UNIVERSITY OF WUPPERTAL
BERGISCHE UNIVERSITÄT WUPPERTAL

EUROPÄISCHE WIRTSCHAFT
UND
INTERNATIONALE MAKROÖKONOMIK

Paul J.J. Welfens
Toni Irawan
Jens K. Perret

# True Investment-GDP Ratio in a World Economy with Investment in Information & Communication Technology

Diskussionsbeitrag 215
Discussion Paper 215

*Europäische Wirtschaft und Internationale Wirtschaftsbeziehungen*
*European Economy and International Economic Relations*
**ISSN 1430-5445**

Paul J.J. Welfens
Toni Irawan
Jens K. Perret

# True Investment-GDP Ratio in a World Economy with Investment in Information & Communication Technology

June 2016

*Herausgeber/Editor: Prof. Dr. Paul J.J. Welfens, Jean Monnet Chair in European Economic Integration*

EUROPÄISCHES INSTITUT FÜR INTERNATIONALE WIRTSCHAFTSBEZIEHUNGEN (EIIW)/
EUROPEAN INSTITUTE FOR INTERNATIONAL ECONOMIC RELATIONS
Bergische Universität Wuppertal, Campus Freudenberg, Rainer-Gruenter-Straße 21,
D-42119 Wuppertal, Germany
Tel.: (0)202 – 439 13 71
Fax: (0)202 – 439 13 77
E-mail: welfens@eiiw.uni-wuppertal.de
www.eiiw.eu

JEL classification: L63, L86, L96, R11
Key words: Macroeconomics, Investment, ICT, Employment, Imbalances

**Summary**: The nominal investment-GDP ratio is playing a key role in the economic debate in the US and in the EU. However, this analysis is largely misleading as a rising share of overall investment is in the form of ICT investment: The price of ICT investment goods has been falling for decades so that it is adequate to consider the “real effective” investment-GDP ratio calculated on the basis of real ICT investment relative to real GDP. The gap between the two ratios is about 3-6 percentage points for the USA and Germany, and indeed some other EU countries, so that effective investment-GDP ratios in both the United States and Germany are seriously underestimated if nominal-GDP ratios are used – as the DIW, Berlin, did for Germany and other EU countries. There are, of course, critical implications for the debate about how large the investment gap is in Germany, France, Italy, Spain and other countries; this analysis is also highly relevant for the issue of overcoming slow growth and high unemployment rates. As regards Germany, there is only a small private investment gap, while that gap is much larger in Italy and Spain – judging by the real effective investment ratio of 2007 compared to the previous periods. In countries where the real effective investment-output ratio is quite different from the nominal investment-GDP ratio, the implication is that the savings rate and the current account position in the uses side of GDP in the System of National Accounts also need to be recalculated. The IMF should take the new methodology into account for the debate about international current account imbalances.

**Zusammenfassung**: Die nominale Investionsquote in Bezug auf das BIP spielt in der aktuellen ökonomischen Debatte, sowohl in der EU als auch den USA, eine zentrale Rolle. Die im Rahmen dieser Diskussion angeführten Argumente sind allerdings in ihrer Aussagekraft verzerrt, da ein großer Teil der Investitionen Investitionen in IKT Kapital sind: Der Preis von IKT bezogenen Investitionsgütern ist seit Dekaden kontinuierlich am Fallen, so dass es notwendig wird eine "reale effektive" Investitionsquote zu bestimmen, welche den IKT Anteil in den Investitionen berücksichtigt. Die Abweichung zwischen der diskutierten nominalen Investitionsquote und einer realen effektiven Investitionsquote beträgt für die USA und Deutschland, als auch andere EU-Mitgliedsstaaten, immerhin 3-5 Prozentpunkte, was zeigt, dass die effektiven Investitionsquote insbesondere in den USA und Deutschland deutlich unterschätzt werden - so auch in der Studie des DIW, die sich auf Länder der EU insbesondere aber auch Deutschland bezog. Die vorliegende Diskrepanz hat einen essentiellen Einfluss auf die Diskussion über die Investitionslücke in Deutschland, Frankreich, Italien, Spanien und andere Länder und spielt auch im Kontext der Überwindung einer Stagnation und hoher Arbeitslosenzahlen eine Rolle. In Bezug auf Deutschland liegt nur eine geringe Investitionslücke vor, in Ländern wie Italien und Spanien ist diese wesentlich höher - bezogen auf die reale effektive Investitionsquote von 2007. Für Länder, in denen eine hohe Diskrepanz zwischen der real-effektiven und der nominalen Investitionsquote vorliegt, folgt, dass ebenso die Sparquote und der Leistungsbilanzsaldo angepasst werden müssen.

*Prof. Dr. Paul J.J. Welfens, Jean Monnet Professor for European Economic Integration; Chair for Macroeconomics; President of the European Institute for International Economic Relations at the University of Wuppertal, (Rainer-Gruenter-Str. 21, D-42119 Wuppertal; +49 202 4391371), Alfred Grosser Professorship 2007/08, Sciences Po, Paris; Research Fellow, IZA, Bonn; Non-Resident Senior Fellow at AICGS/Johns Hopkins University, Washington DC*

*Prof. Welfens has testified before the US Senate, the German Parliament, the EP, the IMF etc.*

welfens@eiiw.uni-wuppertal.de , www.eiiw.eu

*Toni Irawan, Department of Economics, Bogor Agricultural University (IPB), Bogor, Indonesia International Center for Applied Finance and Economics Bogor Agricultural University (IPB), Bogor, Indonesia*

*Jens K. Perret, European Institute for International Economic Relations at the University of Wuppertal, Rainer-Gruenter-Str. 21, 42119 Wuppertal, Germany, Tel.: +49 202 439 3174, e-mail: perret@wiwi.uni-wuppertal.de*

**EIIW 2015 = 20 years of award-winning research**

# True Investment-GDP Ratio in a World Economy with Investment in Information & Communication Technology

Discussion Paper 215

## Table of Contents

**Table of Contents** ..... I

**List of Tables** ..... II

**1. Introduction** ..... 1

**2. ICT Investment Goods Prices and Real ICT Investment: Some New Calculations for Selected OECD Countries** ..... 3

**3. Calculating the Real Effective Investment-GDP Ratio** ..... 4

**4. Problems with Measuring the True Savings and the Current Account in Real Terms** ..... 9

**5. Conclusions for Economic Policy and Future Research** ..... 10

**References** ..... 14

**Appendix** ..... 15

# List of Tables

**Table 1: The comparison between ICT investment-GDP ratio and the real ICT investment-real GDP ratio for selected OECD countries ..... 4**

**Table 2: The differences between nominal investment-GDP ratio and real effective investment-GDP ratio for selected OECD countries ..... 5**

**Table 3: Variables in the investment-GDP ratio model ..... 5**

**Table 4: Regression results (nominal investment-GDP ratio as dependent variable / 1994-2007) ..... 6**

**Table 5: Regression results (real effective investment-GDP ratio as dependent variable) ..... 8**

**Table 6: Real effective investment-output ratio and standard investment-output ratio (ICT Capital Goods Index with base year 1995; the true investment share is calculated as nominal investment without ICT investment/nominal GDP plus real ICT investment/real GDP; based on the assumption that the 2007 ratio of the real effective investment-output ratio to the nominal investment-GDP ratio is also valid for 2008-2012) ..... 15**

# 1. Introduction

Western OECD countries suffered a strong decline of real output in 2008/09 and it took five to six years for the US, the UK and Germany, for example, to recover and once again attain the output levels reached prior to the crisis year of 2008; the unemployment rate in the US has come down in 2014 to the level of 2008, however, the number of discouraged workers in the US is fairly high (COUNCIL OF ECONOMIC ADVISORS, 2014). A major banking crisis in the US, the UK and some euro area countries, erupted in 2007-09 and since there was so much leverage built up by banks in many OECD countries, moving out of the crisis took a rather long time. The US and the UK have adopted a broad change of their respective banking laws and adopted a rather unusual expansionary monetary policy which stands for a comprehensive expansionary open market policy – "quantitative easing" (QE) - in the context of central bank interest rates at the lower zero bound. By contrast, the euro area and the European Central Bank have not adopted a broad QE policy. The output increase in the US was about 10 percentage points higher than in the euro area in 2008-2015 and the euro area in 2015/2016 might even face stagnation and deflationary pressure – the latter not least since the inflation rate has come down considerably in the euro area and was down to just 0.3% in September 2014 (with an ECB forecast for 2015 of 1.1% and the actual figure being close to zero). A group of German research institutes came up with a downward revision of their spring forecast: The expected growth of output in Germany was only 1% in 2015 – with due account taken of calendar differences across years; the actual growth rate was 1.7% in Germany and if one corrects for the strange 0% real growth rate of the biggest (ranked by population) German federal state, North Rhine-Westphalia, it was even much higher. In Germany, the think-tank DIW (BALDI ET AL. 2014) has argued that there is a considerable private sector investment gap, namely 3.7% in Germany and about 2% in the euro area in 2010-12. This investment gap was calculated by DIW on the basis of a pooled OLS regression analysis for the nominal investment-GDP ratio of selected OECD countries where the output growth rate, the savings rate, the employment ratio and the share of industry are significant independent variables – with an R squared of 0.36.

