Intangible capital and labour productivity growth: A review of the literature", Hamburg discussion papers in international economics, no. 4*. University of Hamburg.

Roth, F., & Thum, A. E. (2013). Intangible capital and labour productivity growth–panel evidence for the EU from 1998-2005. *Review of Income and Wealth, 59*(3), 486–508.

Corporation, S. (2017). *Stata longitudinal-data/panel-data reference manual release 15*. Stata Press.

Temple, J. (1999). The new growth evidence. *Journal of Economic Literature, 37*(1), 112–156.

Thum-Thysen, A.-E., Voigt, P., Bilbao-Osorio, B., Maier, C., & Ognyanova, D. (2019). Investment dynamics in Europe: Distinct drivers and barriers for investing in intangible versus tangible assets? *Structural Change and Economic Dynamics, 51*, 77–88.

Timmer, M., van Moergastel, T., Stuivenwold, E., Ypma, G., O'Mahony, M., & Kangasniemi, M. (2007). *EU KLEMS growth and productivity accounts, version 1.0, part I: Methodology*, EU KLEMS deliverable.

Van Ark, B. (2016). Europe's productivity slowdown revisited: A comparative perspective to the United States. In P. Askenazy, L. Bellmann, A. Bryson, & E. Moreno Galbis (Eds.), *Productivity puzzles across Europe* (pp. 26–48). Oxford University Press.

Van Ark, B., & O'Mahony, M. (2016). Productivity growth in Europe before and since the 2008/2009 economic and financial crisis. In D. Jorgensen, K. Fukao, & M. Timmer (Eds.), *The world economy: Growth stagnation* (pp. 111–152). Cambridge University Press.

Van Ark, B., & Jäger, K. (2017). Recent trends in Europe's output and productivity growth performance at the sector level, 2002–2015. *International Productivity Monitor, 33*, 8–23.

Chapter 3
The Rule of Law and Labor Productivity Growth by Businesses: Evidence for the EU, 1998–2005

Felix Roth

Abstract This contribution analyses the relationship between the rule of law and labor productivity growth by businesses within an EU country sample over the period 1998–2005. It finds that the rule of law affects labor productivity growth (LPG) by businesses within the EU via two distinct channels. First, the rule of law positively affects labor productivity growth by stimulating total factor productivity (TFP) growth. Second, the rule of law positively influences business investments in intangible capital. The author concludes that the rule of law is beneficial in facilitating an economy's transformation towards becoming a knowledge economy.

JEL Classifications E02 · E22 · O34 · O43 · O52 · P14

Keywords Rule of law · Labor productivity growth · Intangible capital investment · EU

1 Introduction

The academic literature (Barro, 2001, p. 13; Knack & Keefer, 1995, p. 210), as well as policymaking institutes (European Commission, 2013a, p. 1, World Bank, 2006, pp. 87–99) and non-profit organizations (Agrast et al., 2013, p. 8) have stressed that respect for the rule of law constitutes a prerequisite for a nation's economic

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performance. In this context, the European Commission recently claimed that in the EU "the quality (. . .) of national justice systems plays a key role in restoring (. . .) the return to growth" (European Commission, 2013a, p. 1). Given this prominent claim by the European Commission and the fact that economic empirical literature focuses strongly on the dichotomy between developed and developing economies (see among others Acemoglu et al., 2001; Barro, 2001; Easterly & Levine, 2003; Hall & Jones, 1999; Kaufmann & Kraay, 2002; Knack & Keefer, 1995; Rigobon & Rodrik, 2005; Rodrik et al., 2004; c.f. World Bank 2006, p. 4, pp. 96–99), this contribution's aim is to assess the relationship between the rule of law and a country's economic performance in an EU context.

In this respect, it can be claimed, that the economies of most EU member states, similar to those of the US (Corrado et al., 2005, 2009; Nakamura, 2010) and other highly developed economies, such as Japan (Fukao et al., 2009), are on the verge of evolving into knowledge economies (Piekkola 2011). This claim is substantiated by empirical evidence, which highlights that in some EU countries such as France, Sweden, and the United Kingdom, business intangible capital investments already represent two-thirds made in tangible capital investment. Similarly, when accounting for labor productivity growth of businesses in the EU, the growth of intangible capital services explains a larger share (50%) than the growth of tangible capital services (40%) (Roth & Thum, 2013). Given these and other most recent empirical findings, which underline the importance of intangible capital investment for labor productivity growth in the EU (Marrano et al., 2009; Edquist, 2011), this contribution utilizes an intangible capital-enhanced production model as introduced by Roth and Thum (2013) to explore the relationship between the rule of law and labor productivity growth by businesses in the EU. Following the existing literature (Benhabib & Spiegel, 1994; Knack & Keefer, 1995), this contribution identifies two main theoretical channels of how the rule of law might affect labor productivity growth by businesses. First, the rule of law might directly influence labor productivity growth by businesses via its TFP component. Second, the rule of law might influence labor productivity growth indirectly via its impact on business investments in tangible and intangible capital.

This study is structured in the following manner: The second section explores the theoretical links between the rule of law and labor productivity growth and identifies two transmission channels through which the rule of law affects a country's labor productivity growth by businesses. The third section introduces the model specifications for the two main theoretical channels and elaborates upon the research design, the operationalization of the rule of law and the data sources used. The fourth section carries out a descriptive analysis of the distribution of the rule of law across an EU-27 country sample and the bivariate relationship between the rule of law and intangible and tangible capital investments. The fifth section undertakes an econometric analysis of the relationship between the rule of law and labor productivity growth by businesses, as well as the rule of law and business investments in tangible and intangible capital. The last section presents the main findings, discusses the empirical findings in light of the theoretical discussion and offers policy conclusions.

2 The Rule of Law and Labor Productivity Growth by Businesses: Theoretical Links in an EU Context

Although final agreement on precisely what constitutes the rule of law has yet to be established (Botero & Ponce, 2011, p. 2), the academic literature in the general social sciences has identified four theoretical links through which the rule of law is associated with economic growth: namely 1) the provision of the personal security of individuals, 2) the security of property and enforcement of contracts, 3) institutional checks on government, and 4) control of private capture and corruption (Haggard & Tiede, 2011, pp. 674–75). Within these four theoretical links, the economic literature has identified the security of property and enforcement of contracts as one of the core theoretical links through which the rule of law affects economic growth (Haggard & Tiede, 2011, p. 675). The preeminence of the security of property rights and the enforcement of contracts within the discipline of economics has been theoretically elaborated upon by classical economic thinkers such as Smith (1998, pp. 407–408, p. 459) and contemporary economists such as North (1990, pp. 64–65). The fact that the rule of law is essential for a nation's economic performance, inter alia, by securing property rights and enforcing contracts, is also used as a theoretical presumption by the extensive empirical economic literature focusing on the relationship between the rule of law and economic performance (Acemoglu et al., 2001, p. 1369; Barro, 2001, p. 13; Brunetti et al., 1998, p. 353; Hall & Jones, 1999, p. 84; Knack & Keefer, 1995, p. 207; c.f. Li & Li, 2013; for a general review, see Asoni, 2008).

In this respect, some authors even start their analysis of the relationship between the rule of law and economic growth with the remark that "few would dispute that the security of property and contractual rights (. . .) are significant determinants of the speed with which countries grow" (Knack & Keefer, 1995, p. 207). However, although there is a clear understanding in the economic literature that the rule of law, among others, by securing property rights and enforcing contracts, is important for the economic performance of a nation, it seems worthwhile to once more identify the theoretical transmission channels between the rule of law and a country's labor productivity growth by businesses. This is particularly the case considering the fact that, within an EU context, it is necessary to differentiate business investments in intangible capital from those in tangible capital. Following the argumentation of the existing economic growth literature (Benhabib & Spiegel, 1994 on modelling political instability; Knack & Keefer, 1995 on modelling the rule of law), one is able to identify two transmission channels of how the rule of law might influence a country's labor productivity growth by businesses. First, the rule of law might directly be related to labor productivity growth by stimulating TFP growth. Second, the rule of law might stimulate business investments in intangible and tangible capital.

2.1 Direct Influence of the Rule of Law on Labor Productivity Growth by Businesses

The direct influence of the rule of law on labor productivity growth by businesses is exerted through its influence on an economy's TFP growth (or technological progress) by businesses. TFP accounts for all components, which facilitate the overall production process and thus imply an amelioration of the general efficiency and effectiveness with which the business sector utilizes its given level of intangible and tangible capital. In this respect, an important channel through which the rule of law might positively impact the business sector's TFP growth is via the reduction of transaction costs as proposed within the theoretical framework by North (1990, pp. 27–28 and pp. 64–65). Applying this theoretical framework, one can argue that a lower level of the rule of law will lead to higher transaction costs, hampering those activities that aim at raising productivity, for example, the invention and innovation of new technologies, resulting in a lower level of technological progress within a country's business sector (North, 1990, pp. 64–65). This theoretical reasoning is prominently picked up by Hall and Jones (1999) in their elaboration of the rule of law as one central indicator within their concept of the term "social infrastructure". Hall and Jones (1999) argue that the rule of law, by protecting the output of individual productive units and preventing predator behavior, is beneficial for high levels of output per worker by encouraging technological progress (Hall & Jones, 1999, pp. 95–97). The above argumentation is universal in nature and can be applied in the context of developing as well as highly developed economies, such as the EU member states.

2.2 Indirect Influence of the Rule of Law on Labor Productivity Growth by Businesses

In the absence of a substantial level of the rule of law, one would expect that entrepreneurs and businesses will in general invest less in intangible and tangible capital as the economic environment is strongly prone to uncertainty (Brunetti et al., 1998). Thus, a large part of the economic literature agrees on the fact that the rule of law should positively influence economic performance via the indirect channel by stimulating business investments in capital (c.f. Li & Li, 2013 who discuss the Chinese case). In this context, the literature argues that it would be expected that a business environment characterized by unclear property rights and uncertain contract enforcement would be associated with lower investment by companies (Brunetti et al., 1998, p. 353). Along these lines, it is argued that without secure property and contractual rights, investment would be discouraged (Knack & Keefer, 1995, p. 207), which will lead to lower levels of investments in capital (Hall & Jones, 1999, p. 95; North, 1990, p. 65).

However, before concluding that the rule of law would always be positively related to business investments, in particular when analyzing a country sample of advanced economies, such as the one from the EU, it seems necessary, for an adequate discussion, to distinguish between investments in tangible and intangible capital, given that the EU economies are on the verge of transforming themselves into knowledge economies (Piekkola 2011). Whereas protecting the property rights of *tangible* capital, such as nonresidential investments and machinery and equipment, has long been internalized within the institutional framework of many highly developed EU economies—with the rule of law's roots being traceable inter alia to the Roman Empire (Finley, 1976)—protectiing the property rights of *intangible* capital, such as investments in enhancing the knowledge base of businesses including computerized information, innovative property, and economic competencies (Corrado et al., 2005) leading to patents, trademarks, copyrights, and design rights, is a more recent phenomenon tht prominently emerge in the 19 century (Mayer-Schönberger, 2010, p. 164).

In this respect, when considering advanced economies, such as those of the EU member states, one can take for granted that investments in *tangible* capital are well protected from theft and expropriation, even in countries with relatively lower levels of the rule of law. Conversely, in those economies exhibiting a relatively higher level of the rule of law it might even be that the rule of law, in its role as a regulator (Mayer-Schönberger, 2010, pp. 155–160), hampers investments in *tangible* capital. In this respect, a higher level of the rule of law might be associated with a higher level of, e.g., labor market regulations. By making the factor input of labor more costly, however, these labor market regulations might act as an incentive to invest in an environment that is less prone to regulation and in which the utilization of the labor factor is less costly (Nicoletti & Scarpetta, 2003). Thus, it would be plausible, for example, that within the transition countries of the EU a lower level of the rule of law would be associated with higher business investments in *tangible* capital. It might also potentially be that lower levels of the rule of law are associated with higher levels of corruption which ultimately act as a grease in fostering investment in *tangible* capital and growth (for a discussion of the literature asserting a positive relationship between corruption and growth, see Méon & Sekkat, 2005, p. 70).

Similar to the ambivalent relationship between the rule of law and *tangible* capital investments, one is able to identify both sets of arguments for the relationship between the rule of law and business investments in *intangible* capital. On the one hand, the rule of law's function as a protector and enforcer of intellectual property rights will most likely be a key prerequisite for enhancing investment in *intangible* capital, and thus the knowledge base of businesses, aimed at generating patents, trademarks, copyrights, and design rights (Gould & Gruben, 1996, p. 323; pp. 326–327; for specific R&D activity see Park & Ginarte, 1997, p. 60). The fact that adequate protection and enforcement of intellectual property rights might be indeed a basic prerequisite for business investments in *intangible* capital in the EU context

is related to the fact that the given institutional structure has not yet fully adapted to the new reality of a knowledge economy, thus making intangible capital investments more prone to theft and property rights violation. Thus, in particular, in an EU context, it can be argued that the rule of law, by securing intellectual property rights, functions as a core incentive for entrepreneurial activity and business investments in *intangible* capital (Baumol, 2002, p. 8; Mayer-Schönberger, 2010, pp. 164–65). However, similar to the arguments presented in the discussion above on investment in *tangible* capital investments, it should also be mentioned that an excessively strict intellectual property regime might hamper innovation activity, as it might be primarily used by large corporations to block new market entrants (Dosi et al., 2006; Mayer-Schönberger, 2010, p. 166; Verspagen, 2006).

To conclude, in the context of the EU, the theory on the impact of the rule of law on both types of business capital investments, *tangible* and *intangible* capital, remains ambiguous and needs to be tested empirically.

3 Model Specifications, Research Design, Operationalization, and Data

3.1 Model Specifications

As mentioned above, the literature on economic growth (see notably Benhabib & Spiegel, 1994, on modelling political instability and Knack & Keefer, 1995, on modelling the rule of law) has identified two distinct channels of how the rule of law might affect labor productivity growth: 1) a direct channel by stimulating TFP growth and 2) an indirect channel by stimulating business investments in intangible and tangible capital.

3.1.1 A Model for the Direct Contribution of the Rule of Law to Labor Productivity Growth

Following the theoretical framework by Roth and Thum (2013, pp. 494–95), who combine a model specification by Corrado et al. (2009) with one from Benhabib and Spiegel (1994), the starting point for estimating the direct contribution of the rule of law on labor productivity growth by businesses is the following intangible capital-augmented Cobb-Douglas production function,

$$Q_{i,t} = A_{i,t} K^{\alpha}{}_{i,t} L^{\gamma}{}_{i,t} R^{\beta}{}_{i,t} \varepsilon_{i,t} \tag{3.1}$$

where $Q_{i,t}$ is GVA (Gross Value Added for the non-farm business sectors c-k + o excluding real estate activities) expanded by the investment flows of business

intangible capital in country i and period t, R is the intangible capital stock by businesses, K is the tangible capital stock by businesses, L is labor, and A is TFP. Following the authors and assuming constant returns to scale, rewriting the Cobb-Douglas production function in intensive form and taking differences in natural logarithms, the following equation is obtained:

$$\begin{aligned}\left(\ln q_{i,t} - \ln q_{i,t-1}\right) = &\left(\ln A_{i,t} - \ln A_{i,t-1}\right) + \alpha\left(\ln k_{i,t} - \ln k_{i,t-1}\right) \\ &+ \beta\left(\ln r_{i,t} - \ln r_{i,t-1}\right) + u_{i,t}\end{aligned} \tag{3.2}$$

where $u_{i,t} = \ln \varepsilon_{i,t} - \ln \varepsilon_{i,t-1}$, $(\ln q_{i,t} - \ln q_{i,t-1})$ is labor productivity growth (GVA for the non-farm business sectors c-k + o excluding real estate activities expanded by the investment flows of business intangible capital in country i and period t, $(\ln k_{i,t} - \ln k_{i,t-1})$ and $(\ln r_{i,t} - \ln r_{i,t-1})$ represents the growth of tangible and intangible capital services and $(\ln A_{i,t} - \ln A_{i,t-1})$ represents the TFP growth.[1]

As elaborated above, we believe that the rule of law should positively affect labor productivity growth by businesses via its TFP term. Utilizing an extended approach of Roth and Thum (2013, 495), a model for $(\ln A_{i,t} - \ln A_{i,t-1})$ is specified as follows:

$$\begin{aligned}\left(\ln A_{i,t} - \ln A_{i,t-1}\right) = &\, c + nRoL_{i,t} + gH_{i,t} + mH_{i,t}\frac{\left(Q_{\max,t} - Q_{i,t}\right)}{Q_{i,t}} \\ &+ p(1 - ur_{i,t}) + q\sum_{j=1}^{k} X_{j,i,t} + cd_{i,t=2001}\end{aligned} \tag{3.3}$$

where c is the constant term and represents exogenous technological progress, $RoL_{i,t}$ is the level of the rule of law of a country, $H_{i,t}$ is the level of human capital and reflects the capacity of a country to innovate domestically, the term $H_{i,t}\frac{\left(Q_{\max,t} - Q_{i,t}\right)}{Q_{i,t}}$ proxies a catch-up process, the term $(1 - ur_{i,t})$ takes into account the business cycle effect (and is measured as 1–unemployment rate),[2] the term $\sum_{j=1}^{k} X_{j,i,t}$ is a sum of k extra policy variables that could possibly explain TFP growth and $cd_{i,t=2001}$ is a crisis dummy to control for the economic downturn in 2001 after the bursting of the Information Technology bubble in the year 2000 and the 9/11 attack in the United

[1] For the detailed formula of the calculation of the tangible and intangible capital services growth, see Roth and Thum (2013).

[2] This approach was introduced by Guellec and van Pottelsberghe de la Potterie (2001, pp. 107–116).

States in 2001. Inserting Eq. (3.3) into Eq. (3.2) provides the baseline model to be estimated within the econometric estimation in Sect. 5:

$$\begin{aligned}\left(\ln q_{i,t} - \ln q_{i,t-1}\right) = c + nRoL_{i,t} + gH_{i,t} + mH_{i,t}\frac{\left(Q_{\max,t} - Q_{i,t}\right)}{Q_{i,t}} \\ + p(1 - ur_{i,t}) + q\sum_{j=1}^{k} X_{j,i,t} + cd_{i,t=2001} \\ + \alpha(\ln k_{i,t} - \ln k_{i,t-1}) + \beta(\ln r_{i,t} - \ln r_{i,t-1}) + u_{i,t} \quad (3.4)\end{aligned}$$

We now turn our attention to displaying the model specification of the indirect contribution of the rule of law to labor productivity growth.

3.1.2 The Indirect Contribution of the Rule of Law to Labor Productivity Growth

Applying the logic of the model specifications by Knack and Keefer (1995, pp. 220–23) and Benhabib and Spiegel (1994, pp. 163–66) to the model specification of Eq. (3.4), the indirect impact of the rule of law on labor productivity via the two investment channels, business investment in intangible and tangible capital can be expressed as follows:

$$N_{i,t} = c + nRoL_{i,t} + m_1 R_{i,t} + gH_{i,t} + p(1 - ur_{i,t}) + q\sum_{j=1}^{k} X_{j,i,t} + cd_{i,t=2001} + \varepsilon_{i,t} \quad (3.5)$$

$$I_{i,t} = c + nRoL_{i,t} + m_2 K_{i,t} + gH_{i,t} + p(1 - ur_{i,t}) + q\sum_{j=1}^{k} X_{j,i,t} + cd_{i,t=2001} + \varepsilon_{i,t} \quad (3.6)$$

where $N_{i,t}$, $I_{i,t}$ represent the real investment rates for intangible and tangible capital by businesses respectively, c displays the constant term, $RoL_{i,t}$ is the level of the rule of law in country i and period t, $R_{i,t}$, and $K_{i,t}$ are the intangible and tangible capital stock by businesses, respectively, $H_{i,t}$ is the level of human capital, the term $(1 - ur_{i,t})$ takes into account the business cycle effect, the term $\sum_{j=1}^{k} X_{j,i,t}$ is a sum of k extra policy variables which could possibly explain investment rates in tangible and intangible capital, $cd_{i,t\,=\,2001}$ is a crisis dummy to control for the economic downturn in 2001 following the bust of the Information Technology bubble in 2000 and the 9/11 attack in 2001 and $\varepsilon_{i,t}$ is the error term.

3.2 Research Design

Whereas the description of the distribution of the rule of law indicator of the World Bank's Worldwide Governance Indicators Project (WGIP) (Kaufmann et al., 2010) was conducted within an EU-27 country sample, the econometric analysis between the rule of law and labor productivity growth as well as between the rule of law and investments in intangible and tangible capital will be limited to an EU-13 country sample. Similar to the analysis of Roth and Thum (2013, pp. 495–96), this is due to limitations in the EUKLEMS data (O'Mahony & Timmer, 2009) concerning tangible capital data. The econometric exercise is thus limited to the following 13 EU countries: Austria, Czech Republic, Denmark, Finland, France, Germany, Ireland, Italy, the Netherlands, Slovenia, Spain, Sweden, and the United Kingdom. Due to data availability concerning intangible stocks and the construction of intangible capital services, the time period of the analysis is restricted to 1998 to 2005. Following an approach by Bassanini and Scarpetta (2001) and utilizing yearly data, an overall amount of 98 observations were retrieved.[3] Given that the two transition countries—the Czech Republic and Slovenia—are following a different pattern than the 11 EU-15 countries (see Fig. 3.4), a full country sample with all 13 EU countries will be compared to a sample of 11 EU-15 countries, excluding the two transition countries. The whole research design applies to non-farm business sectors c-k + o.

3.3 Operationalization and Measurement of the Data

Although data from the World Justice Project (WJP) (Agrast et al., 2013) would have been based on an excellent operationalization of the rule of law (Agrast et al., 2013, p. 11) and would have offered high-quality data by utilizing output measures, as well as individually constructed and polled data (Agrast et al., 2013, pp. 185–90) (for a detailed discussion, see Appendix 1), the data are incompatible with this contribution's research design as the WJP only started to conduct its first wave of polling in 2009. Similarly, data from the European Commission (CEPEJ, 2012; European Commission, 2013a), offering a multitude of interesting input indicators concerning the rule of law, are incompatible with the present study's research design, as these indicators are only measured from 2004 onward. Moreover, in contrast to data from WGIP and WJP, the European Commission has not yet constructed an overall rule of

[3] Due to shorter time series in intangible capital investment in the Czech Republic and Slovenia, we were able to generate only five time observations for intangible capital services for these two transition countries but eight for the other 11 countries.

law index, by combining the most relevant indicators to form an overall index. Given the fact that the WGIP offers time series data from 1996 to 2012[4] and thus covers the time from 1998 to 2005, data from the WGIP are utilized in the descriptive and econometric sections of this contribution. In addition, although the WGI's operationalization of the rule of law is less conceptualized than the one from the WJP (for a detailed elaboration, see again Appendix 1), it offers a wider set of information by aggregating indicators concerning the rule of law from 23 different data sources, including a total of 84 indicators.[5] All single indicators are then aggregated to construct the rule of law indicator by using an unobserved components model (Kaufmann et al., 2010, p. 9). The unit of the rule of law indicators applied to the 214 countries are those of a standard normal random variable and range from −2.5 to 2.5 (Kaufmann et al., 2010, p. 9 and p. 15).

Beyond the rule of law indicators, the other data for the following econometric analysis were taken from the various sources described below. Data on the real investments rates and stock data of intangible capital were taken from the INNODRIVE macro dataset (INNODRIVE, 2011). In accordance with the INNODRIVE data, intangible capital investment included investment in: 1) software, 2) R&D, 3) new architectural and engineering designs, 4) new product development in the financial services industry, 5) mineral exploration and copyright and licenses costs, 6) organizational capital (own account component), 7) organizational capital (purchased component), 8) firm-specific human capital, 9) advertising, and 10) market research. The construction of intangible capital stocks and intangible capital services follows the approach by Roth and Thum (2013, p. 497). Data on GVA (nonfarm business sectors excluding real estate activities), tangible capital stocks, capital compensation, gross fixed tangible capital investments, tangible investment price indices and labor input (number of hours worked), and depreciation rates were taken from the EUKLEMS database (O'Mahony & Timmer, 2009). Tangible capital included: 1) communications equipment, 2) computing equipment, 3) total nonresidential investment, 4) other machinery and equipment, 5) transport equipment, and 6) other assets, but excluded residential capital. Similar to intangible capital services, tangible capital services were constructed following the approach by Roth and Thum (2013, p. 497). Human capital is measured as the percentage of the population who attained at least upper secondary education, which is taken as a proxy for the inherent stock of human capital. These data are provided by Eurostat. The unemployment rate is taken from Eurostat and is utilized to calculate the business-cycle effect.

[4] The data from 1996 to 2002 have only been collected on a 2-year basis in 1996, 1998, 2000, and 2002. Thus, for the econometric analysis at hand, the values for 1995, 1997, 1999, and 2001 have been interpolated by linear interpolation. The data can be downloaded from http://info.worldbank.org/governance/wgi/index.aspx#home.

[5] A list of all 23 data sources and 84 indicators can be downloaded online from the World Bank's website (http://info.worldbank.org/governance/wgi/index.aspx#doc).

4 Empirical Description of the Rule of Law within the EU

To analyze the cross-sectional variance of the rule of law in the European context, Fig. 3.1 displays the distribution of the average value of the rule of law in an EU-27 country sample over the time period 1998–2005. The lower and upper bound values, indicated by the symbols ● and ▲, respectively, report the 90% confidence interval associated with the rule of law estimate to identify potential measurement errors (Kaufmann et al., 2010, p. 13).

Figure 3.1 clarifies three important issues. First, across the EU-27, there exists a significant variance concerning the rule of law. Whereas Finland leads the ranking with an average value of 1.95, Bulgaria and Romania, which are positioned at the end of the ranking, only display average values of −0.20 and −0.19. The fact that there is sufficient variation even in an EU-27 country sample is also highlighted by a sizeable standard deviation of 0.61 by a given mean of 1.09 (see variable named "Rule of law - EU27 - average 98-05" in Table 3.A1 in Appendix A3).

Second, the given variance in the rule of law is driven by certain country regime typologies.[6] Whereas countries from the coordinated, liberal, and Scandinavian regime typology are solely located at the upper third of the distribution, eight of the nine countries in the lower third of the distribution are from transition and Baltic countries.

Third, Italy, the fourth-largest EU economy, is the only EU-15 country that is positioned in the lower third of the distribution, with a value of 0.66. Even if considering Italy's upper bound value of 0.95, it still ranks behind the lower

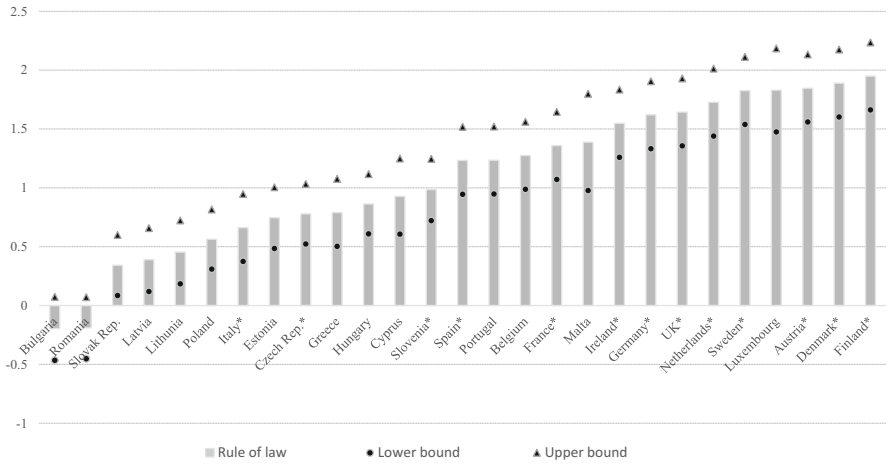

Fig. 3.1 The rule of law in the EU-27, 1998–2005
Notes: The data are based upon the WGIP (Kaufmann et al., 2010) and are averaged from 1998 to 2005. The 13 countries included in the econometric analysis are denoted with an asterisk.

[6] For an introduction to the different regime typologies, see among others Hall and Soskice (2001).

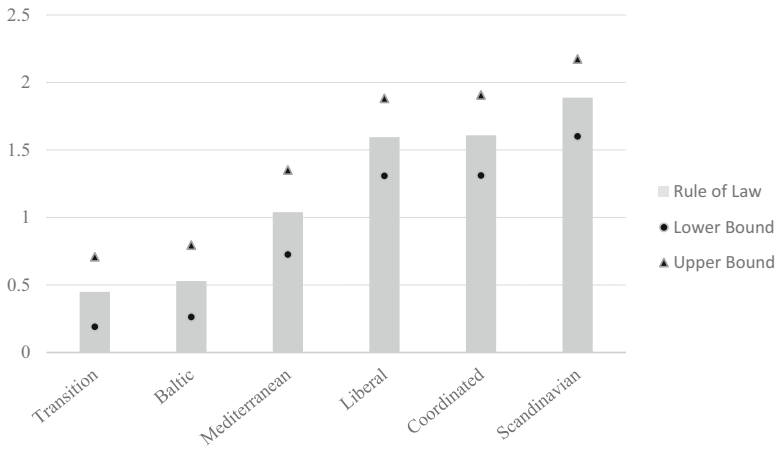

Fig. 3.2 Regime typologies and rule of law in the EU-27, 1998–2005
Notes: Data are based on the World Governance Indicators by Kaufmann et al. (2010). Data are averaged data from 1998 to 2005. The Baltic regime typology, which is marked with an asterisk, is the only typology not present within the econometric analysis.

bound values of France (1.07), Germany (1.33), and the UK (1.36). Thus, Italy's level of the rule of law is significantly smaller in comparison to the three other equally large EU economies.[7]

The fact that the variance in the rule of law indicator within the EU is driven by regime characteristics is more clearly highlighted in Fig. 3.2, which compares six regime typologies within the EU-27. Whereas the Scandinavian (Finland, Denmark, and Sweden), Coordinated (Austria, Luxembourg, the Netherlands, Germany, France, and Belgium), and Liberal (the United Kingdom and Ireland) regime typologies are all positioned at values of 1.5 and above, the Mediterranean (Italy, Spain, Greece, Portugal, Cyprus, and Malta) typology is positioned only at a value of around 1.0. The transition (Bulgaria, Romania, Slovak Republic, Poland, Czech Republic, Hungary, and Slovenia) and Baltic (Lithuania, Latvia, and Estonia) regime typologies display significantly lower levels of the rule of law than the other four.

Having already shown that there is a substantial degree of variance between the countries of the EU-27 and its various regime typologies, Fig. 3.3 explores whether there is also sufficient variance in the time trends within the EU-27. Figure 3.3 clarifies that, in contrast to the significant between-variance, the within-variance is less pronounced in the time period 1998 to 2005 (identified in Fig. 3.3 with the two

[7] This significant difference between Italy and the other large EU economies is also shown in the analysis of four important subindicators of the rule of law, as presented in Fig. 3.A2 in Appendix A3: 1) *enforcement of patents and copyrights*, 2) *property rights*, 3) *stable laws,* and 4) *effective enforcement of civil justice.* Italy's scores are significantly lower than those of the UK, France, and Germany in all four indicators.

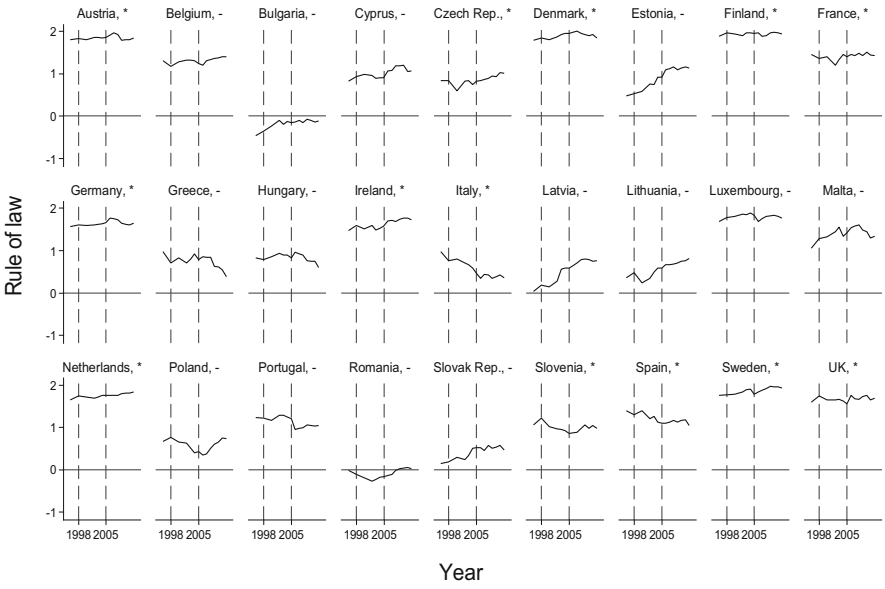

Fig. 3.3 Trends of the rule of law in the EU-27, 1998–2005
Notes: Time trends display the period from 1996 to 2012. The two dashed lines represent the time period for the econometric analysis from 1998 to 2005. The * next to the country name denotes those countries that are included in the econometric analysis.

dashed lines). In most countries, time trends behave in a very stable fashion. In fact, within the time period 1998 to 2005, there is no significant increase or decline to be observed when analyzing a 90% confidence interval. However, the conclusion that the rule of law indicator is a constant variable without any within-variance would also be premature. In analyzing changes over time from 1996 to 2012 (as in addition displayed in Fig. 3.3 outside the dashed lines) particularly in Estonia and Latvia, one finds significant increases when using the 90% confidence interval (see here also Kaufmann et al., 2010, p. 28). Relaxing the 90% confidence interval as suggested by Kaufmann et al. (2010, p. 14), over the same time period, one would, e.g., also detect a significant decrease in the level of the rule of law in Italy.[8,9]

Overall, given the stable within-variation in most countries (utilizing the 90% confidence interval) and the significant between-variation, a positive relationship

[8] It should be noted that the indicators utilized were increased from 7 in 1996 to 13 in 2012. However, those indicators which were utilized over the 17-year time period decreased steadily. The country report for Italy can be downloaded at http://info.worldbank.org/governance/wgi/index.aspx#countryReports.

[9] The assumption that the rule of law is not a constant variable is also confirmed by analyzing time series data from the WJP for the case of Spain. From 2012 to 2013, in times of economic crisis, the WJP data identify a decline in Spain in four out of eight rule of law indicators (World Justice Project, 2014, p. 37).

between the rule of law and labor productivity growth and intangible and tangible capital investment rates would foremost be based on the cross-sectoral or between-variance.

Before shifting our attention to the econometric analysis, Fig. 3.4 depicts respectively the bivariate relationship between the rule of law and business investment in intangible and tangible capital for the 13 EU economies, as covered within the following econometric exercise. Whereas one detects a positive bivariate relationship between the rule of law and business investment in intangible capital, interestingly the opposite is true for the relationship between the rule of law and business investments in tangible capital. Figure 3.4 clarifies, however, that this negative relationship between the rule of law and tangible capital investment is strongly driven by the two transition countries Czech Republic and Slovenia. The same does not hold for the relationship between the rule of law and intangible capital investment. Once the transition countries are excluded, the positive relationship between the rule of law and intangible capital investment remains robust (see here also Fig. 3.A1 in Appendix A3, which depicts the relationship for an EU-25 country sample).

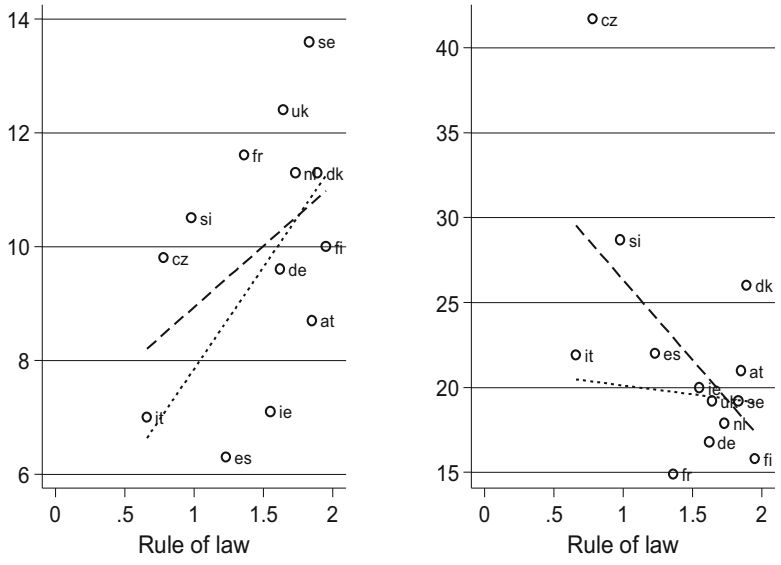

Fig. 3.4 Scatter plot of the relationship between the rule of law and business investments in intangible and tangible capital in the EU-13, 1998–2005

Notes: Data on intangible capital investments are taken from the INNODRIVE dataset (INNODRIVE, 2011). Data on tangible capital investment are taken from the EUKLEMS dataset (O'Mahony & Timmer, 2009). The rule of law indicator is taken from the WGIP. The long dashed line represents the linear regression line for a sample considering all countries. The short dashed line represents the linear regression line for a scenario excluding the two transition countries the Czech Republic and Slovenia.

5 Econometric Results

5.1 *Econometric Results between the Rule of Law and Labor Productivity Growth*

When estimating Eq. (3.4), the standard methods for panel estimations are fixed or random. The fixed effects are calculated from differences within each country across time; the random-effects estimation, in contrast, incorporates information across individual countries as well as across periods of time. The major drawback with random-effects estimations, despite their being more efficient, is that they are consistent only if the country-specific effects are uncorrelated with the other explanatory variables (Forbes, 2000, c.f. Mundlak, 1978). A Hausman specification test can evaluate whether this independent assumption is satisfied (Hausman, 1978). The Hausman test applied here indicates that a random-effects model can be utilized.[10] In addition, to control for potential cross-sectional heteroskedasticity, a robust VCE estimator was used.[11] As highlighted within the research design of this study, the random-effects estimation uses 13 countries with 98 observations. It is an almost balanced panel, with two countries (the Czech Republic and Slovenia) missing three time observations from 1998 to 2000. Regression 1 in Table 3.1 shows the estimation results when estimating Eq. (3.4) (Table 3.1).

In accordance with economic theory, with a coefficient of 1.3, the rule of law indicator is positively related to labor productivity growth. However, the effect is weak (significant only at the 90% confidence level). Controlling for endogeneity,[12] by utilizing the lagged value of the rule of law indicator in regression 2, renders a slightly higher coefficient (1.6) and increases the significance of the relationship (95% level). Whereas utilizing a lagged value of the potential endogenous variable is a common approach in the economic literature (see e.g. Clemens et al., 2012, p. 591), utilizing an instrumental approach is argued to be preferable (Reed, 2013). However, as the author was not able to retrieve a valid *external* instrument in the EU context[13] and as the utilization of internally generated instruments by using the lags of the endogenous variables (Griliches & Hausman, 1986) would lead to weak instruments (Mc Kinnish, 2000) and respectively strongly biased estimates (Murray, 2006; Stock

[10] The test statistic is $\chi^2(7) = 2.70$. This clearly fails to reject the null hypothesis of no systematic differences in the coefficients.

[11] Using an xtoverid command (Schaffer & Stillman, 2010), the Sargan-Hansen test statistic is $\chi^2(7) = 5.4$. This clearly fails to reject the null hypothesis of no systematic differences in the coefficients.

[12] When running growth regressions, such as in Eq. (3.4), one must be aware of the possibility that the left-hand side and the right-hand side variables will affect each other. More specifically, the rule of law might be endogenous, affected by a common event such as an economic shock, or stand in a bidirectional relationship with labor productivity. Thus, an increase in labor productivity growth might, for example, increase spending in the judicial system and increase the level of the rule of law.

[13] For a discussion of a valid instrument for the rule of law within the field of development economics, see Appendix A2.

Table 3.1 Rule of law and labor productivity growth by businesses

Estimation method	Random-effects	Random-effects	Random-effects
Equation	1	2	3
Rule of law	1.3*	1.6**	1.8**
	(0.69)	(0.81)	(0.80)
Intangible services growth	Yes	Yes	Yes
Tangible services growth	Yes	Yes	Yes
Upper secondary education 15+	Yes	Yes	Yes
Catch-up	Yes	Yes	Yes
Business cycle	Yes	Yes	Yes
Crisis dummy 2001	Yes	Yes	Yes
Observations	98	98	88
Number of countries	13	13	11
R-square overall	0.52	0.52	0.51
R-square within	0.37	0.38	0.37
R-square between	0.73	0.72	0.75

Notes: Labor productivity growth was calculated with GVA of the non-farm business sectors c-k + o excluding real estate activities expanded with intangible capital. Robust standard errors are provided below coefficient estimates between brackets.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

& Watson, 2007), the above-mentioned lagged value approach was chosen.[14] In this respect, one should highlight that in general within the social sciences causal inference should be foremost theoretically driven and generally cannot be demonstrated directly from the data (Frees, 2004, 205). Applying this study's research design and excluding the two transition countries Czech Republic and Slovenia in regression 3, the coefficient increases (1.8) and the relationship is rendered more significant.

How should one interpret the coefficient of 1.8, as displayed in regression 3? The rule of law indicator for the given 98 observations in the sample ranges from 0.47 in Italy in the year 2005 to 1.97 in Finland in the year 2004 (for the summary statistics, see also the variable named "Rule of Law – EU13" in Table 3.A1 in Appendix A3). Given the fact that most of the variance of the rule of law indicator is cross-sectional (see here Figs. 3.1 and 3.3), it seems reasonable to interpret the coefficients as follows: If Italy, with an average value of 0.66 (as displayed in Fig. 3.1) would hypothetically be able to reach the same level of the rule of law as Finland, with an average value of 1.95 (as displayed in Fig. 3.1). this increase would be associated with an increase of its labor productivity growth by approximately 2.3%.[15]

[14] In addition, the utilization of internally generated instruments by using the lagged values only holds if the error term would be serially uncorrelated (Griliches and Hausmann 1986, p. 94). A test for serial correlation of the error term as introduced by Drukker (2003) indicates that this assumption was violated. Detailed results can be obtained from the author if it were able on request.

[15] The calculation is as follows: Given that the distance from the average value of Italy to the average value of Finland is 1.29 (1.95–0.66), labor productivity growth gains for Italy would be approximately 2.3% (1.29*1.8) if it managed to close the gap with Finland.

However, as the overall effect of all TFP components within the utilized model specification and research design only accounts for 10% of the share of labor productivity (Roth & Thum, 2013, p. 503), the analysis will now continue to explore the indirect channels.

5.2 *Determinants of Intangible and Tangible Business Capital Investment*

Regression 1 in Table 3.2 shows the results when estimating Eq. (3.5) with the help of a random-effects estimation controlling for potential cross-sectional heteroscedasticity.[16] When estimating the association between the rule of law and investment in business intangible capital, one detects a positive (1.1) but weak association (significant at the 90% confidence level). Applying a similar methodological logic as discussed above and controlling for endogeneity,[17] regressions 2–4 incorporate the first, second, and third lag of the value of the rule of law. Whereas the first lag renders an insignificant association, the incorporation of both the second and third lag yields similar coefficients (1.4 and 1.0) and more significant associations between the rule of law and business investment in intangible capital (significant at the 95% confidence level). If one excludes the two transition countries Czech Republic and Slovenia (for their location within the bivariate relationship (see also Fig. 3.4), the coefficient remains robust (1.2) and significant at the 95% confidence level). Similar to the above interpretation, the coefficient of 1.2% could be interpreted in the following manner: if Italy would be able to gain the same average level of the rule of law as Finland, this increase would be associated with an increase in intangible capital investment of approximately 1.5%.[18]

Regressions 6–10 estimate Eq. (3.6), the association between the rule of law and tangible capital investment by businesses, and apply the same methodological procedure as in regressions 1–5. In alignment with the bivariate relationship (Fig. 3.4), regressions 6–9 yield a negative coefficient of −5.7 to −7.3. Utilizing

[16] Using an xtoverid command (Schaffer & Stillman, 2010), the Sargan-Hansen test statistic is $\chi^2(5) = 4.8$. This clearly fails to reject the null hypothesis of no systematic difference in the coefficients. Thus, the test applied here indicates that a random-effects model with a robust VCE estimator can be used.

[17] When running growth regressions, such as in Eqs. (5) and (6), one must be aware of the possibility that the left-hand side and the right-hand side variables will affect each other. More specifically, the rule of law might be endogenous, affected by a common event such as an economic shock, or stand in a bidirectional relationship with investments in tangible and intangible capital. Thus, an increase in the investment in intangible and tangible capital might, for example, be related to an increase in spending in the judicial system and ultimately lead to a higher rule of law.