Assuming that the regression values indicate an optimum investment-GDP ratio, one can take the difference between the hypothetical value and the actual value as indicating a positive or negative investment gap. This procedure is, however, rather doubtful as will be explained subsequently. In the following analysis we take a critical look at the investment statistics of selected OECD countries in order to find out whether or not there exists an investment gap in Germany and other industrialized countries. It should be emphasized that a regression analysis for nominal investment-nominal GDP ratios is misleading, not only because of a large underestimation of true ICT investment dynamics, but one should also consider the fact that artificially low risk premiums in 2003-2006 in the US and western capital markets, respectively, have brought about artificially high investment-GDP ratios that were unsustainable once risk premiums had adjusted to normal levels. Also, one might have to consider that there could be a declining trend in the output growth of western OECD countries; this, however, is not really clear since over time the imputed value-added by private households active on the internet might have increased considerably since the late 1990s – along with the expansion of the internet – as has been emphasized by

WELFENS/PERRET (2014). To the extent that skilled workers in their leisure time are more active on the internet than unskilled workers, who might spend more time in a rather passive way on the internet or might prefer watching TV, the implicit value-added by online households even has a dimension for differential implicit labor demand for skilled workers and unskilled workers. However, in the subsequent analysis the main focus is on the adequate coverage of real investment in the overall economy where part of investment dynamics concerns ICT equipment and ICT capital, respectively.

Taking due account of the important role of investment in information & communication technology (ICT) in OECD countries, we conclude that for Germany no critical private sector investment gap exists. This comes from an analysis that considers the role of the ongoing fall of the ICT investment price index. Since considerable differences exist between the nominal investment-GDP ratio considered by the DIW (and other institutions) and the real effective investment GDP ratio calculated here, the conclusions drawn here are considerable different from the views that are derived on the basis of the nominal investment GDP ratio. The real effective investment GDP ratio derived subsequently – and the sectoral real ICT investment-real GDP ratio (based on 1995 prices) – shows that taking into account the ICT investment goods deflator brings a difference of 3-5 percentage points for effective real investment GDP ratio compared to the nominal GDP ratio; a misperception of the investment GDP ratio by about 1/5 is a serious problem and policymakers looking for an optimal policy mix to overcome the problems of stagnation and incipient deflation in the euro area would be wise to carefully consider the subsequent analysis before rushing to unfounded investment promotion policies. The broad concern about a lack of public investment in the euro area – voiced, for example, by the IMF (2014) - is, however, fully adequate and will not be discussed in-depth here.

The contribution is organized as follows: Section 2 picks up the idea of an investment gap in Germany and the euro area, respectively, and presents a critical discussion about adequate measurement of investment-GDP figures. Section 3 presents an empirical approach to the real effective investment-output ratio and shows some key new insights. Section 4 briefly picks up the issue of what the implications of our findings are for the current account-GDP ratio. Section 5 contains the policy conclusions and briefly explains why the euro area should consider some broader form of QE policy and why higher public investment is so important for the euro area and the EU, respectively. At the bottom line, the analysis shows that economic recovery and higher employment can only be expected from a policy approach that takes into account the relevant real economic dynamics in OECD countries and Newly Industrialized Countries (some of which are similar to Eastern European EU countries or some cohesion countries in the EU).

# 2. ICT Investment Goods Prices and Real ICT Investment: Some New Calculations for Selected OECD Countries

In the subsequent analysis we want to highlight how large the fall of the nominal and relative ICT investment goods price index has been in many OECD countries over decades and how important ICT investment in real terms has become. This point has already been emphasized in WELFENS/PERRET (2014) where the authors have also tried to come up with a first estimation of the imputed value-added on the internet by users and prosumers (private households as internet users whose digital activities partly stand for value-added). The following graphs and tables show the development of ICT investment goods prices for selected countries, it becomes apparent that there are some international differences in sectoral price dynamics. One may state the hypothesis that countries will have a higher ICT price index than the benchmark country US if there are unfavorable factors present in the respective country:

- A relatively high corruption index
- A relatively small degree of true trade openness (as defined by the size-corrected definition of BRETSCHGER/HETTICH (2002)
- A relatively small internet density since this stands for lack of global market transparency
- A large government sector which is assumed here to be less price sensitive than the private sector
- A large share of cumulated FDI is assumed to bring a lower national ICT price index since subsidiaries of multinational companies are expected to have a high price elasticity when buying ICT capital goods.

In the following table, the nominal ICT investment-GDP ratio and the real ICT investment-real GDP ratio are indicated for OECD countries. Table 2 suggests that the ratio of ICT investment to GDP is much larger if the ratio is measured in real terms relative to nominal terms. Moreover, the differences between real terms and nominal terms are getting larger over time. As an example, the difference between the ICT-GDP ratio in real terms and nominal terms for Germany was 0.5 percent in the period 1994-2000. The gap is getting larger over the period 2001-2007, then as much as 3.5 percent. The same pattern also applies for other selected OECD countries (with various magnitudes).

**Table 1: The comparison between ICT investment-GDP ratio and the real ICT investment-real GDP ratio for selected OECD countries**

| Country | Nominal ICT investment-GDP ratio | | Real ICT investment-real GDP ratio | |
|---|---|---|---|---|
| | 1994-2000 | 2001-2007 | 1994-2000 | 2001-2007 |
| Australia | 0.030 | 0.031 | 0.043 | 0.154 |
| Austria | 0.020 | 0.021 | 0.027 | 0.067 |
| Canada | 0.090 | 0.066 | 0.112 | 0.149 |
| Czech Rep. | 0.032 | 0.025 | 0.050 | 0.090 |
| Denmark | 0.030 | 0.034 | 0.048 | 0.147 |
| Germany | 0.021 | 0.020 | 0.026 | 0.055 |
| Italy | 0.020 | 0.018 | 0.026 | 0.052 |
| Japan | 0.030 | 0.028 | 0.034 | 0.047 |
| Netherlands | 0.028 | 0.028 | 0.039 | 0.088 |
| Slovenia | 0.028 | 0.027 | 0.032 | 0.051 |
| Spain | 0.023 | 0.025 | 0.030 | 0.056 |
| Sweden | 0.034 | 0.033 | 0.036 | 0.047 |
| United Kingdom | 0.033 | 0.030 | 0.043 | 0.091 |
| United States | 0.035 | 0.033 | 0.049 | 0.095 |
| Finland[(1)] | 0.025 | 0.026 | 0.056 | 0.214 |

Note: (1) The price index of computing equipment is used as a proxy for the ICT capital price index
Source: OECD Database, EU-KLEMS

# 3. Calculating the Real Effective Investment-GDP Ratio

The overall real effective investment-GDP ratio can be derived in a rather straightforward way if one assumes that the price index of capital goods – without ICT goods – is rising parallel to the general price level:

- 1) Calculate – based on the above assumption – the ratio of non-ICT nominal investment relative to GDP.
- 2) Calculate the ratio of real ICT investment to real GDP.
- We add (1) and (2) and dub this the real effective investment output ratio.

The results of this procedure are shown subsequently. Since not all OECD countries are covered in the EU-KLEMS database, we only present the calculation of real effective investment output ratios for 15 OECD countries.

**Table 2: The differences between nominal investment-GDP ratio and real effective investment-GDP ratio for selected OECD countries**

| Country | Nominal investment-GDP ratio (a) | | Real effective investment-GDP ratio (b) | | Differences (b) – (a) | |
|---|---|---|---|---|---|---|
| | 1994-2000 | 2001-2007 | 1994-2000 | 2001-2007 | 1994-2000 | 2001-2007 |
| Australia | 0.253 | 0.271 | 0.267 | 0.394 | 0.014 | 0.123 |
| Austria | 0.249 | 0.229 | 0.257 | 0.275 | 0.008 | 0.046 |
| Canada | 0.203 | 0.218 | 0.226 | 0.302 | 0.023 | 0.084 |
| Czech Rep. | 0.301 | 0.280 | 0.319 | 0.346 | 0.018 | 0.066 |
| Denmark | 0.199 | 0.211 | 0.218 | 0.324 | 0.018 | 0.113 |
| Germany | 0.219 | 0.184 | 0.224 | 0.219 | 0.005 | 0.035 |
| Italy | 0.198 | 0.212 | 0.204 | 0.246 | 0.007 | 0.034 |
| Japan | 0.270 | 0.228 | 0.274 | 0.247 | 0.004 | 0.019 |
| Netherlands | 0.219 | 0.198 | 0.231 | 0.258 | 0.012 | 0.060 |
| Slovenia | 0.249 | 0.271 | 0.252 | 0.295 | 0.004 | 0.024 |
| Spain | 0.231 | 0.286 | 0.237 | 0.317 | 0.007 | 0.031 |
| Sweden | 0.172 | 0.181 | 0.174 | 0.195 | 0.002 | 0.014 |
| United Kingdom | 0.176 | 0.175 | 0.186 | 0.236 | 0.011 | 0.061 |
| United States | 0.223 | 0.224 | 0.237 | 0.285 | 0.014 | 0.062 |
| Finland[(1)] | 0.191 | 0.207 | 0.222 | 0.395 | 0.031 | 0.187 |

Note: (1) The price index of computing equipment is used as a proxy for the ICT capital price index

Source: Own calculation based on OECD Database and EU-KLEMS Database

Table 2 suggests that after correcting for the ICT capital price index, the nominal investment-GDP ratio is always smaller than the real effective investment-GDP ratio. The differences vary across countries ranging from 1 percent to 18 percent. Furthermore, as the ICT capital price index is decreasing over time, the gap between the nominal investment-GDP ratio and the real effective investment-GDP ratio is also getting larger. Consequently, the conclusions that could be derived from the real effective investment-GDP ratio model might be different than those for the nominal terms. In order to test this hypothesis, we replicate the investment-GDP ratio model which is published in DIW (2014). Table 4 shows the details of dependent and exogenous variables in the model.

**Table 3: Variables in the investment-GDP ratio model**

| Variable | Definition | Source |
|---|---|---|
| gdcapavg | Average GDP per capita in the period 1995-1999 (PPP) | WDI |
| gdpgr | Growth of GDP (%) | WDI |
| grsav | Gross savings (% of GDP) | WDI |
| emp | Employment to population ratio, 15+, total (%) | WDI |
| ind | Industry, value added (% of GDP) | WDI |
| marcap | Market capitalization of listed companies (% of GDP) | WDI |
| infla | Inflation, consumer prices (annual %) | WDI |
| pricre | Domestic credit to private sector (% of GDP) | WDI |

| | | |
|---|---|---|
| rerstd | Fluctuation of real exchange rate (standard deviation of monthly real exchange rate for each respective year) | BIS |
| bankcre | Domestic credit to private sector by banks (% of GDP) | WDI |
| nomstd | Fluctuation of nominal exchange rate (standard deviation of monthly nominal exchange rate for each respective year) | BIS |
| olddep | Age dependency ratio, old (% of working-age population) | WDI |

In Table 4, we present the replication of the BALDI ET AL. (2014) model by using 15 OECD countries during the period 1994-2007. Generally, the results are similar with BALDI ET AL. (2014) even though the number of observation is only half that of BALDI ET AL. (2014).

**Table 4: Regression results (nominal investment-GDP ratio as dependent variable / 1994-2007)**

| | NOM1 | NOM2 | NOM3 | NOM4 |
|---|---|---|---|---|
| gdpcapavg | -0.123 ** | -0.075 | -0.122 ** | -0.209 *** |
| | (0.059) | (0.062) | (0.059) | (0.056) |
| gdpgr | 0.542 *** | 0.0401 ** | 0.551 *** | 0.335 ** |
| | (0.161) | (0.173) | (0.157) | (0.156) |
| grsav | 0.240 *** | 0.246 *** | 0.243 *** | 0.294 *** |
| | (0.061) | (0.066) | (0.061) | (0.060) |
| emp | 0.045 | 0.088 ** | 0.043 | -0.089 ** |
| | (0.036) | (0.034) | (0.035) | (0.040) |
| ind | 0.212 ** | 0.198 ** | 0.209 ** | 0.102 |
| | (0.094) | (0.098) | (0.095) | (0.101) |
| marcap | -0.019 *** | -0.014 *** | -0.019 *** | -0.018 *** |
| | (0.004) | (0.005) | (0.005) | (0.004) |
| infla | 0.230 | 0.208 | 0.229 | -0.010 |
| | (0.188) | (0.189) | (0.186) | (0.158) |
| pricre | 0.028 *** | | 0.028 *** | 0.032 *** |
| | (0.006) | | (0.006) | (0.006) |
| rerstd | 0.009 | 0.147 | | -0.072 |
| | (0.193) | (0.183) | | (0.163) |
| bankcre | | 0.013 * | | |
| | | (0.007) | | |
| nomstd | | | 0.062 | |
| | | | (0.226) | |
| olddep | | | | -0.466 *** |
| | | | | (0.075) |
| Constant | 8.185 ** | 6.286 | 8.207 ** | 31.716 *** |
| | (4.070) | (4.237) | (4.117) | (5.871) |
| $R^2$ | 0.403 | 0.352 | 0.403 | 0.501 |
| F-Statistic | 15.001 *** | 12.071 *** | 15.001 *** | 20.080 *** |
| N | 210 | 210 | 210 | 210 |

* p < 0.10; ** p < 0.05; *** p < 0.01

By implementing the nominal investment-GDP ratio, Table 4 basically replicates the DIW study (BALDI ET AL., 2014) on impact factors of the investment ratio – even though, however, both studies refer to a different set of countries. Taking a look at the coefficients

reported in Table 4 shows that the results of the present study approximately replicate those of the DIW study. While differences in the size of coefficients can be explained in part by possible different measurements applied to the variables implemented in the studies – the DIW does not report on the way variables in their study are measured – the signs of the coefficients remain – as far as they are significant in either of the two studies – unchanged. Even most of the insignificant variables report signs corresponding with those of the study by the DIW. $R^2$ statistics on the other hand vary significantly. The overall trend is that most variables significant in the study by the DIW are also significant at a comparable level in the results presented above. Discrepancies can easily be explained. Considering that a smaller number of countries were considered in the study above, it might be assumed that these countries are more homogeneous and thus their variance can be explained better than when implementing a broader sample of countries. A second explanation for higher $R^2$ statistics is the reduction of the considered time frame from an initial consideration of the years up to 2012, in the case above the time frame spans only the years up to 2007. Reducing the time frame thusly excludes heterogeneity generated by the economic crisis that become clearly visible only at the beginning of 2008. Summarizing, the estimation, as performed above and reported in Table 4, sufficiently replicates the results of the study by the DIW, and thus their underlying estimation and implementation of data (even though the scope of countries has been decreased and the time frame has been truncated), to provide a suitable basis for additional analysis of the investment ratio.

In light of this result, the same data set is implemented in a modified estimation set-up where the dependent variable – previously the nominal investment ratio – is subsidized by the real effective investment GDP ratio – as defined at the beginning of this section and as illustrated in Table 2 above. Table 5 summarizes the results of this modified estimation.

**Table 5: Regression results (real effective investment-GDP ratio as dependent variable)**

| | REAL1 | REAL2 | REAL3 | REAL4 |
|---|---|---|---|---|
| gdpcapavg | -0.180 ** | -0.118 | -0.188 ** | -0.283 *** |
| | (0.084) | (0.090) | (0.086) | (0.086) |
| gdpgr | 0.156 | 0.140 | 0.170 | -0.091 |
| | (0.240) | (0.248) | (0.244) | (0.249) |
| grsav | 0.424 *** | 0.397 *** | 0.426 *** | 0.489 *** |
| | (0.118) | (0.124) | (0.119) | (0.118) |
| emp | 0.211 *** | 0.239 *** | 0.212 *** | 0.050 |
| | (0.054) | (0.052) | (0.054) | (0.061) |
| ind | 0.333 * | 0.357 ** | 0.281 | 0.201 |
| | (0.170) | (0.175) | (0.168) | (0.188) |
| marcap | 0.025 * | 0.027 ** | 0.024 * | 0.026 * |
| | (0.014) | (0.013) | (0.014) | (0.014) |
| infla | 0.084 | 0.110 | 0.117 | -0.203 |
| | (0.194) | (0.207) | (0.227) | (0.157) |
| pricre | 0.025 ** | | 0.020 ** | 0.030 *** |
| | (0.011) | | (0.010) | (0.010) |
| rerstd | -0.987 *** | -0.876 *** | | -1.085 *** |
| | (0.347) | (0.323) | | (0.315) |
| bankcre | | 0.023 ** | | |
| | | (0.011) | | |
| nomstd | | | -0.845 ** | |
| | | | (0.418) | |
| olddep | | | | -0.559 *** |
| | | | | (0.143) |
| Constant | -3.191 | -6.644 | -1.365 | 25.021 ** |
| | (7.013) | (7.263) | (7.016) | (10.976) |
| $R^2$ | 0.249 | 0.248 | 0.235 | 0.298 |
| F-Statistic | 7.368 *** | 7.329 *** | 6.826 *** | 8.490 *** |
| N | 210 | 210 | 210 | 210 |

* p < 0.10; ** p < 0.05; *** p < 0.01

Comparing the results presented in Tables 4 and 5, even just a cursory glance reveals the significant differences between both approaches. The most significant changes are the loss in significance of GDP growth and the market capitalization, as well as the industry value added in the models REAL1 and REAL3. Furthermore, the two variables concerning the nominal and real exchange rates gain in significance, as does the ratio of private bank credits.