[18] The calculation is as follows: Given that the distance from the average value of Italy to the average value of Finland is 1.29 (1.95–0.66), investments in intangible capital by businesses would be approximately 1.5% (1.29*1.2) higher if it managed to close the gap with Finland.

Table 3.2 Rule of law and investment in intangible and tangible capital by businesses

Dependent Variable	IC	IC	IC	IC	IC	TC	TC	TC	TC	TC
Estimation method	RE	RE	RE	RE	RE	RE	RE	RE	RE	RE
Equation	1	2	3	4	5	6	7	8	9	10
Rule of law	1.1*	0.9	1.4**	1.0**	1.2**	−5.7*	−6.3*	−7.6**	−7.3***	−2.8
	(0.56)	(0.63)	(0.58)	(0.46)	(0.56)	(3.03)	(3.49)	(3.01)	(1.96)	(2.34)
Intangible capital stock	Yes	Yes	Yes	Yes	Yes	No	No	No	No	No
Tangible capital stock	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes
Upper secondary education 15+	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Business cycle	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Crisis dummy 2001	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	98	98	98	98	88	98	98	98	98	88
Number of countries	13	13	13	13	11	13	13	13	13	11
R-square overall	0.34	0.33	0.30	0.28	0.36	0.72	0.73	0.74	0.75	0.01
R-square within	0.18	0.17	0.20	0.19	0.22	0.11	0.11	0.13	0.14	0.18
R-square between	0.31	0.3	0.26	0.25	0.38	0.60	0.61	0.63	0.64	0.02

Notes: IC = Business intangible capital investment; TC = Business tangible capital investment; RE = Random-Effects. Robust standard errors are provided below coefficient estimates between brackets.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

the third lag of the rule of law in regression 9 yields the most significant result (significant at the 99% confidence level). However, again in alignment with the bivariate relationship in Fig. 3.4, once the two transition countries Czech Republic and Slovenia are excluded in regression 10, the relationship between the rule of law and investments in tangible capital loses significance (and explanatory power with a R-square between value as low as 0.02).

Thus, the significant negative relationship between the rule of law and investment in business tangible capital is entirely driven by the two transition countries. In those two countries, a relatively low level of the rule of law is associated with a high investment rate in tangible capital. As theoretically discussed, this might be because a lower level of the rule of law is associated with less regulatory activity, thus making it more attractive for enterprises to make tangible capital investments.

6 Empirical Conclusion, Discussion, and Policy Conclusion

6.1 Empirical Conclusion

This contribution has investigated the relationship between the rule of law and labor productivity growth in an EU context. Seven findings emerge from the empirical analysis.

First, there exists considerable variance concerning the rule of law within an EU-27 country sample. The Baltic, transition, and Mediterranean countries incorporate significantly lower levels of rule of law than the liberal, coordinated, and Scandinavian countries. Countries such as Romania, Bulgaria, Italy, and Greece have significantly lower positions than the three largest economies in the EU, namely France, Germany, and the UK.

Second, although one detects a significant variance in some EU countries over time, e.g. an increase in Latvia and Estonia, the main variance is cross-sectional in nature. In countries such as Germany, Austria, and Finland, time trends behave in a very stable fashion.

Third, using a random-effects estimation among an EU-13 country sample with 98 overall observations in an intangible capital-augmented production model and controlling for endogeneity by using the first lag, the rule of law is significantly and positively related to labor productivity growth by stimulating its TFP growth.

Fourth, in analyzing the relationship between the rule of law and business intangible capital investment graphically within a bivariate relationship for an EU-25 country sample and econometrically by using a random-effects estimation across an EU-13 country sample with 98 observations and controlling for endogeneity by using the second and third lag, one detects a positive association between the level of the rule of law and business investment of intangible capital.

Fifth, in contrast to the positive and significant association between the rule of law and business investments in intangible capital, business investments in tangible capital are negatively related to the level of the rule of law. This negative finding is entirely driven by the two transition countries in which a low level of the rule of law is associated with a high level of investment in tangible capital by businesses.

Sixth, overall, the results indicate that an improvement in the rule of law in those countries with relatively low levels would be beneficial in facilitating the transformation towards becoming knowledge economies. It seems that the rule of law, by protecting and enforcing the intellectual property rights associated with patents, copyrights, and trademarks, stimulates investments in intangible capital.

Seventh, it should be highlighted that more empirical research is needed to corroborate these first findings. It would be of particular interest in corroborating the findings by utilizing an external instrumental variable to address potential endogeneity issues.

6.2 Discussion of the Results Considering the Underlying Theoretical Literature

The empirical findings in the EU context over the period 1998–2005 confirm the theoretical arguments that the rule of law, by lowering transaction costs, positively contributes to economic performance (North, 1990; Hall & Jones, 1999).

Concerning the ambivalent theoretical reasoning on the relationship between both the rule of law and investments in intangible and tangible capital by businesses, the empirical findings support the theoretical argument that in the EU from 1998 to 2005, the rule of law, by securing intellectual property rights, was beneficial to business investments in intangible capital (Baumol, 2002, p. 8; Mayer-Schönberger, 2010, pp. 164–65). The empirical findings seem to reject concerns about an excessively strict intellectual property regime hampering innovation activity (Dosi et al., 2006; Mayer-Schönberger, 2010, p. 166; Verspagen, 2006). However, the rule of law is either negatively (once accounting for the transition countries) or insignificantly related to investment in tangible capital. In the EU context from 1998 to 2005, the findings indicate that the rule of law in its role as regulator either hampers business investment in tangible capital (Mayer-Schönberger, 2010, pp. 155–160; Nicoletti & Scarpetta, 2003) or that the variance in the rule of law does not matter for investment in tangible capital.

Overall, these first empirical findings of this study tend to support the validity of the European Commission's claim that the rule of law is important for the economic performance of EU economies (European Commission, 2013a, p. 1).

6.3 Policy Conclusions

Six policy conclusions can be drawn from the foregoing analysis.

First, in order to enhance labor productivity growth—in line with the Europe 2020 strategy (European Commission, 2010)—it would be beneficial to enhance the level of the rule of law in those countries that perform relatively worse in an EU context. In EU-15 countries such as Italy and Greece, and transition countries such as Romania and Bulgaria, low levels of the rule of law hamper labor productivity growth. In those countries, enhancing the level of the rule of law by reforming the judiciary system seems to be essential. In this regard, it is favorable that the European Commission is well aware of the necessity to improve the rule of law in those countries. Among other ways, this awareness is made explicit by its country recommendations within the European semester. In the Italian case, the European Commission recommends to "simplify the administrative and regulatory framework for citizens and businesses and reduce the duration of case-handling and the high levels of litigation in civil justice, including by fostering out-of-court settlement procedures (. . .) and strengthening the legal framework for the repression of corruption" (European Commission, 2013b, p. 7). In the case of Romania, the European Commission recommends: "to strengthen the governance and the quality of institutions and the public administration (. . .) and step up efforts to improve the quality, independence and efficiency of the judicial system in resolving cases and fight corruption more effectively" (European Commission, 2013c, p. 7).

Second, the low level of the rule of law in the third-largest economy in the eurozone, Italy, needs to be taken into consideration in particular in efforts to improve the governance of the euro area. The significant difference in the rule of law in those three countries, with Italy performing significantly worse compared to France and Germany, leads, inter alia, to a continued divergence in labor productivity growth and time-lagged investments to business intangible capital. Thus, in the long run, in order to smooth economic divergences between the three largest euro area economies, Italy's level of the rule of law would need to be increased.

Third, DG Justice should continue its effort to construct a scoreboard on the rule of law. Similar to the methodological approaches taken by the WJP and WGIP, this scoreboard should aim at building an index based on the rich data as presented by the CEPEJ (2012) from 2004 onward. The operationalization of this index could be based on the methodological approach of the WJP In contrast to the WJP, however, the index could consist of a mix of the rule of law as measured de facto and as measured based upon expenditure-based data. In this regard, it would be important that the European Commission would be willing to contribute sufficient resources to allow for constructing time series data over the coming years, which would allow researchers to compare potential changes in a rule of law index over time.

Fourth, in the medium to long run, such an index as constructed by DG Justice, which takes into consideration the specific aspects of the EU economies, should be incorporated as a benchmark indicator within the European semester. In particular, an improvement in the various underlying indicators of the rule of law in some

Mediterranean and transition economies should be closely monitored by the European semester. Most importantly, however, the progress of the third-largest euro area economy and the fourth-largest EU economy, namely Italy, should be closely monitored.

Five, DG Justice should finance research exploring the effects of the most recent economic crisis in the euro-area periphery, particularly in Spain and Greece, on the levels of the rule of law. First evidence from the WJP indicates that the rule of law in Spain has dropped in four out of the eight dimensions measured (World Justice Project, 2014, p. 37). In light of the systemic trust crisis in Spain triggered by the economic crisis (Roth et al., 2013), the development of a decrease in the rule of law in the fourth-largest eurozone economy, i.e., Spain, ought to be closely monitored.

Six, following the initial theoretical arguments advanced by the World Bank (2006, p. 98), future research endeavors should evaluate how much of the expenditure in the national judicial systems should be considered investment in intangible capital. As these investments are most often undertaken by the public sector and not by the business sector, they should be coined *public* investment in intangible capital. In this regard, it can easily be concluded that a share of the public expenditure in the judicial system represents an investment by its very nature, as the existence of an efficient judicial system is a prerequisite for the protection and enforcement of property and contract rights, which are essential for the conduct of economic activities within functioning market economies. Future research endeavors should thus try to estimate how much of the expenditure should be considered investment in order to be able to adequately revise the national accounting systems.

Appendices

Appendix 1 Operationalization of the Rule of Law

Given the theoretical character of the discussion in this contribution, a promising operationalization of the concept of the rule of law has been offered by the World Justice Project (WJP) (Agrast et al., 2013). The WJP's working definition of the rule of law is based on the following four universal principles: 1) governmental and private actors are accountable under the law, 2) the laws protect the security of persons and property, 3) the laws are efficiently enforced, and 4) the law is delivered in a timely fashion by competent and independent representatives (Agrast et al., 2013, p. 9). All four principles broadly cover the rule of law's function of protecting and enforcing property and contract rights, including the accountability of governmental and private agents, the efficient protection and enforcement of property, as well as the timely delivery of justice. The four guiding principles are measured with the help of eight factors: 1) limited government powers, 2) absence of corruption, 3) order and security, 4) fundamental rights, 5) open government, 6) regulatory enforcement, 7) civil justice, and 8) criminal justice—all of which in turn are based on a total of 48 sub-indicators. An aggregation of all eight factors is statistically

sound (Saisana & Saltelli, 2013, p. 198) and leads to an index of the rule of law for 20 of the 27 EU countries.[19] In addition to an adequate conceptualization and operationalization, a comparative advantage of the WJP data, in contrast to other data sources (WGIP), is the fact that the database consists of new data collected from independent original sources (Agrast et al., 2013, p. 19) and that the data have been measured in de facto terms (Agrast et al., 2013, p. 17). Although all of the above-mentioned arguments would indeed indicate the use of the WJP data for this study's research design, the WJP database has a severe disadvantage: it offers no observations for the time period 1998–2005, as the first wave and pilot study of the WJP was launched as recently as 2009, with only six countries included. Only from 2009 onward was the country sample expanded to cover over 100 countries in the 2012–13 wave (Fig. 3.A2).

In contrast to the WJP database, the WGIP database (Kaufmann et al., 2010) offers times series data from 1996 to 2012. The World Bank's WGIP defines the rule of law as "capturing perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence". (Kaufmann et al., 2010, p. 4). The WGIP consists of 84 individual indicators from 23 separate data sources.[20] The 84 individual questions consist of indicators concerning the enforceability of contracts, the protection of (intellectual) property rights, and the timeliness of judicial decisions, but they also cover rule of law indexes and indicators concerning the respondents' trust in the justice system.[21] All single indicators are then aggregated to construct the rule of law indicator by using an unobserved components model (Kaufmann et al., 2010, p. 9). The unit of the rule of law indicator applied to the 214 countries is that of a standard normal random variable and ranges from −2.5 to 2.5 (Kaufmann et al., 2010, p. 9 and p.15). The WGIP began to systematically construct a rule of law indicator from 1996 onward. Starting from a 2-year base in 1998, 2000, 2002, from 2002 onward, the

[19] Cyprus, Malta, Latvia, Lithuania, Luxembourg, the Slovak Republic, and Ireland are not included due to missing data in the WJP data.

[20] The 23 sources are: African Development Bank Country Policy and Institutional Assessments, Afrobarometer Survey, Asian Development Bank Country Policy and Institutional Assessments, Business Enterprise Environment Survey, Bertelsmann Transformation Index, Freedom House Countries at the Crossroads, Economist Intelligence Unit Riskwire and Democracy Index, Freedom House, World Economic Forum Global Competitiveness Report, Global Integrity Index, Gallup World Poll, Heritage Foundation Index of Economic Freedom, Cingranelli-Richards' Human Rights Database and Political Terror Scale, IFAD Rural Sector Performance Assessments, Institutional Profiles Database, Latinobarometro, World Bank Country Policy and Institutional Assessments, Political Risk Services International Country Risk Guide, US State Department Trafficking in People report, Vanderbilt University Americas Barometer, Institute for Management and Development World Competitiveness Yearbook, World Justice Project Rule of Law Index, and Global Insight Business Conditions and Risk Indicators. The list can be downloaded at http://info.worldbank.org/governance/wgi/index.aspx#doc.

[21] A list of all 23 data sources and 84 indicators can be downloaded online on the World Bank website (http://info.worldbank.org/governance/wgi/index.aspx#doc).

aggregated data on the rule of law continued to be constructed on a yearly basis, with the latest published data stemming from 2012. The WGI data are most often based on experts, perceptions and, similar to the WJP, measures the rule of law in de facto terms. Although the WGI indicators have been criticized on various accounts (Kaufmann et al., 2007), the very thorough and transparent manner in which the authors have set up their rebuttal to the various criticisms (Kaufmann et al., 2007), in the author's view, has secured confidence in the general validity of the methodological approach and the data of the WGIP. Thus, overall the WGIP indicators fulfill the methodological requirements for their use in the EU context, taking into consideration the methodological background information (e.g., interpreting the data by utilizing the provided confidence intervals within the cross-sectoral and time series data, controlling individual country cases for measurement changes in the time series data, etc.) as pointed out by the authors (Kaufmann et al., 2010, pp. 9–12 and p. 29). Thus, given the lack of time series data from the WJP, the WGI data represent a well-designed alternative with which to measure the rule of law. In addition, it should be mentioned that the WJP rule of law index correlates as high as 0.98 for the year 2012 in a sample of 20 EU-27 countries (see also Fig. 3.A3 in Appendix A3). It thus seems appropriate to conclude that they both measure the same construct on an aggregated level.

As this contribution focuses in particular on the EU, a third data source should not be overlooked, namely data from the new EU Justice Scoreboard as published by DG Justice and Home Affairs (European Commission, 2013a). Most of the data contained within this scoreboard stem from a very detailed report by the European Commission on the Efficiency of Justice (CEPEJ, 2012) and offer a range of cross-sectional statistics on EU countries. However, since the data were only collected from 2004 onward, similar to the WJP, no adequate time series data are available for the period of interest (1998–2005).

Appendix 2 An External Instrument for Measuring the Rule of Law in the Context of Development Economics

A prominent instrument to disentangle the causality-related issues between the rule of law and economic performance (log of per capita income), as discussed in the literature focusing on the dichotomy between developed vs. developing economies, has been introduced by Acemoglu et al. (2001). In their seminal study, the authors introduce the variable "settlers' mortality" to serve as an instrument for the institutional differences (largely property rights) among countries colonized by Europeans. The theory behind this instrument is as follows: depending upon the mortality rate in the various colonies established by European powers, the European settlers would decide to either settle for the long-term or simply to set up "extractive states" in order to obtain a maximum quantity of resources. In countries with lower mortality rates, such as the US, Canada, Australia, and New Zealand, settlers replicated the

institutional design of former European countries, stressing the protection of property rights and the introduction of checks and balances against government power. In countries with a high mortality rate, European countries set up extractive states in which little emphasis was placed on ensuring an effective and equitable property rights regime. Given the assumption that the original institutional design persisted even after independence, Acemoglu et al. (2001) utilize the settlers' mortality rate during times of colonization for the current institutional design (and the rule of law) within a country in order to causally explain a country's current economic performance. In developing their concept of social infrastructure, Hall and Jones (1999) used a slightly different set of instruments, based on geographical, inguistic, and trade-related variables.

Both sets of literature are focused on the dichotomy between developed and developing economies. Unfortunately, neither of these prominent papers offers a valid instrument for analyzing the impact of the variance of the rule of law on labor productivity growth in an EU country sample. Future research endeavors in this field of research should be devoted to generating a valid and relevant instrumental variable, avoiding the usual weak instrumental bias (Murray, 2006; Stock & Watson, 2007).

Appendix 3 Selected Statistics

Table 3.A1 Descriptive statistics

	Mean	St. Dev.	Min.	Max.	Cou.	Obs.
Rule of law—EU27—average 98–2005	1.09	0.61	−0.20	1.95	27	27
Rule of law—EU13	1.50	0.40	0.47	1.97	13	98
IC investment in %	10	2	6	15	13	98
TC investment in %	21	6	14	44	13	98
IC stock	0.28	0.31	0	1	13	98
TC stock	0.32	0.31	0	1	13	98
Secondary education in %	66	12	38	83	13	98
Business cycle	0.93	0.03	0.85	0.98	13	98
Labor productivity growth in %	2.4	1.8	−2.2	8.4	13	98
Intangibles services growth in %	4.1	2.4	−2.8	9.2	13	98
Tangible services growth in %	3.3	1.8	0.3	9.9	13	98
Interaction education catch-up	0.16	0.26	0	1.16	13	98

Notes: WGIP data on the rule of law have been interpolated for the years 1999 and 2001. IC = intangible capital; TC = tangible capital.

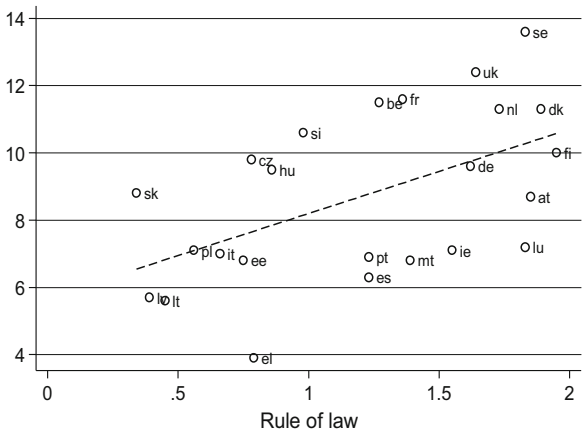

Fig. 3.A1 Scatter plot of the relationship between rule of law and business investment in intangible capital (% of GVA) in the EU-25, 1998–2005
Data sources: Data on intangible capital investments are taken from the INNODRIVE dataset (I NNODRIVE, 2011). Data on the rule of law are taken from the WGIP (Kaufmann et al., 2010). Data on intangible capital investment are missing for Romania and Bulgaria.

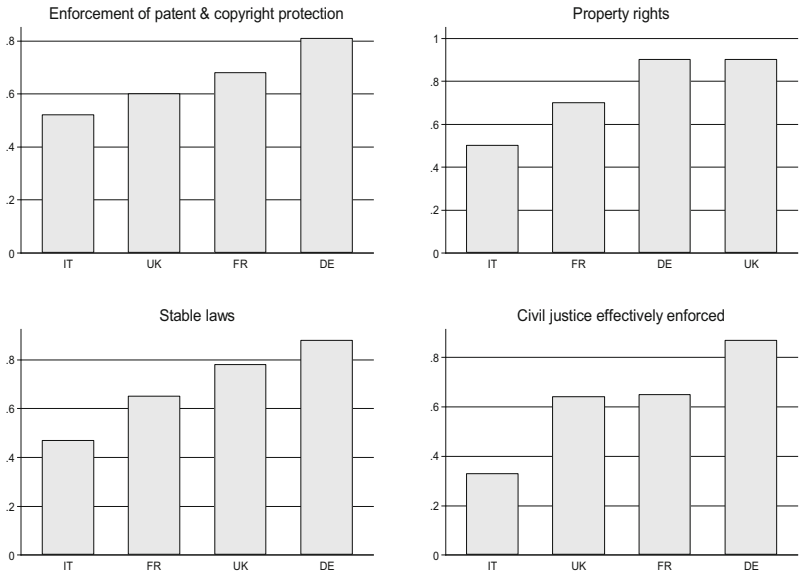

Fig. 3.A2 A comparison of four selected indicators of the rule of law—in the four largest EU economies
Notes: The data on "Enforcement of patent & copyright protection" and "Property rights" are taken from the WGIP (Kaufmann et al., 2010) based on the Institute for Management Development's "World Competitiveness Yearbook" and the Heritage Foundation's Index of Economic Freedom, respectively. The data stem from the year 2005. The data concerning "Stable laws" and "Civil justice effectively enforced" are taken from the WJP (Agrast et al., 2013). The data stem from the year 2012.

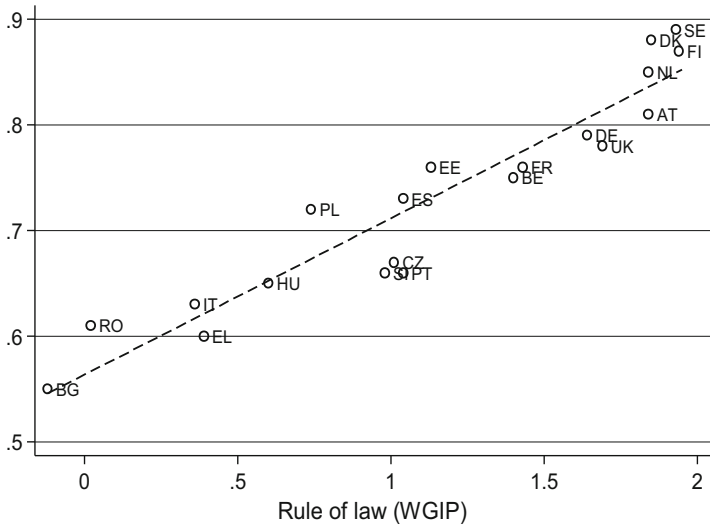

Fig. 3.A3 Scatter plot showing the relationship between the rule of law indicator by the WGIP and the rule of law index by the WJP, EU-27, 2012
Notes: Data on the rule of law from the WGIP are from Kaufmann et al. (2010). Data on the WJP are from Agrast et al. (2013). Both sets of data are from the year 2012. Cyprus, Malta, Latvia, Lithuania, Luxembourg, the Slovak Republic, and Ireland are not represented, due to missing data in the WJP database.

References

Acemoglu, D., Johnson, S., & Robinson, J. A. (2001). The colonial origins of comparative development: An empirical investigation. *American Economic Review, 91*, 1369–1401.

Agrast, M., Botero, J., Martinez, J., Ponce, A., & Pratt, C. (2013). *WJP rule of law index 2012–2013*. World Justice Project.

Asoni, A. (2008). Protection of property rights and growth as political equilibria. *Journal of Economic Surveys, 22*, 953–987.

Barro, R. J. (2001). Human capital and growth. *American Economic Review, 91*, 12–17.

Bassanini, A., & Scarpetta, S. (2001). The driving forces of economic growth: Panel evidence for the OECD countries. *OECD Economic Studies, 33*, 9–56.

Baumol, W. J. (2002). Entrepreneurship, innovation and growth: The David-goliath Symbiosis. *Journal of Entrepreneurial Finance, 7*, 1–10.

Benhabib, J., & Spiegel, M. M. (1994). The role of human capital in Economic Development–Evidence from aggregate cross-country data. *Journal of Monetary Economics, 34*, 143–173.

Botero, C. B., & Ponce, A. (2011). Measuring the rule of law, world justice project working paper series no. 001. World Justice Project.

Brunetti, A., Kisunko, G., & Weder, B. (1998). Credibility of rules and economic growth: Evidence from a worldwide survey of the private sector. *World Bank Review, 12*, 353–384.

CEPEJ (2012). *Evaluation of European judicial systems, report of the European Commission for the efficiency of justice*. Council of Europe. http://www.coe.int/t/dghl/cooperation/cepej/evaluation/default_en.asp

Clemens, M. A., Radelet, S., Bhavnani, R. R., & Bazzi, S. (2012). Counting chickens when they hatch: Timing and the effects of aid on growth. *Economic Journal, 122*, 590–617.
Corrado, C., Hulten, C., & Sichel, D. (2005). Measuring capital and technology: An expanded framework. In C. Corrado, J. Haltiwanger, & D. Sichel (Eds.), *Measuring Capital in the new Economy* (pp. 11–46). University of Chicago Press.
Corrado, C., Hulten, C., & Sichel, D. (2009). Intangible capital and U.S. Economic Growth. *Review of Income and Wealth, 55*, 661–685.
Dosi, G., Marengo, L., & Pasquali, C. (2006). How much should society fuel the greed of innovators? On the relations between appropriability, opportunities and rates of innovation. *Research Policy, 35*, 1110–1121.
Drukker, D. (2003). Testing for serial correlation in linear panel-data models. *Stata Journal, 3*, 168–177.
Easterly, W., & Levine, R. (2003). Tropics, germs and crops: How endowments influence economic development. *Journal of Monetary Economics, 50*, 3–39.
Edquist, H. (2011). Can investment in intangibles explain the Swedish productivity boom in the 1990s?. *Review of Income and Wealth, 57*, 658–682.
European Commission. (2010). *Europe 2020. A strategy for smart sustainable and inclusive growth*. Communication from the European Commission.
European Commission. (2013a). *The EU justice scoreboard - a tool to promote effective justice and growth*, COM (2013) 160 final. European Commission.
European Commission. (2013b). *Recommendation for a council recommendation on Italy's 2013 national reform programme,* COM (2013) 362 final. European Commission.
European Commission. (2013c). Recommendations for a council recommendation on Romania's 2013 national reform programme, COM (2013) 373 final. European Commission.
Finley, M. (1976). *Studies in Roman property*. Cambridge University Press.
Forbes, K. (2000). A reassessment of the relationship between inequality and growth. *American Economic Review, 90*, 869–887.
Frees, E. W. (2004). *Longitudinal and panel data: Analysis and applications in the social sciences*. Cambridge University Press.
Fukao, K., Miyagawa, T., Mukai, K., Shinoda, Y., & Tonogi, K. (2009). Intangible Investment in Japan: Measurement and contribution to economic growth. *Review of Income and Wealth, 55*, 717–736.
Gould, D. M., & Gruben, W. C. (1996). The role of intellectual property rights in economic growth. *Journal of Development Economics, 48*, 323–350.
Griliches, Z., & Hausman, J. A. (1986). Errors in variables in panel data. *Journal of Econometrics, 31*, 93–118.
Guellec, D., & van Pottelsberghe de la Potterie, B. (2001). R&D and productivity growth: Panel data analysis of 16 OECD countries. *OECD Economic Studies, 33*, 103–126.
Haggard, S., & Tiede, L. (2011). The rule of law and economic growth: Where are we? *World Development, 39*, 673–685.
Hall, R., & Jones, I. (1999). Why do some countries produce so much more output per worker than others? *Quarterly Journal of Economics, 114*, 83–116.
Hall, P. A., & Soskice, D. (Eds.). (2001). *Varieties of capitalism: The institutional foundations of comparative advantage*. Oxford University Press.
Hausman, J. A. (1978). Specification tests in econometrics. *Econometrics, 46*, 1251–1271.
INNODRIVE. (2011). INNODRIVE intangibles database. https://cordis.europa.eu/project/id/214576/reporting/de.
Kaufmann, D., & Kraay, A. (2002). Growth without governance, World Bank Policy Research Working Paper 2928. World Bank.
Kaufmann, D., Kraay, A., & Mastruzzi, M. (2007). The worldwide governance indicators project: Answering the critics, World Bank Policy Research Working Paper 4149. World Bank.

Kaufmann, D., Kraay, A., & Mastruzzi, M. (2010). The worldwide governance indicators: Methodology, data and analytical issues, World Bank policy research working paper no. 5430. World Bank.
Knack, S., & Keefer, P. (1995). Institutions and economic performance: Cross country tests using alternative institutional measures. *Economics and Politics, 7*, 207–227.
Li, R. Y. M., & Li, Y. L. (2013). Is there a positive relationship between law and economic growth? A paradox in China. *Asian Social Science, 9*, 19–30.
Marrano, M. G., Haskel, J., & Wallis, G. (2009). What happened to the knowledge economy? ICT, intangible investment, and britain's productivity record revisited. *Review of Income and Wealth, 55*, 686–716.
Mayer-Schönberger, V. (2010). The law as stimulus: The role of law in fostering innovative entrepreneurship. *Journal of Law and Policy for the Information Society, 6*, 153–188.
Mc Kinnish, T. G. (2000). *Model sensitivity in panel data analysis: Some caveats about the interpretation of fixed effects and differences estimators, unpublished manuscript*. University of Colorado.
Méon, P. G., & Sekkat, K. (2005). Does corruption grease or sand the wheels of growth? *Public Choice, 122*, 69–97.
Mundlak, Y. (1978). On the pooling of times series and cross-section data. *Econometrica, 1*, 69–85.
Murray, M. P. (2006). Avoiding invalid instruments and coping with weak instruments. *Journal of Economic Perspectives, 20*, 120–126.
Nakamura, L. I. (2010). Intangible assets and National Income Accounting. *Review of Income and Wealth, 56*, S135–S155.
Nicoletti, G., & Scarpetta, S. (2003). Regulation, productivity and growth: OECD evidence. *Economic Policy, 18*, 9–72.
North, D. C. (1990). *Institutions, institutional change and economic performance*. Cambridge University Press.
O'Mahony, M., & Timmer, M. P. (2009). Output, input and productivity measures at the industry level: EU KLEMS database. *Economic Journal, 199*, F374–F403.
Park, W. G., & Ginarte, J. C. (1997). Intellectual property rights and economic growth. *Contemporary Economic Policy, XV*, 51–61.
Piekkola, H. (2011). Intangible Capital: the Key to Growth in Europe. *Intereconomics*, *46*, 222–228.
Reed, W.R. (2013). *On the practice of lagging variables to avoid simultaneity*, manuscript 28. August.
Rigobon, R., & Rodrik, D. (2005). Rule of law, democracy, openness and income. *Economics of Transition, 13*, 533–564.
Rodrik, D., Subramanian, A., & Trebbi, F. (2004). Institutions rule: The primacy of institutions over geography, and integration in economic development. *Journal of Economic Growth, 9*, 131–165.
Roth, F., & Thum, A. E. (2013). Intangible capital and labour productivity growth: Panel evidence for the EU from 1998-2005. *Review of Income and Wealth, 59*, 486–508.
Roth, F., F. Nowak-Lehmann D. and T. Otter (2013). Crisis and trust in national and European Union institutions – Panel evidence for the EU, 1999 to 2012, EUDO/RSCAS working paper series 2013/31, European University Institute.
Saisana, M. and A. Saltelli (2013). Statistical audit. In: M. Agrast, J. Botero, J. Martinez, A. Ponce and C. Pratt (2013). WJP rule of law index 2012–2013, World Justice Project, 193–199.
Smith, A. (1998). *The wealth of nations*. Oxford University Press.
Schaffer, M.E., & Stillman, S. (2010). Xtoverid: Stata Module to Calculate Tests of Overidentifying Restrictions after xtreg, xtivreg, xtivreg2 and xthtaylor. http://ideas.repec.org/c/boc/bocode/s456779.html.

Stock, J. H., & Watson, M. W. (2007). *Introduction to econometrics*. Pearson-Addison Wesley.
Verspagen, B. (2006). University research, intellectual property rights and European innovation systems. *Journal of Economic Surveys, 20*, 607–632.
World Bank. (2006). *Where is the wealth of nations? Measuring capital for the 21st century*. World Bank.
World Justice Project. (2014). *WJP rule of law index 2014*. World Justice Project.

Chapter 4
Organizational Trust, Fear of Job Loss, and TFP Growth: A Sectoral Analysis for the EU

Felix Roth

Abstract Analyzing the sectoral variance in growth rates of total factor productivity in a European country sample from 1996 to 2006, this contribution detects no significant relationship between organizational trust and TFP growth. Yet, the relationship between fear of job loss and TFP growth seems to be significantly associated, in an inverted U-shaped relationship. This relationship proves to be robust to a range of alterations. The analysis concludes that depending on the specific sector, to enhance productivity it might be beneficial to liberalize or regulate employment relations. When analyzing the non-farm market sectors C-K, the relationship takes the form of a significant, negative linear relationship.

Keywords Organizational trust · Fear of job loss · TFP growth · Sectoral analysis · EU

JEL Classifications D24 · J89 · L23 · L60 · L70 · L80 · O30 · O52 · Z13

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1 Introduction

In analyzing the productivity gap between the US and Europe over the period 1995–2006, Timmer et al. (2010, p. 32 and p. 36) and van Ark et al. (2008, pp. 39-41) highlight that the gap largely results from slower growth of total factor productivity (TFP) in European market services, particularly in distributive trade as well as financial and business services. The authors argue that among other factors it will most likely be the missing input of intangible capital that is able to explain the result of slower TFP growth in European market services (Timmer et al., 2010, pp. 259–262; Van Ark et al., 2008, pp. 41–42). Concerning the conceptualization of intangible capital, Corrado et al. (2005, 2009) group intangible capital into three categories: 1) software, 2) innovative properties, and 3) economic competencies. The last category, economic competencies, is further subdivided into three indicators: 1) brand names, 2) firm-specific human capital, and 3) organizational capital. Within this wide range of indicators, this contribution concentrates primarily on the concept of organizational capital—more concretely, it analyzes the relationship between organizational trust, fear of job loss, and TFP growth over the period 1996–2006 at the sectoral level within a given sample of 15 European countries and 10 economic sector clusters. In this instance, the manufacturing sectors (C-F) are differentiated from the service sectors (G-K), the public sectors (L-N), and the non-farm business sector (C-K).

2 Theoretical Links

2.1 Organizational Capital and Economic Performance

Organizational capital is seen by many authors as a key driver of economic performance in industries or individual economic sectors (Lev & Radhakrishnan, 2005, p. 73; Black & Lynch, 2005, p. 205; Corrado et al., 2005, p. 29 and p. 33). Van Ark et al. (2008, p. 41), and Timmer et al. (2010, pp. 259–260) conclude that among other intangible capital indicators, a lack of organizational capital might explain slower TFP growth in European market services and thus the productivity gap between the US and Europe. But how can organizational capital best be conceptualized? An initial, suitable working definition of organizational capital is given by Lev and Radhakrishnan (2005, p. 75), who define organizational capital as “an

agglomeration of technologies" that enables some firms in contrast to others to produce higher output by utilizing more efficiently their given level of physical and human capital. These technologies include organizational processes and design (Lev & Radhakrishnan, 2005), work design and employee voice (Black & Lynch, 2005), and corporate management practices (Bloom & van Reenen, 2007).

Whereas the above-mentioned factors could be classified as *formal* indicators of organizational capital contributing to economic performance, another strand of the literature from diverse scientific fields (including psychological, organizational, business, management, and economic studies) identifies rather *informal* indicators of organizational capital as being key to organizational performance. Alongside general factors like organizational climate (Patterson et al., 2004) and employee working conditions (Royuela & Surinach, 2009), these *informal* indicators include more specific factors, such as organizational social capital (Nahapiet & Goshal, 1998; Leana & van Buren III, 1999, 2000), and those connected to organizational trust[1] (in some of the literature called workplace trust[2] or employees' trust[3]) and fear of job loss (also identified with job insecurity).[4]

2.2 Organizational Trust and Economic Performance

In its conceptualization of organizational trust, this contribution follows Leana and van Buren III (1999, 2000), who identify two types of organizational trust as being particularly important to the competitiveness of an organization and thus its economic performance: 1) *employees'* trust among colleagues and 2) *employees'* trust towards their superiors/bosses.[5] But how does employees' trust affect economic performance? The argumentation presented below sheds light on this question without being caught up in the positive trust bias that is common in this field.[6] Leana and van Buren (2000, pp. 221–25) identify three main factors explaining how employees' trust fosters the competitiveness of an organization. If trust exists, 1) employees are more committed to their organizations than to the particular

[1] On organizational trust, see among others Mayer et al. (1995), Dirks and Ferrin (2001), Dirks and Skarlicki (2004), Harisalo and Stenvall (2004) and Gargiulo and Ertug (2006).

[2] Concerning workplace trust, see Heliwell (2006), Heliwell et al. (2009) and Heliwell and Huang (2011).

[3] With regard to employees' trust, see Leana and van Buren III (1999, 2000) and on workers' trust, see Schotter (1996).

[4] On fear of job loss, see Blanchflower (1991), Brockner et al. (1992), Probst (2002), Sverke et al. (2002), Probst et al. (2007), Staufenbiel and König (2010).

[5] On the importance of trust in leaders, see also Dirks and Skarlicki (2004).

[6] Two books by prominent academics from the discipline of political science, *Trust* by Francis Fukuyama (1996) and *Bowling alone* by Robert Putnam (2000), are biased towards the positive effects of trust. Both books tend to neglect the "dark side of trust" (Gargiulo and Ertug, 2006).

work they do, 2) the goal of creating a more flexible work organization will be easier to achieve, and 3) collective action will be more easily managed within the firm. According to the authors, all three factors add to the competitiveness of an organization.

A similar but more specified discussion is given by Gargiulo and Ertug (2006) on the "dark side of trust", in which the authors identify a theoretical curvilinear relationship between trust and economic performance. Summarizing the literature on the consequences of trust, the authors point to three theoretical channels through which trust might be beneficial for economic performance (p. 170). First, trust is related to lower levels of monitoring, vigilance, and safeguards concerning the actions of the trusted party. This argument is in accordance with Knack and Keefer (1997) and Whiteley (2000), who stress among other things that an employer's monitoring costs are lower in high-trust societies. Second, trust is related to higher levels of commitment concerning the interaction with the trusted party. Third, trust is related to an enlargement of the scale of the exchange between parties. According to the authors, this will then lead to positive economic performance by 1) lowering information processing costs, 2) increasing satisfaction, and 3) reducing uncertainty. In the context of employees' trust towards colleagues/bosses, the second and third arguments are more important than the first, as the first argument would imply the employer's trust of the employee.

Interestingly, alongside these positive outcomes, the authors also identify the negative effects of *excessive* levels of trust on economic performance (growth): 1) blind faith, 2) complacency, and 3) unnecessary obligations. For a start, excessive trust can produce blind faith, leading to a reduction of monitoring below an optimal threshold, thereby increasing the risk of malfeasance. Furthermore, excessive trust can turn commitment into complacency, which may prevent rapid intervention in declining performance. This argument is in accordance with Bidault and Castello (2009), who assert that when there is a very high level of trust, actors might become too complaisant, leading to diminished levels of task-oriented conflicts and thus lower effectiveness (p. 267). In this instance, Hardin (2006) mentions the potential of blocking social capital (p. 94). Dirks and Ferrin (2001) discuss empirical evidence showing that positive attitudes, such as satisfaction, are not robustly linked to work performance (p. 455). Finally, excessive trust can lead to a swift enhancement of a relationship beyond the optimal level, thereby creating unneeded obligations that act as constraints on the interaction.

2.3 *Fear of Job Loss and Economic Performance*

The above-derived theoretical, curvilinear relationship between organizational trust and growth and the explicit reference to the paradigm of excessive trust already points towards the potential importance of an opposite[7] but distinct

[7] According to theoretical (Ashford et al., 1989, p. 808) and empirical studies (Sverke et al., 2002, p. 253), the concept of trust and fear of losing one's job are negatively related to one another.

concept from trust, that of fear,[8] for explaining economic performance. To conceptualize fear this contribution uses a prominent concept of fear, namely employees' fear of losing their jobs (for a definition see De Witte, 2005, p. 1; Sverke et al., 2002, p. 243; and Greenhalg & Rosenblatt, 2010, pp. 9–10).[9] But how is employees' fear of losing their jobs related to economic performance? Research from the disciplines of psychology and business studies depicts a curvilinear relationship between job insecurity and economic performance. In this context, the popular management literature points out that the relationship between stress (being induced by, among other phenomena, job insecurity) and economic performance takes an inverted U shape (Marks, 2003, p. 42). A similar argument from the academic literature, directly related to job insecurity, is made by Brockner et al. (1992). The assumption of a curvilinear relationship seems to be well embedded in the literature, which puts forward mixed theoretical arguments highlighting both the positive and negative effect of unemployment fears on economic performance.

Concerning the positive relationship, some scholars stress that job insecurity creates a cognitive awareness on the part of employees that will consequently increase their performance (Probst et al., 2007). In addition, heightened perceptions of job insecurity may lead employees to engage in less counterproductive work behavior out of the "fear of termination and the associated financial ramifications with potential job loss" (Probst et al., 2007, p. 483). Staufenbiel and König (2010) argue that fear of losing one's job might motivate employees to work harder in order to safeguard against that loss (p. 103). Another argument is given in the economic literature by Blanchflower (1991), specifically, that fear of unemployment among employees depresses wages significantly, thereby granting the hiring organization a comparative advantage over its competitors.

Concerning the negative relationship, Sverke et al. (2002) conclude that job insecurity lowers economic performance because less secure employees are 1) less involved with the organization and 2) have incentives to withdraw from the organization. Probst et al. (2007) suggest that job insecurity might influence productivity and performance negatively because of a drain of the working memory resources owing to anxiety. Staufenbiel and König (2010) contend that job insecurity produces stress, which in turn negatively affects an employee's organizational commitment (p. 102). Renzl (2008) holds that fear in the workplace leads to a disruption of knowledge sharing, which is of crucial importance to the innovativeness and competitiveness of a firm.

[8] Concerning the generalized paradigm of fear, classical sociological thinking has long held that fear is one of the main driving forces behind the evolution of advanced societies and economic performance (see Elias, 1980, pp. 447–51; Marcuse, 1998).

[9] The fear of losing one's job is a more specialized conceptualization than, for example, the organizational climate of fear (Ashkanasy & Nicholson, 2003).

The foregoing discussion clarifies that, similar to the theoretical arguments on organizational trust, fear of job loss and economic performance are related in a curvilinear manner.

3 Model Specification, Research Design, and Data

3.1 Model Specification

Following Nicoletti and Scarpetta (2003) and McMorrow et al. (2010), who use a neo-Schumpeterian growth model, the baseline specification takes the following form:

$$\begin{aligned}\widehat{\mathrm{TFP}}_{i,j,t} = {} & \beta_0 + \beta_1 \widehat{\mathrm{TFP}}_{L,j,t} + \beta_2 \left[\ln \left(\mathrm{TFP}_{i,j,t-1} \right) - \ln \left(\mathrm{TFP}_{L,j,t-1} \right) \right] \\ & + \beta_3 \, \mathrm{OTF}_{i,j,t} + \beta_4 \left(\mathrm{OTF}_{i,j,t} \right)^2 + \beta_5 X_{i,j,t} + \gamma_i + \alpha_j + \varepsilon_{i,j,t} \, , \end{aligned} \tag{4.1}$$

where the sign "^" represents the growth rates of the depicted variables; $\widehat{\mathrm{TFP}}_{i,j,t}$ is the average TFP growth in country i and sector j for the 11-year period 1996–2006; $\widehat{\mathrm{TFP}}_{L,j,t}$ represents TFP growth at the frontier economy L and is supposed to capture the degree to which countries have to do analogous innovation activity as lead countries or acquire potential knowledge spillovers; $\ln(\mathrm{TFP}_{i,j,t-1}) - \ln(\mathrm{TFP}_{L,j,t-1})$ represents the productivity gap between a country and the frontier in order to proxy the room for adoption of technologies from the frontier; $\mathrm{OTF}_{i,j,t}$ and $(\mathrm{OTF}_{i,j,t})^2$ represent the level and the squared level respectively of organizational trust and fear of job loss in country i, sector j at time t[10]; $X_{i,j,t}$ is a vector of supplementary explanatory variables containing policy and control variables in country i, sector j at time t[11]; γ_i and α_j represent dummy variables for country i and sector j; the residual $\varepsilon_{i,j,t}$ is, as always, assumed to follow a normal distribution where the mean equals zero and a constant standard variance σ_ε^2. β_0 depicts a constant term.