Aside from the change in single significance levels, each of the models loses between ten and twenty percentage points in explanatory power as evidenced by the reduction of the $R^2$ statistics.

However, the model still retains its overall high significance as deduced from an F-Test as shown in the second to last row of Table 5.

The last aspect in particular can be motivated via the fact that the modified real investment ratio puts an additional emphasis on the ICT sector. None of the models, however, include

any variable that specifically accounts for either the dynamics of the ICT industry or the spread of ICTs across the implemented countries. Thus additional heterogeneity is introduced into the models. An indicator that additional heterogeneity has been introduced into the model can be seen by the changes in the average GDP per capita and thus the time invariant country specific effects.

Conceptualizing a modified estimation layout thus needs to account for ICT specific aspects as well. Important aspects to be considered might include:

- The availability of ICTs in the respective country. (Measureable via the availability of 'broadband' internet access and respective costs)
- Nearness to the technological frontier of high-tech products and their share in the overall economic structure. (Measurable via the relative share of patents in high-tech industries and the revealed comparative advantages of high-tech industries)
- Sufficient absorptive capacity regarding the use of ICTs (Measurable via the amount of inhabitants that majored in MINT study programs)

Aside from these overall shortcomings of all four models, it is essential to mention the change in real and nominal exchange rates as they not only increase in size to be considered significant but differ even more considerably from the results of the study by the DIW than all other results. This underlines that as soon as the specific role that ICTs play for the industry, and thus the investment process, is considered, the importance of an international perspective rises considerably.

In the same context, domestic variables lose importance as is evidenced by the loss in significance of the GDP growth rate, market capitalization and industry value added. Whereas, when considering industry value added it needs to be taken into account that the variable might lose in significance but the coefficients themselves increase in all four models. In contrast, the market capitalization keeps the absolute size of the coefficients, while, however, the signs for all coefficients turn from a negative into a positive impact which in a single case even becomes significant.

# 4. Problems with Measuring the True Savings and the Current Account in Real Terms

If the true real investment-GDP ratio is different from the nominal investment-GDP ratio, then there are implications for other elements of the uses side of the GDP equation; assuming that real consumption is measured adequately, there are two questions to consider, namely the size of the current account in real terms and the overall savings rate (private sector plus government budget deficit). The current account data in nominal terms are readily available and measuring the current account in real terms should also not be difficult at first glance. There is an export price index, an index for import goods and the nominal exchange rate is known (as the exchange rate is changing almost every minute it is not fully known at what exact exchange rate each export or import was executed and often the forward exchange rate is relevant). If savings in real terms are measured adequately, the current account position in real terms will be different than the official statistics suggest

since savings of the private sector plus government minus investment is equal to the current account (all variables in real terms). For Germany and the US, respectively, this would imply that Germany's current account surplus is smaller in real terms than the official figures suggest; and that the current account deficit of the US is larger in real terms than the official statistics show. Alternatively, savings in real terms are not measured correctly; the government budget deficit is easy to measure, true private savings is much more difficult to assess; the World Bank has developed a concept of adjusted net savings which basically adds to the official savings figure expenditures on education and subtracts the depletion of natural resources (one might also ask: should one define savings only with respect to income not spent or also include non-realized capital gains). The difference between the ratio of real effective investment to real GDP and the nominal investment-GDP ratio could, however, also indicate that both the current account and the savings figures in real terms are not calculated adequately in the existing System of National Accounts.

# 5. Conclusions for Economic Policy and Future Research

Looking at the economic situation in the Eurozone, it makes a considerable difference if there is a major private sector investment gap or if mainly other elements can explain the small growth rate in the euro area or in parts of it. According to the analysis presented here, there is an apparent weakness of private investment mainly in the southern part of the euro area where Italy and Spain stand out as countries with a rather modest real effective investment-GDP ratio. There, bank lending has reduced considerably and this might explain part of the problem. The fact that the share of manufacturing industry is rather small in Italy and Spain also explains why the ICT-related true investment gap is not playing a very important role – assuming that ICT investment in manufacturing industries plays a dominant role in leading OECD economies (in some countries, such as the UK and Ireland, the banking industry also accounts for a large share of ICT investment).

Since a falling relative price of ICT investment goods will stimulate the expansion of ICT capital in the total capital stock in the long run, it is rather likely that the most innovative firms are particularly focusing on raising ICT investment that goes along with new options for regular software updating and thus "repowering" of the ICT capital stock that otherwise would face very high capital depreciation rates. Here it would be useful to conduct more future research.

The output growth rates in EU countries in 2015 were rather high and this also does not suggest that there is underinvestment in leading OECD countries. Even Germany's growth rate was rather high (2.2%) if one considers Germany without its biggest state – in terms of population – namely, North Rhine-Westphalia, whose output growth rate was 0 and thus an outlier (along with the state of Saxony-Anhalt that was also below 1%); the leading state in Germany in 2015 was Baden-Württemberg with a growth rate of 3.1%. Germany's official growth rate was 1.7%, but without North Rhine-Westphalia which has suffered from some sectoral shocks and years of inadequate regional economic and innovation policies, respectively; while it is true that the regional investment-GDP ratio of North Rhine-Westphalia was rather low in 2013/2014/2015, it is also true that the R&D-GDP ratio in

the regional economy (business expenditure on R&D/regional output) was at 1.1% in 2013, while that of Baden-Württemberg was 3.9%. China's respective indicator was 0.9% in 2009 and 1.5% in 2013 – with perspectives for further increases in the medium term.

As regards bottlenecks in financing investment projects, there are no clear arguments why in a setting with the European Central Bank adopting Quantitative Easing in 2015/2016 there should be major problems in investment financing of firms; there are, however, good arguments that government public expenditures should increase. In this respect, the German government has unfortunately adopted a strange constitutional change after the early years of the Euro crisis, namely the rule that the maximum structural deficit-GDP ratio of the national government after 2016 should be 0.35 percent, while that of the German states should be zero from 2020 on. If one assumes that Germany's real trend growth rate is 1.5%, the implied long-term debt-GDP ratio would be only 23.3% if one uses the Domar rule. This new deficit-GDP ratio is clearly too low and amounts to a weakening of the average government bond rating in the Eurozone in the long run, thus contributing to higher real interest rates and a lower effective investment-GDP ratio in Europe.

In a more general European perspective, there is no need to push banks to raise lending to firms but one could also launch an EU initiative to encourage the expansion of capital markets. Hence, the rating of firms could be supported, but this raises, of course, the issue about the quality of rating companies. Here, the leading rating companies are known to not really work in a professional manner – if scientific standards and organizational quality are the basis of judgement. The US government found that rating agencies were working poorly in the three years prior to the collapse of Lehman Brothers; the latter was rated AAA just a week before it collapsed and while only three of the 30 Dow Jones companies had AAA rating for corporate bonds, there were more than 3000 ABS/MBS products that miraculously carried such a top rating. Moreover, the US rating agencies also did a rather poor job in the field of corporate bond rating as publicly available balance sheet data were not included. The European Commission should reconsider the issue of creating a European Rating Agency; e.g., in the form of a foundation that would give the rating task, within the framework of a competitive tender process, to a network of university institutes with relevant specialization. In Germany, and several other EU countries, there is hardly a private investment weakness, rather the general issue is a lack of public investment.

As regards public investment, there is not much doubt that with real interest rates on government debt below 1.5 percent in many EU countries, a broader public investment initiative would be adequate. This raises to some extent the question of whether or not the new limit of a structural deficit of 0.5% in the EU Fiscal Pact is adequate; if the deficit-GDP ratio is to be raised, e.g. by 1 percentage point, this would then require that government makes considerable cuts in non-investment spending of the public sector. A more flexible rule could be that the 0.5% limit can only be exceeded for a maximum of three years if the increase in the budget deficit fully reflects public investment or higher R&D expenditures. This could imply for some countries that government adopts some projects where the rate of return is below the financing cost but as a pragmatic route of stabilization policy this might be considered.

The analysis has shown that effective ICT investment is grossly underestimated in some OECD countries if one puts the focus on the nominal investment-GDP ratio as a starting

point for assessing the need for policy makers to come up with intervention in the economy. The real effective investment-GDP ratio as calculated here is a much better point of reference for organizing the discussion about macroeconomic policies in industrialized countries. There is a need to explore the reasons why the ICT price index differs considerably across OECD countries. Hence a broader research agenda should be considered to give economic policy makers a sound basis for policy intervention.

As regards the discussion about the depreciation of the euro, beginning in autumn 2014, the popular argument that the OECD area is facing a currency war is far-fetched, the euro was bound to depreciate once the QE policy in the US and in the UK would be phased out. The depreciation of the euro will finally reflect what a normal exchange rate would have been had no QE policy been adopted in these two countries or had the ECB adopted the same QE policy as the US and the UK in 2009-2014. The Branson model (BRANSON, 1977) clearly suggests that an expansionary open market policy will bring about a fall of the interest rate and a nominal – and real – depreciation of the currency. It is also clear that the QE policy in the US and the UK has not only reduced the interest rate in these two countries but also the real interest rates worldwide; to some extent there were additional safe-haven effects that have depressed interest rates in the US, the UK, France and Germany considerably (a German bond with 30 years maturity was sold at 1.8% in October 2014 which implies a zero real interest rate in the long run if one assumes that the ECB will stick to its inflation limit of close to 2%).

To the extent that ICT capital is capital intensive in its production, the low cost of capital implies that global ICT production will expand, at the same time ICT goods benefit from a high rate of technological progress while ICT services often are characterized by network effects that imply a considerable role of endogenous growth elements. If one assumes that ICT expansion stands for skill-biased technological progress – as emphasized in the IMF paper of JAUMOTTE ET AL. (2008) – the ongoing increase of real ICT investment in overall investment could stand for a long-term push for a rise of the skilled workers' wage premium. The ICT sector is, however, rather heterogeneous. One should not overlook that ICT equipment is often produced under rather competitive international conditions while in the ICT services sector the role of import competition is rather limited in most countries. If the fall of the relative ICT capital goods price should continue for another decade, one should not be surprised if the share of ICT investment goods in total investment goods will be increasing over time. In many countries the share of ICT investments in total investments will exceed 1/3 or even ½ by 2020 if earlier trends should continue. With the internet linked to all traditional machinery and equipment, the role of the internet seems likely to become even more important in the perception of the public and of leading politicians. It will be necessary to study more in detail the specific digital and overall economic dynamics of leading ICT countries, however, it is fairly clear that economic policymakers should base their decisions on true ICT investment-GDP ratios and true (real effective) overall investment-GDP ratios.

Alternative regression analyses for the real effective investment output ratio to test for robustness of the results presented in Table 6 should consider the following aspects:

- a) Real per capita GDP, the growth rate of real GDP, the employment ratio, the share of industry in output and the savings ratio (this is the list of variables used by BALDI ET AL., 2014)

- b) The relative price of ICT investment goods (ICT capital goods price index/GDP deflator); the expected sign is negative since a relatively lower ICT investment goods price will stimulate capital-saving digital investment.
- c) The growth rate of the real ICT investment goods price
- d) The ratio of cumulated inward FDI to the total capital stock: The higher this ratio is, the higher investment from profits of foreign subsidiaries in the country considered should be.
- e) The ratio of outward FDI flows to GDP; the higher this ratio is, the lower the domestic real effective investment-GDP ratio should be.

This type of robustness check, however, is not part of the present paper but promises to be an interesting topic for future research.

# References


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

Branson W.H. (1977), Asset markets and relative price in exchange rate determination, Sozialwissenschaftliche Analen 1:69–89

Bretschger, L.; Hettich, F. (2002), Globalisation, Capital Mobility and Tax Competition: Theory and Evidence for OECD Countries, European Journal of Political Economy, Vol. 18, 695-716.

Council of Economic Advisors (2014), Economic Report of the President, Washington D.C.

IMF (2014), World Economic Outlook, October, Washington D.C.

Jaumotte, F.; Lall, S. and Papageorgiou, C. (2008), Rising Income Inequality: Technology, or Trade and Financial Globalization?, IMF Working Paper 08/185.

Welfens, P.J.J. and Perret, J. (2014). Information & communication technology and true real GDP: economic analysis and findings for selected countries, International Economics and Economic Policy, Vol. 11, 5-27.

# Appendix

**Table 6: Real effective investment-output ratio and standard investment-output ratio (ICT Capital Goods Index with base year 1995; the true investment share is calculated as nominal investment without ICT investment/nominal GDP plus real ICT investment/real GDP; based on the assumption that the 2007 ratio of the real effective investment-output ratio to the nominal investment-GDP ratio is also valid for 2008-2012)**

| Country | Investment Share_nom | | | | True Investment Share_Adj | | | | Differences (Adj-nom) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1993-1997 | 1998-2002 | 2003-2007 | 2008-2012 | 1993-1997 | 1998-2002 | 2003-2007 | 2008-2012 | 1993-1997 | 1998-2002 | 2003-2007 | 2008-2012 |
| Australia | 0.247 | 0.252 | 0.272 | 0.282 | 0.249 | 0.277 | 0.351 | 0.394 | 0.002 | 0.025 | 0.079 | 0.113 |
| Austria | 0.248 | 0.241 | 0.228 | 0.221 | 0.249 | 0.261 | 0.266 | 0.265 | 0.001 | 0.020 | 0.038 | 0.044 |
| Czech Republic | 0.300 | 0.288 | 0.276 | 0.276 | 0.300 | 0.297 | 0.293 | 0.296 | 0.000 | 0.009 | 0.017 | 0.020 |
| Denmark | 0.186 | 0.207 | 0.214 | 0.199 | 0.188 | 0.241 | 0.286 | 0.283 | 0.002 | 0.034 | 0.072 | 0.084 |
| Germany | 0.219 | 0.209 | 0.180 | 0.197 | 0.220 | 0.222 | 0.214 | 0.248 | 0.000 | 0.014 | 0.034 | 0.051 |
| Italy | 0.194 | 0.205 | 0.213 | 0.201 | 0.194 | 0.214 | 0.228 | 0.219 | 0.001 | 0.008 | 0.015 | 0.017 |
| Japan | 0.284 | 0.245 | 0.226 | 0.207 | 0.285 | 0.257 | 0.257 | 0.237 | 0.001 | 0.012 | 0.031 | 0.030 |
| Netherlands | 0.213 | 0.218 | 0.195 | 0.207 | 0.214 | 0.235 | 0.224 | 0.240 | 0.001 | 0.017 | 0.029 | 0.033 |
| Slovenia | 0.223 | 0.260 | 0.282 | 0.238 | 0.228 | 0.248 | 0.271 | 0.231 | 0.005 | -0.011 | -0.011 | -0.007 |
| Spain | 0.215 | 0.256 | 0.294 | 0.234 | 0.216 | 0.262 | 0.299 | 0.238 | 0.001 | 0.006 | 0.004 | 0.004 |
| Sweden | 0.164 | 0.179 | 0.182 | 0.230 | 0.164 | 0.179 | 0.188 | 0.240 | 0.000 | 0.000 | 0.006 | 0.011 |
| United Kingdom | 0.168 | 0.180 | 0.175 | 0.165 | 0.169 | 0.199 | 0.209 | 0.199 | 0.001 | 0.019 | 0.035 | 0.035 |
| United States | 0.213 | 0.227 | 0.226 | 0.189 | 0.215 | 0.250 | 0.261 | 0.224 | 0.001 | 0.024 | 0.035 | 0.035 |

## EIIW Discussion Papers

**ISSN 1430-5445:**
Standing orders (usually 13 issues or more p.a.): academic rate 95 Euro p.a.; normal rate 250 Euro p.a.
Single orders: academic rate 10 Euro per copy; normal rate 20 Euro per copy.

Die Zusammenfassungen der Beiträge finden Sie im Internet unter:
The abstracts of the publications can be found in the internet under:

http://www.eiiw.eu

No. 100 **Gavrilenkov, E.:** Macroeconomic Situation in Russia - Growth, Investment and Capital Flows, October 2002

No. 101 **Agata, K.:** Internet, Economic Growth and Globalization, November 2002

No. 102 **Blind, K.; Jungmittag, A.:** Ausländische Direktinvestitionen, Importe und Innovationen im Dienstleistungsgewerbe, February 2003

No. 103 **Welfens, P.J.J.; Kirn, T.:** Mittelstandsentwicklung, BASEL-II-Kreditmarktprobleme und Kapitalmarktperspektiven, Juli 2003

No. 104 **Standke, K.-H.:** The Impact of International Organisations on National Science and Technology Policy and on Good Governance, March 2003

No. 105 **Welfens, P.J.J.:** Exchange Rate Dynamics and Structural Adjustment in Europe, May 2003

No. 106 **Welfens, P.J.J.; Jungmittag, A.; Kauffmann, A.; Schumann, Ch.:** EU Eastern Enlargement and Structural Change: Specialization Patterns in Accession Countries and Economic Dynamics in the Single Market, May 2003

No. 107 **Welfens, P.J.J.:** Überwindung der Wirtschaftskrise in der Eurozone: Stabilitäts-, Wachstums- und Strukturpolitik, September 2003

No. 108 **Welfens, P.J.J.:** Risk Pricing, Investment and Prudential Supervision: A Critical Evaluation of Basel II Rules, September 2003