[10] For pragmatic reasons it is assumed that organizational trust and fear of job loss remain stable over time. This assumption was necessary to be able to utilize an organizational trust and fear of job loss indicator from 2005 as an explanatory variable for TFP growth from 1996 to 2006. In this instance, Blanchflower and Oswald (1999) find out, when analyzing the trend in job insecurity levels in the US for the period 1977–1998, that job insecurity remains stable. Yet, when comparing the 2005 European Working Conditions Survey (EWCS) (Eurofound, 2005) with the 2010 EWCS (Eurofound, 2010a) data from the INDICSER project (Saam et al., 2011), the fear values differ significantly, particularly in sectors that have been strongly exposed to the economic crisis, such as construction. This finding is also confirmed by Eurofound (2010b, p. 2). Still, the question arises of whether a comparison between these two periods makes a valid counter case, as between 2005 and 2010 nothing less than the worst financial and economic crisis since the 1930s hit most advanced economies around the world.

[11] The control and policy variables have been constructed as averages from 1996 to 2006.

3.2 Research Design

The dependent variable is the average TFP growth from 1996 to 2006 in sector *j* and country *i*. The country sample consists of 15 European countries: Austria, Belgium, the Czech Republic, Denmark, Finland, France, Germany, Hungary, Ireland, Italy, Portugal, Slovenia, Spain, Sweden, and the UK. Of these 15 countries, 12 are from the EU-15 and 3 are transition countries. Overall, 10 sectors (A-B, CtD, F, G, H, I, J, K, L, MtN) are included in the analysis.[12] Following the INDICSER[13] methodology, only sectoral cells with more than 30 observations were utilized (Saam et al., 2011). Given this limitation, with 10 sectors and 15 countries, it was possible overall to retrieve 103 observations for organizational trust and 100 observations for fear of job loss as depicted in Table 4.1 (in Sect. 4) and Table 4.A1 (in the Appendix).

3.3 Data

Following the approach of the INDICSER project (Saam et al., 2011), data on organizational trust and fear of job loss were taken from the European Working Conditions Survey (EWCS) conducted on behalf of the European Foundation for the Improvement of Living and Working Conditions (Eurofound), as it is the only *publicly* available dataset that enables employees' attitudes and working conditions to be matched with specific economic sectors in a larger European country sample.[14,15] More concretely, data were taken from the fourth wave of the EWCS

[12] The empirical design of the paper has been constructed around the built-in "NACE11-variable", which is given in the fourth wave of the EWCS (Eurofound, 2005). For reasons that seem to be arise from an erroneous coding by Eurofound, the NACE11 variable has included sectors O-Q in the missing category. This error should be corrected by the responsible persons at Eurofound. Being based on the output of the NACE11 variable, the econometric analysis of this paper thus focuses solely on sectors AtN. In contrast to this paper, the INDICSER project (Saam et al., 2011) also depicts data on sectors O-Q by retrieving data from a variable within the fourth EWCS, which provides information at a more disaggregated level than the 1-digit NACE classification. Sector E had to be dropped because the cells had fewer than 30 observations in all 15 countries.

[13] The INDICSER ("Indicators for evaluating international performance in service sectors") project is funded by the European Commission under its Seventh Framework Program (https://cordis.europa.eu/project/id/244709/de).

[14] According to Eurofound (2007) the statistical population of the EWCS includes all persons aged 15 or older whose usual place of residence is in the territory across 31 European countries and who are in employment during the reference period. A person is considered in employment if he or she did any work for pay or profit during the reference week for at least 1 hour. The EWCS draws a representative sample by using multistage sampling; thus, in the first stage, population sampling units were selected using stratified random sampling. The target number of interviews was 1,000 in 14 of the 15 countries in the sample, with the exception being Slovenia, for which the target was 600 interviews.

[15] Although other data sources, such as the European Social Survey, have recently started to collect data on the sectoral structure, these surveys do not include an equally rich range of survey questions concerning working conditions.

(Eurofound, 2005) because it was the first to include information on both of the relevant items: organizational trust and fear of job loss.

To adequately measure the concept of *employees'* organizational trust and fear of job loss, the raw population of the EWCS 2005 was filtered by the following criteria: first, self-employed persons were dropped. Second, to analyze a sample of employees who follow a regular work-engagement week, only those employees were kept who worked at least 8 hours but less than 84 hours a week.[16] Third, managers with supervisory tasks were dropped. Fourth, employees who worked alone (without any other colleagues) were eliminated from the survey.

As direct measures of trust have not been included in the EWCS for ethical reasons,[17] a trust proxy had to be devised. This proxy is based on the question of whether an employee can get assistance from his or her colleagues and/or boss.[18] The survey item thus reads as follows: "For each of the following statements, please select the response which best describes your work situation. You can get assistance from colleagues if you ask for it. You can get assistance from your superiors/boss if you ask for it." The responses are based on a Likert scale, with the five answer categories being "almost always," "often," "sometimes," "rarely," "almost never," and "don't know" or "refusal." Following the INDICSER methodological approach (Saam et al., 2011), net measures have been formed by adding the categories "almost always" and "often" and subtracting them from the sum of the two categories "rarely" and "almost never." To measure fear of job loss, there is a question in line with the given literature in the field (Sverke et al., 2002, p. 243): "How much do you agree or disagree with the following statements describing some aspects of your job? I might lose my job in the next 6 months." This survey item also uses a Likert scale, with the five responses being "strongly agree," "agree," "neither agree nor disagree," "disagree," "strongly disagree," "don't know," and "refuse to answer." In accordance with organizational trust, a net fear of job loss variable is calculated by adding the responses "strongly agree" and "agree" and subtracting the sum of those who "strongly disagree" and "disagree."

[16] It might theoretically be that, for example, employees who undertake shifts work more than 84 hours. To control for any potential outliers however the author believes that it is valid to exclude any work arrangements of less than 8 hours (or one working day) or more than 84 hours.

[17] In an e-mail communication with the author, an expert at Eurofound noted that the items on trust in one's colleagues and boss are not included in the EWCS on the grounds that they "are very difficult to handle and are easily abused." An adequate survey item for measuring trust, such as "[e]valuate how well or poorly the following descriptions apply to your own workplace: very well, rather well, rather poorly or very poorly. . .[t]he relationships between the workers and the management are open and based on trust," has been used by Eurofound only in the Finnish Quality of Life Survey.

[18] An expert from Eurofound confirmed that Eurofound itself proxies an item like trust in colleagues and the boss through the above-stated proxy on support from colleagues and the boss. Although this item seems to be more strongly connected to the concept of organizational social capital than organizational trust, to the author's knowledge it is the best publically available proxy for organizational trust.

Other data have been gathered from the following sources:

- Sectoral TFP growth data were retrieved from the EUKLEMS[19] database. For the dependent variable, the average annual growth rate over the period 1996–2006 was calculated. TFP growth for the aggregated sectors CtD and MtN were calculated following formulas from Timmer et al. (2007, pp. 14–16).
- Sectoral TFP-level data were taken from the GGDC Productivity Level Database (Inklaar & Timmer, 2008). Categories CtD and MtN had to be combined according to the formula in Inklaar and Timmer (2008, pp. 36–38).[20] Being based on 1997 PPP and the US as a benchmark, the data have been recalculated for the base year 1995 and using Germany as the benchmark.
- The intangible capital variable for sectoral firm-specific human capital and a sectoral indicator for employment protection legislation were taken from the INDICSER (2013) project.[21]
- Sectoral data on the size of firms and type of working contract for the instrumental variable estimation were taken from the fourth wave of the EWCS (Eurofound, 2005).
- Sectoral data on R&D intensity and product market regulation were taken from the OECD.
- The data for the micro-analysis were taken from the fourth wave of the EWCS (Eurofound, 2005).

4 Descriptive Statistics

Table 4.1 shows all 100 aggregated values (subdivided into 15 countries and 10 sectors) of the fear of job loss that are used in the econometric analysis of this contribution. With a value of −95.1%, Austrian employees who work in the public administration and defense sector (L) have the lowest fear of job loss, whereas Czech employees who work in the construction sector (F) have the highest fear of job loss, with a value of 30.4%. As can be seen from Table 4.A1, with a mean value of −55% and a standard deviation of 25%, on average only a minority of employees are afraid of losing their jobs.

The sectors with the highest fear of job loss are 1) agriculture and fisheries (AtB) at −16.7%, 2) hotels and restaurants (H) at −33% (with −39.6% being the highest value in the EU-15 country sample), and 3) construction (F) at −40.6%. The sectors

[19] EUKLEMS refers to the research project "Productivity in the European Union: A Comparative Industry Approach" and involves EU-level analysis of capital (K), labor (L), energy (E), materials (M), and service (S) inputs. The data can be downloaded from the EUKLEMS website (http://www.euklems.net/).

[20] The author wishes to thank Robert Inklaar for providing the *ex-ante* capital compensation data required to perform the valid calculation to combine sectors C with D and sectors M with N.

[21] The author is grateful to Anna Rinkow for providing the data.

Table 4.1 Levels of fear of job loss in different economic sectors and countries

	AtB	CtD	F	G	H	I	J	K	L	MtN	Avg.
Austria	–	−61.7	−53.5	−42.9	−47.5	−50.0	–	−55.9	**−95.1**	−88.5	−61.9
Belgium	–	−45.7	–	−49.0	–	−66.7	−83.8	−50.0	−82.5	−82.7	−65.8
Czech Republic	–	11.9	**30.4**	19.7	−13.3	−3.1	–	–	−20.0	−27.9	**−0.3**
Germany	–	−43.4	−34.7	−40.4	–	−46.9	–	–	–	−66.0	−46.3
Denmark	–	−77.9	−77.5	−76.5	–	−72.3	–	−85.4	−87.2	−80.8	**−79.7**
Spain	–	−60.8	−28.9	−45.3	−12.5	−56.7	–	−36.5	−70.3	−78.3	−48.7
Finland	–	−54.8	−35.0	−55.6	–	−63.6	–	−60.7	−61.9	−75.3	−58.1
France	–	−66.9	–	−72.3	–	−60.9	–	−44.7	−91.7	−87.7	−70.7
Hungary	−16.7	−28.3	−19.6	−7.2	–	−50.9	–	–	−38.4	−46.7	−29.7
Ireland	–	−68.2	−70.7	−65.5	−58.8	−66.7	–	−65.1	−79.6	−77.2	−69.0
Italy	–	−46.6	–	−58.2	–	−65.6	–	−49.3	−82.5	−82.8	−64.2
Netherlands	–	−56.2	–	−57.0	–	−47.4	−66.7	−37.8	−63.6	−71.9	−57.2
Sweden	–	−51.1	–	−56.8	–	−37.5	–	−43.3	−57.7	−66.9	−52.2
Slovenia	–	−6.0	–	−20.8	–	–	–	−15.0	–	−61.3	−25.7
UK	–	−69.8	−75.6	−78.9	–	−77.3	–	−68.8	−90.2	−85.5	−78.0
Observations, all	1	15	9	15	4	14	2	12	13	15	–
Average, all	**−16.7**	−48.4	−40.6	−47.1	−33.0	−54.7	**−75.2**	−51.0	−70.8	−72.0	–
Observations, EU-15	–	12	7	12	3	12	2	11	11	12	–
Average, EU-15	–	−58.6	−53.7	−58.2	**−39.6**	−59.3	−75.2	−54.3	−78.4	**−78.6**	–

Notes: As the figure depicts net fear of job loss, values can range from a potential of +100 (complete fear of job loss) to −100 (no fear of job loss at all). In addition, all values above 0 indicate that a majority of the respondents are afraid of losing their jobs. Minimum and maximum values for the specific country and sector sample are depicted in bold. Cells are empty where there were fewer than 30 observations (and thus sector E has been dropped). To facilitate interpretation of the table, net fear of job loss measures have been multiplied by 100.
Source: EWCS 2005 (Eurofound, 2005).

with the lowest fear of job loss are financial intermediation (J) at −75.2%, education and health (MtN) at −72.0% (with −78.6% being the lowest value in the EU-15 country sample), and public administration and defense (L) at −70.8%. When differentiating the non-agricultural market sectors (CtK) from the public sectors (LtN), with the exception of sector J, one finds overall lower levels of job insecurity in the public sector.

When analyzing the average level of fear of job loss from a country perspective, the distribution of fear of job loss is more pronounced compared with the sectoral analysis (−16% to −75.2%). It ranges from −0.3% in the Czech Republic to −79.7% in Denmark. Most notably, there exists a significant difference between fear of job loss levels in the three new member states, the Czech Republic, Hungary, and Slovenia (with levels of −0.3%, −29.7%, and − 25.7%, respectively) and the other EU-15 countries (which range in values from around −50% to −80%). The only exceptions among the EU-15 countries are Germany and Spain, with an average fear of job loss level of −46.3% and −48.7%, respectively, among employees.[22] Workers in similar large economies, such as France, the UK, and Italy, have markedly lower levels of fear of job loss, with −70.7%, −78.0%, and −64.2%, respectively.

In contrast to fear of job loss, which was depicted for all 100 individual observations, Fig. 4.1 shows the net levels of the proxies for *trust* in *colleagues* and the *boss* within the sectoral and country aggregations, while Table 4.A1 shows the summary statistics of net trust in colleagues and the boss. Figure 4.1 reveals that in the transport and communication sector (I), employees' trust in colleagues ranges from 7% in France to 96% in Denmark. With a mean value of 69% and a standard deviation of 19%, levels of net trust in colleagues are in general relatively high and quite evenly distributed around the mean. As depicted in Fig. 4.1, from a sectoral point of view (left side of Fig. 4.1), net trust in colleagues varies from 54% in the transport and communication sector to 78% in the financial intermediation sector (J). The picture looks somewhat more differentiated when analyzing net trust in colleagues from a country standpoint. France and Italy, with values of 33% and 39%, respectively, have significantly lower levels of net trust in colleagues than the other European countries and the mean of 69%.

Concerning net trust in the boss, the mean value of 52% is 17% points lower than net trust in colleagues. In addition, the variation is more pronounced, with trust ranging from −11% in the Italian education and health sector (MtN) to 83% in the Irish wholesale and retail sector (G) and a standard deviation of 0.23 compared with 0.19. Concerning sectors, it is quite evenly distributed, ranging from 41% in transportation and communication (I) to 65% in financial intermediation (J). Looking at individual countries, a startling finding can be detected. Although net trust is relatively evenly distributed among 13 EU countries, Italy and France are clearly outliers. On average net trust in the boss in France is only 2.8% and in Italy it is only 4.3%. This is an astonishing difference compared with the high levels in Sweden (59%) and Denmark (77%), for example, and a mean of 52%.

[22] It has to be pointed out, however, that data for sector L in Germany is missing. As the values for sector L are on average higher than in other sectors, this fact partially contributes to a lower average value in Germany.

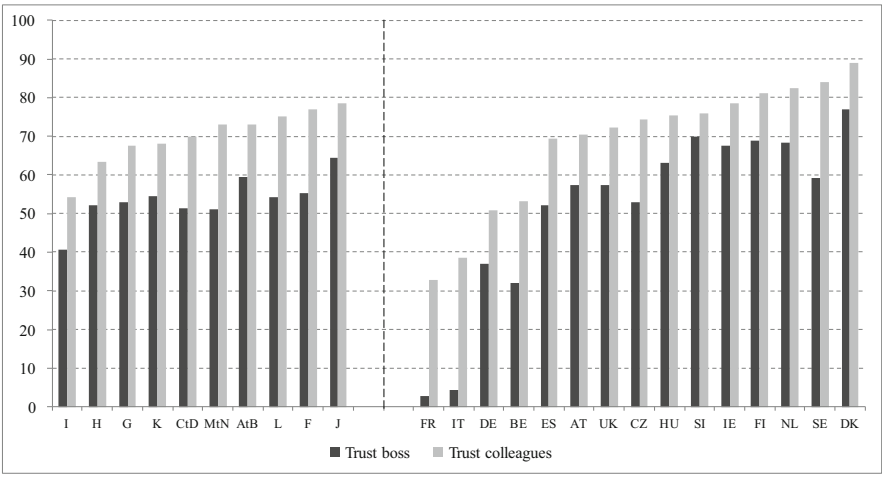

Fig. 4.1 Organizational trust within the different economic sectors and countries
Notes: As the figure depicts net trust, values can range from a potential +100 (complete trust) to −100 (complete mistrust). In addition, all values above 0 indicate that a majority of the respondents have trust. The left-hand side of the figure shows the variation by sector. The right-hand side of the figure shows the variation by country.
Source: EWCS 2005 (Eurofound, 2005).

Figure 4.2 shows a partial regression plot between fear of job loss and TFP growth, which reveals the regression results from regression 4 in Table 4.2 (see Sect. 5). When controlling for an economic sector dummy variable in an EU-27 country sample (including the 15 countries under study), the significant curvilinear relationship between fear of job loss and TFP growth is strongly driven by the three transition countries, the Czech Republic, Slovenia, and Hungary.[23] In the Czech Republic, in particular, high levels of fear of job loss in almost all sectors are associated with low levels of TFP growth.

Figure 4.3 shows a partial regression plot between fear of job loss and TFP growth based on regression 6 in Table 4.2. When analyzing an EU-15 country sample without the Czech Republic, Slovenia, and Hungary and controlling for country effects but not for sectoral effects (in order to fully attribute the full sectoral variance), a significant curvilinear relationship between fear of job loss and TFP growth is detected. Specific sectors that exhibit levels of fear of job loss that are too low and too high with respect to TFP growth rates are identified by country and sector in Fig. 4.3.[24] Those exhibiting fear of job loss levels that are too low are public administration (L) in Austria, Spain, and France, education and health (MtN) in Austria and Spain, and financial intermediation (J) in Belgium. Sectors exhibiting

[23] As depicted in regression 3 in Table 4.2, this relationship turns out to be insignificant when controlling for country effects.

[24] The calculation is based on the distance of these cases to the mean. If the distance is larger than one standard deviation, they are displayed in Fig. 4.3 with the country and sector identification.

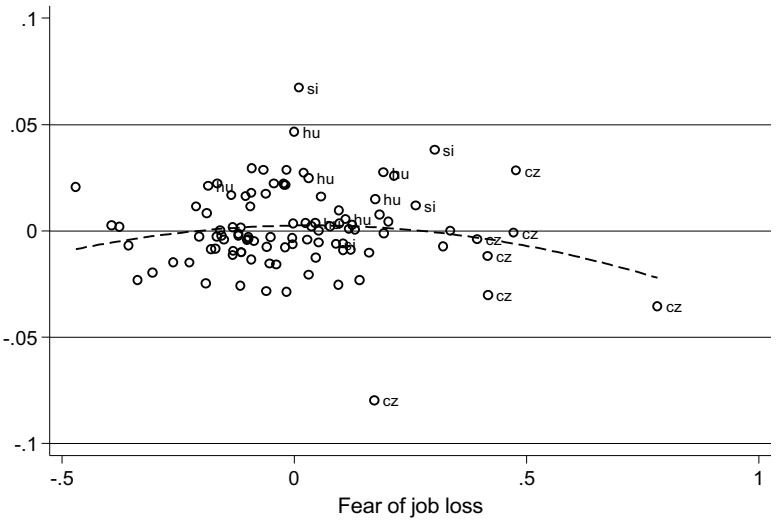

Fig. 4.2 Partial regression plot between fear of job loss and TFP growth—all countries
Notes: For country abbreviations, cz = Czech Republic; si = Slovenia; hu = Hungary.

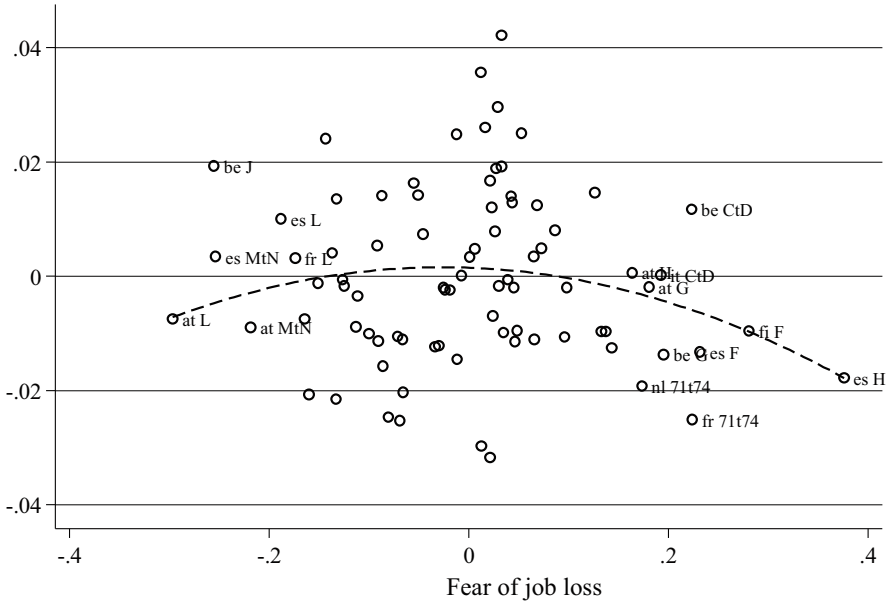

Fig. 4.3 Partial regression plot between fear of job loss and TFP growth—sectors in EU-15 countries
Notes: On sector abbreviations, CtD = manufacturing; F = construction; G = wholesale and retail trade; H = hotels and restaurants; J = financial intermediation; 71–74 = K71–74 = business activities, excluding real estate activities; MtN = education and health; L = public administration. For countries, be = Belgium; fr = France; nl = the Netherlands; fi = Finland; es = Spain, it = Italy; at = Austria.

high levels of fear of job loss include wholesale and retail trade (G) in Austria and Belgium, hotels and restaurants (H) in Spain and Austria, manufacturing (CtD) in Belgium and Italy, construction in Spain and Finland, and business in the Netherlands and France (K71–74). In this instance, the high levels of fear of job loss in the knowledge-intensive production of business activities (K71–74) in the Netherlands and France seem worrying for the competitiveness of their firms.

5 Econometric Analysis

When estimating Eq. (4.1) in Sect. 3, a least square dummy variable (LSDV) approach is applied to take into account the interdependence of observations in sectors and countries.[25][26] In addition, to control for potential cross-sectional heteroscedasticity, a robust-VCE estimator has been utilized.[27] Regressions 1 and 2 depict the relationship between the trust *proxies* and TFP growth.[28] Both trust *proxies* turn out to be insignificant. The results hold no matter which dummies are included in the regressions.[29]

Regressions 3–7 analyze the relationship between fear of job loss and TFP growth. When analyzing all countries in the given sample and controlling for country and industry-specific effects (regression 3), the squared term of the fear of job loss exhibits no significant relationship. Once excluding the country dummy in regression 4, however, the relationship of the squared term becomes significant (at the 90% level) with a coefficient of −0.04. As depicted earlier in Fig. 4.2, this curvilinear relationship seems to be strongly driven by the three transition countries, the Czech Republic, Slovenia, and Hungary. As can be observed from Table 4.1 above, in those three countries the levels of fear of job loss are significantly higher in almost all sectors compared with those of EU-15 countries, especially in the Czech Republic (with values close to 0). Given that these three countries act as outliers with respect to the EU-15 country sample, regressions 5–7 focus on the remaining

[25] The assumptions on the residuals are met and allow the estimation through LSDV. The residuals are symmetrically distributed around 0 and follow a normal distribution. The underlying graphical results from the rvfplot, qnorm, and pnorm Stata command can be obtained from the author on request.

[26] McMorrow et al. (2010) have also utilized sectoral and country dummies in their analysis.

[27] The Stata robust command is based on the Huber-Sandwich Estimator.

[28] To reduce the degree of multicollinearity, when constructing the squared terms of each respective variable, the underlying variables were first centered. This means that the mean of the variable was subtracted from its real value (see here Kutner et al., 2004, p. 295). It turns out that the correlation between these two variables effectively goes down from 0.92 to 0.57.

[29] In addition, both proxies turn out to be insignificant when modeling them linearly. The results can be obtained from the author. The insignificant result might also stem from the fact that the proxy used misspecified the concept of trust.

Table 4.2 Organizational trust, fear of job loss, and TFP growth, LSDV estimation

Estimation method	LSDV, robust	LSDV, robust	LSDV, robust	LSDV, robust	LSDV, robust	LSDV, robust	2SLS, robust
Country sample	All	All	All	All	EU-15	EU-15	EU-15
Equation	1	2	3	4	5	6	7
Trust colleagues, squared	−0.013 (0.024)	– –	– –	– –	– –	– –	– –
Trust colleagues, squared	−0.026 (0.042)	– –	– –	– –	– –	– –	– –
Trust boss	– –	−0.003 (0.027)	– –	– –	– –	– –	– –
Trust boss, squared	– –	−0.020 (0.043)	– –	– –	– –	– –	– –
Fear of job loss	–	–	0.000 (0.026)	0.008 (0.009)	−0.031 (0.019)	−0.001 (0.013)	−0.005 (0.020)
Fear of job loss, squared	–	–	0.006 (0.035)	−0.040* (0.024)	−0.066 (0.046)	−0.111** (0.045)	−0.138* (0.082)
Catch-up term[a]	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Growth at the frontier[a]	No	No	No	No	No	Yes	Yes
Country dummies	Yes	Yes	Yes	No	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes	Yes	No	No
No. of observations	103	103	100	100	82	82	82
No. of countries	15	15	15	15	12	12	12
R-square	0.57	0.56	0.57	0.42	0.57	0.35	0.35

Notes: Organizational trust and fear of job loss variables are centered to reduce the degree of multicollinearity (Kutner et al., 2004, pp. 295–300).
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.
[a]For the EU-15 sample, these variables differ slightly from the larger sample, as technological leaders might change. Instrumental variables in regression 7 include the type of working contract and size of organization. The numbers in parentheses are robust standard errors.

12 countries of the EU-15 country sample. When controlling for country and industry effects in regression 5, no significant relationship between fear of job loss and TFP growth appears in the EU-15 country sample. However, as this contribution is foremost interested in a cross-sectoral approach rather than a cross-country approach, it seems reasonable to exclude the industry dummy in order to obtain the full variance of the industrial sector observations. When excluding the industry dummy in regression 6, a significant (at the 95% level) negative effect (with a coefficient of −0.111) between the squared term of fear of job loss and TFP growth appears. The specific pattern of this curvilinear relationship is shown in detail in Fig. 4.3. The coefficient of fear of job loss in regression 6 is −0.001 for the linear

term and −0.111 for the squared term. With a coefficient of this size, the optimal level of fear of job loss is −64% in the EU-15 country sample.[30] Thus, from a productivity point of view, the optimal proportions of fear of job loss at the aggregated level should equal approximately four-fifths (82%) of employees who do not fear job loss and one-fifth (18%) who do. With a current mean of −63%, aggregate fear of job loss is at its optimal point. Comparing the optimal level of fear of job loss with the average sectoral levels in Table 4.1, it becomes apparent that there are sectors with fear of job loss levels that are too high, optimal, and too low. The sectors with fear of job loss levels that are excessively high are hotels and restaurants (H) (24.4), construction (F) (10.3), and business activities (K) (9.7). The sectors with an optimal fear of job loss level are wholesale and retail trade (G) (5.8), manufacturing and mining (CtD) (5.4), and transport and communication (I) (4.7). The sectors that on average have fear of job loss levels that are too low are financial intermediation (J) (−11.2), public administration (L) (−14.4), and education and health (MtN) (−14.6). Analyzing these results from a country perspective, one could conclude that employees report too much fear of job loss in Germany (17.7) and Spain (15.3), an optimal level in Austria (2.1), Belgium (−1.8), and Italy (−0.2), and too little in the UK (−14) and Denmark (−15.7).

When running growth regressions, such as in eq. (4.1) and regression 6, one must be aware of the possibility that the left-hand side and the right-hand side variables will affect one another. More specifically, the independent variable *fear of job loss* might be endogenous, affected by a common event ,such as an economic shock, or stand in a bi-directional relationship with TFP growth; thus, lower levels of TFP growth might, for example, influence an agent's fear of job loss. As there is no information on fear of job loss for the period *t-1*, the only possible solution is to retrieve valid *external* instruments[31] for fear of job loss. To address the possibility of endogeneity, a two-stage least squares (2SLS) estimation has been applied in regression 7. The set of instruments utilized include among others the firm size (medium and large) and type of working contract (indefinite and fixed). The

[30] The calculation to determine the optimal level of fear of job loss in an EU-15 country sample has been derived in the following manner: first, one differentiates Eq. (4.1) with respect to $OTF_{i,j,t}$. With $\beta_3 = -0.001$ and $\beta_4 = -0.111$ one arrives at $\frac{\widehat{\partial TFP_{i,j,t}}}{\partial\ OTF_{i,j,t}} = -0.001 - 0.222\ OTF_{i,j,t}$. Second, to determine the optimal $OTF_{i,j,t}$ value, one solves the following equation: $-0.001 - 0.222\ OTF_{i,j,t} = 0$ with respect to $OTF_{i,j,t}$ and we obtain $OTF_{i,j,t} = 0.001/-0.222 = -0.0045$. As this value is still centered, it still has to be demeaned by adding the mean value of −0.6294 to the optimal point of −0.0045 to obtain a demeaned optimal point of $-0.6339 \approx -0.63$. For reasons of comparability with Table 4.1, this value is multiplied by 100 to derive an optimal value of −64%. Utilizing the same methodology for regression 4, the optimal level of fear of job loss is then −45%.

[31] In the context of curvilinear relationships (as depicted in regression 6), Woolridge (2002, pp. 230–237) advises the direct application of the 2SLS method to both endogenous regressors (the linear and quadratic effect) with the supplementary nonlinear transformations (quadratic terms) of exogenous variables appearing somewhere in the system. A second option is to predict the linear term with the exogenous variables and to square this prediction. Subsequently, the predicted $(\widehat{y}_i)^2$ is then added to the instrumental variables regression. Regression 7 depicts the coefficient for the linear and squared term of fear of job loss when utilizing the second option.

underlying specification tests show that the instrument set is valid[32] and relevant.[33] Utilizing this set of instruments yields a significant coefficient for the squared term at the 90% level. The size of the coefficient becomes slightly smaller with a coefficient of −0.005/−0.138 and an optimal point of fear of job loss of −65%.

5.1 Sensitivity of Results

To control whether the empirical result between fear of job loss and TFP growth in regression 6 in Table 4.2 can be considered robust, Table 4.3 presents the results of a sensitivity analysis on the coefficient of fear of job loss in regression 6 in Table 4.2. The first row, under the heading "Baseline Regression" thus depicts the coefficient of regression 6.

The second row excludes obvious outliers that might drive the curvilinear relationship as identified in Fig. 4.3. After excluding Spain's hotel and restaurant sector (es H), the coefficient remains significant at the 95% level. After additionally excluding Austria's public administration and defense sector (at L) in row 3, the coefficient remains significant at the 95% level.

Rows 4–7 analyze the robustness among the various sectors. Figure 4.3 has already highlighted that cases from the public sector seem to be more oriented towards the left-hand side effect of the curvilinear relationship (positive relationship) and those from the service and manufacturing sectors towards the right-hand side (negative relationship). With this observation taken for granted, rows 4–7 differentiate specific sectoral clusters by modeling them in a linear relationship. When analyzing the service (GtK) and manufacturing (C-F) sectors in rows 4 and 5, one detects a non-significant negative relationship (although for the service sector the 90% level of significance is only slightly missed). As each of the two sectors only has a small number of observations, row 6 pools the observations of the service and manufacturing sectors into a non-farm market sector classification (C-K). When analyzing the 59 observations from the non-farm market sector (C-K), a negative linear relationship (at the 95% level) is notable. This result gives some initial empirical evidence of the assumption that the left-hand side effect of the curvilinear relationship (positive relationship) is driven by the public sector while the right-hand side effect (negative relationship) is driven by the non-farm market sector. The obtained β_3-coefficient of −0.06 should be interpreted in the following manner: on average a sector with a fear of job loss level that is 10% higher is associated with 0.6% lower TFP growth. In accordance with this argument, when analyzing the

[32] An overidentification test (Hansen J statistic) of the validity of the instruments was automatically performed within the utilized ivreg2 Stata command (Baum et al., 2010). With a $\chi(3)$ value of 3.67, the rejection of the null hypothesis fails. This indicates that the instruments used are valid.

[33] An underidentification test (Kleibergen-Paap rk LM statistic) was automatically performed within the utilized ivreg2 Stata command (Baum et al., 2010). With a $\chi(4)$ value of 20.3, the rejection of the null hypothesis fails. This indicates that the instruments used are relevant.

Table 4.3 Fear of job loss and TFP growth—sensitivity analysis

Row	Specification change	Fear of job loss/fear of job loss squared	Standard error	No. of observations	R-squared
Baseline regression					
1	No change	−0.001/−0.111**	(0.013)/(0.045)	82	0.35
Outliers					
2	Spain sector H	−0.003/−0.150**	(0.01)/(0.06)	81	0.34
3	Austria sector L and Spain sector H	−0.003/−0.150**	(0.01)/(0.07)	80	0.34
Restructuring—different sectors					
4	Service sectors G-K	−0.05	(0.03)	40	0.47
5	Manufacturing sector	−0.03	(0.08)	19	0.89
6	Nonfarm business sector C-K	−0.06**	(0.02)	59	0.45
7	Public sector	0.03	(0.02)	23	0.83
Control and policy variables—LR					
8	R&D intensity	−0.04*	(0.03)	46	0.68
9	Employment protection	−0.06**	(0.02)	59	0.46
Control and policy variables—CLR					
10	Product market regulation	0.005/−0.12***	(0.01)/(0.04)	82	0.37
11	Firm-specific human capital	−0.02/−0.07**	(0.01)/(0.04)	71	0.54

Notes: On abbreviations, LR = linear relationship and CLR = curvilinear relationship. The fear of job loss variable is centered to reduce the degree of multicollinearity (Kutner et al., 2004, pp. 295–300). All regressions include country dummies; numbers in parentheses are robust standard errors. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

public sectors (L-N) in row 7, one detects a positive but insignificant relationship (which might stem from the small sample size).

To control for the effect of potential control and policy variables, rows 8–11 include R&D (McMorrow et al., 2010), firm-specific human capital, labor market regulation (Nicoletti & Scarpetta, 2003; Timmer et al., 2010), and product market regulation (McMorrow et al., 2010; Nicoletti & Scarpetta, 2003; Timmer et al., 2010). As the variables for R&D and labor market regulation are only available for the non-farm business sector, the coefficient of the linear relationship as depicted in row 6 is used as the basis of the sensitivity analysis in rows 8 and 9. After including the control variable, the coefficient remains negative and significant at the 90% and 95% levels. Rows 10 and 11 control for the inclusion of firm-specific human capital and product market regulation. The significance of the curvilinear relationship is not altered.

5.2 How Do these Results Fit in with Other Existing Empirical Results?

To the author's knowledge, this is the first empirical analysis of the relationship between *organizational trust, fear of job loss* and *TFP growth* at a *sectoral* level. This section discusses the empirical evidence, using different research designs for interpreting the results presented above.

The non-significant empirical results between organizational trust and economic performance contrast with the positive finding by Frenkel and Orlitzky (2005) that higher workplace trust leads to higher workplace labor productivity. The results also contrast with the negative finding by Langfred (2004), that an excessively high trust level among autonomous, self-managing work teams leads to diminished monitoring activity and lower overall team performance, as well as the finding by Zaheer et al. (1998) of a positive relationship between interorganizational trust and economic performance. Likewise, the empirical results differ from the existing curvilinear evidence between interpersonal trust at the nation-state level (Roth, 2009) and individual level (Butler et al., 2009), and between interorganizational trust (Bidault & Castello, 2009) and economic performance. A final interpretation of the results, however, should be treated with caution, as the invalidity of the proxy may be affecting the empirical results.

The significant curvilinear relationship between job insecurity and economic performance may be related to empirical results by Brockner et al. (1992), who find a curvilinear relationship between job insecurity and employees' work efforts. The left-hand side of the curvilinear relationship (positive relationship) is in accordance with empirical work by Probst (2002, p. 211), who finds that job insecurity is associated with higher productivity but lower quality output, and by Probst et al. (2007), who find that job insecurity is associated with higher productivity but lower creative problem-solving. The right-hand side of the curvilinear relationship (negative relationship) can be linked to empirical results by Reisel et al. (2007), who report a negative relationship between job insecurity and organizational performance, and by D'Souza et al. (2006), who focus on sickness absence as a key indicator of labor productivity and find a negative relationship between job insecurity and organizational performance. The results are in contrast to the claim by Sverke et al. (2002) who find, when conducting a meta-analysis, that job insecurity and work performance are not significantly related to one another.

5.3 Objective Forces Driving Job Insecurity at the Individual Level

For a policy-relevant conclusion, one might turn to the question of which objective factors potentially shaped by policy-makers are the driving forces behind employees' fears of job loss. To answer this question, the results of a generalized

Table 4.4 Type of work contract and employees' fear of job loss, EU-15, 2005

	Marginal effects	
	Strongly disagree	Strongly agree
Indefinite contract	0.12***	−0.03***
	(0.02)	(0.01)
Fixed contract	−0.14***	0.07***
	(0.03)	(0.02)

Notes: Estimation by a generalized ordered probit model. The displayed values depict the marginal effects. The control variables include gender, age, size of household, tenure, living with partner, at least one other income in the household, education dummies for ISCED 3–4 and ISCED 5–6, gender of boss, regional unemployment rate, ISCO dummies, country dummies, and sectoral dummies (Table 4.A2). The excluded categories are other contracts, ISCED 0–2, female, female boss, no other income, and no partner. Similar, but distinct control variables have been used by Campbell et al. (2007). The numbers in parentheses are robust standard errors. The number of observations is 6, 774 employees from 12 EU-15 countries. Filters have been utilized as described above.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.
Source: EWCS 2005 (Eurofound, 2005).

ordered probit model[34] estimating individual data from the EWCS fourth wave (Eurofound, 2005) with a total of 6, 744 employee observations (drawn from 12 of the EU-15 countries) are presented in Table 4.4. Based on the given theoretical and empirical literature (Leana & van Buren III, 2000, p. 230; Eurofound, 2010b; Campbell et al., 2007, p. 552), the analysis focuses primarily on one objective factor regarded by the author as realistically influenced by policy-makers: the impact of the type of working contract on an employee's fear of job loss.[35] Table 4.4 shows the results (marginal effects) for the two response categories "*Strongly disagree*" and "*Strongly agree*" of a generalized ordered probit model with job insecurity as the dependent variable, and indefinite and fixed working contracts as independent variables (under the control of various, theoretically important variables). When interpreting the marginal effects of the two response categories "Strongly agree" and "Strongly disagree," it can be concluded that concerning indefinite contracts, in all sectors the probability of responding "Strongly disagree" is around 12% higher for employees who have an indefinite contract and 14% lower for employees who have a fixed contract. Concerning fixed contracts, in all sectors, the probability of

[34] Because the measurement of job insecurity in the EWCS of 2005 (Eurofound, 2005) is on a five-point scale, an ordered probit analysis has been utilized for this purpose. As the underlying assumptions for estimating a proportional odds model are violated, the likelihood-ratio test of the equality of coefficients clearly rejects the null hypothesis of no violation, a generalized ordered probit model is estimated in which coefficients are allowed to vary over outcome categories (Boes, 2006).

[35] In contrast to Campbell et al. (2007), who find that 77% of workers who have a high fear of job loss have indefinite contracts, among the given population of 6,744 employees within the fourth wave of the EWCS (Eurofound, 2005), only 57% of the workers who have a high fear of job loss (agree + strongly agree) have indefinite contracts.

responding "Strongly agree" is around 7% higher for employees who have a fixed contract and 3% lower who have an indefinite contract.

6 Conclusion

This contribution has analyzed the relationship between organizational trust, fear of job loss, and TFP growth at a sectoral level in a European country sample. Six *empirical conclusions* are noteworthy.

First, there is no significant relationship between organizational trust and TFP growth at the sectoral level. This finding is in contrast to most other findings in the general literature on trust and economic performance. As the non-significant result might, however, be due to the invalidity of the proxy used, this result should be interpreted with caution. Taking the theoretical literature and the most recent empirical work on the relationship between trust and economic performance seriously, a valid measure of trust should most likely yield a curvilinear relationship between trust and growth.

Second, there is a curvilinear relationship between fear of losing one's job and TFP growth at the sectoral level in a European country sample of 100 observations consisting of 15 EU-27 countries. This curvilinear relationship is driven by the three transition countries, the Czech Republic, Slovenia, and Hungary, indicating that in all three countries fear of job loss levels are above optimality with respect to TFP growth.

Third, given an EU-15 country sample with a total of 82 observations, a curvilinear relationship is detected. This curvilinear relationship proves to be robust 1) when controlling for potential endogeneity, 2) excluding outliers, and 3) including relevant policy variables. The curvilinear relationship is driven by the sectoral variance within the given sample. The sectors with levels of fear of job loss that are excessively high are hotels and restaurants, construction, and business activities. The sectors with an optimal level of fear of job loss are wholesale and retail trade, manufacturing and mining, and transport and communication. The sectors that on average have fear of job loss levels that are too low are financial intermediation, public administration, and education and health.

Fourth, when analyzing the curvilinear relationship between fear of job loss and TFP growth in the EU-15 country sample from a sectoral perspective, the individual sectors exhibiting levels of fear of job loss that are too low are public administration in Austria, Spain, and France, education and health in Austria and Spain, and financial intermediation in Belgium. Those exhibiting fear of job loss levels that are too high are wholesale and retail trade in Austria and Belgium, hotels and restaurants in Spain and Austria, manufacturing in Belgium and Italy, construction in Spain and Finland, and business in the Netherlands and France.

Fifth, when analyzing the curvilinear relationship between fear of job loss and TFP growth within the EU-15 country sample from a country perspective, employees exhibit excessive fear of job loss across the sectors in Germany and Spain, an optimal level in Austria, Belgium, and Italy, and too little in the UK and Denmark.

Sixth, on an individual basis, an objective factor that is associated with fear of job loss is the type of contract an employee possesses. As expected, employees with indefinite contracts are significantly less afraid of losing their jobs than those with fixed contracts.

The following four *policy conclusions* can be drawn. The first two are general policy conclusions and the latter two seek to improve lagging TFP growth.

First, to address ethical concerns, Eurofound should consider incorporating a valid measure of organizational trust in the next design of the EWCS (most likely to be conducted in 2015). The concept of organizational trust is theoretically too important not to be validly measured in publicly available surveys.[36]

Second, as job insecurity theoretically and empirically seems to have a significant and curvilinear relationship with TFP growth, academic research in economics that interlinks such psychological concepts as trust to economic performance should also extend awareness of the importance of the concept of fear (of job loss). In addition, the concept of the "dark side of trust" (Gargiulo & Ertug, 2006) has been neglected by current academic research focusing on the relationship between trust and economic performance. Being aware of this "dark side of trust", academic research should incorporate models of trust and economic performance in a curvilinear manner.

Third, from a policy point of view, most sectoral fear of job loss levels in the three transition countries are well above the optimal degree of fear of job loss with respect to TFP growth. In all three countries, employment relations seem to be too deregulated and liberalized with respect to the high levels of job insecurity found in most sectors. From a fear of job loss perspective, these countries should implement regulations enhancing job security. Such regulations should be implemented by governmental actors in consultation with labor unions and employer organizations.

Fourth, from a policy point of view, there are some sectors in the EU-15 in which employment relations need to be further deregulated and liberalized to improve the EU's productivity performance, especially public administration, health and education, and financial intermediation. In other sectors, notably construction on the manufacturing side, and hotels and restaurants and business services on the services side, fear of job loss has already reached levels that are counterproductive to Europe's productivity performance. Here, foremost, the excessive levels of fear of job loss in the business services seem particularly worrying, as this sector is deeply engaged in knowledge production—a key asset for the future competitiveness of European economies. In these sectors, liberalization has already been taken too far, triggering growth-hampering effects, as discussed in the theoretical part of this contribution. These sectors should be regulated again towards more job security.

[36] Private consultancy firms that are aware of the importance of trust do measure it, but their results are not made publicly available to academic researchers.

Appendix

Table 4.A1 Summary statistics for the aggregate data analysis

Variable	Observations	Mean	Std. Dev.	Min.	Max.
TFP growth	165	0.007	0.023	−0.091	0.074
Catch-up term	165	−0.63	0.58	−4.79	0
Growth at the frontier	165	0.009	0.027	−0.029	0.07
Trust colleagues	103	0.69	0.19	0.075	0.96
Trust boss	103	0.52	0.23	−0.11	0.83
Fear of job loss	100	−0.55	0.25	−0.95	0.30
Contract fixed	82	0.11	0.072	0.0	0.42
Indefinite contract	82	0.77	0.14	0.25	0.98
Medium-size firm	82	0.45	0.10	0.22	0.69
Large-size firm	82	0.30	0.16	0.02	0.73
R&D intensity (in %)	46	1.92	3.11	0	12.95
Employment protection	59	2.30	1.28	0.46	5.61
Product market regulation	82	0.15	0.13	0.019	0.43
Firm-specific human capital	71	0.11	0.079	0.018	0.35

Table 4.A2 Summary statistics for the individual analysis

Variable	Observations	Mean	Std. Dev.	Min.	Max.
Job insecurity	6774	1.90	1.17	1	5
Male	6774	0.47	0.50	0	1
Age	6774	40.6	11.6	15	72
Tenure	6774	20.6	12.5	0	64
Size of household	6774	2.8	1.4	1	13
Indefinite contract	6774	0.79	0.41	0	1
Fixed contract	6774	0.11	0.31	0	1
Living with a partner	6774	0.64	0.49	0	4
At least one other income	6774	0.61	0.49	0	1
ISCED 3–4	6774	0.50	0.50	0	1
ISCED 5–6	6774	0.30	0.46	0	1
Male boss	6774	0.68	0.47	0	1
Regional unemployment rate	6774	7.12	3.35	2.6	21.3

References

Ashford, S. J., Lee, C., & Bobko, P. (1989). Content, causes and consequences of job insecurity: A theory-based measure and substantive test. *Academy of Management Journal, 32*(4), 803–829.

Ashkanasy, N. M., & Nicholson, G. J. (2003). Climate of fear in organisational settings: Construct definition, measurement and a test of theory. *Australian Journal of Psychology, 55*(1), 24–29.

Bidault, F., & Castello, A. (2009). Trust and creativity: understanding the role of trust in creativity-oriented joint developments. *R&D Management, 39*(3), 259–270.

Baum, C. F., Schaffer, M. E., & Stillman, S. (2010). *IVREG2: Stata module for extended instrumental variables/2SLS, GMM and AC/HAC, LIML and k-class regression*. Boston College. http://ideas.repec.org/c/boc/bocode/s425401.html

Black, S. E., & Lynch, L. M. (2005). Measuring organizational capital in the new economy. In C. Corrado, J. Haltiwanger, & D. Sichel (Eds.), *Measuring capital in the new economy* (pp. 205–236). University of Chicago Press.

Blanchflower, D., & Oswald, A.J. (1999). Well-Being, Insecurity and the Decline of American Job Satisfaction. Mimeo, 22 July.

Blanchflower, D. (1991). Fear, unemployment and pay flexibility. *Economic Journal, 101*(406), 483–496.

Bloom, N., & van Reenen, J. (2007). Measuring and explaining management practices across firms and nations. *Quarterly Journal of Economics, 122*(4), 1351–1408.

Boes, S. (2006). GOBROBIT: Stata module to estimate generalized ordered probit models. http://fmwww.bc.edu/repec/bocode/g/goprobit.ado.

Brockner, J., Grover, S., Reed, T. F., & Dewitt, R. L. (1992). Layoffs, job insecurity, and survivors' work effort: evidence of an inverted-U relationship. *Academy of Management Journal, 35*(2), 413–425.

Butler, J., Guilano, P., & Guiso, L. (2009). *The right amount of trust, EUI working papers – ECO 2009/33*. Department of Economics, European University Institute.

Campbell, D., Carruth, A., Dickerson, A., & Green, F. (2007). Job insecurity and wages. *Economic Journal, 117*(518), 544–566.

Corrado, C., Hulten, C., & Sichel, D. (2005). Measuring capital and technology: An expanded framework. In C. Corrado, J. Haltiwanger, & D. Sichel (Eds.), *Measuring capital in the new economy* (pp. 11–45). University of Chicago Press.

Corrado, C., Hulten, C., & Sichel, D. (2009). Intangible capital and economic growth in the US. *Review of Income and Wealth, 55*(3), 661–685.

D'Souza, R. M., Strazdins, L., Brom, D. H., Rodgers, B., & Berry, H. L. (2006). Work demand, job insecurity and sickness absence from work: How productive is the new, flexible labour force? *Australian and New Zealand Journal of Public Health, 30*(3), 205–212.

De Witte, H. (2005). Job insecurity: Review of international literature on definitions, prevalence, antecedents and consequences. *The Journal of Individual Psychology, 31*(4), 1–6.

Dirks, K. T., & Ferrin, D. L. (2001). The role of trust in organizational settings. *Organization Science, 12*(4), 450–467.

Dirks, K. T., & Skarlicki, D. P. (2004). Trust in Leaders: Existing Research and Emerging Issues. In R. M. Kramer & K. S. Cook (Eds.), *Trust and distrust in organizations – dilemmas and approaches*. Russell Sage Foundation.

Elias, N. (1980). *Über den Prozeß der Zivilisation – Soziogenetische und psychogenetische Untersuchungen. Zweiter Band. Wandlungen der Gesellschaft – Entwurf zu einer Theorie der Zivilisation*. Suhrkamp.

Eurofound (2005). *European working conditions survey, 2005 [computer file]*. UK Data Archive [distributor], SN: 5639. Colchester, Essex, May 2007. https://doi.org/10.5255/UKDA-SN-5639-1.

Eurofound (2007). *Quality report of the 4th European working condition survey*. Eurofound.

Eurofound. (2010a). *European Working Conditions Survey, 2010* [computer file]. UK Data Archive [distributor], SN: 6971. Colchester, Essex, February 2012. https://doi.org/10.5255/UKDA-SN-6971-1.

Eurofound. (2010b). *Changes over time – First findings from the fifth European Working Condition Survey*. Eurofound. http://www.eurofound.europa.eu/pubdocs/2010/74/en/3/EF1074EN.pdf

Frenkel, S., & Orlitzky, M. (2005). Organizational trustworthiness and workplace labour productivity: Testing a new theory. *Asia Pacific Journal of Human Resources, 43*(1), 34–51.

Fukuyama, F. (1996). *Trust: The social virtues and the creation of prosperity*. Free Press.

Gargiulo, M., & Ertug, G. (2006). The dark side of trust. In R. Bachmann & A. Zaheer (Eds.), *Handbook of trust research*. Edward Elgar.

Greenhalg, L., & Rosenblatt, Z. (2010). Evolution of research on job insecurity. *International Studies of Management & Organization, 40*(1), 6–19.

Hardin, R. (2006). *Trust*. Polity Press.

Harisalo, R., & Stenvall, J. (2004). Trust as capital: The foundation of management. In M. Huotari & M. Iivonen (Eds.), *Trust in knowledge management and systems in organizations*. Idea Group Publishing.

Heliwell, J. F., & Huang, H. (2011). Well-being and trust in the workplace. *Journal of Happiness Studies, 12*(5), 747–767.

Heliwell, J. F. (2006). Well-Being, social capital and public policy: What's new? *Economic Journal, 166*, C34–C55.

Heliwell, J. F., Huang, H., & Putnam, R. D. (2009). How's the job? Are trust and social capital neglected workplace investments? In V. O. Bartkus & J. H. Davis (Eds.), *Social capital: Reaching out, reaching in* (pp. 87–144). Edward Elgar Publishing.

INDICSER. (2013). *Indicators for evaluating international performance in service sectors, project coordinator*. Birmingham Business School, University of Birmingham. https://cordis.europa.eu/project/id/244709/de

Inklaar, R., & Timmer, M. P. (2008). *GGDC productivity level database: International comparisons of output, inputs and productivity at the industry level, groningen growth and development centre research memorandum GD-104*. University of Groningen.

Knack, S., & Keefer, P. (1997). Does social capital have an economic payoff—A cross-country comparison. *Quarterly Journal of Economics, 112*, 1251–1288.

Kutner, M. H., Nachtsheim, C. J., Neter, J., & Li, W. (2004). *Applied linear statistical models*. McGraw-Hill.

Langfred, C. W. (2004). Too much of a good thing? Negative effects of high trust and individual autonomy in self-managing teams. *Academy of Management Journal, 47*(3), 385–399.

Leana, C., & van Buren, H. J., III. (1999). Organizational social capital and employment practices. *Academy of Management Review, 24*(3), 538–555.

Leana, C., & van Buren, H. J., III. (2000). Eroding organizational social capital among US firms: The price of job instability. In R. Burke & C. Cooper (Eds.), *The organization in crisis – Downsizing, restructuring and privatization*.

Lev, B., & Radhakrishnan, S. (2005). The valuation of organizational capital. In C. Corrado, J. Haltiwanger, & D. Sichel (Eds.), *Measuring capital in the new economy* (pp. 73–110). University of Chicago Press.

Marcuse, H. (1998). *Der eindimensionale Mensch – Studien zur Ideologie der fortgeschrittenen Industriegesellschaft*. München.

Marks, L. M. (2003). *Charging back up the hill: Workplace recovery after mergers, acquisition and downsizing*. Jossey-Bass.

Mayer, R. C., Davis, J., & Schoorman, D. (1995). An integrative model of organizational trust. *Academy of Management Review, 20*(3), 709–734.

McMorrow, K., Röger, W., & Turrini, A. (2010). Determinants of TFP growth: A closer look at industries driving the EU–US gap. *Structural Change and Economic Dynamics, 21*(3), 165–180.

Murray, M. P. (2006). Avoiding invalid instruments and coping with weak instruments. *Journal of Economic Perspectives, 20*(4), 120–126.

Nahapiet, J., & Goshal, S. (1998). Social capital, intellectual capital and the organizational advantage. *Academy of Management Review, 23*(2), 242–266.

Nicoletti, G., & Scarpetta, S. (2003). Regulation, productivity and growth: OECD evidence. *Economic Policy, 18*(36), 9–72.

Patterson, M., Warr, P., & West, M. (2004). Organizational climate and company productivity: The role of employee affect and employee level. *Journal of Occupational and Organizational Psychology, 77*(2), 193–216.

Probst, T. (2002). Layoffs and tradeoffs: Production, quality, and safety demands under the threat of job loss. *Journal of Occupational Health Psychology, 7*(3), 211–220.

Probst, T., Stewart, S. M., Gruys, M. L., & Tierney, B. W. (2007). Productivity, counter productivity and creativity: The ups and downs of job insecurity. *Journal of Occupational and Organizational Psychology, 80*(3), 479–497.

Putnam, R. D. (2000). *Bowling alone: The collapse and revival of American community*. Simon & Schuster.

Reisel, W. D., Chia, S.-L., Maloles, C. M., III, & Slocum, J. W., Jr. (2007). The effects of job insecurity on satisfaction and perceived organizational performance. *Journal of Leadership & Organizational Studies, 14*(2), 106–116.

Renzl, B. (2008). Trust in management and knowledge sharing: The mediating effects of fear and knowledge documentation. *Omega, 36*(2), 206–220.

Roth, F. (2009). Does too much trust hamper economic growth? *Kyklos, 62*(1), 103–128.

Royuela, V., & Surinach, J. (2009). *Quality in work and aggregate productivity, working paper 2009/01*. Research Institute of Applied Economics (IREA).

Saam, M., Cerquera, D., Reitze, G., Inklar, R., O'Mahony, M., Peng, F., Rammer, C., Rincon-Aznar, A., Roth, F., & Sarbu, M. (2011). *First version of indicators on innovation, ICT use and intangibles – Annotations*. INDICSER Discussion Paper 4.

Schotter, A. (1996). *Worker trust, system vulnerability, and the performance of work groups, economic research report no. 32*. New York University.

Staufenbiel, T., & König, C. J. (2010). A model for the effects of job insecurity on performance, turnover intention, and absenteeism. *Journal of Occupational and Organizational Psychology, 83*(1), 101–117.

Stock, J. H., & Watson, M. W. (2007). *Introduction to econometrics*. Pearson-Addison Wesley.

Sverke, M., Hellgren, J., & Näswell, K. (2002). No security: A meta-analysis and review of job insecurity and its consequences. *Journal of Occupational Health Psychology, 7*(3), 242–264.

Timmer, M., van Moergastel, T., Stuivenwold, E., Ypma, G., O'Mahony, M., & Kangasniemi, M. (2007). EU KLEMS growth and productivity accounts version 1.0 Part I: Methodology. EU KLEMS deliverable.

Timmer, M., Inklaar, R., O'Mahony, M., & van Ark, B. (2010). *Economic growth in Europe*. Cambridge University Press.

Van Ark, B., O'Mahony, M., & Timmer, M. P. (2008). The productivity gap between Europe and the United States: Trends and causes. *Journal of Economic Perspectives, 22*(1), 25–44.

Whiteley, P. F. (2000). Economic growth and social capital. *Political Studies, 48*(3), 443–466.

Woolridge, J. M. (2002). *Econometric analysis of cross section and panel data*. MIT Press.

Zaheer, A., McEvily, B., & Perrone, V. (1998). Does trust matter? Exploring the effects of interorganizational and interpersonal trust on performance. *Organization Science, 9*(2), 141–159.

Chapter 5
Intangible Capital and Labor Productivity Growth: Panel Evidence for the EU from 1998–2005

Felix Roth and Anna-Elisabeth Thum

Abstract Using new international comparable data on intangible capital investment by business within a panel analysis between 1998–2005 in an EU country sample, a positive and significant relationship between intangible capital investment and labor productivity growth is detected. This relationship proves to be robust to a range of alterations. The empirical analysis confirms previous findings that the inclusion of business intangible capital investment in the asset boundary of the national accounting framework increases the rate of change of output per hour worked more rapidly. In addition, intangible capital is able to explain a significant portion of the unexplained international variance in labor productivity growth and becomes a dominant source of growth.

JEL Codes C23 · O47 · O52

Keywords Intangible capital · Labor productivity growth · Panel analysis · EU

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1 Introduction

As highly developed economies transform more and more into knowledge economies, the input of intangible capital becomes vital for the future competitiveness of their economies (Corrado et al., 2005; World Bank, 2006), as well as the competitiveness of their firms (Teece, 1998, p. 76; Eustace, 2000, p. 6; Lev & Radhakrishnan, 2003, 2005). Although further refinement of the concept of intangible capital is still clearly needed, the overall measurement of the different dimensions of intangible capital has largely improved, and past assessments, which have called into question the possibility of measuring certain dimensions of intangible capital, seem to have been too pessimistic.[1] Nevertheless, it remains an open question as to which range of intangible capital indicators should be incorporated into the asset boundary (Hill, 2009; Stiglitz et al., 2009) and which dimensions should be included in a definition of intangible capital (World Bank, 2006).

This contribution focuses on intangible capital investment by *businesses*. Using international comparable data on business intangible capital investment generated within the INNODRIVE project[2] (INNODRIVE, 2011; Jona-Lasinio et al., 2011), this contribution aims to present new econometric evidence about the impact of investments in business intangible capital on labor productivity growth in the business sector. As envisaged in the INNODRIVE framework (Jona-Lasinio et al., 2011), the dimensions of business intangible capital were generated along the framework originally proposed by Corrado et al. (2005, 2009). However, as the

[1] As recently as 1999, Robert Solow criticized the introduction of the term "social capital" into the discipline of economics, by highlighting that "the term *capital* stands for a stock of produced or natural factors of production that can be expected to yield productive services for some time." He continues to state the view that: "Originally, anyone who talked about capital had in mind a stock of *tangible*, solid, often durable things such as buildings, machinery, and inventories" (Solow, 1999, p. 6; emphasis added). Ten years later, the concept of *intangible capital* (including social and human capital) seems to have found its way into the economic discipline. Other than the notion of social capital, *intangible* capital defines itself exactly as not being *tangible*. Hence, the term intangible capital seems to offer an umbrella term for all those forms of capital that are theoretically important for productivity but are not tangible in nature. A very similar definition is used in the World Bank (2006) book entitled *Where is the Wealth of Nations?*, in which the authors use intangible capital as an umbrella term for human capital, the skills and know-how of the workforce, social capital, the level of generalized trust among citizens, and an economy's institutional framework, such as an efficient judicial system and clear property rights, which exert a positive influence on the overall economy.

[2] The INNODRIVE (Intangible Capital and Innovation: Drivers of Growth and Location in the EU) project consists of the National Intangibles Database and the Company Intangibles Database. The INNODRIVE National Intangibles Database provides time series of the Gross Fixed Capital Formation for different intangible capital components for the EU-27 countries and Norway. This dataset is utilized in the following empirical analysis and is cited as INNODRIVE, 2011. A detailed description of the dataset is given in Jona-Lasinio et al. (2011). The goal of the INNODRIVE macro approach was to replicate the intangible capital measures which were produced by CHS (2005 and 2009) for the US for the EU.

author wholly shares the view of the World Bank (2006), namely that the dimensions of human and social capital should also be classified as intangible capital, the dimensions of human and social capital have been included in the Total Factor Productivity (TFP) term of the utilized model specification.

2 Theoretical Links between Business Intangible Capital and Labor Productivity Growth

2.1 Theoretical Relationship between Intangible Capital and Labor Productivity Growth

The importance of Business Enterprise Research & Development (BERD) and innovation was explicitly recognized in the "Lisbon process" and has been adopted by the European 2020 strategy for smart, sustainable, and inclusive growth (European Commission, 2010). Although the importance of business investment in Research & Development has already been widely acknowledged—by policy-makers and in economic theory—our knowledge of the contribution of business intangibles to labor productivity growth is still incomplete. Generating a wider concept of innovation and focusing on the issue of a possible revision of the national accounting framework, Corrado et al. (2005) have grouped various items that constitute the knowledge of the firm into three basic categories: 1) computerized information, 2) innovative property, and 3) economic competencies.

Whereas computerized information includes knowledge that is contained in computer programs and computerized databases, innovative property includes the *scientific* knowledge embedded in patents, licenses, and general know-how, as well as "the innovative and artistic content in commercial copyrights, licences and designs" (Corrado et al., 2005, pp. 23–26). Corrado et al. (2005, p. 28) define the economic competencies category of intangibles as "the value of brand names and other knowledge embedded in firm-specific human and structural resources". It includes expenditures on advertising, market research, firm-specific human capital, and organizational capital. These measures indicate that the potential of intangible capital for stimulating productivity growth lies in the provision of knowledge, an increase in the selling potential of a product, and the development of processes and a productive environment for the actual physical production of a good, or as van Ark et al. (2009, p. 63) stress, that products and services are becoming more knowledge-intensive.

While the positive relationship between computerized information, here in particular via an interaction effect with organizational capital (Brynjolfsson et al., 2002), and certain dimensions of innovative property (scientific R&D) (Lichtenberg, 1993; Coe & Helpman, 1995; Park, 1995; Guellec & van Pottelsberghe de la Potterie, 2001) on labor productivity growth have already been extensively discussed it seems important to stress once more the theoretical importance of the

single dimensions of economic competencies, namely brand names, firm-specific human capital, and organizational capital.

In theory, *brand names* should positively affect labor productivity growth since an important aspect of today's products is the "image" attached to them. Cañibano et al. (2000) argue that the ownership of a brand that is appealing to customers permits a seller to acquire a higher margin for goods or services that are like those offered by competitors. As the consumer's choice among the products of competing firms is often motivated by a perception of reliability and trustworthiness, the development of this image or brand has to be considered pivotal in the yield of future benefits. Expenditure on market research comprises, next to expenditure on advertising, an important part of the investment in brand equity.

Firm-specific human capital is another important asset of a firm. Cañibano et al. (2000) stress that a firm with more competent employees is likely to earn higher profits than competitors whose workers are less skilled. In this regard, Abowd et al. (2005) argue that the value of companies will increase if the quality of their human resources increases.

In addition to the "image" projected by a firm or a product and the quality of the training of workers, the management of a production process involving highly technological physical capital has also become important. As goods become more and more sophisticated, production processes become more complex and the *organizational capital* of a firm becomes crucial. Lev and Radhakrishnan (2005, p. 75) define organizational capital as "an agglomeration of technologies – business practices, processes and designs and incentive and compensation systems – that together enable some firms to consistently and efficiently extract from a given level of physical and human resources a higher value of product than other firms find possible to attain." Organizational capital is seen by them (Lev & Radhakrishnan, 2003, 2005) as the only competitive asset truly owned by a firm, while the others are tradable and thus available to any firm that wants to invest in them.

2.2 The Treatment of Intangible Expenditures

Although, as argued above, the existing literature widely recognizes the importance of the various dimensions of business intangible capital for the enhancement of growth, in contemporary accounting practice, intangibles are treated as intermediate expenditures and are not classified as investments in Gross Fixed Capital Formation (GFCF). This situation has improved with the inclusion of software, mineral exploration, and entertainment, literary, and artistic originals within the asset boundary of the national accounts. Moreover, for innovative properties, such as scientific R&D investment, national accounts have started to set up satellite accounts.

In the economic literature, this situation has gradually improved as a result of Corrado et al.'s (2005) approach to capitalize the above-mentioned intangibles. Utilizing standard intertemporal capital theory, they define investments as "any

use of resources that reduces current consumption in order to increase it in the future" (Corrado et al., 2005, pp. 17–19) and treat intangibles, in contrast to the national accounting framework, as investments rather than as intermediate goods; thus, including it in the asset boundary rather than netting it out. Corrado et al. (2009, pp. 663–66) model the impact of capitalizing intangible assets on the sources-of-growth model as follows:

$$g_Q(t) = s_L(t)g_L(t) + s_K(t)g_K(t) + s_R(t)g_R(t) + g_A(t) \tag{5.1}$$

where Q is GDP expanded by the flow of new intangibles, $g_X(t)$ denotes the rate of growth of the respective variables, and $s_X(t)$ represents the input shares. L is labor, K is the tangible capital stock, R is the intangible capital stock, and A is the TFP term.

3 Estimates of Intangible Capital Investment

Following Corrado et al. (2005, 2009), the INNODRIVE macro approach (INNODRIVE, 2011; Jona-Lasinio et al., 2011) has classified business intangible capital investment into three groups: 1) computerized information, 2) innovative property, and 3) economic competencies. Moreover, it differentiates two "old" intangible capital variables[3]—1) software and 2) mineral exploration and copyright and license costs[4]—in to eight new intangible capital variables: 3) scientific R&D, 4) new product development in the financial services industry, 5) new architectural and engineering designs, 6) advertising, 7) market research, 8) firm-specific human capital, 9) own-account, and 10) purchased component of organizational capital.

The first group, computerized information, contains: 1) computer software. Computer software was measured by using data from the EUKLEMS[5] project, as well as official national account data and the use table from the supply and use framework (Jona-Lasinio et al., 2011, pp. 35–36).

The second group, innovative property, contains the following variables: 2) scientific R&D, 3) new product development in the financial services industry, 4) new architectural and engineering designs, and 5) mineral exploration and copyright and license costs.

[3] In the INNODRIVE macro approach (INNODRIVE, 2011), software and mineral exploration, and copyright and license costs (for the development of entertainment, literary, and artistic originals) are considered national account intangibles (i.e., they have already been included in the national accounts), whereas the other intangibles are considered as new intangibles.

[4] In contrast to Corrado et al. (2005, 2009), the INNODRIVE macro approach (INNODRIVE, 2011) has merged these two variables when presenting the final investment data.

[5] EUKLEMS refers to the research project "Productivity in the European Union: A Comparative Industry Approach" and stands for EU level analysis of capital (K), labor (L), energy (E), materials (M), and service (S) inputs. The data can be downloaded at: http://www.euklems.net/.

To measure investment in *scientific R&D*, data on expenditure on R&D by businesses were retrieved from Eurostat. To avoid double-counting of software investment and investment in the development of new products within the financial services industry, data for the subsector K72 (computer and related activities) and sector J (financial intermediation) were subtracted from the R&D expenditure. In accordance with Corrado et al. (2005), expenditure in scientific R&D was considered a 100% investment in intangible capital (Jona-Lasinio et al., 2011, pp. 37–39).

Mineral exploration and copyright and license costs were measured with the help of data from the national accounts and the use tables from the supply and use frameworks (Jona-Lasinio et al., 2011, p. 39).

Investment in *new architectural and engineering designs* has been measured using data from the national accounts (Jona-Lasinio et al., 2011, pp. 40–41).

Investment in *new product development in the financial services industry* was measured, according to Corrado et al. (2005), on the basis of 20% of total intermediate spending for intermediate inputs by the financial intermediation industry, which is defined as excluding insurance and pension funding (NACE J65) (Jona-Lasinio et al., 2011, pp. 41–42).

The third group, economic competencies, contains the following variables: 6) advertising expenditure, 7) expenditure on market research, 8) firm-specific human capital, 9) own-account development of organizational structure, and 10) purchased organizational structure.

To measure investment in *advertising*, a private data source (Zenith Optimedia) was used.[6] Zenith Optimedia data report the expenditure on advertising in newspapers and other media which should capture the purchased and own-account expenditure. Following Corrado et al. (2005), who followed Landes and Rosenfield (1994), only 60% of the actual expenditure was considered investment (Jona-Lasinio et al., 2011, pp. 42–44). In order to measure the investment in market research, data on the turnover of subsector K7413 (Market Research and Public Opinion Polling) from Eurostat's Structural Business Statistics on Business Services were taken. Following the approach of Corrado et al. (2005), the prevalence of own-account market and consumer research was estimated by doubling the estimate of the data on market research (Jona-Lasinio et al., 2011, pp. 44–46).

Data on *firm-specific human capital* were taken from Eurostat's Continued Vocational Training Survey. This variable is a measure of the training expenditure by enterprises and is computed as the cost of continued vocational training courses as a percentage of total labor costs multiplied by employee compensation. This training expenditure was considered a 100% investment in intangible capital. The estimation method is applied at the industry level to guarantee that the compositional changes of industries are taken into account. The measures are then aggregated to obtain data on the national level (Jona-Lasinio et al., 2011, pp. 46–49).

Organizational capital is measured by the own-account and purchased investment in the organizational structure of a firm. Data on the own-account component of

[6] Felix Roth is grateful to Zenith Optimedia for making the data available to him.

organizational capital are taken from the EU Structure of Earnings Survey (in 2002) and the EU Labor Force Survey. Own-account organizational capital is represented by the compensation of the management. Manager compensation is computed as the manager compensation share multiplied by the compensation of all employees. The manager compensation share is the share of gross earnings of managers over the gross earnings of all employees. Following Corrado et al. (2005), it was assumed that 20% of manager compensation is spent on investment in the organizational structure of a firm. Data on the purchased component of organizational capital are taken from Eurostat's Structural Business Statistics on Business Services and the FEACO[7] Survey of the European Management Consultancy Market. Purchased organizational capital is represented by management consultancy fees. In order to compute the purchased component of organizational capital, the nominal gross output or turnover of NACE 7414 (business and management consultancy activities) was used. It was assumed that 80% of business sector expenditure is considered an investment (Jona-Lasinio et al., 2011, pp. 49–54, 61–62).

As can be inferred by the INNODRIVE macro dataset (INNODRIVE, 2011), all investment rates were constructed for the non-farm business sector and thus for NACE sectors c–k + o.[8]

4 Previous Empirical Results

Several empirical studies have tried to estimate the importance of business intangible assets for labor productivity growth. Up to now, all existing studies have utilized a growth accounting methodology.[9] There is an extensive body of literature studying intangible capital investment both at the micro (firm) level (e.g., Brynjolfsson & Yang, 1999; Webster, 2000; Brynjolfsson et al., 2002; Cummins, 2005; Lev & Radhakrishnan, 2005) and at the macro (national) level. A detailed summary of the microeconomic studies, as mentioned above, is not undertaken here as this analysis focuses solely on the macroeconomic level.

[7] FEACO stands for Fédération Européene des Associations de Conseils en Organisation.

[8] NACE stands for Nomenclature Générale des Activités Economiques dans I′Union Européenne and covers sectors from a to q. According to NACE rev. 1.1, sectors c to k plus o cover the non-farm (a + b) market sectors: mining and quarrying (c), manufacturing (d), electricity, water, and gas supply (e), construction (f), wholesale and retail trade (g), hotel and restaurants (h), transport, storage, and communication (i), financial intermediation (j), real estate, renting, and business activities (k), and other community, social, and personal service activities (o). They exclude: public administration, defense, and compulsory social security (l), education (m), health and social work (n), activities of households (p), and extra-territorial organizations and bodies (q).

[9] For a more detailed discussion, see Barro and Sala-i-Martin (2004, pp. 433–60) or Temple (1999, pp. 120–21).

Recent literature on the macroeconomic level has highlighted three important lines of results once intangibles are capitalized: 1) the share of intangible capital investments as a percentage of GDP or market sector gross value added (MGVA), 2) the contributions of intangible capital on output growth within an accounting framework, and 3) the growth acceleration. Table 5.1 provides an overview of these three dimensions in the literature most recently published in this field. Corrado et al. (2005) find for the United States that the investment in business intangibles represented 10%–12% of existing GDP between 1998 and 2000 and approximately 13% of non-farm business output in 2003 (see Fig. 2 of Corrado et al., 2009, p. 673). In line with Corrado et al., Nakamura (2010, p. S138), analyzing a timeframe from 1959 to 2007, finds that investments in intangibles become as important as investment in tangibles in the US around 2000. Marrano et al. (2009) show that in the United Kingdom the private sector spent a sum equivalent to 13% of adjusted MGVA on business investment in intangibles in 2004. A working paper by Jalava et al. (2007) finds that the Finnish investment in non-financial business intangibles was 9.1% of unrevised GDP in 2005. Fukao et al. (2009) estimate 11.1% of GDP was invested in intangible capital in Japan in 2000–2005. According to Hao et al. (2009), Germany and France invested 7.1% and 8.8%, respectively, and Italy and Spain invested 5.2% in intangibles in the market sector over GDP in 2004. A working paper by Van Rooijen-Horsten et al. (2008) finds an investment share for intangibles of 8.3% of GDP when general government industry is excluded for the Netherlands in 2001–2004. Van Ark et al. (2009) find intangible investment shares in the market sector of 6.5% in Austria, 6.5% in the Czech Republic, and 7.9% of GDP in Denmark in 2006.[10] Investments for the UK, Germany, France, Italy, Spain, and the US are similar to those in the other papers. Edquist (2011) finds that in Sweden, total business investment in intangibles was equivalent to 10% of GDP, or approximately 16% of the business sector gross value added (GVA) in 2006.

Second, when looking at the contribution of intangible capital to output growth, Corrado et al. (2009) find for the US that 27% of labor productivity growth in 1995–2003 is explained by intangible capital. Marrano et al. (2009) find that 20% of labor productivity growth is accounted for by intangible capital deepening in 1995–2003 in the United Kingdom. Jalava et al. (2007) find that intangible capital accounts for 16% of labor productivity growth in 1995–2000 and for 30% in 2000–2005 in the Finnish case. Fukao et al. (2009) show that intangible capital explains 27% of the Japanese growth rate in 1995–2000 and 16% in 2000–2005. Hao et al. (2009) find that intangibles account for 31% of labor productivity growth in Germany, 37% in France, 59% in Italy, and 64% in Spain. Van Ark et al. (2009) find that in Germany, France, Italy, Spain, Austria, the Czech Republic, and Denmark, intangible capital accounts for, respectively, 21%, 24%, 41%, 26%, 23%,

[10]The authors also provide estimates for Greece and Slovakia. These are not reported here as they are not part of the country sample in this paper.

15%, and 34% of labor productivity growth. Finally, Edquist (2011) finds for Sweden that the contribution of intangible capital drops from 41% in the period 1995–2000 to 24% from 2000 to 2006.

Third, overall the capitalization of intangible capital accelerates productivity growth. Detailed results of the growth acceleration values will be discussed in comparison with the INNODRIVE data in Sect. 6.

Table 5.1 Summary of existing empirical studies

Article	Country	Investment (as a % of GDP)	Contribution to LPG in %[a]	Growth acceleration in %
Corrado et al. (2005)	US	10–12 (98–00)	/	/
Nakamura (2010)	US	Intangible = Tangible (00–07)	/	/
Corrado et al. (2009)	US	~13[f] (03)	27 (95-03)	11.2 (95–03)
Marrano et al. (2009)	UK	13[b] (04)	20 (95-03)	13.1 (95–03)
Fukao et al. (2009)	JAP	11.1 (00–05)	27, 16 (95–00), (00–05)	17.3, −1.4 (95–00), (00–05)
Jalava et al. (2007)	FI	9.1 (05)	16, 30 (95–00), (00–05)	13.2, 2.1 (95–00), (00–05)
Van Rooijen et al. (2008)	NL	8.3[d] (01–04)	/	/
Hao et al. (2009)	DE, FR, IT, ES	7.1, 8.8, 5.2, 5.2 (04)	31, 37, 59, 64 (95–03)	10.5, 13.8, 37.2, 40 (95–03)
Van Ark et al. (2009)	DE, FR, IT, ES, AT, CZ, DK	7.2, 7.9, 5.0, 5.5, 6.5, 6.5, 7.9 (06)	21, 24, 41, 26, 23, 15, 34 (95–06)[c]	11.2, 9.3, 11.5, 30.6, 18.6, 2.2, 37.0 (95–06)[c]
Edquist (2011)	SE	10/~16[e] (04)	41, 24 (95–00), (00–06)	16, −2.3 (95–00), (00–06)

[a]LPG = Labor Productivity Growth.
[b]Measure here is adjusted MGVA.
[c]Only for Czech the period ranges from 1997 to 2006.
[d]Measure here is intangible capital spending excluding general government industry.
[e]Measure here is GVA.
[f]Measure here is non-farm business output.
Notes: AT = Austria; CZ = Czech Republic; DE = Germany; DK = Denmark; ES = Spain; FI = Finland; FR = France; IT = Italy; JAP = Japan; NL = the Netherlands; SE = Sweden; UK = the United Kingdom; US = the United States.
The numbers in parentheses refer to the relevant time periods.

5 Model Specification, Research Design, and Data

5.1 Model Specification

The model specification within this contribution follows an approach by Benhabib and Spiegel (1994), which Temple (1999) coined "cross-country growth accounting" or "growth accounting with externalities" (p. 124). The model by Benhabib and Spiegel (1994) differs from the framework of a traditional single growth accounting methodology as depicted by Eq. (5.1) by two components. First, the output elasticities are estimated, rather than imposed. Second, part of the model can be designed to explain the international variance in TFP growth.

One advantage of the utilization of stock data for tangible and intangible capital, in contrast to other econometric growth estimations (e.g., Mankiw et al., 1992), is that one is able to estimate the production function without the term for initial efficiency and thus without "the complexities of dynamic panel data models, provided that TFP growth is unrelated to initial income" (Temple, 1999, p. 125). Like the approach by Fleisher et al. (2010), the empirical model by Benhabib and Spiegel (1994) is applied in a panel context.

Following the theoretical framework of Corrado et al. (2009) as depicted in Eq. (5.1), Benhabib and Spiegel's (1994) model specifications are expanded by intangibles. The starting point for the estimation is then an augmented Cobb-Douglas production function,

$$Q_{i,t} = A_{i,t} K_{i,t}^{\alpha} L_{i,t}^{\gamma} R_{i,t}^{\beta} \quad \varepsilon_{i,t}, \tag{5.2}$$

where intangible capital R is added to the conventional production function because it is treated as investments rather than intermediate expenses. $Q_{i,t}$ is GVA (non-farm business sectors c–k + o excluding real estate activities) expanded by the investment flows in intangible capital in country i and period t. Similar to Eq. (5.1), K is the tangible capital stock, L is labor, and A is TFP. Assuming constant returns to scale and rewriting the Cobb-Douglas production function in intensive form, the following equation is obtained: with lower case letters indicating variables in terms of total hours worked. If differences in natural logarithms are taken, the annual growth relationship can be expressed as follows:

$$q_{i,t} = A_{i,t} k_{i,t}^{\alpha} r_{i,t}^{\beta} \quad \varepsilon_{i,t} \tag{5.3}$$

with lower-case letters indicating variables in terms of total hours worked. If differences in natural logarithms are taken, the annual growth relationship can be expressed as follows:

$$\begin{aligned}\left(\ln q_{i,t} - \ln q_{i,t-1}\right) = {} & \left(\ln A_{i,t} - \ln A_{i,t-1}\right) + \alpha\left(\ln k_{i,t} - \ln k_{i,t-1}\right) \\ & + \beta\left(\ln r_{i,t} - \ln r_{i,t-1}\right) + u_{i,t}\end{aligned} \tag{5.4}$$

where

$$u_{i,t} = \ln \varepsilon_{i,t} - \ln \varepsilon_{i,t-1}. \tag{5.5}$$

Unless the TFP growth term is estimated, the estimation of this equation will be biased. (Benhabib & Spiegel, 1994; Temple, 1999). Therefore, using a similar but extended approach to Benhabib and Spiegel (1994), a model for $(\ln A_{i,t} - \ln A_{i,t-1})$ is specified as follows:

$$\begin{aligned}\left(\ln A_{i,t} - \ln A_{i,t-1}\right) = {} & c + gH_{i,t} + mH_{i,t}\frac{\left(Q_{\max,t} - Q_{i,t}\right)}{Q_{i,t}} + n(1 - ur_{i,t}) \\ & + p\sum_{j=1}^{k} X_{j,i,t} + cd_{i,t=2001}\end{aligned} \tag{5.6}$$

where the constant term c represents exogenous technological progress, the level of human capital ($gH_{i,t}$) reflects the capacity of a country to innovate domestically, the term $mH_{i,t}\frac{\left(Q_{\max,t}-Q_{i,t}\right)}{Q_{i,t}}$ proxies a catch-up process, the term $n(1 - ur_{i,t})$ takes into account the business cycle effect,[11] the term $p\sum_{j=1}^{k} X_{j,i,t}$ is a sum of k extra policy variables which could possibly explain TFP growth, and $cd_{i,t=2001}$ is a crisis dummy to control for the economic downturn in 2001 after the IT (information technology) bubble burst in the year 2000 and the 9/11 attack in 2001. Inserting Eq. (5.6) into Eq. (5.4) provides the baseline model to be estimated within the econometric estimation in Sect. 7:

$$\begin{aligned}\left(\ln q_{i,t} - \ln q_{i,t-1}\right) = {} & c + gH_{i,t} + mH_{i,t}\frac{\left(Q_{\max,t} - Q_{i,t}\right)}{Q_{i,t}} + n(1 - ur_{i,t}) \\ & + p\sum_{j=1}^{k} X_{j,i,t} + cd_{i,t=2001} + \alpha\left(\ln k_{i,t} - \ln k_{i,t-1}\right) \\ & + \beta\left(\ln r_{i,t} - \ln r_{i,t-1}\right) + u_{i,t}\end{aligned} \tag{5.7}$$

[11] Similar to Guellec and van Pottelsbergh (2001, pp. 107–116), as the research design of this contribution uses yearly growth data, a control for the business cycle is specified as $(1 - ur_{i,t})$. The analysis by de la Fuente (2002, p. 580) uses only uses $ur_{i,t}$.

5.2 Research Design

The econometric analysis covers 13 EU-27 countries for a time period from 1998 to 2005. The countries included are Germany, France, Italy, the United Kingdom, Spain, Sweden, Denmark, Finland, Austria, Ireland, the Netherlands, Slovenia, and the Czech Republic.[12] Although the INNODRIVE Macro approach (INNODRIVE, 2011) has managed to produce a complete set of intangible capital variables for all 27 EU countries plus Norway, the following econometric analysis had to be restricted to a maximum of 13 EU countries, due to a lack of sectoral tangible capital input data within the EUKLEMS database. With the 13 countries and the given timeframe, this leaves the analysis with 98 overall observations (the Czech Republic and Slovenia, each miss three time observations from 1998 to 2000). Following existing empirical studies (e.g., Bassanini & Scarpetta, 2001), annual growth rates over the time period 1998–2005, rather than long-term growth rates from 1998 to 2005, have been chosen to be able to apply a panel data analysis.[13] With intangible capital stocks having been calculated for the period 1995–2005, the econometric analysis was restricted to a time-frame of 1998–2005 as the calculation of capital services (as can be depicted in Supplementary Appendix A2) needed intangible capital stock information from 1995 to 1997 to produce intangible capital service growth for the year 1998. The whole research design applies to non-farm business sectors c–k + o. The output measure is GVA for the non-farm business sectors c–k + o excluding real estate activities. Tangible and intangible are non-farm business investments c–k + o. Tangible capital investments excluded residential capital.

5.3 Data

The data for the following econometric analysis were taken from various different data sources, as described below.

- Data on the single components of intangible capital were taken from the INNODRIVE macro dataset (INNODRIVE, 2011). The INNODRIVE macro data to a large extent conforms to EUKLEMS data, and GFCF data are provided for all intangible assets and all EU-27 countries plus Norway.
- Data on GVA (non-farm business sectors excluding real estate activities), tangible capital stocks, capital compensation, gross fixed tangible capital investments, tangible investment price indices, labor input (number of hours worked per persons engaged), and depreciation rates for tangible capital were calculated

[12] Felix Roth wishes to thank Mary O'Mahony for making available the capital input data for France and Ireland.

[13] By using annual data this contribution assumes that intangible capital stocks have an immediate effect on labor productivity growth that specific year. By contrast, the growth accounting approaches, as described before, take into account the long-term effects of capital services.

from the EUKLEMS database. Tangible capital included communications equipment, computing equipment, total non-residential investment, other machinery and equipment, transport equipment, and other assets, but excluded residential capital.

- Human capital is measured as the "percentage of population who attained at least upper secondary education", which is taken as a proxy for the inherent stock of human capital. These data are provided by Eurostat.
- The variable rule of law is taken from the Worldwide Governance Indicators project (Kaufmann et al., 2010). The World Bank (2006) uses this indicator as a proxy for generalized trust, an important indicator of social capital (Roth, 2009).
- The data on openness to trade are retrieved from the Penn World Table Version 6.2 (Heston et al., 2006).
- The data on unemployment rates, the stocks of foreign direct investment (FDI) (as a % of GDP), total government expenditure (as a % of GDP), total expenditure on social protection (as a % of GDP), total general government expenditure on education (as a % of GDP), inflation rates (annual average rate of change in Harmonized Indices of Consumer Prices), taxes on income (as a % of GDP), and the stock market capitalization (as a % of GDP) are taken from Eurostat.

5.4 A Note on the Construction of Intangible Capital Stocks

Intangible capital stocks for the 11 EU-15 countries for the time period 1995–2005 were constructed by applying the perpetual inventory method (PIM) to series of intangible capital investments going back to 1980 and using the depreciation rates, δ_R, suggested by Corrado et al. (2009): 20% for scientific R&D, new architectural and engineering designs, and new product development in the financial services industry; 40% for own and purchased organizational capital and firm-specific human capital; and 60% for advertising and market research. In accordance with EUKLEMS for software, a depreciation rate of 31.5 was used.[14] Intangible capital stocks for the two transition countries, Slovenia and the Czech Republic, were calculated by applying the PIM to investment flows from 1995 to 1999, constructing stocks for the 6-year period 2000–2005. For the calculation of the intangible capital stock R_t the PIM takes the following form:

$$R_t = N_t + (1 - \delta_R)R_{t-1} \tag{5.8}$$

which assumes: 1) geometric depreciation, 2) constant depreciation rates over time, and 3) depreciation rates for each type of asset are the same for all countries. The real

[14] Intangible capital stocks on mineral exploration and copyright and license costs had to remain in the tangible capital stock as they could not be distinguished from tangible assets in the remaining category "other" in the EUKLEMS dataset.

investment series for N_t use a GVA price deflator which is the same for all intangible assets.

5.5 *A Note on the Construction of Intangible and Tangible Capital Services*

Data on intangible capital services were generated according to the literature by Oulton and Srinivasan (2003) and Marrano et al. (2009), and are consistent with the EUKLEMS approach (Timmer et al., 2007). This literature argues that rather than using a wealth measure for capital (like the capital stock), it is crucial to derive the flow of services a capital stock can provide to production. An overview of the technical steps in how intangible and tangible capital services were constructed is given in Appendix A2.

6 Descriptive Analysis

Table 5.A1 in Appendix A1 shows the descriptive statistics of the data utilized over the 13 EU countries and over the time period 1998–2005. Annual labor productivity growth increases by 0.10 (from 2.3 to 2.4) percentage points, or by 4.4%, when taking into account the contribution of intangibles in the measure of GVA. This value is smaller than most values reported by the existing literature as depicted in Table 5.1, which find that productivity growth increased by 11% in Germany, 9%–14% in France, 11%–37% in Italy, 31%–40% in Spain, 19% in Austria, 37% in Denmark, and 13% in the UK when adding intangible capital to the asset boundary. The mean value of 4.4% however is larger than the value for Sweden of −2.3%, for Finland of 2.1%, and the Czech Republic with 2.2%. The descriptive results in Table 5.A1 also show that the services of the intangible capital stock (4.1%) grow on average faster than the services of the tangible capital stock (3.3%).