No. 109 **Welfens, P.J.J.; Ponder, J.K.:** Digital EU Eastern Enlargement, October 2003

No. 110 **Addison, J.T.; Teixeira, P.:** What Have We Learned About The Employment Effects of Severance Pay? Further Iterations of Lazear et al., October 2003

No. 111 **Gavrilenkov, E.:** Diversification of the Russian Economy and Growth, October 2003

No. 112 **Wiegert, R.:** Russia's Banking System, the Central Bank and the Exchange Rate Regime, November 2003

No. 113 **Shi, S.:** China’s Accession to WTO and its Impacts on Foreign Direct Investment, November 2003

No. 114 **Welfens, P.J.J.:** The End of the Stability Pact: Arguments for a New Treaty, December 2003

No. 115 **Addison, J.T.; Teixeira, P.:** The effect of worker representation on employment behaviour in Germany: another case of -2.5%, January 2004

No. 116 **Borbèly, D.:** EU Export Specialization Patterns in Selected Accession Countries, March 2004

No. 117 **Welfens, P.J.J.:** Auf dem Weg in eine europäische Informations- und Wissensgesellschaft: Probleme, Weichenstellungen, Politikoptionen, Januar 2004

No. 118 **Markova, E.:** Liberalisation of Telecommunications in Russia, December 2003

No. 119 **Welfens, P.J.J.; Markova, E.:** Private and Public Financing of Infrastructure: Theory, International Experience and Policy Implications for Russia, February 2004

No. 120 **Welfens, P.J.J.:** EU Innovation Policy: Analysis and Critique, March 2004

No. 121 **Jungmittag, A.; Welfens, P.J.J.:** Politikberatung und empirische Wirtschaftsforschung: Entwicklungen, Probleme, Optionen für mehr Rationalität in der Wirtschaftspolitik, März 2004

No. 122 **Borbèly, D.:** Competition among Cohesion and Accession Countries: Comparative Analysis of Specialization within the EU Market, June 2004

No. 123 **Welfens, P.J.J.:** Digitale Soziale Marktwirtschaft: Probleme und Reformoptionen im Kontext der Expansion der Informations- und Kommunikationstechnologie, Mai 2004

No. 124 **Welfens, P.J.J.; Kauffmann, A.; Keim, M.:** Liberalization of Electricity Markets in Selected European Countries, July 2004

No. 125 **Bartelmus, P.:** SEEA Revision: Accounting for Sustainability?, August 2004

No. 126 **Welfens, P.J.J.; Borbèly, D.:** Exchange Rate Developments and Stock Market Dynamics in Transition Countries: Theory and Empirical Analysis, November 2004

No. 127 **Welfens, P.J.J.:** Innovations in the Digital Economy: Promotion of R&D and Growth in Open Economies, January 2005

No. 128 **Welfens, P.J.J.:** Savings, Investment and Growth: New Approaches for Macroeconomic Modelling, February 2005

No. 129 **Pospiezna, P.:** The application of EU Common Trade Policy in new Memberstates after Enlargement – Consequences on Russia's Trade with Poland, March 2005

No. 130 **Pospiezna, P.; Welfens, P.J.J.:** Economic Opening up of Russia: Establishment of new EU-RF Trade Relations in View of EU Eastern Enlargement, April 2005

No. 131 **Welfens, P.J.J.:** Significant Market Power in Telecommunications: Theoretical and Practical Aspects, May 2005

No. 132 **Welfens, P.J.J.:** A Quasi-Cobb Douglas Production Function with Sectoral Progress: Theory and Application to the New Economy, May 2005

No. 133 **Jungmittag, A.; Welfens, P.J.J:** Institutions, Telecommunications Dynamics and Policy Challenges: Theory and Empirical Analysis for Germany, May 2005

No. 134 **Libman, A.:** Russia's Integration into the World Economy: An Interjurisdictional Competition View, June 2005

No. 135 **Feiguine, G.:** Beitritt Russlands zur WTO – Probleme und Perspektiven, September 2005

No. 136 **Welfens, P.J.J.:** Rational Regulatory Policy for the Digital Economy: Theory and EU Policy Options, October 2005

No. 137 **Welfens, P.J.J.:** Schattenregulierung in der Telekommunikationswirtschaft, November 2005

No. 138 **Borbèly, D.:** Determinants of Trade Specialization in the New EU Member States, November 2005

No. 139 **Welfens, P.J.J.:** Interdependency of Real Exchange Rate, Trade, Innovation, Structural Change and Growth, December 2005

No. 140 **Borbély D., Welfens, P.J.J.:** Structural Change, Innovation and Growth in the Context of EU Eastern Enlargement, January 2006

No. 141 **Schumann, Ch.:** Financing Studies: Financial Support schemes for students in selected countries, January 2006

No. 142 **Welfens, P.J.J.:** Digitale Innovationen, Neue Märkte und Telekomregulierung, März 2006

No. 143 **Welfens, P.J.J.:** Information and Communication Technology: Dynamics, Integration and Economic Stability, July 2006

No. 144 **Welfens, P.J.J.:** Grundlagen rationaler Transportpolitik bei Integration, August 2006

No. 145 **Jungmittag, A.:** Technological Specialization as a driving Force of Production Specialization, October 2006

No. 146 **Welfens, P.J.J.:** Rational Regulatory Policy for the Digital Economy: Theory and EU-Policy Options, October 2006

No. 147 **Welfens, P.J.J.:** Internationalization of EU ICT Industries: The Case of SAP, December 2006

No. 148 **Welfens, P.J.J.:** Marktwirtschaftliche Perspektiven der Energiepolitik in der EU: Ziele, Probleme, Politikoptionen, Dezember 2006

No. 149 **Vogelsang, M.:** Trade of IT Services in a Macroeconomic General Equilibrium Model, December 2006

No. 150 **Cassel, D., Welfens, P.J.J.:** Regional Integration, Institutional Dynamics and International Competitiveness, December 2006

No. 151 **Welfens, P.J.J., Keim, M.:** Finanzmarktintegration und Wirtschaftsentwicklung im Kontext der EU-Osterweiterung, März 2007

No. 152 **Kutlina, Z.:** Realwirtschaftliche und monetäre Entwicklungen im Transformationsprozess ausgewählter mittel- und osteuropäischer Länder, April 2007

No. 153 **Welfens, P.J.J.; Borbély, D.:** Structural Change, Growth and Bazaar Effects in the Single EU Market, September 2008

No. 154 **Feiguine, G.:** Die Beziehungen zwischen Russland und der EU nach der EU-Osterweiterung: Stand und Entwicklungsperspektiven, Oktober 2008

No. 155 **Welfens, P.J.J.:** Ungelöste Probleme der Bankenaufsicht, Oktober 2008

No. 156 **Addison J.T.:** The Performance Effects of Unions. Codetermination, and Employee Involvement: Comparing the United States and Germany (With an Addendum on the United Kingdom), November 2008

No. 157 **Welfens, P.J.J.:** Portfoliomodell und langfristiges Wachstum: Neue Makroperspektiven, November 2008

No. 158 **Welfens, P.J.J.:** Growth, Structural Dynamics and EU Integration in the Context of the Lisbon Agenda, November 2008

No. 159 **Welfens, P.J.J.:** Growth, Innovation and Natural Resources, December 2008

No. 160 **Islami, M.:** Interdependence Between Foreign Exchange Markets and Stock Markets in Selected European Countries, December 2008

No. 161 **Welfens, P.J.J.:** Portfolio Modelling and Growth, January 2009

No. 162 **Bartelmus, P.:** Sustainable Development – Has It Run Its Course?, January 2009

No. 163 **Welfens, P.J.J.:** Intégration Européenne et Mondialisation: Défis, Débats, Options, February 2009

No. 164 **Welfens, P.J.J.:** ЭКОНОМИЧЕСКИЙ РОСТ, ИННОВАЦИИ И ПРИРОДНЫЕ РЕСУРСЫ, February 2009

No. 165 **Welfens, P.J.J.; Vogelsang, M.:** Regulierung und Innovationsdynamik in der EU-Telekommunikationswirtschaft, February 2009

No. 166 **Welfens, P.J.J.:** The International Banking Crisis: Lessons and EU Reforms, February 2009

No. 167 **Schröder, C.:** Financial System and Innovations: Determinants of Early Stage Venture Capital in Europe, March 2009

No. 168 **Welfens, P.J.J.:** Marshall-Lerner Condition and Economic Globalization, April 2009

No. 169 **Welfens, P.J.J.:** Explaining Oil Price Dynamics, May 2009

No. 170 **Welfens, P.J.J.; Borbély, D.:** Structural Change, Innovation and Growth in the Single EU Market, August 2009

No. 171 **Welfens, P.J.J.:** Innovationen und Transatlantische Bankenkrise: Eine ordnungspolitische Analyse, August 2009