Figure 5.1 shows the business intangible capital investments over GVA for the ten single intangible assets and the three core dimensions as described in Sect. 3. Overall business intangible capital investments differ considerably across the 13 EU countries used in the econometric estimation.[15] Sweden ranks first, with an overall investment of 13.6% of GVA. As can be inferred from Table 5.1, this is within the range of the values pointed out by Edquist (2011), who finds investment rates of 10% over GDP and 16% over business GVA. Sweden is followed by the UK, which has an investment rate of intangible capital of 12.4%. As depicted in Table 5.1, this is quite similar to the value for the UK, as measured by Marrano et al. (2009), of 13%. The UK is followed by the second largest economy, France, with an investment rate

[15] For a comparison of the intangible capital investment in the EU-25, see Gros and Roth (2012).

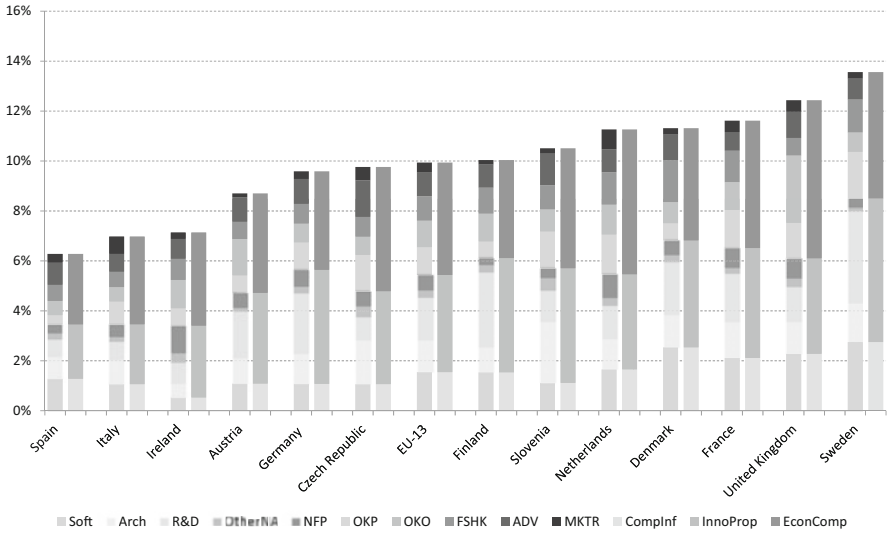

Fig. 5.1 Business intangible investment (as a percentage of GVA) in 13 EU countries, 1998–2005
Notes: The left bar chart for each country shows all ten single intangible capital items and the right bar chart indicates the three dimensions: Computerized Information, Innovative Property, and Economic Competencies. All variables in the graph are compared to GVA (non-farm business sector c–k + o excluding real estate activity). Soft = Software; Arch = New architectural and engineering designs; NFP = New product development in the financial services industry; R&D = Scientific research and development; Other NA = Other national account intangibles (mineral exploration and copyright and license costs), OKP = Organizational capital (purchased component); OKO = Organizational capital (own-account component); FSHK = Firm-specific human capital; ADV = Advertising; MKTR = Market research; CompInf = Computerized Information; InnoProp = Innovative Property and EconComp = Economic Competencies.
Source: INNODRIVE data (INNODRIVE, 2011).

of 11.6%. France's investment rate is in the range of the results of Hao et al. (2009), who report that it invests 8.8% of GDP. The two large Mediterranean economies of Italy and Spain are situated within the two last positions in the distribution. Spain invests 6.3% on intangibles and Italy around 7.0% on intangible capital. This again fits with the reported investment rate by Hao et al. (2009) of 5.2% and 5.2%, and van Ark et al. (2009), with investment rates of 5.5% and 5.0% over GDP. The largest European economy—Germany—is positioned in the middle of the distribution, with an overall investment of 9.6%.

This is in accordance with van Ark et al. (2009) and Hao et al. (2009), who find investment rates of 7.2% and 7.1%, respectively. On average the included 13 EU countries invest 9.9% in intangibles over GVA.

The right-hand bar charts in Fig. 5.1 make clear that overall the largest shares of intangibles are in either economic competencies or innovative properties, and only a small part of the investment consists of investment in software. In order to identify the distribution between the three dimensions in each country more clearly, Fig. 5.2 shows a scatterplot between the two larger dimensions, innovative property and

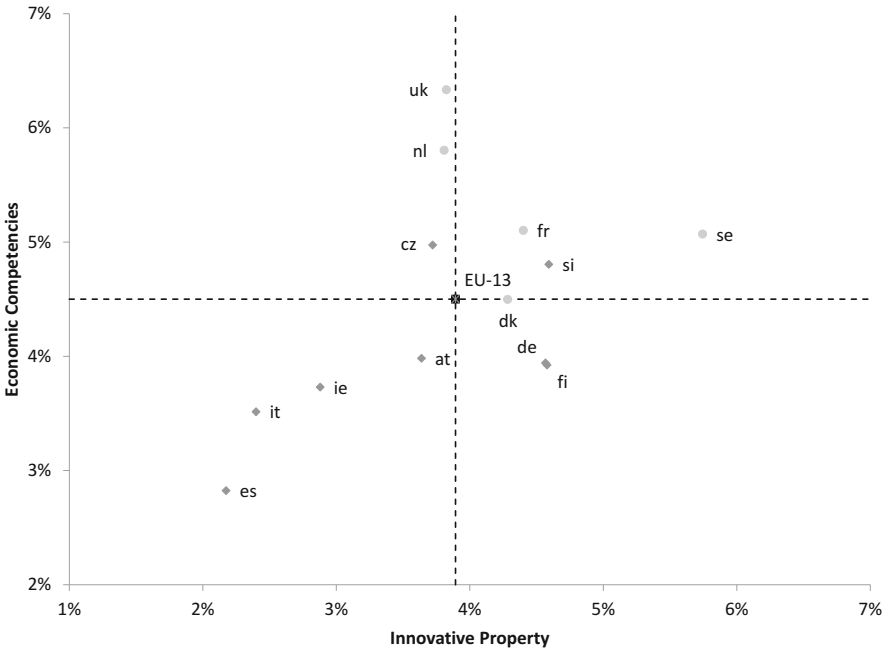

Fig. 5.2 Scatterplot between innovative property and economic competencies (as a percentage of GVA), 1998–2005
Notes: EU-13 mean value of all 13 countries; es = Spain, it = Italy; fr = France; fi = Finland; de = Germany; dk = Denmark; at = Austria; ie = Ireland; cz = Czech Republic; nl = the Netherlands; si = Slovenia; uk = United Kingdom; ◆ Low Computerized Information; ● High Computerized Information.
Source: INNODRIVE data (INNODRIVE, 2011).

economic competencies. These are the countries that can be classified as being highly innovative and investing strongly into economic competencies, and which can be detected in the upper right corner, namely Sweden, Slovenia, and France. In addition, France and Sweden score high on computerized information. On the other hand, these are the economies that invest more in innovative properties than in economic competencies, such as Denmark, Finland, and Germany. The third category includes those countries that score low on innovative property and high on economic competencies: the UK, the Netherlands, and the Czech Republic.[16] The fourth category includes those countries that score low on both dimensions: Austria, Ireland, Italy, and Spain. Overall, Fig. 5.2 clarifies that the sole focus of the Europe 2020 strategy (European Commission, 2010) on R&D investment seems to be too narrow in view of the significant investments in economic competencies.

[16] One reason for this significant difference might be the fact that those economies that invest higher proportions in economic competencies are more specialized in the services sector. However, this argument will be more consistent for the Netherlands and the United Kingdom than for the Czech Republic.

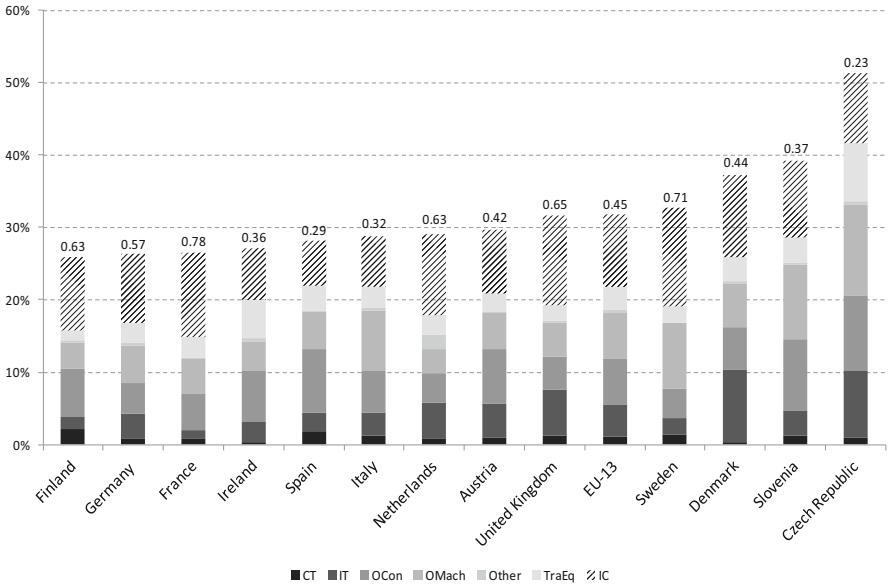

Fig. 5.3 Business tangible and intangible investment (as a percentage of GVA) in 13 EU countries, 1998–2005

Notes: CT = Communications equipment; IT = Computing equipment; OCon = Total nonresidential capital investment; OMach = Other machinery and equipment; Other = Other assets; TraEq = Transport equipment; IC = Intangible capital. Residential capital has been excluded.

Source: INNODRIVE data (INNODRIVE, 2011) and EUKLEMS data.

Figure 5.3 shows a comparison between business investments in intangible capital and tangible capital as it is used in the econometric estimation. Interestingly, one detects that when including intangible capital investments, the average investment for the 13 EU countries is over 30% of GVA. This value is significantly higher than when solely considering tangible investments. Values on top of the bar charts depict the ratio of intangible/tangible capital investment. Ratios close to but still less than 1 indicate that intangible capital investment is almost as large as tangible capital. France, Sweden, the UK, the Netherlands, and Finland have reached ratios of larger than 0.6, with France already having reached a value of 0.78. It thus seems sound to conclude that some EU countries have started to converge towards the US, for which Nakamura points out that investment in intangible capital has become as large as investment in tangible capital. In the transition countries Slovenia and the Czech Republic, and the Mediterranean countries Spain and Italy, tangible capital still dominates investments, with ratios below 0.4 (ratios of 0.37, 0.23, 0.29, and 0.32, respectively).

7 Econometric Analysis

Without a lagged initial income term on the left-hand side, the baseline model in Eq. (5.7) may be estimated without the complexities of a dynamic panel analysis.[17] Thus, when estimating Eq. (5.7), the standard methods of panel estimation are fixed effects or random-effects. The fixed effects are calculated from differences within each country across time; the random-effects estimation, in contrast, incorporates information across individual countries as well as across periods.[18] The major drawback with random-effects is, although being more efficient, they are consistent only if the country-specific effects are uncorrelated with the other explanatory variables. A Hausman specification test can evaluate whether this independent assumption is satisfied (Hausman, 1978; Forbes, 2000, p. 874). The Hausman test applied here indicates that a random-effects model can be used.[19] In addition, to control for potential cross-sectional heteroskedasticity, a robust VCE estimator has been utilized.[20] As highlighted in Sect. 5.2, the random-effects estimation uses 13 countries with a total of 98 observations. It is a balanced panel, with two countries (the Czech Republic and Slovenia) missing three time observations from 1998 to 2000. Regression 1 in Table 5.2 shows the estimation results when estimating the traditional production function (without the inclusion of intangible capital and specifically excluding software from the tangible capital investment).[21] The overall R-square value is 0.40, with a within R-square value of 0.20 and a between R-square value of 0.63. The growth of tangible capital services is positively associated with labor productivity growth and has a coefficient of 0.47, explaining a 65% share of labor productivity growth.[22] Regression 2 shows the same model specification when including intangible capital investment. When including intangible capital investment in the asset boundary, the overall R-square value increases by 11% points to 0.51, the within R-square value increases by 16% points to 0.36, and the between R-square value increases by 9% points to 0.72. Growth of intangible capital services

[17] For the complexities of modeling the lagged income term within the growth econometric equation, see, for example, Bond et al. (2001) and Roodman (2009a, 2009b).

[18] More precisely, a random-effects estimator uses a GLS estimator which produces a matrix weighted average of the between and within results.

[19] The test statistic is $\chi^2(6) = 3.45$. This clearly fails to reject the null hypothesis of no systematic differences in the coefficients.

[20] Using a xtoverid command (Schaffer & Stillman, 2010) the Sargan–Hansen test statistic is $\chi^2(6) = 5.5$. This clearly fails to reject the null hypothesis of no systematic difference in the coefficients.

[21] It was not possible to exclude mineral exploration and copyright and license costs from the tangible assets as the EUKLEMS category "other" is a rest category and separate elements cannot be filtered out. Thus, tangible capital services and GVA in regression 1 include mineral exploration and copyright and license costs, but exclude software.

[22] Considering Eq. (5.7), with the mean value of $(\ln q_{i,t} - \ln q_{i,t-1})$ being 0.23, the mean value of $(\ln k_{i,t} - \ln k_{i,t-1})$ being 0.32, and a being 0.47, the calculation can be set up as follows: $(0.47 \cdot 0.32)/0.23 = 0.65$.

Table 5.2 Intangibles and labor productivity growth; random-effects estimations

Estimation method	Random-effects	Random-effects	Random-effects	G2SLS
Equation	1	2	3	4
Intangible services growth	–	0.29***	–	0.25*
		(0.09)		(0.13)
Tangible services growth[a]	0.47***	0.29**	0.24**	0.30*
	(0.13)	(0.11)	(0.12)	(0.18)
Computerized information services growth	–	–	0.03	–
			(0.03)	
Innovative property services growth	–	–	0.09	–
			(0.09)	
Economic comp. services growth	–	–	0.2***	–
			(0.05)	
Upper secondary education 15+	Yes	Yes	Yes	Yes
Catch-Up[a]	Yes	Yes	Yes	Yes
Business cycle	Yes	Yes	Yes	Yes
Crisis dummy 2001	Yes	Yes	Yes	Yes
Observations	98	98	98	72
Number of countries	13	13	13	13
R-square overall	0.40	0.51	0.56	0.53
R-square within	0.20	0.36	0.41	0.35
R-square between	0.63	0.72	0.77	0.81

Notes: Labor Productivity Growth was calculated with GVA of the non-farm business sectors c–k + o excluding real estate activities. Labor Productivity Growth is in all regressions, except in RE1, expanded with intangible capital. Robust standard errors are provided below coefficient estimates in parentheses. Tangible capital excludes residential capital. Intangible and tangible depict business (sectors c–k + o) services growth.

***p < 0.01, **p < 0.05, *p < 0.1.

[a]For equation 1, this variable is without software but includes mineral exploration and copyright and license costs.

is positively related to labor productivity growth, with a coefficient of magnitude 0.29. With this magnitude, intangible capital is able to explain around 50% of labor productivity growth. As can be inferred from Table 5.1, a value of 50% is in close range to the results of the growth accounting results for the relevant country cases presented in this contribution; in particular, the results from Hao et al. (2009), who find 59% for France, 59% for Italy, and 64% for Spain. It is larger than the value of Marrano et al. (2009) of 20%, however. Once including intangible capital, the impact of tangible capital diminishes to 40%. TFP then changes from 35% to 10% and is thus diminished by 25%. As intangible and tangible capital are able to explain 90% of labor productivity, the finding by Corrado et al. (2009) that capital deepening becomes the dominant source is sustained.

In order to assess which dimensions of intangible capital services are the main drivers of the positive relationship between intangible capital and labor productivity growth, regression 3 includes the three dimensions of 1) computerized information,

2) innovative property, and 3) economic competencies, instead of the overall intangible capital index. Interestingly, the main driver is not innovative property as expected from the guidelines of the Europe 2020 strategy (European Commission, 2010), but rather economic competencies.

When running growth regressions, such as in Eq. (5.7), one must be aware of the possibility that the left-hand side and the right-hand side variables will affect each other. More specifically, the growth of the factor inputs intangible and tangible capital deepening might be endogenous, affected by a common event such as an economic shock (Temple, 1999, p. 125), or stand in a bi-directional relationship with labor productivity; thus, an increase in labor productivity growth might, for example, influence the agent's decision to invest in tangible and intangible capital. Following Temple (1999, p. 125), as the authors have not been able to retrieve valid *external* instruments,[23] for example, for intangible capital, lagged levels of intangible and tangible capital as instruments were chosen. Regression 4 shows the estimation results when instrumenting with lagged levels of intangible and tangible capital.[24] A Sargan–Hansen test of overidentification confirms the validity of the utilized instruments.[25] After controlling for endogeneity, the relationship between intangible capital and labor productivity remains significant (90% level) and the coefficient is only slightly reduced to 0.25. Therefore, it seems valid to conclude that the estimation results from regression 2 were indeed unbiased and not affected by uncontrolled endogeneity. Thus, the following sensitivity analysis will further explore the robustness of the coefficient of intangible capital on labor productivity growth, from regression 2, permitting us to conduct an analysis with a maximum of 98 observations.

7.1 Sensitivity Analysis

Table 5.3 shows a sensitivity analysis of regression 2 in Table 5.2. The first row, under the title *Baseline regression*, depicts the coefficient of regression 2 in

[23] Which is quite common in such cases and normally leads to a weak instrument problem (Stock & Watson, 2007).

[24] To be precise, the first three lagged levels of tangible and intangible services growth have been utilized as instruments. Next to the lagged levels, the estimation has used education, the catch-up term, the business cycle control, and the crisis dummy as instruments adding up to a total of 10 instruments. With a rule of thumb being that the total amount of instruments used should be below the country cases (Roodman, 2009a, p. 128), the total usage of 10 instruments thus seems adequate. The use of too large an instrument collection tends to overfit endogenous variables as it weakens the Sargan–Hansen test (Roodman, 2009b). This is why typically difference and system gmm estimator should be applied in cases of large n and small t, as within the gmm methodology instruments tend to explode with increasing t (Roodman, 2009a, p. 99).

[25] A Sargan–Hansen test of the validity of the instruments was performed via the command xtoverid cluster-robust (Schaffer & Stillman, 2010) after the G2SLS estimation. With $\chi^2(4)$ a value of 7.3, the rejection of the null hypothesis fails. This indicates that the used instruments are valid.

Table 5.3 Sensitivity analysis for the baseline random-effects model

Row	Specification change	Coefficient on intangibles	Standard error	Countries	Observations	R-square
Baseline regression						
(1)	Baseline—RE2	0.29***	(0.09)	13	98	0.51
Influential cases						
(2)	Ireland and Italy	0.24**	(0.10)	11	82	0.47
(3)	Sweden	0.35***	(0.09)	12	90	0.53
Restructuring of data						
(4)	1998–2001	0.32***	(0.08)	13	46	0.46
(5)	2002–2005	0.30*	(0.18)	13	52	0.57
Restructuring of country sample						
(6)	Without transition	0.26***	(0.09)	11	88	0.47
(7)	Mediterranean	0.60***	(0.14)	2	16	0.91
(8)	Liberal	0.14	(0.18)	2	16	0.58
(9)	Coordinated	0.33***	(0.13)	4	32	0.58
(10)	Scandinavian	0.25	(0.26)	3	24	0.55
Specifications						
(11)	Rule of law	0.28***	(0.08)	13	98	0.52
(12)	Openness	0.29***	(0.08)	13	98	0.57
(13)	FDI	0.31***	(0.08)	13	97	0.58
(14)	Government expenditure	0.29***	(0.08)	13	98	0.52
(15)	Social expenditure	0.28***	(0.08)	13	98	0.54
(16)	Educational expenditure	0.29***	(0.09)	13	98	0.50
(17)	Inflation	0.29***	(0.09)	13	98	0.51
(18)	Income tax	0.29***	(0.09)	13	98	0.51
(19)	Stock market capitalization	0.30***	(0.10)	13	91	0.58
(20)	Forward BC	0.28***	(0.09)	13	98	0.50
(21)	Dummies for all years	0.22**	(0.10)	13	98	0.56
(22)	Dummy for 2000	0.22**	(0.09)	13	98	0.48
Methods						
(23)	Jackknife	0.22***	(0.08)	13	98	0.56

Notes: The R-Squared values represent the overall R-Squared in a random-effects regression. Robust standard errors are provided in parentheses.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 5.2. The second and third row exclude potential influential cases from the country sample.[26] Thus, in row 2 of Table 5.3, Ireland and Italy are excluded from the country sample. After the exclusion, the intangible capital coefficient is reduced (0.24) and remains significant at the 95% level. With Sweden being an outlier in opposition to the positive relationship, when excluding Sweden in row 3 the relationship gets significantly larger, with a coefficient of 0.35. When restructuring the data in rows 4 and 5 into the two time periods 1998–2001 and 2002–2005, we detect that the relationship seems to be slightly stronger in the time period 1998–2001 (0.32) than in 2002–2005 (0.30). In addition, the relationship is highly significant in the 1998–2001 time period and only significant at the 90% level in the 2002–2005 time period. Since the EU-13 country sample analyzed is very heterogeneous considering its economic structure, rows 6–10 explore the different regime typologies.[27] Excluding the two transition countries, Czech Republic and Slovenia, from the country sample does not alter the coefficient in a significant manner. Whereas the four coordinated (Germany, Austria, the Netherlands, and France) and two Mediterranean cases (Spain and Italy) remain highly significant, the two liberal cases (Ireland and the UK) and the three Scandinavian cases (Sweden, Denmark, and Finland) lose significance. Moreover, the coefficient increases significantly for the Mediterranean case.

Since labor productivity growth might be related to many other determinants of labor productivity growth, in particular, characteristics of the institutional settings within the 13 EU economies, rows 11–19 include a range of policy variables. The magnitude of the coefficient of intangible capital remains robust after their inclusion, and thus none of the included policy variables is able to alter the relationship. Rows 20–22 alter the included Business Cycle (as after a downturn in the economy, unemployment usually starts to rise with a lagged effect), incorporate 8-year dummies, and add an additional crisis dummy for the year 2000. Using a forward lagged business cycle in row 20 does not alter the coefficient. The 8-year dummies or an additional crisis dummy for the year 2000 are only able to alter the significance of the coefficient partially (to the 95% level) but tend to reduce its size to 0.22. When utilizing a jackknife post-estimation command (Stata Corporation, 2007, p. 22) in row 23, the coefficient is also around 0.22. A coefficient of 0.22 would still represent an impact of 39% on labor productivity growth.

[26] These cases have been detected by the usage of the command xtdata (Stata Corporation, 2007, pp. 59–64). Results can be obtained from the authors on request.

[27] For the classification of the different regime typologies, see Hall and Soskice (2001). In contrast to Hall and Soskice, France was included in the coordinated cases, and Scandinavian and transition countries were grouped into individual regime typologies. As the number of observations reach numbers as small as 16, which are below standard statistical reasoning, the results for the regime typologies should be considered as economically significant (McCloskey & Ziliak, 1996).

8 Conclusion

Using new international comparable panel data on business intangible capital investment within a panel analysis from 1998 to 2005 in an EU country sample, this contribution detects a positive and significant relationship between business investments in intangible capital and labor productivity growth within the business sector. Five findings emerge. First, the empirical analysis confirms the view that intangible capital investment is able to explain a significant portion of the unexplained international variance in labor productivity growth, and becomes the dominant source of growth of labor productivity. Second, this result is robust to a range of alterations and holds when controlling for endogeneity. The result is stronger in Mediterranean and Coordinated countries and within the time period 1998–2001. Third, the empirical analysis confirms the finding that the inclusion of intangible capital investment in the asset boundary of the national accounting framework implies that the rate of change of output per worker increases more rapidly. Fourth, the empirical analysis demonstrates that when incorporating intangibles into the national accounting framework, tangible and intangible capital become the unambiguously dominant source of growth. Fifth, the most important intangible capital dimension seems to be the dimension of economic competencies. Innovative property and software do not seem to have an impact on labor productivity growth within the given research design of this contribution.

In light of these five points, three main policy conclusions can be drawn from our analysis of European economies. First, measuring innovation by solely focusing on R&D, as is currently proposed in the European 2020 agenda, seems to be problematic, and the R&D benchmark measure should be substituted by a wider intangible capital benchmark. Second, incorporating intangible capital into today's national accounting framework seems to be necessary as developed economies transition into knowledge societies and thus the significant change of investment from tangible to intangible investment is not acknowledged in today's national accounting framework. The current accounting framework seems to be inaccurate as it incorrectly depicts levels of capital investment within European economies that are too low. In reality, European economies' levels of capital investment are significantly greater once incorporating investment in intangible capital. Third, incorporating a wider dimension of innovation investments seems to be a first important step in revising today's national accounting framework, in particular when focusing on the business sector. In addition, a next step seems to involve the wider adaptation of the national accounting framework by environmental, educational, health, and social capital.[28] Moreover, wider reform of the national accounting framework should be envisaged to achieve a more accurate signaling of real economic performance, to allow developed and emerging countries to strive for sustainable economic growth.

[28] See the report by Stiglitz et al. (2009), for example.

Appendices

Appendix 1 Descriptive Statistics

Table 5.A1 Descriptive statistics, EU13, 1998–2005*

	Observations	Mean	Standard deviation	Minimum	Maximum
LPG (%)	98	2.3	1.9	−2.1	8.9
LPG—Expanded by intangibles (%)	98	2.4	1.8	−2.2	8.4
Intangible services growth (%)	98	4.1	2.4	−2.8	9.2
Tangible services growth—Expanded by intangibles (%)	98	3.3	1.8	0.3	9.9
Tangible services growth (%)	98	3.2	1.8	0.3	9.9
Computerized information Ser. Gr. (%)	98	7.6	5.7	−4.3	25.5
Economic competencies Ser. Gr. (%)	98	2.8	3.2	−6.4	11.2
Innovative property Ser. Gr. (%)	98	4.0	2.4	−1.5	11.4
Education 15+ (%)**	98	65.7	11.8	38.3	83.2
Interaction education and catch-up	98	16.4	26.4	0.0	116.2
Business cycle (%)	98	92.9	2.6	85.0	97.5
Rule of law***	98	1.5	0.4	0.5	2.0
Openness (%)	98	82.3	30.8	45.2	157.5
Stock of FDI (% of GDP)****	97	36.8	28.3	8.3	133.9
Government expenditure (% of GDP)	98	47.2	6.4	31.5	58.8
Social expenditure (% of GDP)	98	26.1	4.7	12.0	33.2
Education expenditure (% of GDP)	98	5.6	1.2	4.0	8.2
Inflation (%)	98	2.2	1.4	−0.1	8.6
Income tax (% of GDP)	98	13.9	5.4	7.3	28.9
Stock market capitaliz. (% of GDP)	91	76.5	51.6	13.3	284.0

Notes: LPG = Labor productivity growth. *For Slovenia and the Czech Republic the included values range from 2001 to 2005. **Three missing values were interpolated by linear interpolation. ***Missing data were extra and interpolated. ****One value is missing for Austria in 2004.

Appendix 2 Construction of Intangible and Tangible Capital Services

The consecutive steps required to construct the services are briefly depicted in this section. They broadly follow the literature by Oulton and Srinivasan (2003) and

Marrano et al. (2009) and the EUKLEMS approach (Timmer et al., 2007). In Eq. (5.7), the growth of tangible and intangible capital services ($\ln k_{i,t} - \ln k_{i,t-1}$) and ($\ln r_{i,t} - \ln r_{i,t-1}$), or respectively $\Delta \ln k_{i,t}$ and $\Delta \ln r_{i,t}$ are specified as:

$$\Delta \ln k_{i,t} = \sum_{i=1}^{m} \overline{v}_{i,t} \Delta \ln a_{i,t} \tag{5.A1}$$

$$\Delta \ln r_{i,t} = \sum_{i=m+1}^{n} \overline{v}_{i,t} \Delta \ln a_{i,t} \tag{5.A2}$$

where small letters for k, r, and a are reflecting variables divided by hours worked in the entire industry and for all assets, and where capital services from each asset i are assumed to be proportional to the capital stocks. More concretely, in the equation, $a_{i,t}$ is the asset-specific capital stock in hours worked obtained by applying the PIM on the asset investments and dividing the stock by the hours worked. Assets 1 to m refer to tangible capital and assets from $m + 1$ to n refer to intangible capital. The capital stocks are weighted by a two period average weight $\overline{v}_{i,t}$ given as:

$$\overline{v}_{i,t} = \frac{1}{2}\left[v_{i,t} + v_{i,t-1}\right] \text{ and } v_{i,t} = \left(\frac{p^A_{i,t} A_{i,t}}{\sum_{i=1}^{n} p^A_{i,t} A_{i,t}}\right) \tag{5.A3}$$

The weight consists of the user cost of a specific asset (tangible or intangible) $p^A_{i,t}$ and the capital stocks $A_{i,t}$ for each asset i. The user cost equation can be displayed as:

$$p^A_{i,t} = p^I_{i,t-1} i_t + \delta_{i,t} p^I_{i,t} - \left[p^I_{i,t} - p^I_{i,t-1}\right] \tag{5.A4}$$

with the capital gain term $\left[p^I_{i,t} - p^I_{i,t-1}\right]$, following Niebel and Saam (2011), being expressed as

$$\left[p^I_{i,t} - p^I_{i,t-1}\right] = \frac{1}{2}\left(ln\left(p_{i,t}\right) - ln\left(p_{i,t-2}\right)\right) p_{i,t-1} \tag{5.A5}$$

where $p^I_{i,t-1}$ is the investment price derived from the price index for gross fixed capital investments, i_t is the overall time-specific rate of return, and $\delta_{i,t}$ is the asset-specific, time-variant depreciation rate. As relative contributions of industries to the total business sector ($c - k + o$) change over time, depreciation rates are allowed to vary over time and are calculated from the EU KLEMS dataset as:

$$\delta_{i,t} = \frac{A_{i,t-1} + I_{i,t} - A_{i,t}}{A_{i,t-1}} \tag{5.A6}$$

where $A_{i,\,t}$ is the asset-specific capital stock and $I_{i,\,t}$ the asset-specific investment. The rate of return i_t is common to all assets (tangible and intangible) under assumption of profit maximization (Oulton & Srinivasan, 2003) and it is the only unknown element in the user cost equation (Eq. 12). Following Timmer et al. (2007) it can be estimated using an ex post approach where it is assumed that total capital compensation is equal to the sum of all rental payments. It can as such be calculated using the following equation:

$$i_t = \frac{p_t^A A_t + \sum_i \left[p_{i,t}^I - p_{i,t-1}^I\right] A_{i,t} - \sum_i p_{i,t}^I \delta_{i,t} A_{i,t}}{\sum_i p_{i,t-1}^I A_{i.t}} \tag{5.A7}$$

Following Timmer et al. (2007), the first term at the right-hand side is the total nominal capital compensation and has been obtained by subtracting the labor compensation from the value added.

References

Abowd, J. M., Haltiwanger, J., Jarmin, R., Lane, J., Lengermann, P., McCue, K., McKinney, K., & Sandusky, K. (2005). The relation among human capital, productivity and market value: Building up from micro evidence. In C. Corrado, J. Haltiwanger, & D. Sichel (Eds.), *Measuring capital in the new economy* (pp. 153–204). University of Chicago Press.

Barro, R. J., & Sala-i-Martin, X. (2004). *Economic growth*. MIT Press.

Bassanini, A., & Scarpetta, S. (2001). The driving forces of economic growth: Panel evidence for the OECD countries. *OECD Economic Studies, 33*, 9–56.

Benhabib, J., & Spiegel, M. M. (1994). The role of human capital in Economic Development—Evidence from aggregate cross-country data. *Journal of Monetary Economics, 34*, 143–173.

Bond, S., Hoeffler, A., & Temple, J. (2001). *"GMM estimation of empirical growth models", CEPR discussion paper no. 3048*. Centre for Economic Policy Research.

Brynjolfsson, E., & Yang, S. (1999). *The intangible costs and benefits of computer investments: Evidence from the financial markets*. Proceedings of the International Conference on Information Systems.

Brynjolfsson, E., Hitt, L. M., & Yang, S. (2002). Intangible assets: Computers and organizational capital. *Brookings Papers on Economic Activity, 2002-1*, 137–198.

Cañibano, L., Garcia-Ayuso, M., & Sánchez, P. (2000). Accounting for intangibles: A literature review. *Journal of Accounting Literature, 19*, 102–130.

Coe, D. T., & Helpman, E. (1995). International R&D spillovers. *European Economic Review, 39*, 859–887.

Corrado, C., Hulten, C., & Sichel, D. (2005). Measuring capital and technology: An expanded framework. In C. Corrado, J. Haltiwanger, & D. Sichel (Eds.), *Measuring capital in the new economy* (pp. 11–46). University of Chicago Press.

Corrado, C., Hulten, C., & Sichel, D. (2009). Intangible capital and U.S. economic growth. *Review of Income and Wealth, 55*, 661–685.

Cummins, J. G. (2005). A new approach to the valuation of intangible capital. In C. Corrado, J. Haltiwanger, & D. Sichel (Eds.), *Measuring capital in the new economy* (pp. 47–72). University of Chicago Press.

de la Fuente, A. (2002). On the sources of convergence: A close look at the Spanish regions. *European Economic Review, 46*, 569–599.

Edquist, H. (2011). Can Investment in Intangibles Explain the Swedish productivity boom in the 1990s? *Review of Income and Wealth, 57*, 658–682.

European Commission. (2010). *Europe 2020. A Strategy for Smart Sustainable and Inclusive Growth*. Communication from the Commission, European Commission.

Eustace, C. (2000). *The intangible economy impact and policy issues, report of the european high level expert group on the intangible economy*. European Commission.

Fleisher, B., Haizheng, L., & Zhao, M. Q. (2010). Human capital, economic growth and regional inequality in China. *Journal of Development Economics, 92*, 215–231.

Forbes, K. (2000). A reassessment of the relationship between inequality and growth. *American Economic Review, 90*, 869–887.

Fukao, K., Miyagawa, T., Mukai, K., Shinoda, Y., & Tonogi, K. (2009). Intangible investment in Japan: Measurement and contribution to economic growth. *Review of Income and Wealth, 55*, 717–736.

Gros, D., & Roth, F. (2012). *The Europe 2020 strategy—Can it maintain the EU's competitiveness in the world?* CEPS.

Guellec, D., & van Pottelsberghe de la Potterie, B. (2001). R&D and productivity growth: Panel data analysis of 16 OECD countries. *OECD Economic Studies, 33*, 103–126.

Hall, P. A., & Soskice, D. (Eds.). (2001). *Varieties of capitalism: The institutional foundations of comparative advantage*. Oxford University Press.

Hao, J. X., Manole, V., & van Ark, B. (2009). Intangible capital and growth—An international comparison. *COINVEST Working Paper, D3*(6).

Hausman, J. A. (1978). Specification tests in econometrics. *Econometrics, 46*, 1251–1271.

Heston, A., Summers, R., & Aten, B. (2006). *Penn World Table Version 6.2*. Center for International Comparison of Production, Income and Prices at the University of Pennsylvania.

Hill, R. J. (2009). Introduction to special section on intangible capital. *Review of Income and Wealth, 55*, 658–660.

INNODRIVE. (2011). INNODRIVE intangibles database. https://cordis.europa.eu/project/id/214576/reporting/de.

Jalava, J., Aulin-Ahmavaara, P., & Alanen, A. (2007). *"Intangible capital in the finnish business sector, 1975–2005," ETLA discussion papers no. 1103*. The Research Institute of the Finnish Economy.

Jona-Lasinio, C., Iommi, M., & Roth, F. (2011). National measures of intangible capital in the EU-27 and Norway. In H. Piekkola (Ed.), *Intangible capital—Driver of growth in Europe* (Vol. 167, pp. 20–62). Proceedings of the University of Vaasa.

Kaufmann, D., Kraay, A., & Mastruzzi, M. (2010). "The worldwide governance indicators: A summary of methodology, data and analytical issues", World Bank policy research working paper no. 5430, World Bank.

Landes, E. M., & Rosenfield, A. M. (1994). The durability of advertising revisited. *Journal of Industrial Economics, 42*, 263–276.

Lev, B., & Radhakrishnan, S. (2003). *"The measurement of firm-specific organization capital," NBER working paper no. 9581*. National Bureau of Economic Research.

Lev, B., & Radhakrishnan, S. (2005). The valuation of organizational capital. In C. Corrado, J. Haltiwanger, & D. Sichel (Eds.), *Measuring capital in the new economy* (pp. 73–110). University of Chicago Press.

Lichtenberg, F. (1993). R&D investment and international productivity differences. In H. Siebert (Ed.), *Economic growth in the world economy* (pp. 89–110). J. C. B. Mohr.

McCloskey, D., & Ziliak, S. T. (1996). The standard error of regressions. *Journal of Economic Literature, 34*, 97–114.

Mankiw, N. G., Romer, D., & Weil, D. N. (1992). A contribution to the empirics of economic growth. *Quarterly Journal of Economics, 107*, 407–437.

Marrano, M. G., Haskel, J., & Wallis, G. (2009). What happened to the knowledge economy? ICT, intangible investment, and Britain's productivity record revisited. *Review of Income and Wealth, 55*, 686–716.

Nakamura, L. I. (2010). Intangible assets and National Income Accounting. *Review of Income and Wealth, 56*, S135–S155.
Niebel, T. & Saam, M. (2011). Productivity of ICT and non-ICT capital: The role of rates of return and capital prices. ZEW discussion papers, no. 11–083.
Oulton, N., & Srinivasan, S. (2003). "Capital stocks, capital services, and depreciation: An integrated framework", Bank of England, working paper no. 192. Bank of England.
Park, W. G. (1995). International R&D spillovers and OECD economic growth. *Economic Inquiry, 33*, 571–591.
Roodman, D. (2009a). How to do xtabond2: An introduction to difference and system GMMin stata. *The Stata Journal, 9*, 86–136.
Roodman, D. (2009b). A note on the theme of too many instruments. *Oxford Bulletin of Economics and Statistics, 71*, 135–158.
Roth, F. (2009). Does too much trust hamper economic growth? *Kyklos, 62*, 103–128.
Schaffer, M. E., & Stillman, S.. (2010). xtoverid: Stata module to calculate tests of overidentifying restrictions after xtreg, xtivreg, xtivreg2 and xthtaylor. http://ideas.repec.org/c/boc/bocode/s456779.html.
Solow, R. M. (1999). Notes on social capital and economic performance. In P. Dasgupta & I. Serageldin (Eds.), *Social capital a multifaceted perspective* (pp. 6–10). World Bank.
Stata Corporation. (2007). *Stata longitudinal/panel data reference manual release 10*. Stata Press.
Stiglitz, J., Sen, A., & Fitoussi, J.-P.2009. Report by the commission on the measurement of economic performance and social progress.
Stock, J. H., & Watson, M. W. (2007). *Introduction to econometrics*. Pearson-Addison Wesley.
Teece, D. J. (1998). Capturing value from knowledge assets: The new economy, markets for know how, and intangible assets. *California Management Review, 40*, 55–79.
Temple, J. (1999). The new growth evidence. *Journal of Economic Literature, 37*, 112–156.
Timmer, M., van Moergastel, T., Stuivenwold, E., Ypma, G., O'Mahony, M., & Kangasniemi, M. (2007). EU KLEMS growth and productivity accounts, version 1.0, part I: Methodology. EU KLEMS deliverable.
van Ark, B., Hao, J. X., Corrado, C., & Hulten, C. (2009). Measuring intangible capital and its contribution to economic growth in Europe. *European Investment Bank Papers, 14*, 62–93.
Van Rooijen-Horsten, M., van den Bergen, D., & Tanriseven, M. (2008). *"Intangible capital in the Netherlands: A benchmark," Statistics Netherlands, discussion paper no. 08001*. Statistics Netherlands.
Webster, E. (2000). The growth of Enterprise intangible Investment in Australia. *Information Economics and Policy, 12*, 1–25.
World Bank. (2006). *Where is the wealth of nations? Measuring capital for the 21st century*. World Bank.

Chapter 6
Measuring Innovation: Intangible Capital Investment in the EU

Felix Roth

Abstract This contribution is drawn from the discussions of a forum that examined the strategies adopted by the European Commission and the member states for the intensification of innovative activities. It analyses business investment in intangible capital using a new internationally comparable dataset in the EU27 created within the FP7 project INNODRIVE. First, it finds that the EU's innovation agenda would be well advised to switch its benchmark criteria from a sole focus on R&D to a focus on overall investment in intangible capital, in particular, on investments in economic competencies. Second, it finds that today's national accounting framework seems to be ill-suited for identifying the ongoing transition of European economies towards knowledge economies. Without identifying the full range of intangibles as an investment in Gross Fixed Capital Formation, the overall levels of capital investment of European economies are too low.

Keywords Innovation · Intangible capital · R&D · EU · Manufacturing sector · Service sector

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The European Commission's 2020 strategy has put forward five EU targets for the year 2020: focusing on 1) employment, 2) research and innovation, 3) climate change and energy, 4) education, and 5) poverty reduction. The following contribution focuses on the target of research and innovation and is structured as follows. First, the EU-2020 target on Research and Development is briefly discussed and the most recent criticism of the sole measure of R&D to capture innovativeness is highlighted. Second, R&D investment in the EU-25[1] is compared to the wider investments in intangible capital using a new internationally comparable dataset on intangibles for the EU-27 created within the FP7 project INNODRIVE. Third, the comparison of investments in tangible and intangible capital in 11 selected European countries is discussed. This contribution concludes by putting forward policy conclusions.

1 Innovation and EU 2020: Is R&D the Sole Factor for Measuring Innovativeness?

In measuring innovation, most contemporary research identifies investments in Research and Development (R&D) as a percentage of GDP as one of the classical benchmarks. In this sense, many empirical papers on the relationship between innovation and productivity growth focus on a set of R&D indicators.[2] This focus on R&D is prominently emphasized in the European 2020 strategy[3] for smart, sustainable, and inclusive growth, which proposes as one of its headline targets to foster innovation via a 3% benchmark for investment by the individual member states in R&D as a share of GDP. This target of investing 3% of GDP in R&D had already been formulated in the Lisbon strategy in 2000 and seems to be the only

[1] The cases of Bulgaria and Romania were not analyzed, as the data from the INNODRIVE project does not include values for Gross Value Added at current basic prices.

[2] A. Bassanini, S. Scarpetta: Does human capital matter for growth in OECD countries? A pooled mean-group approach, in: Economic Letters, Vol. 74, No. 3, 2002, pp. 399–405; M. Khan, K. Luintel: Sources of Knowledge and Productivity: How Robust is the Relationship?, OECD Science, Technology and Industry Working Paper No. 2006/6; F.R. Lichtenberg: R&D Investment and International Productivity Differences, 1993, In H. Siebert (Ed.), Economic growth in the world economy, J. C. B. Mohr, pp. 89–110.; D. Coe, E. Helpman: International R&D Spillovers, European Economic Review, 39, 859-887. 1995; W.G. Park: International R&D Spillovers and OECD Economic Growth, in: Economic Inquiry, Vol. 33, No. 4, 1995, pp. 571–591; D. Guellec, B. van Pottelsberghe: R&D and productivity growth: panel data analysis of 16 OECD countries, in: OECD Economic Studies No. 33, 2001/II; D. Coe, E. Helpman, A.W. Hoffmaister: International R&D Spillovers and Institutions, NBER Working Paper 14,069, 2008.

[3] European Commission: Europe 2020 – A European strategy for smart, sustainable and inclusive growth, 2010.

benchmark criterion to have been carried over from the original Lisbon strategy.[4] However, initial criticism of exclusively applying the 3% benchmark can already be heard.[5] This criticism is strongly based on the fact that R&D investment does not seem to be a valid indicator of a country's innovativeness. It is rightly claimed that R&D measures are of the utmost concern for those countries with a strong manufacturing sector, e.g. Germany, but can more easily be neglected in those countries with a strong services sector, e.g. the UK.[6] This is one of the reasons why the most recent research financed within the FP7 research program of the European Commission has developed an internationally comparable dataset to measure innovation by including a wider range of innovational dimensions, identifying these dimensions as knowledge or intangible capital.[7] Early research results suggest that an innovation indicator focusing solely on R&D might not take all dimensions of innovation into proper consideration and thus might overlook important information on how to strengthen Europe's competitiveness.[8]

This view of treating innovation as general knowledge capital has been prominently developed by Corrado, Hulten, and Sichel,[9] who have grouped the various items that constitute a firm's knowledge into three basic categories: 1) computerized information, 2) innovative property, and 3) economic competencies. Their approach is currently under consideration by national statistical agencies[10] and think tanks such as the OECD[11] and several research projects financed under the European Commission's 7th Framework Program, as indicated above.[12]

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[4] It should be noted that the Europe 2020 strategy does indicate that it is necessary to develop an indicator that would reflect "R&D and innovation intensity" (p. 9); thus the European Commission seems to be aware of the weakness of putting forward spending on R&D as the sole indicator to measure innovativeness.

[5] S. Tilford, P. Whyte, The Lisbon Scorecard X The road to 2020, Centre for European Reform, London 2010.

[6] S. Tilford, P. Whyte, ibid., p. 23; OECD: The OECD Innovation strategy – Getting a head start on tomorrow, OECD, Paris 2010.

[7] C. Jona-Lasinio, M. Iommi, F. Roth: Report on data gathering and estimations for the INNODRIVE project – Macro approach (Deliverable No. 15, WP9), 2009; F. Roth, A.E. Thum: Does intangible capital affect economic growth?, CEPS Working Document 335, 2010, http://www.ceps.eu/book/does-intangible-capital-affect-economic-growth.

[8] F. Roth, A.E. Thum: Does intangible capital affect economic growth?, op. cit.

[9] C. Corrado, C. Hulten, D. Sichel: Measuring Capital and Technology: An expanded framework, in C. Corrado, J. Haltiwanger, D. Sichel (eds.): Measuring Capital in the New Economy, National Bureau of Economic Research, Studies in Income and Wealth, Vol. 65, Chicago 2005, University Chicago Press, pp. 11–45; C. Corrado, C. Hulten, D. Sichel: Intangible Capital and Economic Growth, Review of Income and Wealth, 55, 661–685, 2009.

[10] J. Kestenbaum: New approaches to measuring innovation, in: S. Tilford, P. Whyte, op. cit, p. 26.

[11] OECD, op. cit.

[12] Two projects measuring a wider set of innovation indicators have been financed under the 7th Framework Program of the European Commission: COINVEST and INNODRIVE. Whereas the COINVEST project has focused on a more detailed measurement for six European countries, the INNODRIVE project has developed an intangible capital dataset for the EU-27.

In particular economic competencies—which include the three dimensions of brand names, workforce training (or firm-specific human capital), and organizational design (or organizational capital) of a firm—seem to be essential prerequisites for innovative processes in the manufacturing and service sectors. In the manufacturing sector, these investments should be regarded as crucial complementary investments alongside classical R&D investment. In the services sector, investments in economic competencies seem to play a key role in enhancing labor productivity.[13]

2 How Does R&D Investment by Businesses Compare to Investment in Intangibles in the EU?

Using newly developed internationally comparable data on intangible capital, Fig. 6.1 shows the overall investment in intangible capital by businesses[14] when including scientific R&D and the three dimensions of economic competencies:

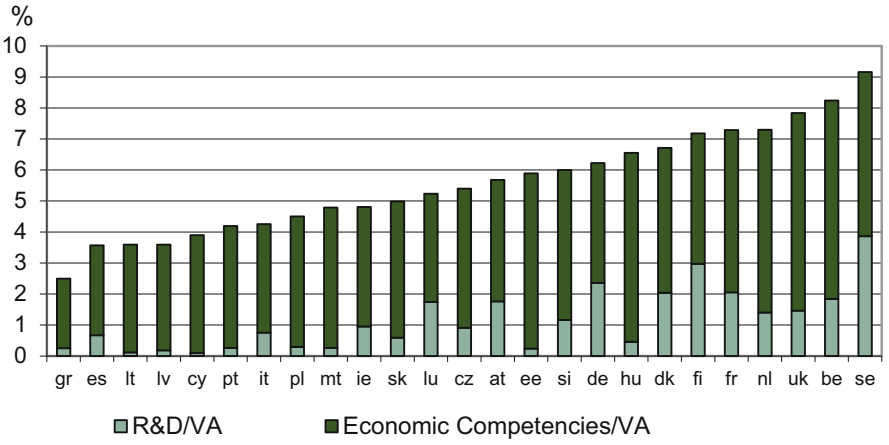

Fig. 6.1 Investment in intangible capital by businesses in the EU25 compared to R&D
Source: INNODRIVE Project (F. Roth, A.E. Thum: Does intangible capital affect economic growth?, op. cit).

[13] Currently the two FP7 projects INDICSER and SERVICEGAP try to identify, among other things, the role of intangible capital on labor productivity within the service sector.

[14] As the Europe 2020 strategy identifies in particular business investment in R&D as significantly lower compared to levels in the US and Japan, it seems crucial to focus on businesses' investments of intangible capital. Concrete reasons why the included intangible indicators should be classified as investment in Gross Fixed Capital Formation are given in C. Jona-Lasinio, M. Iommi, F. Roth, op. cit. and F. Roth, A.E. Thum: Does intangible capital affect economic growth?, op. cit.

1) brand names (advertising and market research investment), 2) firm-specific human capital, and 3) organizational capital investment.[15]

Interestingly, closer analysis of intangible capital investment indicates that the 3% benchmark for total R&D spending is quite low in comparison to intangible capital investments of up to 9% by businesses in Sweden. In addition, the innovation ranking has changed significantly. When focusing solely on business R&D spending, Sweden is followed by Finland, Germany, and France (see R&D share in Fig. 6.1). Furthermore, the UK is positioned at the lower end of the distribution. However, when focusing on a wider range of innovation indicators, Sweden is followed by Belgium and the United Kingdom, both of which have investment rates of approximately 8%. These two countries are then followed by the Netherlands and France. Germany and Austria are positioned in the middle of the distribution, while the two Mediterranean countries Greece and Spain are positioned at the bottom of the distribution. With an investment rate of more than 4%, Italy performs similarly compared to the analysis with a focus solely on R&D. It is the poorest performer among the four big European economies. This finding in combination with Italy's poor achievement when it comes to human capital indicates that the country seems to be ill-equipped for future economic competition.[16] It also underlines once more the deep structural imbalances existing within the Eurozone, with Mediterranean countries lagging behind in terms of innovativeness. Figure 6.2 once more clarifies the significant differences between R&D investments and investment in economic competencies within an EU-15 country sample.

Investment in R&D seems to be positively (although weakly) related to investments in economic competencies. In Sweden and Finland, high investment in R&D

[15] As opposed to the original CHS framework, the author has not included software and entertainment, mineral exploration and literary or artistic originals, as those indicators have already been included in the asset boundary of national accounts (see here F. Roth, A.E. Thum: Does intangible capital affect economic growth?, op. cit.). Furthermore, the following intangible index will not include the indicator "development in the financial service industry," as the inclusion of this indicator creates a clear outlier in the EU-15 in the case of Luxembourg, distracting from the overall importance of the findings for policymaking. Furthermore, taking the financial crisis into consideration, the author feels that the indicator should be handled quite cautiously when measuring intangible capital in future approaches. Focusing on economic competencies in addition to R&D already highlights the inadequacy of an innovation indicator focusing solely on R&D. However, the indicator "development in the financial service industry" will be included in intangible capital measure later in this paper. In 2005, it represented around one-tenth of intangible capital in the EU-25 on average.

[16] D. Gros, F. Roth, The Post-2010 Lisbon Process—The Key Role of Education in Employment and Competitiveness, in: Bundesministerium für Wirtschaft und Arbeit: Die Zukunft der Wirtschaftspolitik der EU—Beiträge zum Diskussionsprozess "Lissabon Post 2010," Vienna 2008, Bundesministerium für Wirtschaft und Arbeit, pp. 179–195; F. Roth, A.E. Thum: The Key Role of Education in the Europe 2020 strategy, CEPS Working Document 338. Centre for European Policy Studies. 2010.

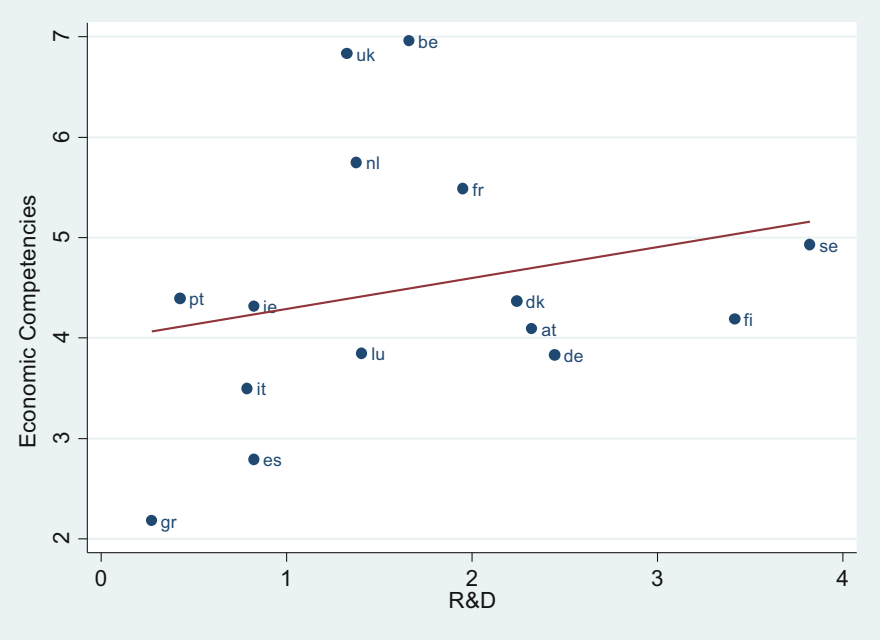

Fig. 6.2 Relationship between investment in R&D and economic competencies
Source: INNODRIVE Project (F. Roth, A.E. Thum: Does intangible capital affect economic growth?, op. cit).

by businesses is associated with moderate investment in the economic competencies of their firms. The same is true for the three economies Denmark, Austria and Germany, as well as for Luxembourg, Ireland, Portugal, and Italy, in which the investments in business R&D are also closely matched to their investments in economic competencies. However, the scatterplot also identifies four interesting cases in which R&D investment seems to be not so closely linked to investment in economic competencies. These countries are the Netherlands, Belgium, the United Kingdom, and Greece. Whereas Greek investment in economic competencies seems to be relatively small compared to its investment in R&D, investments by the Netherlands, the UK, and Belgium are particularly higher than their R&D investment. This finding implies that especially for the UK, the Netherlands, and Belgium, an innovation indicator focusing solely on R&D investment poorly measures these countries' competitiveness if focusing on their innovative potential. In the UK this is due to the fact that its economic structure is more heavily dependent on the services sector as opposed to the manufacturing sector, which tends to be more important in other European member states.

3 Comparison between Tangible and Intangible Capital Investment in the EU

Efforts have been made to stop the steady decline of investment in traditional tangible capital in most advanced economies. However, the efforts to increase investment in tangible capital do not seem to have taken into account the fact that the most advanced economies have simply undergone a structural transformation towards becoming knowledge societies. But since the traditional national accounting framework has not taken these processes into consideration, the accounts were (and still are) not able to identify the actual investments made by businesses in recent decades. Figure 6.3 compares the levels of investment in traditional tangible capital with the new investments made in ICT and intangible capital for an EU11 country sample[17] for the time period 1995–2005. Whereas traditional tangible capital investments have remained at a 16% level, the investments in ICT and intangible capital

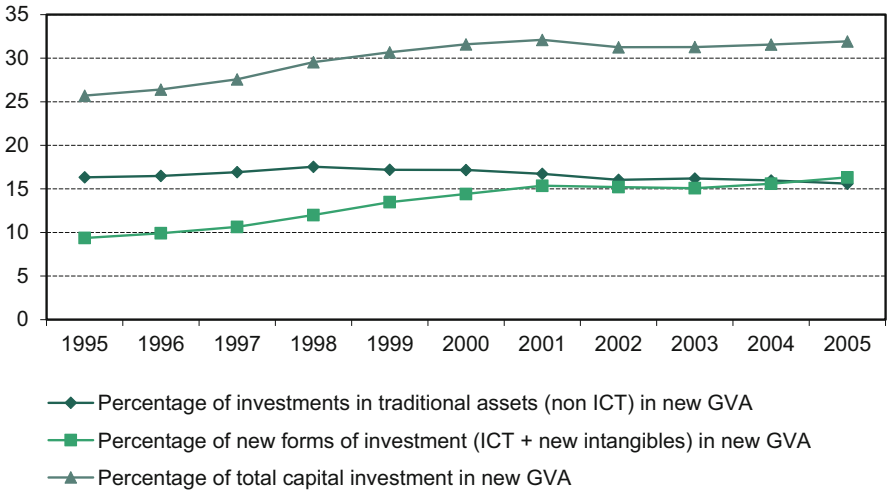

Fig. 6.3 Comparison of business investment in traditional tangible capital and new ICT and intangible capital in an EU11 country sample
Sources: INNODRIVE Project (F. Roth, A.E. Thum: Does intangible capital affect economic growth?, op. cit) and EUKLEMS database (EUKLEMS: EU KLEMS Growth and Productivity Accounts, March 2008 Release, http://www.euklems.net/).

[17]The following 11 countries in the EUKLEMS dataset (EUKLEMS: EUKLEMS Growth and Productivity Accounts, March 2008 Release, http://www.euklems.net/) are included in the aggregated EU-11 trend: Austria, Czech Republic, Germany, Denmark, Finland, Italy, the Netherlands, Portugal, Slovenia, Sweden, and the United Kingdom. ICT includes computing equipment and communications equipment. New intangibles include scientific R&D, economic competencies, software and—as Luxembourg is not included in the country sample—"new development in the financial service industry." The share of investment in "new development in the financial service industry" in 2005 was, as stated above, on average one-tenth of total investment in intangible capital in the EU25 countries.

have risen continuously and in 2005 reached a higher investment ratio than traditional tangible capital investment. Furthermore, if one accounts for both investments, the overall capital investments in the 11 EU member states were as high as approximately 32% in 2005 and have steadily risen (due to ICT investment) from 1995 to 2001 and beyond. Due to the burst of the dot-com bubble, the investment rate in 2005 remained at the same level as in 2001.

Figure 6.3 shows aggregated trends of 11 European countries. But to what extent do the trends differ in the individual EU member states? Figure 6.4 shows the three trends for the United Kingdom. Most interestingly, new investments in ICT and intangibles were already higher than investments in traditional capital investment in 1996, and were equal in 1997 for the last time. From 1997 onward, there has been a steady increase in investment in ICT and intangibles coupled with a steady decrease in traditional tangible capital. Whereas business investment in traditional capital, e.g., machinery, equipment, buildings, etc., reached a level as low as 10% in 2004, investments in new ICT and intangibles doubled that amount. Focusing on the total capital investment shows a steady increase in capital investment in the UK (with a minimal decline from 2002 to 2003 due to the burst of the dot-com bubble), reaching a level of approximately 32% in 2005.

We now turn to Europe's largest economy. Figure 6.5 shows the comparison of business investments in traditional capital investment and new ICT and intangible capital investment in Germany. As in the UK, investments in ICT and intangible capital are diametrically related to each other. Whereas investment in traditional capital has decreased slowly but steadily, investments in ICT and intangibles have gradually grown. In 2001, investments in ICT and intangible capital were already higher than in traditional capital. Furthermore, Germany's overall capital investment

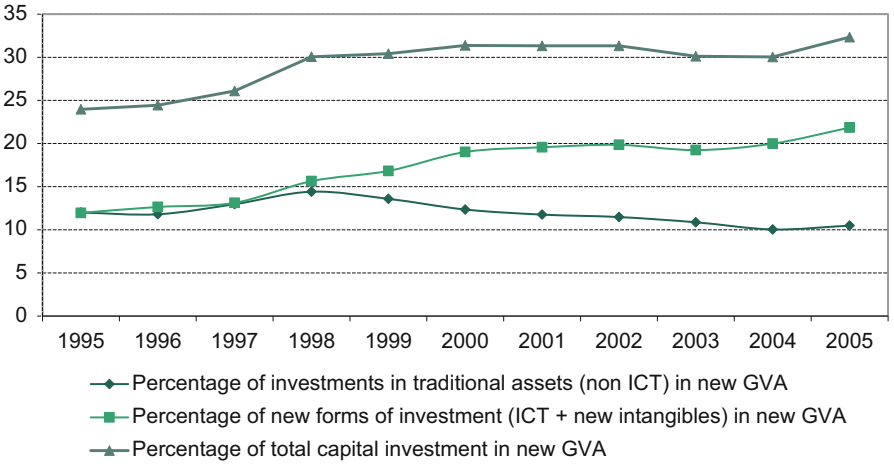

Fig. 6.4 Comparison of business investment in traditional tangible capital and new ICT and intangible capital in the UK
Source: INNODRIVE Project (F. Roth, A.E. Thum: Does intangible capital affect economic growth?, op. cit) and EUKLEMS database (EUKLEMS: EU KLEMS Growth and Productivity Accounts, March 2008 Release, http://www.euklems.net/).

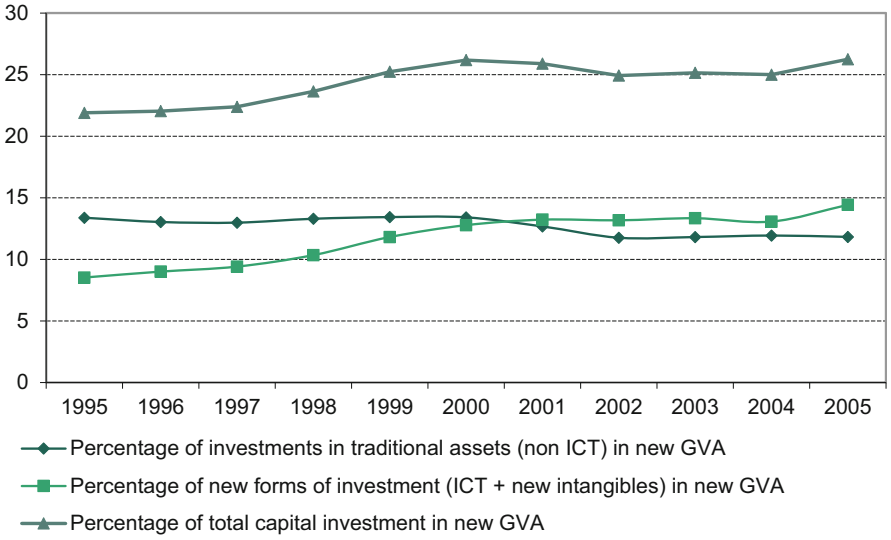

Fig. 6.5 Comparison of business investment in traditional tangible capital and new ICT and intangible capital in Germany
Sources: INNODRIVE Project (F. Roth, A.E. Thum: Does intangible capital affect economic growth?, op. cit) and EUKLEMS database (EUKLEMS: EU KLEMS Growth and Productivity Accounts, March 2008 Release, http://www.euklems.net/).

in 2005 was near the 26% benchmark and increased steadily over the time period 1995–1999 and again from 2002 to 2005 after the bursting of the dot-com bubble.

4 Conclusion

This contribution has analyzed business investment using a new internationally comparable dataset comparing the rate of business investment in intangible capital in the EU27. Two main policy conclusions can be drawn.

First, the European 2020 agenda should switch its benchmark criteria from a sole focus on R&D to a focus on overall investment in intangible capital, in particular, on investments in economic competencies. The R&D indicator seems to be particularly inappropriate for European economies with stronger services sectors, e.g. the United Kingdom, and to overestimate the innovation potential for those countries that rely heavily on manufacturing, e.g. Germany. Thus, including a wider range of intangible capital variables in measuring innovative potential would give a more accurate picture to European policymakers.

Second, today's national accounting framework seems to be ill-suited to correctly identify the ongoing transition of European economies to becoming knowledge economies. Failing to identify intangibles as an investment in Gross Fixed Capital Formation has the effect of strongly mismeasuring the levels of capital investment by European economies. Any policy conclusion based purely on an analysis of "brick

and mortar" investment without accounting for intangible capital variables seems to be highly problematic. The frequently heard lament of falling capital investment levels in the European Union seems to be unsubstantiated once ICT and intangible investments are taken into account. The apparent decline in traditional fixed capital formation is in fact in most European economies more than fully compensated for by an increase of ICT and intangible capital formation. European policymakers should therefore find new ways of promoting investment in intangible capital and stop subsidizing traditional forms of tangible capital, e.g., via the European structural funds.

References

Bassanini, A., & Scarpetta, S. (2002). Does human capital matter for growth in OECD countries? A pooled mean-group approach. *Economic Letters, 74,* 399–405.

Coe, D. T., & Helpman, E. (1995). International R&D spillovers. *European Economic Review, 39,* 859–887.

Coe, D., Helpman, E., & Hoffmaister, A.W. (2008). *"International R&D Spillovers and Institutions", NBER Working Paper 14069.* National Bureau of Economic Research.

Corrado, C., & Hulten, C., & Sichel, D. (2005). Measuring capital and technology: An expanded framework. In C. Corrado, J., Haltiwanger, & D. Sichel (Eds.), *Measuring Capital in the new Economy* (pp. 11–46). University of Chicago Press.

Corrado, C., Hulten, C., & Sichel, D. (2009). Intangible capital and U.S. economic growth. *Review of Income and Wealth, 55,* 661–685.

European Commission. (2010). Europe 2020. *A Strategy for Smart Sustainable and Inclusive Growth*. Communication from the Commission, European Commission.

Gros, D., & Roth, F. (2008). The Post-2010 Lisbon Process—The Key Role of Education in Employment and Competitiveness. In Bundesministerium für Wirtschaft und Arbeit: *Die Zukunft der Wirtschaftspolitik der EU—Beiträge zum Diskussionsprozess "Lissabon Post 2010"* (pp. 179–195), Österreichisches Bundesministerium für Wirtschaft und Arbeit.

Guellec, D., & van Pottelsberghe, B. (2001). R&D and productivity growth: panel data analysis of 16 OECD countries. *OECD Economic Studies, 33,* 2001/II

Jona-Lasinio, C., Iommi, M., & Roth, F. (2009). *Report on data gathering and estimations for the INNODRIVE project – Macro approach* (Deliverable No. 15, WP9). INNODRIVE Consortium.

Kestenbaum, J. (2010). New approaches to measuring innovation. In S. Tilford & Whyte, P. (Eds.), *The Lisbon Scorecard X: The road to 2020.* Centre for European Reform.

Khan, M., & Luintel, K. (2006). *"Sources of Knowledge and Productivity: How Robust is the Relationship?", OECD Science, Technology and Industry Working Paper No. 2006/6.* OECD.

Lichtenberg, F. (1993). R&D investment and international productivity differences. In H. Siebert (Ed.), *Economic growth in the world economy* (pp. 89–110). J. C. B. Mohr.

Park, W.G. (1995). International R&D Spillovers and OECD Economic Growth. *Economic Inquiry, 33,* 571–591.

Roth, F., & Thum, A.E. (2010). *"Does intangible capital affect economic growth?", CEPS Working Document 335.* Centre for European Policy Studies.

Roth, F., & Thum, A.E. (2010). *"The Key Role of Education in the Europe 2020 strategy", CEPS Working Document 338.* Centre for European Policy Studies.

Tilford, S., & Whyte, P. (2010). *The Lisbon Scorecard X: The road to 2020.* Centre for European Reform.

Chapter 7
Does Too Much Trust Hamper Economic Growth?

Felix Roth

Abstract This contribution examines the relationship between trust and economic growth. Taking panel data and using a fixed-effects estimation for a 41-country sample over the time period from1980 to 2004 and with a total of 129 observations, tis points out that economic growth is negatively related to an increase in trust. This negative finding is in contrast to most empirical findings using a cross-sectional design. The common knowledge which has governed the nature of discussions in the social sciences and economics for the last 10 years, namely that trust is generally positively related to economic performance, must be seriously questioned. From a policy point of view, an increase in trust is crucial for countries with low levels of trust, but can likely be neglected by countries with sufficient levels of trust and may even hamper economic performance in countries with high levels of trust. The relationship is tested in the context of EU countries, OECD countries, and developing countries. Interpersonal trust and systemic trust are differentiated.

Keywords Trust · Economic growth · Panel analysis · EU · OECD · Developing countries

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Introduction

Recent years have seen interest in the theoretical and empirical relationship between social capital and economic growth. Social capital is said to be "the glue that holds societies together" and it is emphasized that "without it no economic growth or human well-being is possible" (Serageldin 1999, p. iii). Empirical research shows that there is a positive relationship between interpersonal trust and economic growth (Knack & Keefer, 1997; La Porta et al., 1999; Whiteley, 2000; Zak & Knack, 2001; Beugelsdijk et al., 2004). In contrast to existing works, which examine the relationship between social capital and economic growth using a cross-section research design, this contribution uses a panel research design.

1 Theoretical Links Between Social Capital, Trust, and Economic Growth

1.1 Social Capital and Trust

Many economists focus on the concept of trust when talking about social capital (Knack & Keefer, 1997; Solow, 1999; Whiteley, 2000; Berggren & Jordahl, 2006; c.f. Bjørnskov, 2003; Sabatini, 2008). Tonkiss (2000) comments that "trust regularly features—together with norms and networks—within definitions of social capital" (p. 78). But how is trust related to social capital? Although there are various definitions of social capital (Bourdieu, 1983; Coleman, 1988, 1990; Putnam, 1993; Fukuyama, 1996, p. 26; Temple 2001 in OECD, 2001, p. 39; Ostrom, 1999, p. 176; Newton, 1997, p. 576; for a wide range of definitions see Woolcock, 1998, p. 189), trust is considered to be the most important dimension of social capital (Coleman, 1990; Fukuyama, 1996; Newton, 1997, p. 576; Ostrom, 1998; Uslaner, 1999, p. 122; Tonkiss, 2000; Zak & Knack, 2001).

Therefore, this contribution focuses primarily on the dimension of trust in the concept of social capital in the following empirical application.

Although there is a variety of definitions of *trust* (Fukuyama, 1996, p. 26; Misztal, 1996, p. 16; Delhey & Newton, 2005, p. 311; Dasgupta 1997, p. 5 in Ostrom, 1998, p. 12; Luhmann, 2000, pp. 1, 27), recent literature distinguishes between three different forms: 1) thick trust, 2) interpersonal or generalized trust, and 3) systemic or institutional trust (Putnam, 2000, p. 137; Newton, 1997, p. 578, ff.; Luhmann, 2000).

Newton (1997) and Williams (1988) classify trust that is generated by family networks as thick trust. In contrast, interpersonal or generalized trust is defined as trust that is generated by looser, secondary relations in modern societies, based on everyday interaction between people who do not otherwise know each other. Most scientists focus on interpersonal trust when examining the relationship between economic growth and trust, as it should facilitate cooperation and lower transaction costs in economic systems. Economic systems tend to be characterized by a substantial degree of differentiation, and exchange activity frequently depends upon

trust in strangers. Interpersonal trust can be regarded as a good indicator of the levels of solidarity in society, as well as a good indicator of the overall level of social cohesion in society. This survey item, which is used in several international surveys, is likewise used in this contribution when discussing trust.

The third category of trust, systemic or institutional trust, refers to the confidence people have in certain institutions. When discussing systemic trust here, the focus is on trust in the parliament, the police, the armed forces, and major companies.

1.2 Relationship Between Social Capital, Trust, and Economic Growth

Arrow (1972) argues that the presence of virtues such as trust plays a significant role in the operation of economic systems (p. 345). He builds his assumption upon the paradigm of exchange and elaborates that the process of exchange requires or is greatly facilitated by virtues such as trust (p. 345). For Fukuyama (1996), a nation's well-being and its ability to compete depend upon the level of trust inherent in a society (p. 7). This argument is built upon his belief that economic activity itself is part of the social life and constitutes itself according to the norms, rules, and moral obligations of a society (p. 7). Robert Putnam (1993) comes to the conclusion that high stocks of social capital in an economic region "bolster the performance of the polity and the economy, rather than the reverse" (p. 176). He puts forward four arguments why social capital has a positive effect on the economy: 1) it facilitates coordination and cooperation for mutual benefit, 2) it solves dilemmas of collective action, 3) it reduces the incentives for opportunism, and 4) it reduces egoism (1995, p. 76). In line with this argument, Sen (1999) argues that "the development and use of trust in one another's words and promises can be a very important ingredient of market success" (p. 262) and that "no society would be viable without some norms and rules of conduct" (Sen, 1977, p. 332).

According to Whiteley (2000), interpersonal trust has three direct channels through which it might stimulate economic growth (p. 451).

Firstly, trust has a direct effect on economic performance by reducing transaction costs. Transaction costs evolve during the economic process of exchange and specialization and are defined as the costs associated with banking, insurance, finance, wholesale, and retail trade, or in terms of dealing with lawyers and accountants, etc. (North, 1990, p. 28). For North, the transaction costs are a part of the costs of production. Taking this new production function into consideration, high-trust societies should produce a higher output than low-trust societies as the cost for transactions like monitoring, enforcing, and protecting contracts is smaller. People who trust each other do not spend as much time or money protecting their property rights. They might be able to solve their problems without lawyers or lawsuits.

Secondly, trust has a direct influence on growth because it enables actors to solve collective action problems (Whiteley, 2000, p. 451). These arguments are in line with Hardin (1982) and Ostrom (1990). In high-trust societies, it should theoretically

be easier to cope with free rider problems that evolve, for example, with smog problems, CO_2 emissions, and clean neighborhoods (Hardin, 1982, p. 9), as well as, for example, the problem of overfishing (Ostrom, 1990, p. 3). Generally, in high-trust societies, people will not so readily take advantage of the public infrastructure.

The third direct effect is that principal-agent problems might be much less significant in high-trust societies (North, 1990, pp. 32, 33). According to Knack and Keefer (1997), two arguments can be mentioned in this context: 1) if entrepreneurs devote more time to monitoring possible malfeasance by partners, employees, and suppliers, they will have less time to devote to innovation in new products or processes: and 2) employment contracts in which managers rely on employees to accomplish tasks can be difficult to monitor. Fukuyama (1996) argues that high-trust communities are not as dependent on extensive contracts and legal regulations (p. 26) and that cooperation in high-trust societies will not have to be enforced by coercive means (p. 27). He concludes that "if people who have to work together in an enterprise trust one another, . . . doing business costs less" (p. 27).

It has been argued thus far that trust, and therefore the facilitation of collective action, leads to economic development and growth. But is this necessarily or always the case?

One starting point for a possible negative relationship between trust and economic growth can be found in the literature on collective action by Mancur Olson (1982). This literature admittedly deals with the dimension of networks rather than the dimension of trust, but the discussion proves quite relevant for these purposes. Olson analyses the relationship between collective action and economic performance in quite a contrary way. For example, collective action can undermine the state's power to implement necessary reforms or agendas to maintain high economic growth rates. Olson argues that stable societies are in danger of accumulating "collusions" and "organizations of collective action" over time (p. 41). If a society accumulates too many organizations that function as special interest groups, economic growth is harmed by reduced efficiency, by income being aggregated in the societies in which they operate, and by political life being made more divisive (p. 47). To give one example, if a state desires to implement labor market reform in which, for example, employee rights are reduced, a sector with cheap labor is implemented, working hours are extended, and social spending on unemployment benefits and support is decreased to reduce the costs of the labor factor, a highly trusting and solidaristic society would more likely oppose the state's efforts at reform and will, via the mobilization of collective action, stop the reform agenda, and therefore limit the potential of higher economic growth rates. This argument is built upon Putnam's empirical findings that a vibrant civil society is crucial for high levels of trust (Putnam, 1993, 1995). In fact, it could be actors within civil society such as church groups, professional groups, and Social Movements Organizations (SMOs) that oppose the state's will to implement reforms. Similarly, the number of workers being members of labor unions might be a critical factor for the existence of high levels of trust (Putnam, 1993, 1995, 2000). For Putnam himself, civic associations and stocks of interpersonal trust are clearly interlinked. As such, the negative relationship between trust and economic growth could be driven by associational activity. Groups with strong bonding ties may produce, on an aggregated scale, a

high interpersonal trust stock, while reducing economic outcomes, as described above. Although being aware of various negative outputs that can evolve from a strong civil society, Putnam never really clarified the extent to which civic engagement and high stocks of trust may hamper economic performance.

2 Previous Findings

Using a cross-sectional analysis with 29 market economies as units of observations, Knack and Keefer (1997) discover that trust, in particular, as well as norms, matter for economic growth, but that associations do not. Their social capital variable is measured taking 21 observations from the first wave of the World Value Survey (1981–1984) and eight observations from the second wave of the WVS (1990–1993). Thus, the authors utilize trust values from 1990 to 1993 to explain the economic growth rate from 1980 to 1992. The authors were aware of the endogeneity problem and argue that reverse causation is not problematic due to the fact that the correlation between countries from the first and second wave of the WVS is very high (0.91).

In 2001, Zak and Knack reinvestigated the empirical results from Knack and Keefer were published in 1997. They used a cross-sectional analysis and observations from 41 market economies. They used all three waves from the WVSs of 1981–1984, 1990–1993, and 1995–1997, the Eurobarometer and a government-sponsored survey for the case of New Zealand. Their dependent variables were investment share as a percentage of GDP, averaged over the period from 1970 to 1992, and average annual growth in per capita income over the same period. Depicting the relationship between trust and economic growth, the authors came to the conclusion that a positive relationship exists between trust and growth. They determined that growth rises by nearly 1% point on average for each 15% point increase in trust (p. 309).

Beugelsdijk et al. (2004) analyzed the statistical robustness of the results of Knack and Keefer and Zak and Knack along four dimensions of robustness. They concentrated on the statistical significance and explored the influence of changing sets of conditioning variables on the estimated effect of trust. Moreover, they analyzed the sensitivity of the results for using different proxies or specifications for basic variables like human capital. Finally, they investigated the effects on the significance and effect size when the 29-country sample by Knack and Keefer was extended by 12 in the Zak and Knack paper. They conclude that the empirical literature on trust and economic growth seems to be plagued more by data limitations than by econometric problems such as omitted variable biases. The authors come to the conclusion that "their extensive robustness analysis further adds to the empirical evidence that trust matters for explaining variation in economic performance" (p. 132) (Table 7.1).

Berggren et al. (2007) conducted an extensive robustness analysis of the relationship between trust and growth by investigating a latter time period and a larger sample size. The authors worked with 63 countries using data on trust from the fourth version of the WVS and from the Latinobarometro, as well as new data on

growth, to separate time and sample effects. They investigated whether previous results on the trust-growth relationship for the period of 1970–1992, studied by Zak and Knack and Beugelsdijk et al., also hold for the 1990s. They learned that when outliers are removed (here they mention China, specifically) the trust-growth relationship is only statistically significant (with significance at the 95% level) in 10% of their 1140 regressions and that it is half as large compared to the results that had been previously reported. The authors emphasize however that their results do "not necessarily mean that trust is unimportant for growth, but its importance seems to be more limited and uncertain than previously claimed" (p. 1).

La Porta et al. (1999), using an OLS regression on 39 countries and a cross-section design with a dependent variable, per capita GDP growth rate from 1970 to 1993, found a significant positive relationship between trust and economic growth. They concluded that "in sum trust enhances economic performances across countries" (p. 317) and that "despite economist's skepticism . . . theories of trust hold up remarkably well when tested on a cross-section of countries" (p. 320).

Whiteley (2000) examined the relationship between trust and economic growth in the framework of a modified neoclassical model of economic growth. Using cross-section designs in a 34-country sample, and using the timeframe of 1970–1992, he came to the conclusion that an index of three trust indicators from the World Value Survey (1990–1993) has a positive effect on economic growth, with an impact as great as the variable human capital and conditional convergence. His findings support the idea that "values play a key role in explaining cross-national variations in economic performance and that they cannot be ignored in any properly specified model of economic growth" (p. 460).

In contrast to these findings, Heliwell (1996), taking an OECD country sample (17 OECD countries), found a negative relationship between trust and productivity growth from 1960 to 1992 (associations and social capital, an equally weighted combination between trust and associations, are also negatively related to

Table 7.1 Previous empirical results between trust and economic growth

Dependent variable	Growth of GDP per capita		
Equation	1	2	3
Article	Knack and Keefer (1997)	Zak and Knack (2001)	Berggren et al. (2007)
Growth per capita	80–92	70–92	90–00
Interpersonal trust	0.082*	0.063*	0.062*
Income	Yes	Yes	Yes
Primary schooling	Yes	No	No
Secondary schooling	Yes	No	No
Schooling	No	Yes	Yes
PPP	Yes	Yes	Yes
N	29	41	63

Notes: Yes = variable is included in the growth model; No = variable is not included in the growth model.

*Significance at the 90% level and higher (one-tailed test).

productivity growth). His results seem to be the only cross-country indication of a negative effect between trust and economic performance.

These empirical studies involve a critical and important step in focusing on the concept of trust when reflecting upon economic growth. Their cross-section design strongly supports the hypothesis that trust is relevant to economic growth. Nevertheless, they all neglect to examine how changes in trust affect economic growth. For policy decision-making, however, it might be more relevant to analyze the effect of changes in trust on economic performance. Furthermore, using a fixed-effects model provides two advantages. Firstly, unobserved heterogeneity can be controlled for. Secondly, the problem that the interpretation of the trust items differs across countries can be addressed.

3 Data and Measurement

3.1 Operationalization

The World Value Survey presents only limited data on trust. The trust variable is constructed, as it is usually agreed upon by scholars from various disciplines (Inglehart, 1990, 1999; Knack & Keefer, 1997; Paxton, 1999, 2002; Uslaner, 1999; Alesina & La Ferrara, 2000; Putnam, 2000; Whiteley, 2000; Zak & Knack, 2001; Van Oorschot & Arts, 2005; Delhey & Newton, 2005; Berggren & Jordahl, 2006), by aggregating the answer, "Most people can be trusted."[1] (after deleting the "Don't know." answers) to the item, "Generally speaking, would you say that most people can be trusted or that you need to be very careful in dealing with people?" (WVS 1999–2002).[2] It is thereby possible to compare the stock of trust in different nations, from developed to developing, including transition states. The stock of trust varies from 2.6% in Brazil 1995–1997 (Inglehart 2000) to 66.5% in Denmark 1999–2002 (European Values Study Group and World Values Survey Association, 2004). There are various critiques of this operationalization.[3]

[1] In the Eurobarometer 25, the answer is "Most people could be trusted."

[2] The ending of the question is slightly different in the first three waves of the WVS and the Eurobarometer 25: "[One] can't be too careful in dealing with people." (WVS 1981–84; WVS 1990–93; WVS 1995–97) and "[One] could not be too careful in dealing with people." Eurobarometer 25 (Rabier et al., 1988).

[3] This approach is criticized by referring to the non-comparability of the different cultural backgrounds of the countries that participate in the WVS. Researchers question whether data from China can be compared to data from Germany, when the etymological meaning of the term trust differs in the languages. Although correct, this criticism must be disregarded when comparing different cultures, in so far as intercultural comparison would otherwise be made impossible. One must therefore be pragmatic in using the data are available. Furthermore, recent research provides evidence that individuals from the different countries did interpret the question from the WVS in similar ways (Paxton, 2002, p. 261) and that the trust data are valid and of high quality as they correlate highly to a natural experiment done by the Readers Digest (Knack & Keefer, 1997,

3.2 Model Specification

To be able to compare these results with previous empirical work conducted on the relationship between trust and economic growth, a version of the economic growth model used by Knack and Keefer (1997), Zak and Knack (2001), Beugelsdijk et al. (2004), and Berggren et al. (2007) was used. Furthermore, a version of this type of growth model was used by Forbes (2000) when analyzing the relationship between inequality and economic growth in a panel setting from 1965 to 1995.

In the baseline model, economic growth is estimated as a function of the natural logarithm of initial income, the price level of investment, human capital, and interpersonal and systemic trust. An estimate of an unbalanced panel was made. The baseline growth model for the fixed-effects estimation is modelled as follows:

$$\begin{aligned}\text{Growth}_{i,t} = {} & \alpha_i + \beta_1 \text{Trust}_{i,t-1} \\ & + \beta_2 \text{Income}_{i,t-1} \\ & + \beta_3 \text{Human Capital}_{i,t-1} \\ & + \beta_4 \text{PPPI}_{i,t-1} \\ & + w_{i,t},\end{aligned}$$

where i represents each country and t represents each time period (with $t = 1$–5); $\text{Growth}_{i,t}$ is the average annual growth for country i at period t; $\text{Trust}_{i,t\text{-}1}$, $\text{Income}_{i,t\text{-}1}$, $\text{Human Capital}_{i,t\text{-}1}$, $\text{PPPI}_{i,t\text{-}1}$, and are respectively trust, income, human capital, and price level of investment for country i during period t–1; α_i represents a group-specific constant term and $w_{i,t}$ is the error term.

3.3 Measurement of Data

Data on income and growth are based on per capita income between 1980 and 2004, adjusted for purchasing power parity (PPP, expressed in constant 2000 US Dollars), are drawn from the World Development Indicator Database, 2006. Since yearly growth rates incorporate short-run disturbances, growth is averaged over 5-year periods. The dependent variable here is an average growth rate per capita for the periods 1980–1984, 1985–1989, 1990–1994, 1995–1999, and 2000–2004.

- The data on the price level of investment, population growth as a proxy for the factor, Labor, the investment share of GDP at constant prices, and openness at

p. 1257). Glaeser et al. (2000) doubts that the item measures trusting behavior, and believes that it measures the overall level of trustworthiness in a society. Jagodzinski and Manabe (2005) state that the item does not measure trust but misanthropy, instead, and it was taken as an index of misanthropy by Rosenberg. Sobel (2002, p. 151), Portes (2000, pp. 4 ff.), and Durlauf and Fafchamps (2005) criticise the method of aggregation. For them social trust should more accurately be measured on a micro- and meso-level.

constant prices, are drawn from the Penn World Table 6.1 (Heston et al., 2002). The variables were constructed by using lagged variables (1979, 1984, 1989, 1994, and 1999) to reduce the problem of endogeneity.

- The data on interpersonal trust and systemic trust are drawn from four waves of the WVS 1981–1984, 1990–1993, 1995–1997 (Inglehart et al., 2000), and 1999–2002 (European Values Study Group and World Values Survey Association, 2004) and the Eurobarometer 25 (Rabier et al., 1988) providing data for 1986.
- The data on human capital are based on Barro and Lee (2000) and refer to the total years of schooling of the total population aged 25 and over. Data were taken for 1980, 1985, 1990, 1995, and 2000.

4 Descriptive Statistics

The country sample consists of 41 countries. Table 7.2 lists all interpersonal trust values for the included country observations in my dataset. Twenty-seven out of 30 OECD[4] countries and 14 out of 15 EU15[5] countries are included. The observations were made over the time period from 1980 to 2004 providing five time periods with a total of 129 cases for the analysis.

In contrast to the consensus that interpersonal trust is a constant variable, formed by the cultural background of a nation (Knack & Keefer, 1997; Zak & Knack, 2001; Knowles, 2005; Delhey & Newton, 2005, p. 314; c.f. Inglehart, 1997, p. 224; Inglehart, 1999, p. 95; Noelle, 2005, p. 5), a closer look at Table 7.2 highlights the existing variance in trust, with a strong decline in trust between the years 1990 and 1995.[6]

Only Germany, Japan, and India have increased their levels of trust. On the other end of the scale, the two liberal economies, the UK and the US, face a severe decline. The US loses 14.4% of interpersonal trust and the UK, 12.2%. Poland and Finland face the most severe losses; Poland loses 16.6%, Finland loses 15.1%, South Africa loses 10.1%, China loses 7.8%, and Sweden loses 6.4%. Argentina and Mexico lose around 5%. Only Chile and Norway behave in a more stable manner.

[4] Luxembourg, New Zealand, and the Czech Republic had to be excluded due to data restrictions.

[5] Only Luxembourg had to be excluded.

[6] Although trust values intercorrelate strongly (comparing every combination of two waves gives values from 0.75 to 0.93), there are still very important changes over time. If the wealthiest nation in the world, the United States, and the United Kingdom lose nearly one-third of their original trust level, trust cannot be treated as a constant variable. These changes in trust must be highlighted and examined. Taking the case of Germany for instance clarifies that over the timespan from1950 to 2005, there is steady increase of the level of interpersonal trust (Noelle, 2005). To emphasize the US case once more: Inglehart (1999, p. 95) and Uslaner (1999, p. 132) show that there is a decline in interpersonal trust from 58%in 1960 to 36%in 1994. Paldam (2007), who has worked independently on the analysis of the variance in interpersonal trust, discovers that there exists a great variance in the interpersonal trust data over time.