No. 172 **Erdem, D.; Meyer, K.:** Natural Gas Import Dynamics and Russia´s Role in the Security of Germany´s Supply Strategy, December 2009

No. 173 **Welfens P.J.J; Perret K.J.:** Structural Change, Specialization and Growth in EU 25, January 2010

No. 174 **Welfens P.J.J.; Perret K.J.; Erdem D.:** Global Economic Sustainability Indicator: Analysis and Policy Options for the Copenhagen Process, February 2010

No. 175 **Welfens, P.J.J.:** Rating, Kapitalmarktsignale und Risikomanagement: Reformansätze nach der Transatlantischen Bankenkrise, Februar 2010

No. 176 **Mahmutovic, Z.:** Patendatenbank: Implementierung und Nutzung, Juli 2010

No. 177 **Welfens, P.J.J.:** Toward a New Concept of Universal Services: The Role of Digital Mobile Services and Network Neutrality, November 2010

No. 178 **Perret J.K.:** A Core-Periphery Pattern in Russia – Twin Peaks or a Rat´s Tail, December 2010

No. 179 **Welfens P.J.J.:** New Open Economy Policy Perspectives: Modified Golden Rule and Hybrid Welfare, December 2010

No. 180 **Welfens P.J.J.:** European and Global Reform Requirements for Overcoming the Banking Crisis, December 2010

No. 181 **Szanyi, M.:** Industrial Clusters: Concepts and Empirical Evidence from East-Central Europe, December 2010

No. 182 **Szalavetz, A.:** The Hungarian automotive sector – a comparative CEE perspective with special emphasis on structural change, December 2010

No. 183 **Welfens, P.J.J.; Perret, K.J.; Erdem, D.:** The Hungarian ICT sector – a comparative CEE perspective with special emphasis on structural change, December 2010

No. 184 **Lengyel, B.:** Regional clustering tendencies of the Hungarian automotive and ICT industries in the first half of the 2000's, December 2010

No. 185 **Schröder, C.:** Regionale und unternehmensspezifische Faktoren einer hohen Wachstumsdynamik von IKT Unternehmen in Deutschland; Dezember 2010

No. 186 **Emons, O.:** Innovation and Specialization Dynamics in the European Automotive Sector: Comparative Analysis of Cooperation & Application Network, October 2010

No. 187 **Welfens, P.J.J.:** The Twin Crisis: From the Transatlantic Banking Crisis to the Euro Crisis?,January 2011

No. 188 **Welfens, P.J.J.:** Green ICT Dynamics: Key Issues and Findings for Germany, March 2012

No. 189 **Erdem, D.:** Foreign Direct Investments, Energy Efficiency and Innovation Dynamics, July 2011

No. 190 **Welfens, P.J.J.:** Atomstromkosten und -risiken: Haftpflichtfragen und Optionen rationaler Wirtschaftspolitik, Mai 2011

No. 191 **Welfens, P.J.J.:** Towards a Euro Fiscal Union: Reinforced Fiscal and Macroeconomic Coordination and Surveillance is Not Enough, January 2012

No. 192 **Irawan, Tony:** ICT and economic development: Conclusion from IO Analysis for Selected ASEAN Member States, November 2013

No. 193 **Welfens, P.J.J.; Perret, J.:** Information & Communication Technology and True Real GDP: Economic Analysis and Findings for Selected Countries, February 2014

No. 194 **Schröder, C.:** Dynamics of ICT Cooperation Networks in Selected German ICT Clusters, August 2013

No. 195 **Welfens, P.J.J.; Jungmittag, A.:** Telecommunications Dynamics, Output and Employment, September 2013

No. 196 **Feiguine, G.; Solojova, J.:** ICT Investment and Internationalization of the Russian Economy, Septemper 2013

No. 197 **Kubielas, S.; Olender-Skorek, M.:** ICT Modernization in Central and Eastern Europe, May 2014 Trade and Foreign Direct Investment New Theoretical Approach and Empirical Findings for US Exports & European Exports

No. 198 **Feiguine, G.; Solovjova, J.:** Significance of Foreign Direct Investment for the Development of Russian ICT sector, May 2014

No. 199 **Feiguine, G.; Solovjova, J.:** ICT Modernization and Globalization: Russian Perspectives, May 2014

No. 200 **Syraya, O.:** Mobile Telecommunications and Digital Innovations, May 2014

No. 201 **Tan, A.:** Harnessing the Power if ICT and Innovation Case Study Singapore, June 2014

No. 202 **Udalov, V.:** Political-Economic Aspects of Renewable Energy: Voting on the Level of Renewable Energy Support, November 2014

No. 203 **Welfens, P.J.J.;** Overcoming the EU Crisis and Prospects for a Political Union, November 2014

No. 204 **Welfens, P.J.J.; Irawan, T.:** Trade and Foreign Direct Investment: New Theoretical Approach and Empirical Findings for US Exports and European Exports, November 2014

No. 205 **Welfens, P.J.J,:** Competition in Telecommunications and Internet Services: Problems with Asymmetric Regulations, Dezember 2014

No. 206 **Welfens, P.J.J,:** Innovation, Inequality and a Golden Rule for Growth in an Economy with Cobb-Douglas Function and an R&D Sector, März 2015

No. 207 **Perret, J.K.:** Comments on the Impact of Knowledge on Economic Growth across the Regions of the Russian Federation

No. 208 **Welfens, P.J.J,; Irawan T.:** European Innovations Dynamics and US Economic Impact: Theory and Empirical Analysis, June 2015

No. 209 **Welfens, P.J.J.:** Transatlantisches Freihandelsabkommen EU-USA: Befunde zu den TTIP-Vorteilen und Anmerkungen zur TTIP-Debatte, Juni 2015

No. 210 **Welfens, P.J.J.:** Overcoming the Euro Crisis and Prospects for a Political Union, July 2015

No. 211 **Welfens, P.J.J.:** Schumpeterian Macroeconomic Production Function for Open Economies: A New Endogenous Knowledge and Output Analysis, January 2016

No. 212 **Jungmittag, A.; Welfens, P.J.J.:** Beyond EU-US Trade Dynamics: TTIP Effects Related to Foreign Direct Investment and Innovation, February 2016

No. 213 **Welfens, P.J.J.:** Misleading TTIP analysis in the 6th/7th May 2016 issue of DER SPIEGEL, May 2016

No. 214 **Welfens, P.J.J.:** TTIP-Fehlanalyse im SPIEGEL Heft 6. Mai 2016, Mai 2016

No. 215 **Welfens, P.J.J.; Irawan, T.; Perret, J.K.:** True Investment-GDP Ratio in a World Economy with Investment in Information & Communication Technology, June 2016

## Weitere Beiträge von Interesse:

## Titels of related interest:

**Michael W. Klein; Paul J.J. Welfens** (1992), Multinationals in the New Europe and Global Trade, Springer Berlin Heidelberg

**Paul J.J. Welfens; Klaus Gloede; Hans Gerhard Strohe; Dieter Wagner** (1999), Systemtransformation in Deutschland und Rußland, Physica-Verlag HD

**Paul J.J. Welfens; Anna Wziatek-Kubiak** (2005), Structural Change and Exchange Rate Dynamics, Springer Berlin Heidelberg

**Paul J.J. Welfens** (2011), Innovations in Macroeconomics, Springer Berlin Heidelberg

**Richard Tilly; Paul J.J. Welfens; Michael Heise** (2007), 50 Years of EU Economic Dynamics, Springer Berlin Heidelberg

**Paul J.J. Welfens; Ellen Walther-Klaus** (2008), Digital Excellence, Springer Berlin Heidelberg

**Paul J.J. Welfens; Andre Jungmittag** (2002), Internet, Telekomliberalisierung und Wirtschaftswachstum, Springer Berlin Heidelberg

**Paul J.J. Welfens** (1999), EU Eastern Enlargement and the Russian Transformation Crisis, Springer Berlin Heidelberg

**Paul J.J. Welfens** (1996), Economic Aspects of German Unification, Springer Berlin Heidelberg

**Richard Tilly; Paul J.J. Welfens** (1996), European Economic Integration as a Challenge to Industry and Government, Springer Berlin Heidelberg

**Paul J.J. Welfens** (2012), Clusters in Automotive and Information & Communication Technology, Springer Berlin Heidelberg

**Paul J.J. Welfens** (1992), Economic Aspects of German Unification, Springer Berlin Heidelberg

**Paul J.J. Welfens** (2013), Grundlagen der Wirtschaftspolitik, Springer Berlin Heidelberg

**Huub Meijers; Bernhard Dachs; Paul J.J. Welfens** (2008), Internationalisation of European ICT Activities, Springer Berlin Heidelberg

**Paul J.J. Welfens** (2011), Zukunftsfähige Wirtschaftspolitik für Deutschland und Europa, Springer Berlin Heidelberg

**Richard Tilly; Paul J.J. Welfens** (2000), Economic Globalization, International Organizations and Crisis Management, Springer Berlin Heidelberg