Table 7.2 Levels of interpersonal trust

Country	Trust 81	Trust 86[b]	Trust 90	Trust 95	Trust 99
Argentina	27	–	23.3	17.5	15.4
Australia	47.8	–	–	39.9	–
Austria[a]	–	–	31.8	–	33.9
Bangladesh	–	–	–	20.9	23.5
Belgium[a]	30.2	29.5	33.2	–	30.7
Brazil	–	–	6.7	2.8	–
Britain[a]	44.4	39.7	43.6	31	29.7
Bulgaria	–	–	–	28.6	26.9
Canada	49.6	–	52.4	–	38.8
Chile	–	–	22.7	21.9	22.8
China	–	–	60.1	52.3	54.5
Denmark[a]	56	63.5	57.7	–	66.5
Finland[a]	57.2	–	62.7	47.6	58
France[a]	24.8	21.3	22.8	–	22.2
Germany[a]	29.8	43.4	37.8	41.8	34.8[c]
Greece[a]	–	50	–	–	23.7
Hungary	33.1	–	24.6	–	21.8
Iceland	41.6	–	43.6	–	41.1
India	–	–	34.3	37.9	41
Ireland[a]	40.2	33.3	47.4	–	35.2
Italy[a]	26.3	30.3	35.3	–	32.6
Japan	40.8	–	41.7	46	43.1
Mexico	17.7	–	33.5	28	21.3
The Netherlands[a]	46.2	50.2	55.8	–	59.8
Norway	61.2	–	65.1	65.3	–
Pakistan	–	–	–	20.6	30.8
Peru		–	–	5.0	10.7
Philippines	–	–	–	5.5	8.4
Poland	–	–	34.5	17.9	18.9
Portugal[a]	–	28.4	21.4	–	10
Romania	–	–	16.1	–	10.1
Slovak Rep.	–	–	23	–	15.7
Slovenia	–	–	–	15.5	21.7
South Africa	29	–	28.3	18.2	11.8
South Korea	38	–	34.2	30.3	27.3
Spain[a]	34.5	35.3	33.8	29.7	36.2
Sweden[a]	57.1	–	66.1	59.7	66.3
Switzerland	–	–	43.2	40.9	–
Turkey	–	–	10	6.5	15.7
The United States	45.4	–	50	35.6	35.8
Venezuela	–	–	–	13.7	15.9

(continued)

Table 7.2 (continued)

Country	Trust 81	Trust 86[b]	Trust 90	Trust 95	Trust 99
Observations	22	11	32	27	37
Average	39.9	38.6	37.4	28.9	30.1

Note: Countries in italics represent OECD Countries.
[a]Countries from the EU-15.
[b]The trust data from 1986 were taken from the Eurobarometer 25.
[c]Trust data for Germany were taken from West Germany in 1981, 1986, 1990, and 1995. The data from 1999 were taken from unified Germany.

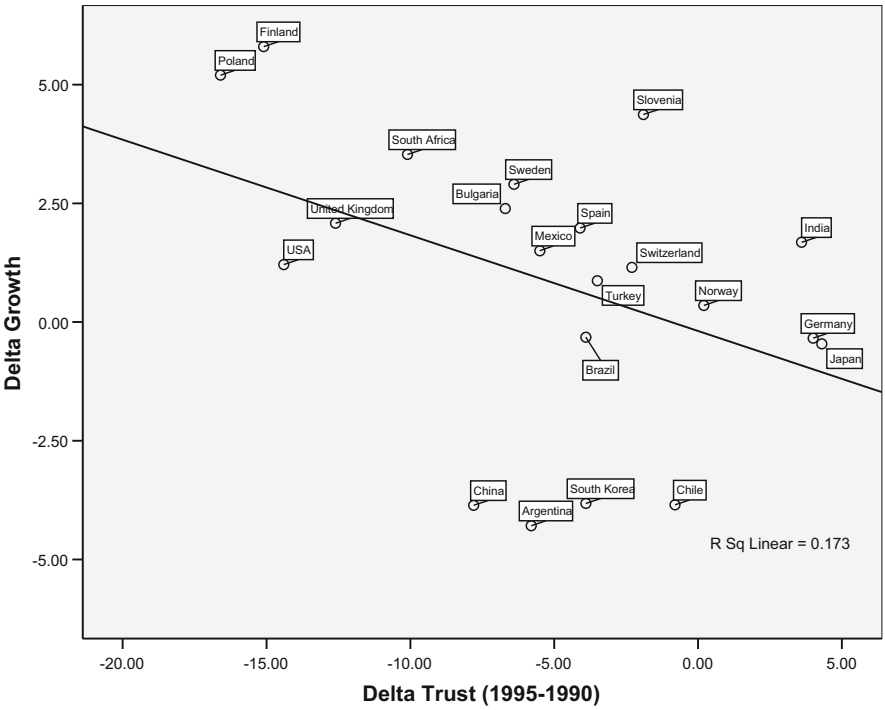

Fig. 7.1 Scatter plot between Δ trust [1995–1990] and Δ growth [9599–9094]

Figure 7.1 shows the relationship between the changes in trust for the period [1995–1990] and the changes in growth in the period [9599–9094] for all countries ("Before and After" Comparison). The change in the trust level in the US of −14.4% is associated with a change in the annual growth for that period of 1.2%. In the US, a decline in trust went hand in hand with a rise in annual growth. In the UK, the same picture is replicated. The change in the trust level of −12.2% is associated with a change in the annual growth rate of 2.08%. The Scandinavian countries Finland and Sweden support the findings on the US and the UK. The decline in trust of −15.1 and −6.4% corresponds to an increase in the growth rate of 5.8% and 2.9%. The

transition countries Poland and Bulgaria behave in the same manner. In Poland the decline in the trust level of 16.6% is related to the increase of 5.2% in annual growth. This relationship changes when observing Argentina and India. In Argentina, a decline in the level of trust of −5.8% corresponds to a decline in the annual growth rate of −4.3%. In India, an increase in the level of trust of 3.4% is followed by an increase in the annual growth rate of 1.7%. In the cases of Argentina and India, there seems to be a positive relationship between trust and economic growth. Taking all countries into consideration, a weak negative relationship exists between delta Trust and delta Growth with an R-Square value of 0.173. Considering only OECD countries, the R-Square rises to 0.461.

5 Econometric Analysis

5.1 Cross-Sectional Analysis

First of all, using a cross-section design, an OLS model is estimated with robust estimators of standard errors for the dataset. For the dependent variable, the average growth rate of GDP per capita for the 15-year period from 1990 to 2004 is used. The country sample consists of 32 countries due to data limitations from the interpersonal trust value in the 1990s. All variables used here are stock variables. Interpersonal trust values are all taken from the second wave of the WVS which was conducted from 1990 to 1993. The variable Human Capital is applied for the 1990s and the price level of investment is taken from 1989.

Regression 1 in Table 7.3 indicates that all variables have the expected signs except the human capital variable. A negative significant coefficient for the income variable (conditional convergence) is produced; likewise, a negative significant coefficient for the price level of investment is produced and the positive significant relationship between interpersonal trust and economic growth is replicated. This result, the positive relationship between Interpersonal Trust and Economic Growth, is in accordance with most empirical findings using a cross-section design (see here particularly Knack & Keefer, 1997; Zak & Knack, 2001).

5.2 Pooled Panel Analysis

Secondly, an estimate for the model using a pooled panel analysis is made. A pooled panel analysis is similar to the method of a standard ordinary least-square estimation, but in order to obtain more reliable estimates of the parameters, a pooled panel estimation widens the database by pooling the time series of the country sample. Hence, the pooled panel consists of 129 observations with 41 individual cases. Using a pooled panel regression and examining all 129 observations, Regression 2 in Table 7.3 replicates the result from the cross-section design and the results of most

Table 7.3 Interpersonal trust and economic growth—a pooled panel analysis

Dependent variable	Growth of GDP per capita 1980–2004				
Estimation method	OLS, robust	OLS, robust	OLS, robust	OLS, robust	OLS, robust
Country sample	All	All	All without transition	All without transition	OECD-23
Equation	1	2	3	4	5
Trust	0.072***	0.05***	0.05***	0.16***	0.17***
	(3.81)	(2.77)	(3.07)	(4.42)	(3.47)
Trust, squared	–	–	–	−0.0015***	−0.002***
				(−3.24)	(−3.47)
Income	−1.13**	−0.69	−0.9**	−1.19***	−1.58***
	(−2.68)	(−1.40)	(−2.12)	(−2.73)	(−2.74)
Education	0.03	0.15	0.26**	0.31***	0.23*
	(0.33)	(1.10)	(2.36)	(2.86)	(1.93)
PPP	−0.03***	−0.03***	−0.04***	−0.03***	−0.02***
	(−2.88)	(−3.30)	(−4.27)	(−4.18)	(−3.18)
Constant	12.8***	8.3**	10.0***	10.3***	14.11***
	(3.76)	(2.25)	(3.00)	(3.09)	(2.85)
R-squared	0.63	0.22	0.35	0.39	0.34
Countries	32	41	35	35	23
Observations	32	129	115	115	83
Period	90–04	80–04	80–04	80–04	80–04

Note: Numbers in parentheses are heteroskedasticity-adjusted t-ratios.
* Significance at the 90% level (one-tailed test).
** Significance at the 95% level (one-tailed test).
*** Significance at the 99% level (one-tailed test).

empirical research. A significant positive coefficient for the trust variable is obtained. However, the proxy for the human capital variable "average years of schooling" shows no significant relationship to economic growth. Furthermore, conditional convergence shows no significant relationship to economic growth. Overall the model does a poor job of describing the variance in the short-term growth rates utilized. Only 22% of the variance of economic growth can be explained by the model. As transition countries follow an economic growth pattern that is quite different from the rest of the countries in the sample, Regression 3 uses a country sample excluding the six transition countries. This country sample still has 115 observations. All variables have the expected signs and are significant. This yields conditional convergence, a positive relationship between human capital and economic growth, a positive relationship between interpersonal trust and economic growth, and a negative coefficient for price levels of investment. Some 35% of the variance in international growth can be explained. Regression 4, taking a country sample without transition countries, modulates trust as a curvilinear relationship to economic growth by including the squared term of interpersonal trust into the

regression. Astonishingly, the curvilinear relationship is highly significant. All variables in the regression have the expected signs and are highly significant (99% level of significance). The linear and squared terms of interpersonal trust are each statistically significant: 0.16 (4.42) and −0.0015 (−3.24). These estimates imply that starting from a low-trust country (where the interpersonal trust value is for instance 2.8, as in Brazil), increases in interpersonal trust tend to stimulate economic growth. However, the positive influence attenuates as the level of trust rises and reaches zero when the indicator takes on a mid-range of 53.3. Therefore, an increase in the level of trust appears to enhance economic growth in countries that have initial low levels of trust but to retard economic growth for countries that have already achieved a substantial level of trust. The model is able to explain 39% of variance in international growth rates (4% more than the linear modulation).

Regression 5 examines an OECD-23 countries sample.[7] A significant curvilinear relationship exists between trust and economic growth. All other variables have the expected signs and behave significantly. Conditional convergence, a positive relationship between human capital and growth and a negative relationship between price level of investments and economic growth, exists. Figure 7.2 shows the partial

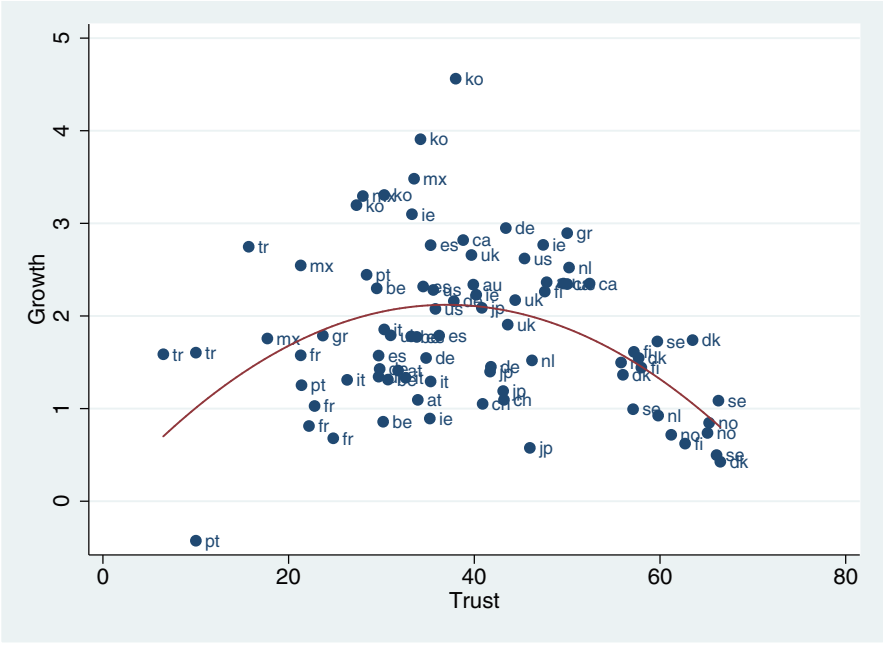

Fig. 7.2 Partial regression plot for 23 OECD countries—trust and economic growth (1980–2004)

[7] The OECD country sample, which includes the three transition countries Slovak Republic, Poland, and Hungary as well as Iceland, has to be differentiated to an OECD23 country sample as the three transition countries are hard to interpret. Iceland is often excluded in cross-country investigations due to the size of its economy.

regression plot between trust and economic growth for the OECD-23 sample. The positive influence attenuates as the level of trust rises and reaches zero when the indicator takes on a mid-range of 42.5.

5.3 *Panel Analysis*

In order to explore how changes in trust levels affect economic growth, the model is estimated using a panel analysis. The standard methods of panel estimation are fixed-effects or random-effects. The fixed-effects estimates are calculated from differences within each country; the random-effects estimation, in contrast, incorporates information across individual countries as well as across periods. The major drawback with the random-effects analysis is that it is consistent only if the country-specific effects are not correlated with the other explanatory variables. A Hausmann specification test can evaluate whether this independence assumption is satisfied (Hausman, 1978; Forbes, 2000, p. 874). The Hausmann test applied here indicates that the fixed-effects model should be used.[8]

Regressions 1 through 4 in Table 7.4 consider the case of linear regression with panel data. As there has been no research conducted on panel data of which the author is aware, it seems most appropriate to begin the estimation of the panel data using the linear regression method. As there is the possibility of cross-sectional heteroskedasticity, a robust estimation technique is used. The coefficients are the same with and without the robust estimation technique; however, the robust estimator produces larger standard errors. The fixed-effects estimations use 41 countries with a total of 129 observations. It is an unbalanced panel. Regression 1 in Table 7.4 contradicts the results of all previous empirical works (Knack & Keefer, 1997; La Porta et al., 1999; Whiteley, 2000; Zak & Knack, 2001, Beugelsdijk et al., 2004; cf. Heliwell, 1996), as well as these results from the cross-section design and the pooled panel analysis, a negative (−0.08) and significant (−2.52) coefficient for the interpersonal trust variable is obtained, indicating that changes in trust and economic growth are negatively related to each other. All other variables in the model have the expected signs. Significant conditional convergence, a positive relationship between human capital and economic growth, and a significant negative coefficient for the variable price level of investment all appear. Some 28% of the within-variance can be explained. Regression 2 presents the random-effects model. As expected when employing a random-effects model, the positive result from the cross-sectional and the pooled panel analysis is replicated. It indicates a positive (0.04) and significant result (significance at the 90% level). Regression 3 shows the results for the growth model when the six transition countries are omitted from the country sample. Interestingly, the relationship between interpersonal trust and economic growth can also be modeled curvilinearly in the 115-country sample when trying to explain

[8] The test statistic is $\chi^2(4) = 1129.17$. This rejects the null hypothesis at any standard of significance.

Table 7.4 Trust and economic growth—fixed and random-effects estimation

Estimation Method	Fixed-Effects Robust Estimation	Random-Effects Robust Estimation	Fixed-Effects Robust Estimation	Random-Effects Robust Estimation
Country sample	All	All	All without Transition	All without Transition
Equation	1	2	3	4
Trust	−0.08**	0.04**	0.18**	0.17***
	(−2.52)	(2.15)	(2.35)	(3.88)
Trust, squared			−0.003***	−0.002***
			(−3.03)	(−3.26)
Income	−4.81***	−0.81	−4.78***	−1.81***
	(−3.67)	(−1.38)	(−3.73)	(−3.05)
Education	0.87***	0.20	1.0***	0.50***
	(3.49)	(1.19)	(4.05)	(3.14)
PPP	−0.04***	−0.03***	−0.03***	−0.03***
	(−3.36)	(−3.00)	(−3.03)	(−3.19)
Constant	46.2***	9.1**	39.9***	14.2***
	(4.12)	(2.09)	(3.58)	(3.09)
R-Squared	0.28	0.32	0.45	0.38
Countries	41	41	35	35
N	129	129	115	115
Period	80–04	80–04	80–04	80–04

Note: Numbers in parentheses are heteroskedasticity-adjusted *t*-ratios. R-Squared is the within-R-Squared for fixed-effects and the between-R-Squared for random-effects.
* Significance at the 90% level (one-tailed test).
** Significance at the 95% level (one-tailed test).
*** Significance at the 99% level (one-tailed test).

the within-variation with a fixed-effects model. In country observations with lower levels of trust, an increase in trust seems to have a positive effect on economic growth, whereas in country observations with high levels of trust, a decrease in trust seems to have a positive effect on economic growth. Regression 4 estimates the 115-country sample with a random-effects model. The results from Regression 4 in Table 7.3 are replicated.

5.3.1 Sensitivity Analysis

Since the negative relationship between interpersonal trust and economic growth in Regression 1 in Table 7.4 challenges econometric work using a cross-sectional design, the robustness of the results must be tested. To test the sensitivity of the results, Table 7.5 shows several specification tests including the exclusion of influential observations, the alteration of case specifications, the inclusion of additional regressors, the restructuring of the data, resampling techniques, and clustering for human capital. The first row of Table 7.5 (labelled “None”) reports the results,

Table 7.5 Sensitivity analysis—fixed-effects estimation

Row	Specification change	Coefficient on trust	Standard Error	Countries	Observations	R-square
Influential cases						
1	None	−0.08**	(−2.52)	41	129	0.28
2	1 (Poland)	−0.06*	(−2.06)	40	126	0.27
3	2 (Poland + Greece)	−0.05	(−1.60)	39	124	0.27
Country samples						
4	OECD	−0.08**	(−2.45)	27	94	0.21
5	OECD-23	−0.05*	(−1.68)	23	83	0.32
6	OECD-23	0.26***/ −0.004***	(3.05 / −3.76)	23	83	0.48
7	EU-15	−0.08*	(−1.91)	14	54	0.34
8	EU-15	0.28***/ −0.004***	(2.31 / −3.13)	14	54	0.52
9	Liberal	−0.09***	(−3.58)	5	18	0.60
10	Scandinavian	−0.21*	(−2.17)	5	15	0.74
11	Developing	0.13*	(1.99)	11	29	0.71
12	Latin America	0.27**	(3.50)	5	13	0.96
Specifications						
13	Open	−0.05*	(−1.68)	41	129	0.46
14	KI	−0.08**	(−2.59)	41	129	0.29
15	Pop. growth	−0.07**	(−2.48)	41	129	0.29
16	Conf. parliament	−0.1***	(−2.64)	41	114	0.26
17	Conf. forces	−0.1***	(−2.95)	41	114	0.26
18	Conf. police	−0.11***	(−3.01)	41	114	0.27
19	Conf. company	−0.04	(−1.35)	41	102	0.46
20	Social expend.	−0.065**	(−2.14)	27	84	0.32
21	Inequality	−0.09**	(−2.27)	20	62	0.42
Restructuring of data						
22	3 Waves (unbal.)	−0.11**	(−2.21)	41	96	0.28
23	3 Waves (bal.)	−0.09*	(−1.81)	15	45	0.60
24	5 Waves (bal.)	−0.08	(−1.30)	3	15	0.50
Methods						
25	Clustering for human capital	−0.08***	(−2.62)	41	129	0.28
26	Boot	−0.08*	(−1.91)	41	129	0.28
27	Jack	−0.08*	(−1.86)	41	129	0.28

Note: Numbers in parentheses are heteroskedasticity-adjusted *t*-ratios. R-Squared is the within-R-squared.

* Significance at the 90% level (one-tailed test).

** Significance at the 95% level (one-tailed test).

*** Significance at the 99% level (one-tailed test).

standard errors, and regression coefficient, taken from Regression 1 in Table 7.4. Successive rows reflect the effects of interpersonal trust on economic growth when the indicated change is made.

The second row of Table 7.5 reports the results after omitting the case of Poland from the country sample. As can be inferred from Fig. 7.1, the case of Poland exhibits the strongest negative relationship between changes in trust and changes in economic growth (specifically, a decrease in interpersonal trust of 16.6% is associated with an increase in economic growth of 5.2%). As suspected, Poland plays an important part in explaining the relationship between trust and economic growth. Although the relationship between trust and economic growth remains significant (significance at the 90% level) the coefficient decreases from −0.08 to −0.06.

In the third row, the case of Greece is omitted. As can be inferred from Table 7.2, Greece's level of trust decreases by 26.7%, whereas its economic growth rate increases by 2.91%. After deleting Greece from the country sample, the relationship between changes in trust and changes in economic growth loses statistical significance.

Rows 4 through 12 examine the different country samples. When analyzing an OECD country sample, changes in trust and changes in economic growth are negatively related (which is strongly influenced by the data on Poland). In the OECD 23-country sample, the relationship can be either linearly modulated or curvilinear. In the linear modulation, a significant negative result appears; however, the curvilinear relationship explains 16% more of the variance in international growth rates. As with the sample of the OECD-23 countries, the EU-15 countries sample can be modulated in both relationships, either linear or curvilinear. In the linear modulation, a significant negative coefficient (strongly influenced by the data on Finland and the United Kingdom) appears; the curvilinear model, however, is able to explain 52% of the within-variation (18% more than the linear model). Apart from Poland and Greece, the negative relationship between trust and economic growth seems to be driven by the highly developed countries from the sample of liberal countries[9] (significance at the 99% level) and the Scandinavian countries sample. As already seen in Fig. 7.1, in the United Kingdom and the United States, a strong decrease in trust is associated with an increase in economic growth. Row 11 examines the sample of developing countries sample.[10] An increase in interpersonal trust is associated with an increase in economic growth (as the author is currently investigating the changes within particular cases, it is not problematic at this time to include China in the sample). After excluding the case of China, the relationship is still significant (90% level) and positive (0.16)). Countries from Latin America (Row 12) face a positive relationship between changes in trust and economic growth. The theoretical claim that, considering developing countries, trust level changes should have a positive effect on economic growth is hereby verified.

[9]Following Hall and Soskice (2001) Liberal Market Economies include the following five countries: the United States, the United Kingdom, Canada, Australia, and Ireland.

[10]The developing country sample includes the 11 countries South Africa, Bangladesh, Pakistan, Philippines, China, India, Argentina, Venezuela, Brazil, Peru, and Chile.

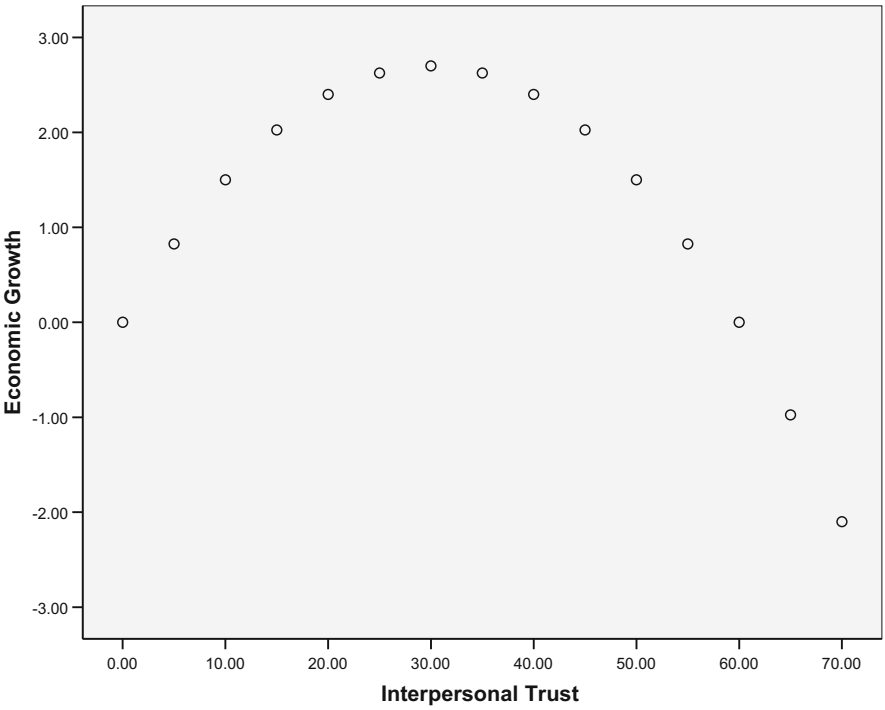

Fig. 7.3 Predicted relationship between trust and economic growth—fixed-effects estimation

Figure 7.3 illustrates the findings between trust and economic growth from Regression 3 in Table 7.4. In a country with a low level of trust, an increase in trust is associated with an increase in economic growth if the increase in trust takes place on the left side of the distribution (the maximum value of the graph is 30). Once a threshold of 30% of trust is exceeded, the increase in trust will hamper economic growth.

Row 13 includes the variable Openness. The trust coefficient stays statistically significant. The model now explains 46% of the within-variation of economic growth (18% more than the original result from Regression 1 in Table 7.4). Openness seems to be a very important variable when trying to explain the within-variation of economic growth. Rows 14 and 15 include the two Solow parameters, Investment Share of GDP and Population Growth. The trust coefficient remains statistically significant.

Rows 16 through 19 include four indicators of systemic trust variables: 1) confidence in the parliament, 2) confidence in the forces, 3) confidence in the police, and 4) confidence in major companies. None of the four systemic trust variables is statistically significantly related to economic growth. However, confidence in companies is related to interpersonal trust as this variable loses statistical significance when the item is included in the regression. Furthermore, when examining an OECD or EU-15-country sample, the variables Confidence in the Parliament and Confidence in

major companies are both negatively related to economic growth. Particularly in the Liberal Market Economies (LMEs), a decline in Confidence in the Parliament is associated with an increase in economic growth (significance at the 99% level).

Row 20 includes social expenditure in the regression (OECD, 2004). If the welfare state creates high levels of interpersonal trust and negatively affects economic growth (see Atkinson, 1999 for a detailed discussion of the relationship between the welfare state and economic growth), an increase in welfare state activity would go hand in hand with an increase in levels of interpersonal trust and a decrease in economic growth. However, the trust coefficient is not altered by the inclusion of social expenditure. The hypothesis, that social expenditure could explain the negative relationship between trust and economic growth, must be rejected. (However, due to data restrictions, the hypothesis was only tested in 27 OECD countries with a total of 84 observations).

Row 21 includes the Gini-Coefficient.[11] On the one hand, taking the empirical results from Forbes (2000) for granted, an increase in social inequality is related to an increase in economic growth. On the other hand, an increase in social inequality seems to be strongly related to a decrease in interpersonal trust. Knack and Keefer (1997), Zak and Knack (2001), Knack and Zak (2002), in particular, as well as Delhey and Newton (2005) and Rothstein and Uslaner (2005), have given first empirical proof that trust is stronger in nations with more equal income among their citizens. However, the trust coefficient is again not altered. The hypothesis that social inequality could explain the negative relationship between trust and economic growth has to be rejected. (Here, also due to data restrictions, the hypothesis was only tested in 20 OECD countries with a total of 62 observations.)

Row 22 examines an unbalanced panel for the time period, 1990–2004. This procedure allows the exclusion of data derived from the Eurobarometer 25. After excluding the first two periods (1980–89), trust is still negatively and significantly related to economic growth. Row 23 considers a balanced panel with 15 countries and 45 country observations examining economic growth from 1990 to 2004 using data from the second, third, and fourth waves of the WVS. Trust is negatively related to economic growth. When using a balanced panel from 1980 to 2004 (Row 24) taking five countries with 15 observations into consideration, trust loses statistical significance (primarily due to the small number of observations).

Row 25 shows the result when clustering for the Human Capital variable. (Clustering for the other variables does not change the results.) This procedure produces an estimator "that is robust to cross-sectional hereroskedasticity and within-panel serial correlation which is asymptotically equivalent to that proposed by Arellano (1987)" (Stata Corporation, 2005, p. 293).

Rows 26 and 27 introduce resampling techniques. Either when using Bootstrap Estimation or Jackknife Estimation, the coefficient remains statistically significant (however only at the 90% level).

[11] Data on income inequality are based on the UN-database, WIDER. Only data originally drawn from the Luxembourg Income Study (LIS) are taken.

6 Conclusion

This contribution examined the relationship between trust and economic growth. Two findings are especially important.

First, taking panel data and using a fixed-effects estimation for a 41-country sample over the time period from 1980 to 2004 and with a total of 129 observations, this contribution points out that economic growth is negatively related to an increase in trust. This negative finding is in contrast to most empirical findings using a cross-sectional design. The negative relationship seems to be mainly driven by developed countries from the OECD (here specifically Poland, Greece, and the United States), and the EU-15 (here particularly the United Kingdom and Finland), and very strongly by LMEs and Scandinavian countries. However, when considering a country sample which excludes the six transition countries, a curvilinear relationship appears. In countries with low initial levels of trust, an increase in trust leads to an increase in economic growth (samples for developing countries and Latin American countries). In countries with high initial levels of trust, an increase in interpersonal trust leads to a decrease in economic growth (especially in the samples of LMEs and Scandinavian countries). The curvilinear relationship can be replicated in a sample of OECD-23 countries, as well as in an EU-15-country sample, meaning that in those countries in the OECD and EU-15 which have low initial stocks of trust, as for instance Portugal, an increase in trust is associated with an increase in economic growth.

Second, when analyzing the relationship between interpersonal trust and economic growth in a cross-section of countries using either a cross-section, pooled panel, or random-effects design, the positive results from previous empirical research were replicated. However, when examining a country sample which excluded the six transition countries, a curvilinear relationship between interpersonal trust and economic growth was detected. In countries with low initial levels of trust, an increase in trust is associated with an increase in economic growth. But once a threshold of trust is surpassed, an increase in trust harms economic growth.

Taking these results into consideration, theoretical implications and empirical findings between trust and economic growth must be reevaluated. More theoretical and empirical research is necessary to clarify the relationship. From a policy point of view, it is important to differentiate between countries with high and low initial levels of trust. An increase in trust is crucial for countries with low levels of trust, but can likely be neglected by countries with sufficient levels of trust and may even hamper economic performance in countries with high levels of trust. The common knowledge which has governed the nature of discussions in social science and economics for the last 10 years, that trust is positively related to economic performance, must be seriously questioned. The relationship depends on the level of trust already existing in a country, thus determining whether it is important to invest in trust-building policies or not.

Still one has to bear in mind that the marked difference across time and across countries, and particularly the difference between a cross-section analysis using long-term growth, could have to do with the fact that a 5-year average of growth could be more sensitive to business cycle influences than, for example, a 10- or 15-year average. Although 5-year growth averages are commonly used for analyzing

short- or medium-term growth dynamics, it is not yet fully clear if business cycle considerations can be neglected without caution.

Furthermore, despite the fact that these results appear to be statistically robust and in line with theoretical assumptions, it is possible that the findings are partly due to the omission of some variable not considered, or that measurement error affected the results, or that the model is misspecified in other ways. Further investigations are necessary to corroborate the findings to be able to answer relevant policy questions.

Appendix

Table 7.A1 Summary statistics

Variable	Year	Observations	Mean	Standard deviation	Minimum	Maximum
Growth	1980	22	1.6	1.6	−1.64	6.65
	1985	11	3.0	1.3	1.17	5.12
	1990	32	1.13	3.21	−5.07	11.38
	1995	27	2.15	2.1	−2.24	7.52
	2000	37	2.29	2.04	−0.58	8.37
Interpersonal Trust	1980	22	39.9	12	17.7	61.2
	1985	11	38.6	12.3	21.3	63.5
	1990	32	37.4	15.8	6.7	66.1
	1995	27	28.9	16.7	2.8	65.3
	2000	37	30.1	15.7	8.4	66.5
Income	1980	22	9.62	0.38	8.49	10.03
	1985	11	9.73	0.23	9.32	10.03
	1990	32	9.50	0.76	7.38	10.33
	1995	27	9.15	0.92	7.19	10.31
	2000	37	9.45	0.87	7.3	10.43
Education	1980	22	7.80	1.85	4.49	11.91
	1985	11	7.28	1.76	3.57	9.42
	1990	32	7.94	2.20	3.68	12
	1995	27	7.76	2.74	2.32	12.18
	2000	37	8.14	2.27	2.45	12.25
PPP	1980	22	101.4	24.6	58.6	143.2
	1985	11	62.6	8.13	47.5	73.9
	1990	32	82.5	24.7	39.8	128.5
	1995	27	75.6	31.3	29.6	154.5
	2000	37	75.3	27.0	31.97	126.8

References

Alesina, A., & La Ferrara, E. (2000). *The determinants of trust, NBER working paper* 7621.

Arrow, K. (1972). Gifts and Exchanges. *Philosophy and Public Affairs, 1*, 343–362.

Atkinson, A. B. (1999). *The Economic Consequences of Rolling back the Welfare State*. MIT Press.

Barro, R., & Lee, J.W. (2000). *International data on educational attainment: Updates and implications. (CID Working Paper, 42, April 2000)* – HUMAN CAPITAL UPDATED FILES.

Berggren, N., & Jordahl, H. (2006). Free to trust: Economic freedom and social capital. *Kyklos, 59*, 141–169.

Berggren, N., Elinder, M., & Jordahl, H. (2007). Trust and growth: A shaky relationship. *Empirical Economics*. Forthcoming.

Beugelsdijk, S., de Groot, H., & van Schaik, A. (2004). Trust and Economic Growth: a Robustness Analysis. *Oxford Economic Papers, 56*, 118–134.

Bjørnskov, C. (2003). The happy few: Cross country evidence on social capital and life satisfaction. *Kyklos, 56*, 3–16.

Bourdieu, P. (1983). Ökonomisches, Kulturelles und Soziales Kapital. In R. Kreckel (Ed.), *Soziale Ungleichheiten* (Vol. 2, pp. 35–74). Soziale Welt.

Coleman, J. (1988). Social capital in the creation of human capital. *American Journal of Sociology, 94*, 95–120.

Coleman, J. (1990). *Foundations of social theory*. Belknap Press of Harvard University Press.

Delhey, J., & Newton, K. (2005). Predicting cross-national levels of social trust: Global pattern or nordic exceptionalism? *European Sociological Review, 21*, 311–327.

Durlauf, S. N., & Fafchamps, M. (2005). Social Capital. In P. Aghion & S. Durlauf (Eds.), *Handbook of Economic Growth: Volume 1B* (pp. 1639–1699). Elsevier.

European Values Study Group and World Values Survey Association. (2004). *European and world values surveys integrated data file, 1999–2002, release I [Computer File]. 2nd ICPSR version. ICPSR Study Number 3975. Cologne, Germany: Zentralarchiv für Empirische Sozialforschung (ZA)/Tilburg, Netherlands: Tilburg University/ Amsterdam, Netherlands: Netherlands Institute for Scientific Information Services (NIWI)/ Madrid, Spain: Analysis Sociologicus Economicos y Politicos (ASEP) and JD Systems (JDS)/ Ann Arbor, MI: Inter-university Consortium for Political and Social Research [producers], 2004. Cologne, Germany: Zenralarchiv für Empirische Sozialforschung (ZA)/Madrid, Spain Analisis Sociologicos Economicos y Politicos (ASEP) and (JDS)/Ann Arbor, MI: Inter-university Consortium for Political and Social Research [distributors]*.

Forbes, K. J. (2000). A reassessment of the relationship between inequality and growth. *American Economic Review, 87*, 869–887.

Fukuyama, F. (1996). *Trust—The social virtues and the creation of prosperity*. Free Press Paperbacks.

Glaeser, E., Laibson, D. I., Scheinkman, J. A., & Soutter, C. L. (2000). Measuring Trust. *The Quarterly Journal of Economics, CXV*, 811–846.

Hall, P., & Soskice, D. (2001). *Varieties of capitalism*. Oxford University Press.

Hardin, R. (1982). *Collective action*. Johns Hopkins University Press.

Hausman, J. A. (1978). Specification tests in econometrics. *Econometrics., 46*, 1251–1271.

Heliwell, J. (1996). *Economic growth and social capital in Asia, NBER working paper 5470*.

Heston, A., Summers, R., & Aten, B. (2002). *Penn world table version 6.1*. Center for International Comparisons at the University of Pennsylvania (CICUP).

Inglehart, R. (1990). *Culture shift*. Princeton University Press.

Inglehart, R. (1997). *Modernization and postmodernization – Cultural, economic and political change in 43 societies*. Princeton University Press.

Inglehart, R. (1999). Trust, well-being and democracy. In M. E. Warren (Ed.), *Democracy and trust* (pp. 88–120). Cambridge University Press.

Inglehart, R., et al. (2000). *World values surveys and European values surveys, 1981–1984, 1990–1993, and 1995–1997 [computer file]. ICPSR version. ICPSR study number 2790*.

Institute for Social Research [producer], 2000. Ann Arbor, MI: Inter-university Consortium for Political and Social Research [distributor].
Jagodzinski, W., & Manabe, K. (2005). How to measure interpersonal trust? A comparison of two different measures. *ZA-Information, 55*, 85–96.
Knack, S., & Keefer, P. (1997). Does social capital have a payoff? A cross-country investigation. *Quarterly Journal of Economics, 112*, 1251–1288.
Knack, S., & Zak, P. J. (2002). Building trust: Public policy, interpersonal trust and economic development. *Supreme Court Economic Review, 10*, 91–107.
Knowles, S. (2005). The Future of Social Capital in Development Economic Research 2005.
La Porta, R., Lopez-de-Silanes, F., Shleifer, A., & Vishny, R. W. (1999). Trust in large organizations. In P. Dasgupta & I. Seregaldin (Eds.), *Social capital – A multifaceted perspective* (pp. 310–324). The World Bank.
Luhmann, N. (2000). *Vertrauen*. Lucius and Lucius.
Misztal, B. A. (1996). *Trust in modern societies—The search for the bases of social order*. Polity Press.
Newton, K. (1997). Social capital and democracy. *American Behavioral Scientist, 40*, 575–586.
Noelle, E. (2005). Vertrauen ist Besser. *Frankfurter Allgemeine Zeitung, 166*, 5.
North, D. C. (1990). *Institutions, institutional change and economic performance*. Cambridge University Press.
OECD. (2001). *The well-being of nations – The role of human and social capital*. OECD.
OECD. (2004). *Social expenditure database (SOCX)*. www.oecd.org/els/social/expenditure.
Olson, M. (1982). *The rise and decline of nations: Economic growth, stagflation and social rigidities*. Yale University Press.
Ostrom, E. (1990). *Governing the commons: The evolution of institutions for collective action*. Cambridge University Press.
Ostrom, E. (1998). A behavioral approach to the rational choice theory of collective action: Presidential Address, American Political Science Association, 1997. *The American Political Science Review, 92*, 1–22.
Ostrom, E. (1999). Social capital: A fad or a fundamental concept? In P. Dasgupta & I. Serageldin (Eds.), *Social capital—A multifaceted perspective* (pp. 172–214). The World Bank.
Paldam, M. (2007). *Generalized trust—The macro perspective*. Article presented at the Workshop and Summer School Social Capital, Corporate Social Responsibility and Sustainable Economic Development at the University of Trento.
Paxton, P. (1999). Is social capital declining in the United States – A multiple indicator assessment? *American Journal of Sociology, 105*, 88–127.
Paxton, P. (2002). Social capital and democracy: An interdependent relationship. *American Sociological Review, 67*, 254–277.
Portes, A. (2000). The two meanings of social capital. *Sociological Forum, 15*, 1–11.
Putnam, R. D. (1993). *Making democracy work: Civic traditions in modern Italy*. Princeton University Press.
Putnam, R. D. (1995). Bowling alone: America's declining social capital. *Journal of Democracy, 6*, 65–78.
Putnam, R. D. (2000). *Bowling alone: The collapse and revival of American community*. Simon & Schuster.
Rabier, J.-R., Helene, R., & Inglehart, R. (1988). *Eurobarometer 25*, Holiday Travel and Environmental Problems. April 1986 [Computer File], ICPSR Study Number 8616.
Rothstein, B., & Uslaner, E. M. (2005). *All for all: Equality and social trust, LSE health and social care discussion paper number 15*. London School of Economics and Political Science.
Sabatini, F. (2008). Social capital and the quality of economic development. *Kyklos, 61*, 466–499.
Sen, A. K. (1977). Rational fools: A critique of the behavioural of economic theory. *Philosophy and Public Affairs, 6*, 317–344.
Sen, A. K. (1999). *Development as freedom*. Anchor books.

Serageldin, I. (1999). Foreword. In: S. Knack (Ed.), *Social capital, growth and poverty: A survey of cross-country evidence, social capital initiative working paper 7* (p. iii).
Sobel, J. (2002). Can we trust social capital? *Journal of Economic Literature, XL*, 139–154.
Solow, R. (1999). Notes on social capital and economic performance. In P. Dasgupta & I. Serageldin (Eds.), *Social capital—A multifaceted perspective* (pp. 6–10). The World Bank.
Stata Corporation. (2005). *Stata longitudinal/panel data reference manual release 9*. Stata Press.
Tonkiss, F. (2000). Trust, social capital and economy. In F. Tonkiss & A. Passey (Eds.), *Trust and civil society* (pp. 72–89). Macmillan.
Uslaner, E. M. (1999). Democracy and social capital. In M. E. Warren (Ed.), *Democracy and trust* (pp. 121–150). Cambridge University Press.
Van Oorschot, W., & Arts, W. (2005). The social capital of European welfare states: The crowding out hypothesis revisited. *Journal of European Social Policy, 15*, 5–26.
Whiteley, P. F. (2000). Economic growth and social capital. *Political Studies, 48*, 443–466.
Williams, B. (1988). Formal structures and social reality. In D. Gambetta (Ed.), *Trust: Making and breaking cooperative relations* (pp. 443–454). Basil Blackwell.
Woolcock, M. (1998). Social capital and economic development: Toward a theoretical synthesis and policy framework. *Theory and Society, 27*, 151–208.
Zak, P. J., & Knack, S. (2001). Trust and growth. *Economic Journal, 111*, 295–321.

Chapter 8
Social Capital, Trust, and Economic Growth

Felix Roth

Abstract This contribution revisits the existing research in the field of social capital, trust, and economic growth, with the aim of elaborating a possible extension of the neo-classical model by incorporating social capital into its assumptions. It describes the state of the art and definition of social capital and interpersonal trust and discusses the positive and negative relationships between social capital, trust, and growth. It offers a brief discussion of the operationalization of social capital and provides an overview of the empirical findings to date with respect to social capital, trust, and growth. In its conclusions, this contribution calls for further research on the relationship between trust and economic growth.

Keywords Social capital · Trust · Economic growth

1 Introduction

In recent years, the concept of "social capital" has been firmly established within the academic discipline of economics under the JEL classification Z13. The World Bank in particular helped to operationalize the concept of social capital by recognizing its contribution to sustainable development and to combatting global poverty. In his Foreword to the 24-volume series on social capital, Ismail Serageldin argues that the

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"traditional composition of natural capital, physical or produced capital, and human capital needs to be broadened to include social capital." (Serageldin, 1999, p. iii). He continues: "Social capital is the glue that holds societies together and without it there can be no economic growth or human well-being." But the World Bank is not the only institution to stress the importance of social capital. The Organization for Co-operation and Economic Development (OECD) has intertwined the paradigm of social capital with that of human capital and analyses possible interaction between social capital, human capital, human well-being, and economic growth (OECD, 2001). In addition, the European Union, while not explicitly emphasizing the paradigm of social capital, promotes in its Lisbon Strategy the idea that, in addition to economic growth and employment, special attention must be paid to increasing social cohesion within the European Community.

2 Extension of the Neoclassical Model Assumption

The logic of social capital has mostly been negotiated in economics as a black-box concept. Social contexts do not play a role in the neoclassical production function (Solow, 1956). One thing is certain: alongside the classic factors of production—capital, labor, and human capital—one finds an equally important factor, namely social infrastructure. In contemporary research, it is referred to under the collective term "social capital". Temple identifies with social capital all those social phenomena that decisively influence long-term growth (Temple, 2001 in OECD, 2001, p. 39). A clear delineation of which cultural and social factors should ultimately be included in the concept of social capital has not yet been made in contemporary research.