**Paul J.J. Welfens; Holger C. Wolf** (1997), Banking, International Capital Flows and Growth in Europe, Springer Berlin Heidelberg

**Paul J.J. Welfens** (2001), European Monetary Union and Exchange Rate Dynamics,Springer Berlin Heidelberg

**Richard Tilly; Paul J.J. Welfens** (2000), Economic Globalization, International Organizations and Crisis Management, Springer Berlin Heidelberg

**David B. Audretsch; Paul J.J. Welfens** (2002), The New Economy and Economic Growth in Europe and the US, Springer Berlin Heidelberg

**Paul J.J. Welfens; Peter Zoche; Andre Jungmittag; Bernd Beckert; Martina Joisten** (2005), Internetwirtschaft 2010, Physica-Verlag HD

**Paul J.J. Welfens** (2008), Digital Integration, Growth and Rational Regulation, Springer Berlin Heidelberg

**Paul J.J. Welfens; Cillian Ryan** (2011), Financial Market Integration and Growth, Springer Berlin Heidelberg

**Paul J.J. Welfens; Cornelius Graack** (1996), Telekommunikationswirtschaft, Springer Berlin Heidelberg

**Paul J.J. Welfens** (1996),European Monetary Integration , Springer Berlin Heidelberg

**John T. Addison; Paul J.J. Welfens** (2003), Labor Markets and Social Security, Springer Berlin Heidelberg

**Paul J.J. Welfens** (1996), Economic Aspects of German Unification, Springer Berlin Heidelberg

**Paul J.J. Welfens; David B. Audretsch; John T. Addison; Hariolf Grupp** (1998), Technological Competition, Employment and Innovation Policies in OECD Countries, Springer Berlin Heidelberg

**Paul J.J. Welfens** (1999), Globalization of the Economy, Unemployment and Innovation, Springer Berlin Heidelberg

**Paul J.J. Welfens; George Yarrow; Ruslan Grinberg; Cornelius Graack** (1999), Towards Competition in Network Industries, Springer Berlin Heidelberg

**Paul J.J. Welfens; Ralf Wiegert** (2002), Transformationskrise und neue Wirtschaftsreformen in Russland, Physica-Verlag HD

**Claude E. Barfield; Günter S. Heiduk; Paul J.J. Welfens** (2003), Internet, Economic Growth and Globalization, Springer Berlin Heidelberg

**Evgeny Gavrilenkov; Paul J.J. Welfens; Ralf Wiegert** (2004), Economic Opening Up and Growth in Russia, Springer Berlin Heidelberg

**Paul J.J. Welfens; Franz Knipping; Suthiphand Chirathivat** (2006), Integration in Asia and Europe, Springer Berlin Heidelberg

**Paul J.J. Welfens; Mathias Weske** (2007),Digital Economic Dynamics, Springer Berlin Heidelberg

**Paul J.J. Welfens; John T. Addison** (2009), Innovation, Employment and Growth Policy Issues in the EU and the US, Springer Berlin Heidelberg

**Paul J.J. Welfens** (2001), European Monetary Union and Exchange Rate Dynamics, Springer Berlin Heidelberg

**Paul J.J. Welfens; George Yarrow; Ruslan Grinberg; Cornelius Graack** (1999), Towards Competition in Network Industries, Springer Berlin Heidelberg

**Paul J.J. Welfens** (1999), Globalization of the Economy, Unemployment and Innovation, Springer Berlin Heidelberg

**Axel Börsch-Supan; Jürgen von Hagen; Paul J.J. Welfens** (1997), Wirtschaftspolitik und Weltwirtschaft, Springer Berlin Heidelberg

**Paul J.J. Welfens** (1992), Market-oriented Systemic Transformations in Eastern Europe, Springer Berlin Heidelberg

**Jürgen v. Hagen; Axel Börsch-Supan; Paul J.J. Welfens** (1996), Springers Handbuch der Volkswirtschaftslehre 1, Springer Berlin Heidelberg

**Jürgen v. Hagen; Paul J.J. Welfens; Axel Börsch-Supan** (1997), Springers Handbuch der Volkswirtschaftslehre 2, Springer Berlin Heidelberg

**Richard Tilly; Paul J.J. Welfens** (1996), European Economic Integration as a Challenge to Industry and Government, Springer Berlin Heidelberg

**Paul J.J. Welfens** (2002), Interneteconomics.net, Springer Berlin Heidelberg

**Timothy Lane; Nina Oding; Paul J.J. Welfens** (2003), Real and Financial Economic Dynamics in Russia and Eastern Europe, Springer Berlin Heidelberg

**Thomas Gries; Andre Jungmittag; Paul J.J. Welfens** (2003), Neue Wachstums- und Innovationspolitik in Deutschland und Europa, Physica-Verlag HD

**Paul J.J. Welfens; Suthiphand Chirathivat; Franz Knipping** (2009), EU – ASEAN, Springer Berlin Heidelberg

**Michael W. Klein; Paul J.J. Welfens** (1992), Multinationals in the New Europe and Global Trade, Springer Berlin Heidelberg

**Paul J.J. Welfens; Cornelius Graack** (1996), Telekommunikationswirtschaft, Springer Berlin Heidelberg

**Paul J.J. Welfens; Holger C. Wolf** (1997), Banking, International Capital Flows and Growth in Europ, Springer Berlin Heidelberg

**Paul J.J. Welfens** (2001), Internationalization of the Economy and Environmental Policy Options, Springer Berlin Heidelberg

**Timothy Lane; Nina Oding; Paul J.J. Welfens** (2003), Real and Financial Economic Dynamics in Russia and Eastern Europe, Springer Berlin Heidelberg

**Paul J.J. Welfens; Evgeny Gavrilenkov** (2000), Restructuring, Stabilizing and Modernizing the New Russia, Springer Berlin Heidelberg

**Paul J.J. Welfens** (2001), Stabilizing and Integrating the Balkans , Springer Berlin Heidelberg

**Paul J.J. Welfens; Jens K. Perret; Tony Irawan; Evgeniya Yushkova** (2015), Towards Global Sustainability, Springer International Publishing

**Paul J.J. Welfens; Leszek Balcerowicz** (1988), Innovationsdynamik im Systemvergleich, Physica-Verlag HD

**Paul J.J. Welfens** (1999), EU Eastern Enlargement and the Russian Transformation Crisis, Springer Berlin Heidelberg

**Paul J.J. Welfens; George Yarrow** (1997), Telecommunications and Energy in Systemic Transformation, Springer Berlin Heidelberg

**John T. Addison; Paul J.J. Welfens** (1998), Labor Markets and Social Security,Springer Berlin Heidelberg

**Paul J.J. Welfens; Cornelius Graack** (1999), Technologieorientierte Unternehmensgründungen und Mittelstandspolitik in Europa, Physica-Verlag HD

**Paul J.J. Welfens; S. Jungbluth; H. Meyer; John T. Addison; David B. Audretsch; Thomas Gries; Hariolf Grupp** (1999), Globalization, Economic Growth and Innovation Dynamics, Springer Berlin Heidelberg

**Edward M. Graham; Nina Oding; Paul J.J. Welfens** (2005), Internationalization and Economic ,Policy Reforms in Transition Countries, Springer Berlin Heidelberg

**Raimund Bleischwitz; Paul J.J. Welfens; ZhongXiang Zhang** (2011), International Economics of Resource Efficiency, Physica-Verlag HD

**Paul J.J. Welfens** (1990), Internationalisierung von Wirtschaft und Wirtschaftspolitik, Springer Berlin Heidelberg

**Paul J.J. Welfens** (1997), European Monetary Union, Springer Berlin Heidelberg

**Paul J.J. Welfens** (2001), Stabilizing and Integrating the Balkans , Springer Berlin Heidelberg

**Paul J.J. Welfens; Andre Jungmittag** (2002), Internet, Telekomliberalisierung und Wirtschaftswachstum , Springer Berlin Heidelberg

**Hermann-Josef Bunte; Paul J.J. Welfens** (2002), Wettbewerbsdynamik und Marktabgrenzung auf Telekommunikationsmärkten, Springer Berlin Heidelberg

**Paul J.J. Welfens** (1997), European Monetary Union, Springer Berlin Heidelberg

**Paul J.J. Welfens; George Yarrow** (1997), Telecommunications and Energy in Systemic Transformation, Springer Berlin Heidelberg

**Paul J.J. Welfens; David B. Audretsch; John T. Addison; Hariolf Grupp** (1998), Technological Competition, Employment and Innovation Policies in OECD Countries, Springer Berlin Heidelberg

**Paul J.J. Welfens** (1992), Market-oriented Systemic Transformations in Eastern Europe, Springer Berlin Heidelberg

**Paul J.J. Welfens** (2013), Social Security and Economic Globalization, Springer Berlin Heidelberg