Nevertheless, research in the field of social capital and economic growth is based primarily on the paradigm of trust (Inglehart, 1990; Putnam, 1993; Fukuyama, 1996; Heliwell, 1996; Knack & Keefer, 1997; Whiteley, 2000; Zak & Knack, 2001; Beugelsdijk et al., 2004; Berggren et al., 2008; Roth, 2007, 2009), the concept of civic engagement (Heliwell, 1996; Inglehart, 1997; Putnam, 1993; Putnam & Helliwell, 1999), and the concept of norms of reciprocity (Knack & Keefer, 1997). Whereas economists first extended the neoclassical production function in the early 1990s to include the human capital paradigm, so that the concept of conditional convergence and international growth rates could be better explained empirically (see Barro, 1991; Mankiw et al., 1992; Barro & Sala-i-Martin, 2004, p. 60), in recent years, the neoclassical model is being extended by the social capital factor (Dasgupta, 1999; Serageldin, 1999; Serageldin & Grootaert, 1999; Whiteley, 2000). In the scientific debate, however, it has not yet been clarified whether social capital should be included in the production model as a simple scale factor (Knack & Keefer, 1997; Zak & Knack, 2001; Whiteley, 2000) or whether it should be included

in total factor productivity as the basis of the entire production process (Dasgupta, 1999, p. 390 ff.). If it is included as a simple scale factor, the true potential and cost of social capital are likely to be underestimated.

3 Criticism of the Concept of Social Capital or Why Is There Capital in Social Capital?

Robert Solow discusses the concept of social capital controversially. On the one hand, he considers research on social capital to be an important but difficult task; on the other hand, he considers the term social capital to be poorly chosen (Solow, 1999, pp. 6–10). He criticizes the term social capital by pointing out that capital is usually a stock of produced and natural production factors that support production. Moreover, he argues, social capital does not correspond to the conventional definition of capital, i.e., a stock of tangible, solid, and enduring things such as buildings, machinery, and inventory. Kenneth Arrow argues similarly (Arrow, 1999, pp. 3–5). He criticizes the use of the term "capital" in social capital. According to Arrow, the concept of capital involves three aspects: 1) extension in time, 2) deliberate sacrifice in the present for future benefit, and 3) alienability. Arrow argues that especially the second point does not apply to social capital. Social networks are not linked for the purpose of economic benefit.

Neither contribution really gets to the heart of the discussion. They suggest, however, that the concept of social capital is controversial. This can certainly be inferred from the fact that the capitalization of social phenomena, such as interpersonal trust as a proxy for civic solidarity and networks of civic engagement, is an indication that these phenomena can no longer be considered as natural, but rather that they are part of a social infrastructure that must be supported by the state and kept alive by civil society. They are not a collective good with unlimited resources, but always run the risk of being written off in the market-economy based production process. This is precisely why politicians are concerned every day about whether the social glue that holds society together is not eroding. Criticizing social capital theorists of poor conceptualization does not help scientific theorizing and prevents formulating questions to describe problems that currently exist. Or as Habisch puts it: "*In a certain way, social capital theory is itself a consequence of a changed reality: for something that is self-evident must first become non-self-evident before it can even be the subject of explicit scientific research, before it can be conceptualized*" (English translation of Habisch, 1999, p. 497).

4 The State of the Art and Definition of Social Capital

In recent years, the literature on the topic of social capital has grown exponentially.[1] Woolcock (1998, pp. 193–196) differentiates six areas of research.[2] And Portes (2000) differentiates between two levels of analysis.[3] This contribution deals with the research on the interface between social capital and economic growth. Although there are various definitions of social capital (Fukuyama, 1996, p. 26; Temple, 2001 in OECD, 2001, p. 39; Ostrom, 1999, p. 176; Newton, 1997, p. 576; Woolcock, 1998, p. 189),[4] the "classical" definitions of James Coleman and Robert Putnam will be used here to clarify the relationship between social capital and trust.

4.1 Coleman's Definition of Social Capital

Coleman clarifies the paradigm of social capital in his treatises *Social Capital in the Creation of Human Capital* and *Foundations of Social Theory* (Coleman, 1988, 1990). According to Coleman's definition, social capital is intended to be a resource from the social structure of actors within society. This resource represents capital for the actors. All social structures favor certain actions by actors who are within the structure, some more effectively and others less so. The concept of social capital

[1] Research has found that only 20 international research papers were published on social capital before 1983, p. 109 between 1991 and 1995, and 1,003 between 1996 and March 1999 (Winter 2000, p. 17 in Putnam, 2001, p. 18). As of June 2006, the number has increased to 1,429. For an historical overview, see Putnam (2001) and Woolcock (1998). For a detailed review of the literature on social capital, see Habisch (1999).

[2] The research areas can be divided into six categories: 1) family and youth, 2) education, 3) community, 4) labor and organizations, 5) democracy, and 6) general cases of collective action problems. In current research, more than six research areas have been established. The research area between social capital and growth and between welfare state mechanisms and social capital should be mentioned here.

[3] The concept of social capital can be differentiated between two levels of analysis. On the one hand, the analysis can take place at the micro-level. In the center of this research are the so-called "networks of an actor". With the help of this research design, relationships between income, human capital, and the networks of a person can be analyzed. This type of research was initiated by Pierre Bourdieu (1983) and James Coleman (1988). Esser (2000) calls this form of social capital "relational capital". Relational capital is a private good. On the other hand, social capital can also be used as a concept at both the meso- and macro-levels. In this kind of relationship, social capital is seen as a stock, which is available for communities, regions, or nations. The analysis then does not focus on the individual actor but on the nation with its particular characteristics. These characteristics include aggregated entities, for example, the yearly change of stock of the Gross Domestic Product, the stock of the labor force, or the stock of human capital. The stock of social capital is, as well, a characteristic of a nation. Esser calls this kind of social capital "system capital". System capital is characterized by its quality as a collective good.

[4] For a detailed list of definitions of social capital, see especially Woolcock (1998, p. 189). For relevant definitions in the field of social capital and growth, see Durlauf and Fafchamps (2005).

offers the possibility of embedding the extremely individualistic *homo oeconomicus*, who acts solely out of the motive to maximize his utility function, in his environment, thereby creating a relationship between the action of an actor and the action of his environment. The actor acts according to the social norms and rules he has learned from his environment (see also Sen, 1977). Coleman regards the socialization paradigm as a crucial explanation for actions, but he misses the importance of the actor's initiative. As this he understands the Rational-Choice paradigm of utility maximization (Coleman, 1988, p. 95). Coleman intends to introduce a new form of capital, alongside the existing forms of capital, such as physical and human capital, in the process of building scientific theories. Just as physical capital is created by changes in materials to create tools that facilitate production, and human capital is created by changes in people that bring skills and capabilities that allow them to act in new ways, social capital is generated through changes in the relations among people that facilitate action. Social capital facilitates productive activity just as much as physical and human capital (Coleman, 1988, pp. 100–101).

Unlike other forms of capital, social capital seems to be embedded in the relationship between two or more people. But what exactly characterizes this relationship, which creates social capital? Coleman names three forms of relationships involving social capital: 1) obligations, expectations, and trustworthiness of structures (the less the exchange of interactions between actors A and B is accounted for in the short run, the more social capital is produced in the relationship between the actors), 2) information channels, and 3) norms and sanctions. Coleman considers the trustworthiness of the social environment as the most important form of social capital (Coleman, 1990 in Whiteley, 2000, p. 448).

4.2 Putnam's Definition of Social Capital

Putnam is one of the first authors to apply the term social capital, which is used by Coleman and Bourdieu at the micro-level, as a concept for the meso-level. Social capital in Putnam's work refers to stocks of social capital that are available to a region (state) (for the change of level within the paradigm of social capital, see Portes, 2000). High stocks of social capital promote the economic development of a region and support state administration (Putnam, 1993, p. 176). Putnam associates certain features of social organizations, such as networks, norms, and trust, with social capital (Putnam, 1993, p. 167). He relates the term social capital automatically with the concept of civic engagement and the existence of a strong civil society. This is also emphasized in his later definition of social capital, in which he links social capital with the concept of civic virtues (Putnam, 2000).

The inclusion of psychological factors (trust and norms) and behavioral structures (networks) into one definition has been criticized. Newton (1997) argues that from an empirical point of view, the concept of social capital should be separated into its component parts. Whether civic engagement and trust are associated must be tested empirically before they can be combined into a common definition. Other

researchers also distance themselves from combining all three indicators in one definition. Knack and Keefer (1997) identify social inequality as a more important determinant of trust than civic engagement, whereas other lines of research focus on the performance of the welfare state as a producer of trust and norms (van Oorschot & Arts, 2005). Therefore, it seems appropriate for future empirical research to examine the individual components of social capital separately, given the number of researchers who attach great importance to the dimension of trust in the context of social capital (Newton, 1997; Fukuyama, 1996; Uslaner, 1999; Tonkiss, 2000; Zak & Knack, 2001; Roth, 2007, 2009). This view is also salient in microeconomics research dealing exclusively with trust and norms (Ostrom, 1998). Even Putnam attaches a high priority to the dimension of trust when he writes that norms and networks are the prerequisites for trust. Thus, trust can be seen as the output of the two other dimensions of social capital. The next section focuses on the paradigm of trust and the relationship between trust and growth.

5 Interpersonal Trust

Luhmann (2000, p. 1) states that "*trust, in the broadest sense of trusting one's own expectations, is an elementary fact of social life*" [English translation]. It is "*the generalized expectation that the other will manage his freedom, the uncanny potential of his possibilities of action, in the sense of his personality – or, more precisely, in the sense of the personality he has presented as his and made socially visible*" [English translation] Luhmann (2000, p. 48). Fukuyama describes trust as the "expectation that arises within a community of regular, honest, and cooperative behavior, based on commonly shared norms" (Fukuyama, 1996, p. 26). Although there is a variety of definitions of trust (Dasgupta, 1999, p. 5 in Ostrom, 1998, p. 12; Misztal, 1996, p. 16; Delhey & Newton, 2005, p. 311), the current research distinguishes between three different forms: interpersonal or generalized trust, thick trust, and systemic or institutional trust (Putnam, 2000, p. 137; Newton, 1997, p. 558 ff.; Luhmann, 2000).

Newton (1997) and Williams (1988) categorize trust that is generated by family networks as "thick trust".[5] In contrast, generalized or interpersonal trust is defined as trust that is generated by looser, secondary relations in modern societies, based on everyday interaction between people who do not otherwise know each other. Most scientists rely on generalized trust when examining the relationship between economic growth and trust, as it should facilitate cooperation and reduce transaction costs in economic systems. Economic systems are characterized by a substantial degree of differentiation, and exchange activity frequently depends upon trust

[5] Thick trust is usually measured by asking whether the respondent trusts his or her own family members. This question is asked, for example, in the second wave of the World Value Survey (1990–93).

between strangers. The third category of trust, systemic or institutional trust, refers to the respondent population's trust in certain institutions. These include, for example, trust in parliament, the police, the army, and large corporations. When trust is referred to in this study, interpersonal trust is meant.

6 Positive Correlation between Social Capital, Trust, and Growth

Arrow (1972, p. 345) argues that the presence of virtues such as trust plays a significant role in the operation of economic systems. Theses virtues represent the basis for or at least facilitate the process of exchange, which is essential for any economy. For Fukuyama (1996), trust is an essential factor of economic performance. A nation's well-being and its ability to compete depend upon the level of trust within the society (Ibid, 7). This argument arises from his general assumption that economic activity is part of the social life and constitutes itself according to the norms, rules, and moral obligations of a society. Sen states that the "development and use of trust in one another's words and promises can be a very important ingredient of market success" (Sen, 1999, p. 262) and that "no society would be viable without some norms and rules of conduct" (Sen, 1977, p. 332). Robert Putnam concludes that "norms and networks have fostered economic growth, not inhibited it" (Putnam, 1993, p. 176).

The foregoing authors argue for a positive relationship between trust and economic benefit. But how is trust related to growth?

Whiteley (2000, p. 451) distinguishes three direct and indirect channels through which interpersonal trust might stimulate economic growth.

First, trust has a direct effect on economic performance through reducing transaction costs. These are defined as costs incurred in the economic processes of exchange and specialization and are typically associated with banking, insurance, finance, wholesale, and retail trade or securing professional services from lawyers and accountants, etc. (North, 1990, p. 28). North therefore advocates the development of a new production function that takes transaction costs into account. In high-trust societies, transaction costs should be lower. Fewer lawyers, fewer police to enforce property rights, and fewer insurance policies to protect against possible risks are needed.

Second, high levels of trust enable actors to solve collective action problems (or "prisoner's dilemma"). Putnam (1995) puts forward four arguments why social capital, including interpersonal trust, has a positive effect on the economy: 1) it facilitates coordination and cooperation, 2) it allows dilemmas of collective action to be resolved and reduced, 3) it reduces incentives for opportunism, and 4) it reduces human egoism. "Making the I into the we" is the technical term in the language of "rational choice" theorists. In high-trust societies, it should theoretically be easier to cope with such problems. Hardin (1982) cites problems that can arise, for example,

with smog and CO_2 emissions, and Ostrom, as well, cites the problem of overfishing (Ostrom, 1990).

The third direct effect is that principal-agent problems might be much less significant in high-trust societies than in low-trust societies. Entrepreneurs who devote more time to monitoring employees, suppliers, and trading partners have less time to devote to innovation in new products or processes. In addition, they might rely on simpler contractual arrangements to retain their managers and specialists. Entrepreneurs with high levels of trust therefore theoretically pay fewer costs to monitor production.

Whiteley (2000) identifies three indirect channels. Trust affects economic growth through its interactions with 1) physical investment, 2) human capital, and 3) conditional convergence. In high-trust societies, on the one hand, the risk appetite of entrepreneurs should be greater to invest in physical capital (see also Keynes, 2000, p. 125); whereas on the other hand, the risk appetite of employees to invest in human capital should be greater. Finally, the diffusion of innovations and the implementation of new technologies should be greater.

It has been argued thus far that trust and the facilitation of collective action have a positive impact on economic growth. But is this necessarily or always the case? The following section presents counter-arguments to this thesis.

7 Negative Relationship Between Social Capital, Trust, and Growth

7.1 Mancur Olson

Let us first consider the argumentation of the American economist and political scientist Mancur Olson (1982). Although his analysis deals primarily with the dimension of networks within the concept of social capital, it is nevertheless appropriate for the present purposes. Olson analyses the relationship between collective action and economic growth in quite a different way from Putnam, arguing in fact that collective action can undermine the state's power to implement necessary reforms aimed at maintaining high economic growth rates. Olson argues that stable societies in highly developed states are in danger of encouraging the formation of cartels and collective action organizations over time. Organizations that function as special-interest groups harm economic growth by reducing economic efficiency, by aggregating income in the societies in which they operate, and by making political life more divisive. Putnam's approach thus seems to be limited.

A high level of solidarity, i.e., high stocks of interpersonal trust, need not automatically promote economic performance if the collective action is aimed at blocking government reform policies and thereby harming the economy. To give one example: If a state desires to implement labor market reform in which employee rights are reduced, a low-wage sector is implemented, working hours are extended,

and social spending on unemployment benefits and support is decreased to reduce the costs of the labor factor, a trusting and solidaristic society would more likely oppose the state's efforts at reform. In response, the mobilization of collective action would stop the reform agenda, thereby limiting the potential of higher economic growth rates. This argument is built upon Putnam's findings that a strong civil society is crucial for high levels of trust to emerge. In fact, it could be civil society actors, such as church groups, professional groups, and social movements organizations (SMOs), that oppose the state's will to implement reforms. Similarly, the number of workers who are (voluntary) labor union members may be a critical factor for the existence of high levels of trust. Thus, higher levels of trust do not necessarily lead to more economic growth.

A synthesis of both Putnam and Olson's approaches seems the most plausible. In low-trust societies, an increase in trust should theoretically have a positive effect on economic performance, given that a certain level of trust is essential for an economic system to function smoothly. A further increase above a certain level of trust, however, might have a negative impact on economic performance, which could subsequently be used to fuel opposition to a government's efforts at reform. Thus, the relationship between trust and economic growth can be expected to be curvilinear (inverted U-shaped).

This relationship should apply both within a country and in a cross-country comparative study design. In Scandinavian states, which are prototypes of highly developed economies with high levels of trust, a decrease in the level of trust should lead to an increase in growth, according to the arguments above. These states already have large stocks of interpersonal trust and actors of collective action. From the point of view of promoting growth, these countries would theoretically have to reduce parts of their solidarity levels. In contrast, in Latin American countries, such as Brazil, where interpersonal trust levels are very low, an increase in trust levels should support economic development. The same applies to Mediterranean countries, such as Turkey, where very low-trust levels are observed. This assumption of a curvilinear relationship between trust and growth is confirmed by the empirical results between democracy and economic growth. Barro and Sala-i-Martin (2004) determine a curvilinear relationship between democracy and growth, i.e. in states with weak democratic structures, democratization appears to enhance growth; but in countries with a highly developed level of democracy, the relationship is reversed and an increase in democracy retards growth.

7.2 Mistrust, Fear, and Economic Growth

The second explanation could be that mistrust or even fear is a key explanatory variable for productivity. A society with high levels of fear will less easily oppose state reform processes. Let us consider an example from organizational theory. It may be part of a company's strategy to create an atmosphere of fear among its employees. This non-solidaristic working atmosphere mobilizes the employees to

monitor themselves, to work harder, and to increase the overall productivity of the company. Another example of the positive relationship between fear and productivity is a high national unemployment rate and the associated fear of losing one's job. Employees who fear losing their jobs work harder, attach less importance to their legal employment rights, take less sick leave, and are less demanding overall. This fear also affects the actions of trade unions. Employers' associations have more leverage to push through wage reductions and extend working hours if trade unions give top priority to the preservation of jobs. The extension of working hours, in turn, has a direct positive impact on economic growth.

8 Operationalization of Social Capital

Based on Putnam's theoretical work, most empirical work in the area of social capital has relied on the three dimensions: trust, norms of reciprocity, and networks. But how can these three dimensions be measured, i.e., operationalized?

1. Interpersonal trust is measured by means of survey respondents' replies to the question: "*Generally speaking, would you say that most people can be trusted or that you need to be very careful in dealing with people?*" The respondent has the option to answer with "*Most people can be trusted,*" "[*One] can't be too careful in dealing with people,*" and third "*Don't know.*" To capture the aggregate trust level of a society, the total valid responses of the surveyed population are first calibrated by removing the "*Don't know*" responses. In the next step, the "*Most people can be trusted*" responses are aggregated.[6] These steps yield trust levels ranging between 2.8% (28 out of 1,000 respondents answering "*Most people can be trusted*") in Brazil (WVS 1995–97[7]) and 66.5% (665 out of 1,000 respondents answering "*Most people can be trusted*") in Denmark (WVS 1999–2002).

   But what is the validity of such a measurement? The informative value of trust levels is widely recognized among researchers (see Knack & Keefer, 1997; Paxton, 1999; Whiteley, 2000; Alesina et al., 2000; Gabriel et al., 2002; Delhey & Newton, 2005; van Oorschot & Arts, 2005). Most notable is the dispersion of the aggregate variable, the discrepancy between Scandinavian countries, which have very high-trust levels, in contrast to countries in Latin America such as Colombia, Brazil, and Peru. But there are also large differences within OECD countries. Countries in Southern Europe and the Mediterranean (for the country

[6] The aggregation of interpersonal trust has been criticized from several sides. Portes (2000), Sobel (2002), Durlauf and Fafchamps (2005) advise working with the concept of trust on the micro-level. Work on the aggregate level would have no theoretical social science foundation (Durlauf & Fafchamps, 2005) or should at least be scaled back from the macro-level (nation) to the meso-level (state, region, or federal state).

[7] WVS refers to the World Value Survey. For a description, see: https://www.worldvaluessurvey.org/wvs.jsp.

typology "Mediterranean-," "coordinated-," and "liberal-" countries, see Hall & Soskice, 2001), such as Portugal, France, and Turkey, are endowed with lower trust levels than countries with coordinated market economies, liberal market economies, and Scandinavian countries.

In addition to interpersonal trust, systemic trust is measured by means of the following question: "*I am going to name a number of organizations. For each one, could you tell me how much confidence you have in them: Is it a great deal of confidence, quite a lot of confidence, not very much confidence or none at all?*" For example, the WVS 1999–2002 lists 15 organizations (4 of the 15 have already been mentioned as examples in Section 5 of this contribution). The answers are first processed by removing the "*Don't know*" answers, and then recoded and aggregated. This results in values of 1–4 for each individual organization, with high values representing high systemic trust. It is now worth considering whether an index construction of the individual institutions is appropriate.

Figure 8.1 shows an example of the trust levels of the countries of the former 15 EU member states[8] and the two largest economies, Japan and the US, in a cross-section of countries (WVS 1999–2002). The three Scandinavian countries and the Netherlands have very high-trust levels of over 55%. The countries Great Britain and Japan have average trust levels between 29.7% and 43.1%. The three Mediterranean countries Portugal, France, and Greece have levels between 10% and 23.7%. If countries from Latin America, such as Brazil with a trust level of 2.8% (WVS 1995–97), were now added to the country sample, the range of variance would increase further. But even without the addition of countries

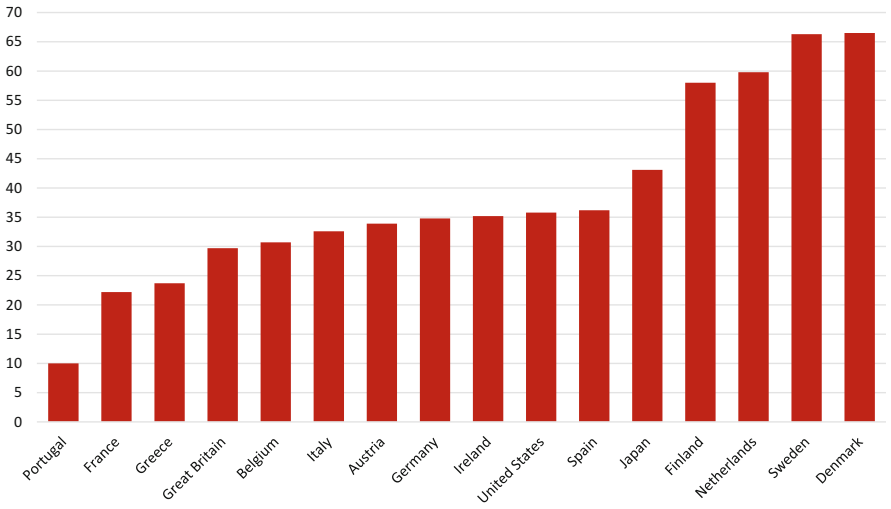

Fig. 8.1 Trust levels in selected countries (in %)

[8] No data were available for Luxembourg.

outside the EU-15, the discrepancy between Portugal with 10% and Denmark with 66.5% is very large.

2. Reciprocity norms are operationalized using questions from the "norms item battery" from the World Value Survey (WVS). The introductory question reads: "*Please tell me for each of the following statements whether you think it can always be justified, never be justified, or something in between."* The respondent has the option to answer using a Likert scale ranging from 1 to 10 with 1 representing "*Never justified*" and 10 representing "*Always justified.*" In the WVS 1999–2002, the item battery consists of 24 individual items. In the panel design, it is possible to rely on four items: "*Claiming government benefits which you are not entitled to,*" "*Cheating on taxes,*" "*Someone accepting a bribe in the course of their duties,*" and "*Avoiding a fare on public transport*". (For the cross-sectional procedure, see Knack & Keefer, 1997. The authors use five items of the item battery). The items are aggregated by their mean value and recorded. The result is a reciprocity norm index, which theoretically takes values between 4 and 40 (in Knack & Keefer, 1997, 5–50), where high values mean that there is a high stock of norms in society and low values mean that there are few reciprocity norms. While the measurement of interpersonal trust is very common, the construction of the norm index is less widespread (while Knack & Keefer, 1997 still worked with this index, Zak & Knack, 2001 were already working with only aggregated trust). One reason for this is that the dispersion of the index does not have the same variance as the aggregated variable trust. Furthermore, the validity of the index is more questionable than that of the trust variable. Further research would be needed to examine the variable in more detail. Knack and Keefer (1997) point to a high correlation between trust stocks and norm stocks.
3. The operationalization of networks has not yet been fully clarified theoretically. It remains worth discussing which types of civic engagement should be included as a basis for social capital. For example, unlike Putnam, Minkoff (1997) argues for including social movement organizations in a conceptualization of social capital. Most common is the measurement of associations using the following item from the WVS: "*Please look carefully at the following list of voluntary organizations and activities and say a) which, if any, do you belong to, and b) for which, if any, you are currently doing unpaid voluntary work?*" Respondents are asked about the following organizations; (1) *groups for social welfare services for elderly, handicapped, or deprived people*, (2) *religious or church organizations*, (3) *education, arts, music, or cultural activity groups*, (4) *labor unions*, (5) *political parties or groups,* (6) *local community action groups on issues like poverty, employment, housing, or racial equality*, (7) *third-world development or human rights advocacy groups*, (8) *environmental groups*, (9) *professional associations*, (10) *youth work groups*, (11) *sports or recreation associations*, (12) *women's groups*, (13) *peace movement*, (14) *voluntary organizations concerned with health*, (15) *Other groups,* and (16) *None*. The "*Not-mentioned*" are removed and the answers "*Belong*" and "*Do voluntary work*" are aggregated and added together.

4. As discussed earlier, current social capital research does not agree on whether or not dimensions of social capital should be summarized as an index. Putnam's approaches, for example, are mostly driven by indexing. In his book *Making Democracy Work* (Putnam, 1993), he works with a civic index; in his paper *Economic Growth and Social Capital in Italy*, he works with an index measuring civic engagement, one measuring institutional performance, and one measuring citizen satisfaction. In the empirical section of his book *Bowling Alone* (Putnam, 2000), Putnam works with a social capital index that consists of five dimensions with 14 individual items. These items are indicators of civic engagement, but also of voting behavior and interpersonal trust. Pamela Paxton, for example, works with a social capital index consisting of 14 items (Paxton, 1999) and a social capital index consisting of two dimensions associations and trust (Paxton, 2002).

9 Social Capital, Trust, and Economic Growth: Empirical Findings

Most economists addressing the relationship between social capital and economic growth refer to the concept of trust (Knack & Keefer, 1997; La Porta et al., 1999; Whiteley, 2000; Zak & Knack, 2001; Beugelsdijk et al., 2004; Berggren et al., 2008; Roth, 2007, 2009). The paper in this area that has received the most attention is probably the 1997 article *Does social capital have a payoff?* by authors Knack and Keefer, whose article takes Robert Solow's (1995) harsh critique of Fukuyama's book *Trust - The social virtues and the creation of prosperity* as a starting point for an empirical examination of Fukuyama and Putnam's theses. Thus, in his book review *But Verify?*, Solow writes: if trust really is to be an important indicator of a nation's economic development, then trust should be able to explain some of the residual growth that remains unexplained, after previously controlling for the factors of labor, share of investment rate in GDP, and human capital. He writes:

> *A standard exercise in economics is to decompose the observed growth of a national economy into its sources. How much can be attributed to the growth of the labour force? How much to the improved quality of labour? How much to the accumulation of the capital in the form of factories, machines, computers and so on? After all this is done, almost always there is a "residual" left over, some part of observed growth that cannot be credited to a measured factor of production. One would expect the contribution of "trust" or the perceived growth of "social capital" to be captured in this residual. If Fukuyama is right, they should be an important contribution to it* (1995, p. 37).

Knack and Keefer examine the relationship between social capital and economic growth in a cross-country comparative research design considering 29 market economies. They use the common method of empirical growth regressions. Relying on Barro's (1991) results, Knack and Keefer apply a widely used production function that includes the basic factors of natural logarithm of initial per capita income (to test for conditional convergence), stock of human capital (primary and secondary

education levels), and initial price level for investment, as well as the dimensions of social capital. The authors examine as the dependent variable the growth of per capita income between 1980 and 1992. They did not include the classic "Solow" variable, i.e. the share of investment in GNP, in their production model because they assume that trust stimulates growth via the impact on investment. The social capital variable is operationalized by the authors into the dimensions of trust, norms of reciprocity, and membership in voluntary associations, as described above. The dimensions of social capital are measured using 21 observations from the first wave of the WVS (1981–84) and 8 observations from the second wave of the WVS (1990–93). The authors conclude that trust and norms of reciprocity have a positive effect on long-term economic growth, but civic associations do not. The authors interpret their results as follows: 1) a 10% rise in trust is associated with an increase in growth of 0.8% and 2) each four-point rise in the reciprocity norms index targeted at a maximum of 50 points is associated with an increase in growth of more than 1% point. To check the robustness of their results, the authors use instrumental variables for trust, include additional regressors in their production function, and examine their results for potential outliers. The significant positive relationship between trust and growth is robust to all these specification changes. It should be noted with respect to the authors' approach that they base their results on the analysis of only 29 cases. Similarly, it is difficult to test for causality because they work with a cross-sectional design and with "flow variables" instead of "stock variables" at the beginning of the growth period to be explained. Data from 1990 to 1993 are used to explain growth in the 1980–1992 period. The authors are themselves aware of the endogeneity problem at hand and argue as follows: Since the trust scores of the first and second waves of the WVS are highly correlated, trust is interpreted as a constant cultural factor of a nation that does not change over time. Therefore, it is possible for the authors to use 1990–1993 trust scores as a proxy for 1980 trust scores. The authors' case selection is based on the assumption that social capital operates only in market economies. Therefore, the authors do not include transition countries or China in their country sample. The latter case, however, is particularly interesting because China, as a socialist and totalitarian state, registers not low but high-trust scores associated with high growth.

Building upon this article, Zak and Knack (2001) examine solely the relationship between trust and economic growth. The authors expand the country sample by nine developing countries and three OECD countries, to reach a total of 41 market economies, taking observations from the third wave of the WVS and including data from the Eurobarometer and an independent survey for the case of New Zealand. The values of the underlying data range from 5.5% for Peru to 61.2% for Norway. Their dependent variable is the average growth in per capita income between 1970 and 1992. The endogeneity problem is more prevalent in this study than in Knack and Keefer's study. The authors use trust variables from 1995 to 1997 to explain growth between 1970 and 1992. The independent variable trust is even lagged behind the dependent variable (growth 1970–1992). The authors are aware of this fact and rely on Knack and Keefer's argument that trust levels behave consistently over time and trust values from 1996 can be used as a proxy for trust

values around 1970. The authors again use a growth model with the control variables price level of investment, human capital, and initial national income. The authors concluded that a positive and significant relationship exists between trust and economic growth. They determined that growth rises by nearly one percentage point on average for every 15% point increase in trust.

Beugelsdijk et al. (2004) reevaluate the results of Knack and Keefer and Zak and Knack using robust regression techniques. They analyzed the results of the two studies along four dimensions of robustness: 1) statistical significance, 2) the influence of changing sets of conditioning variables on the estimated effect of trust, 3) the sensitivity of the results for using different proxies or specifications for basic variables like human capital, and 4) the effects on the significance and size when expanding the country sample to 41 countries. The authors conclude that their study provides further empirical evidence of an important relationship between trust and economic growth.

Whiteley (2000) examined the relationship between trust and growth in the framework of a modified neoclassical model of economic growth. He uses a 34-country sample with growth in per capita income between 1970 and 1992 as the dependent variable. As a social capital variable, he uses a trust index consisting of three different items (trust in one's own family, trust in one's own compatriots, and interpersonal trust) from the WVS 1990–1993. He concludes that the trust index of the three indicators has a positive effect on economic growth, with an impact as great as the variable conditional convergence and human capital. His results support the idea that attitudinal values are indispensable for the correct specification of growth regressions.

La Porta et al. (1999) work with trust data from the second wave of the WVS. They operate on a 39-country sample with the dependent variable growth in per capita income between 1970 and 1993, generated from World Development Report data. A 10% rise in trust is associated with a 0.3% rise in per capita income. They concluded that trust enhances economic performance and is remarkably robust in the cross-section country design.

In contrast to these results, Heliwell (1996) found a negative relationship between trust and productivity growth and between associations and economic productivity growth, in a sample of 17 OECD countries. He works with the dependent variable productivity growth between 1960 and 1992. His negative result in the cross-section country design is the only one known to the present author.

Except for Heliwell's negative result in 1996, all empirical studies conducted to date have found a positive relationship between trust and economic growth. Many social scientists who study the concept rely on the positive research results and mostly associate social capital with a positive relationship between social capital and economic growth. Social capital therefore enjoys a positive image.

Recent research has questioned the significant positive relationship between trust and economic growth. Berggren et al. (2008) test the robustness of the results of Knack and Keefer (1997), Zak and Knack (2001), and Beugelsdijk et al. (2004). They expand the country sample to 63 countries using data from the fourth wave of the WVS and from the Latinobarómetro. They investigated whether previous studies

on the relationship between trust and growth, which produced significant results between 1970 and 1992, also hold for the 1990–2000 period. They learned that when outliers are removed, specifically in China, the relationship between trust and growth is only statistically significant (with significance level of 5%) in 10% of the cases out of 1140 regressions. The authors emphasize that their results "show that the trust-growth relationship is less robust than claimed earlier" (Berggren et al., 2008, 252).

Roth (2007, 2009) even finds a significant negative correlation between trust and economic growth. His research also points to the downside of the social capital paradigm. Willingness to cooperate and high levels of interpersonal trust within a society can, in Olson's sense, turn against state reform processes. Unlike the studies mentioned so far, he works with a panel design. Roth assumes that trust cannot be readily understood as a constant cultural variable and points out that especially countries with a liberal-country regime, such as the US, the UK, Ireland, Canada, and Australia, have experienced strong declines in trust over time. For example, the trust level of the US dropped from 50% to 35.6% between 1990 and 1995. The UK's trust level dropped from 43.6% to 31% between 1990 and 1998. Even though the correlation of all countries between the periods is high, a loss of trust by the world's largest economy, the US, of almost one-third of its trust stocks in a period of only five years, is enough to question the constancy of interpersonal trust.

To Roth, it therefore seems reasonable to examine what impact this loss of trust has on economic performance. The assessment that trust should not be treated as a constant variable is based, among other things, on studies by Inglehart (Inglehart, 1997, 224; Inglehart, 1999, 95) and Noelle (2005). Using Germany as a case study, Noelle shows that interpersonal trust in Germany increased from 15% to 45% between 1950 and 2005. Inglehart (1999) and Uslaner (1999) use the US as a case study to demonstrate that interpersonal trust fell from 58% in 1960 to 36% in 1994. Roth's study (Roth, 2009) examines 41 countries with 129 observation points over the period 1980–2004. The dependent variable is the growth rate of per capita income for the five growth periods 1980–1984, 1985–1989, 1990–1994, 1995–1999, and 2000–2004. Trust data are generated from all four waves of the WVS 1981–1984, 1990–1993, 1995–1997, and 1999–2002, as well as one wave of the Eurobarometer (Eurobarometer 25 from 1986). To avoid endogeneity problems, trust as a stock variable is used as a lagged variable vis-à-vis the growth periods to be explained. The study uses the same growth model as used in the studies by Knack and Keefer (1997), Zak and Knack (2001), Beugelsdijk et al. (2004), and Berggren et al. (2008) for better comparability of results. Using this research design and a fixed-effects model, Roth (2009) finds a significant negative relationship between interpersonal trust and economic growth. A decrease in the level of interpersonal trust within a country is associated with an increase in the growth rate. This negative relationship is at odds with a positive relationship in the cross-section of countries.

10 Concluding Remarks

The finding that interpersonal trust has a positive effect on economic growth has matured into a certainty in the international scientific community in recent years. This positive result is most often associated with the academic work of Knack and Keefer (1997) and Zak and Knack (2001). In particular, the Knack and Keefer article is used to paraphrase the relationship between trust and economic development. More recent research challenges the significant positive relationship found by Knack and Keefer and Zak and Knack (Berggren et al., 2008) and even finds a significant negative relationship between trust and growth (Roth, 2007, 2009). Further research, as well as networking efforts among scientists currently researching the relationship between trust and growth, are necessary. It should be noted that research on the relationship between trust and economic growth remains relevant, as the market-economy based production process embedded in democratic structures depends on a basic level of social trust.

References

Alesina, A., et al. (2000). *The determinants of trust, NBER working paper 7621, National Bureau of economic research*. MA.

Arrow, K. (1972). Gifts and exchanges. *Philosophy and Public Affairs, 1*, 343–362.

Arrow, K. (1999). Observations on social capital. In P. Dasgupta & I. Serageldin (Eds.), *Social capital--A multifaceted perspective* (pp. 3–5). World Bank.

Barro, R. (1991). Economic growth in a cross-section of countries. *Quarterly Journal of Economics, 106*, 407–443.

Barro, R., & Sala-i-Martin, X. (2004). *Economic growth*. MIT Press.

Berggren, N., Elinder, M., & Jordahl, H. (2008). Trust and growth: A shaky relationship. *Empirical Economics, 35*, 251–274.

Beugelsdijk, S., de Groot, H. L. F., & van Schaik, A. B. T. M. (2004). Trust and economic growth: A robustness analysis. *Oxford Economic Papers, 56*, 118–134.

Bourdieu, P. (1983). Ökonomisches, kulturelles und soziales Kapital. In: K. Reinhard (Hrsg.), *Soziale Ungleichheiten (Soziale Welt: Sonderband 2)* (pp. 183–198).

Coleman, J. (1988). Social capital in the creation of human capital. *American Journal of Sociology, 94*, 95–120.

Coleman, J. (1990). *Foundations of social theory*. Harvard University Press.

Dasgupta, P. (1999). Economic progress and the idea of social capital. In P. Dasgupta & I. Serageldin (Eds.), *Social capital—A multifaceted perspective* (pp. 325–424). World Bank.

Delhey, J., & Newton, K. (2005). Predicting cross-national levels of social trust: Global pattern or Nordic exceptionalism? *European Sociological Review, 21*(4), 311–327.

Durlauf, S. N., & Fafchamps, M. (2005). Social capital. In P. Aghion & S. Durlauf (Eds.), *Handbook of economic growth* (pp. 1639–1699). North Holland.

Esser, H. (2000). *Soziologie: Spezielle Grundlagen Band 4: Opportunitäten und Restriktionen*. Campus Verlag.

Fukuyama, F. (1996). *Trust*. The Free Press.

Gabriel, O. W., Kunz, V., Roßteuscher, S., & Van Deth, J. W. (2002). *Sozialkapital und Demokratie—Zivilgesellschaftliche Ressourcen im Vergleich*. WUV-Universitäts-Verlag.

Habisch, A. (1999). Sozialkapital. In K. Wilhelm et al. (Hrsg.) *Handbuch der Wirtschaftsethik, Band 4. Ausgewählte Handlungsfelder* (pp. 472–509). Gütersloh.
Hall, P., & Soskice, D. (2001). *Varieties of capitalism*. Oxford University Press.
Hardin, R. (1982). *Collective action*. Johns Hopkins University Press.
Heliwell, J. (1996). *Economic growth and social capital in Asia, NBER working paper 5470*. National Bureau of Economic Research.
Inglehart, R. (1990). *Culture shift*. Princeton University Press.
Inglehart, R. (1997). *Modernization and postmodernization—Cultural, economic and political change in 43 societies*. Princeton University Press.
Inglehart, R. (1999). Trust, well-being and democracy. In M. E. Warren (Ed.), *Democracy and trust* (pp. 88–120). Cambridge University Press.
Keynes, J. M. (2000). *Allgemeine Theorie der Beschäftigung, des Zinses und des Geldes*. Duncker & Humblot GmbH.
Knack, S., & Keefer, P. (1997). Does social capital have a payoff? A cross-country investigation. *Quarterly Journal of Economics, 112*, 1251–1288.
La Porta, R., et al. (1999). Trust in large organizations. In P. Dasgupta & I. Serageldin (Eds.), *Social capital—A multifaceted perspective* (pp. 310–324). World Bank.
Luhmann, N. (2000). *Vertrauen*. Lucius & Lucius Verlagsgesellschaft mbH.
Mankiw, G., Romer, D., & Weil, D. (1992). A contribution to the empirics of economic growth. *The Quarterly Journal of Economics, 107*, 407–437.
Minkoff, D. (1997). Producing social capital. *The American Behavioral Scientist, 40*, 606–619.
Misztal, B. (1996). *Trust in modern societies--The search for the bases of social order*. Polity Press.
Newton, K. (1997). Social capital and democracy. *American Behavioral Scientist, 40*, 575–586.
Noelle, E. (2005). Vertrauen ist besser. *Frankfurter Allgemeine Zeitung, 166*, 5.
North, D. C. (1990). *Institutions, institutional change and economic performance*. Cambridge University Press.
OECD. (2001). *The well-being of nations—The role of human and social capital*. OECD.
Olson, M. (1982). *The rise and decline of nations: Economic growth, stagflation and social rigidities*. Yale University Press.
Ostrom, E. (1990). *Governing the commons*. Cambridge University Press.
Ostrom, E. (1998). A behavioral approach to the rational choice theory of collective action: Presidential address, American Political Science Association, 1997. *The American Political Science Review, 92*, 1–22.
Ostrom, E. (1999). A fad or a fundamental concept? In P. Dasgupta & I. Serageldin (Eds.), *Social capital--a multifaceted perspective* (pp. 172–214). World Bank.
Paxton, P. (1999). Is social capital declining in the United States—A multiple indicator assessment? *American Journal of Sociology, 105*, 88–127.
Paxton, P. (2002). Social capital and democracy: An interdependent relationship. *American Sociological Review, 67*, 254–277.
Portes, A. (2000). The two meanings of social capital. *Sociological Forum, 15*, 1–11.
Putnam, R. D. (1993). *Making democracy work: Civic traditions in modern Italy*. Princeton University Press.
Putnam, R. D. (1995). Bowling alone: America's declining social capital. *Journal of Democracy, 6*, 65–78.
Putnam, R. D. (2000). *Bowling alone: The collapse and revival of American community*. Simon and Schuster.
Putnam, R. D. (2001). *Gesellschaft und Gemeinsinn*. Bertelsmann Stiftung Verlag.
Putnam, R. D., & Helliwell, J. (1999). Economic growth and social capital in Italy. In P. Dasgupta & I. Serageldin (Eds.), *Social capital—A multifaceted perspective* (pp. 253–268). World Bank.
Roth, F. (2007). *Social capital, trust and economic growth—A cross-sectional and panel analysis. Dissertation zur Erlangung des wirtschaftswissenschaftlichen Doktorgrades der Wirtschaftswissenschaftlichen Fakultät der Universität Göttingen*. http://webdoc.sub.gwdg.de/diss/2007/roth/.

Roth, F. (2009). Does too much trust hamper economic growth. *Kyklos, 62*, 103–128.
Sen, A. K. (1977). Rational fools: A critique of the behavioural of economic theory. *Philosophy and Public Affairs, 6*, 317–344.
Sen, A. K. (1999). *Development as freedom*. Oxford University Press.
Serageldin, I. (1999). Foreword. In S. Knack (Ed.), *Social capital, growth and poverty: A survey of cross-country evidence, social capital initiative working paper 7, social capital initiative* (p. iii). World Bank.
Serageldin, I., & Grootaert, C. (1999). Defining social capital: An integrating view. In P. Dasgupta & I. Serageldin (Eds.), *Social capital—A multifaceted perspective* (pp. 40–58). World Bank.
Sobel, J. (2002). Can we trust social capital? *Journal of Economic Literature, XL*, 139–154.
Solow, R. (1956). A contribution to the theory of economic growth. *The Quarterly Journal of Economics, 70*, 65–94.
Solow, R. (1995). But verify? *The New Republic, 11*, 36–39.
Solow, R. (1999). Notes on social capital and economic performance. In P. Dasgupta & I. Serageldin (Eds.), *Social capital—A multifaceted perspective* (pp. 6–10). World Bank.
Tonkiss, F. (2000). Trust, social capital and economy. In F. Tonkiss & A. Passey (Eds.), *Trust and civil society* (pp. 72–89). Macmillan.
Uslaner, E. M. (1999). Democracy and social capital. In M. E. Warren (Ed.), *Democracy and trust* (pp. 121–150). Cambridge University Press.
van Oorschot, W., & Arts, W. (2005). The social capital of European welfare states: The crowding out hypothesis revisited. *Journal of European Social Policy, 15*, 5–26.
Whiteley, P. F. (2000). Economic growth and social capital. *Political Studies, 48*, 443–466.
Williams, B. (1988). Formal structures and social reality. In D. Gambetta (Ed.), *Trust: Making and breaking cooperative relations*. Oxford University Press.
Woolcock, M. (1998). Social capital and economic development: Toward a theoretical synthesis and policy framework. *Theory and Society, 27*, 151–208.
Zak, P. J., & Knack, S. (2001). Trust and growth. *The Economic Journal, 111*, 295–321.