

UNIVERSITY OF WUPPERTAL  
BERGISCHE UNIVERSITÄT WUPPERTAL

EUROPÄISCHE WIRTSCHAFT  
UND  
INTERNATIONALE MAKROÖKONOMIK



Paul J.J. Welfens

**A Quasi-Cobb Douglas Production Function with Sectoral  
Progress: Theory and Application to the New Economy**

Diskussionsbeitrag 132  
Discussion Paper 132

*Europäische Wirtschaft und Internationale Wirtschaftsbeziehungen*  
*European Economy and International Economic Relations*

ISSN 1430-5445



Paul J.J. Welfens

**A Quasi-Cobb Douglas Production Function with Sectoral  
Progress: Theory and Application to the New Economy**

May 2005

*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@uni-wuppertal.de](mailto:welfens@uni-wuppertal.de)  
[www.euroeiiw.de](http://www.euroeiiw.de)

JEL classification: O33, FO

Key words: technological progress, Cobb-Douglas function, New Economy



**Summary:** A new approach for analyzing technological progress is presented in the context of a quasi-Cobb-Douglas production function which offers within a simple and consistent equation interesting options for identifying different types of technological progress. In particular the approach suggested allows us to shed new light on the New Economy debate and to indeed focus more adequately on process innovation dynamics – this includes a distinction between Harrod neutrality and Solow neutrality of technological progress.

**Zusammenfassung:** Präsentiert wird ein neuer Ansatz zur Analyse des technischen Fortschritts im Kontext mit einer Quasi-Cobb-Douglas-Produktionsfunktion die einen konsistenten und einfachen Ansatz bietet, um verschiedene Arten von technischem Fortschritt zu unterscheiden. In der Tat erlaubt der neue Ansatz eine genauere Ausleuchtung einiger wichtiger Aspekte der New Economy Debatte bzw. eine angemessene Untersuchung von Prozessinnovationen – mit Unterscheidung von Solow-neutralem Fortschritt und Harrod-neutralem Fortschritt auch in empirischen Untersuchungen



Paul J.J. Welfens, Chair in Macroeconomics and Jean Monnet Chair for European Economic Integration; President of the European Institute for International Economic Relations (EIIW) at the University of Wuppertal [www.euroeiiw.de](http://www.euroeiiw.de); [www.econ-international.net](http://www.econ-international.net), welfens@eiiw.uni-wuppertal.de

## **A Quasi-Cobb Douglas Production Function with Sectoral Progress: Theory and Application to the New Economy**

*EIIW paper No. 131, preliminary (advance version)*

<b>1. Introduction .....</b>	<b>1</b>
<b>2. Aspects of Process Innovations and Market Dynamics .....</b>	<b>1</b>
<b>3. A Quasi-Linear Homogeneous Production Function and Technological Progress... 3</b>	<b>3</b>
<b>4. Implications for Empirical Analysis .....</b>	<b>5</b>
<b>References: .....</b>	<b>6</b>





# 1. Introduction

Explaining economic growth has been a standard challenge for economists. Growth rates differ across countries and time so that it is important to understand which elements determine output growth. For example, in the context of EU integration, which raises the issue of economic convergence and the question as to which mechanisms are relevant for relatively backward and leading countries, trade and technological specialization play an important role in Europe as shown in recent empirical analysis (JUNGMITTAG, 2004). In a broader perspective one also would like to understand why there have been periods of growth acceleration or growth deceleration in various countries. The role of information and communication technology apparently has played an important role for faster growth in the US and some other OECD countries, including some eastern European countries (e.g. VAN ARK/PIATKOWSKI, 2004; OLINER/SICHEL, 2002). In the following essay, we will disregard the so-called new growth theory and rather focus on the more traditional neoclassical growth theory. However, we will show that adequate modification can be useful for better understanding technological progress of various types.

The standard neoclassical approach to growth is to assume that output in each firm is based on a production function with inputs such as labor, capital and knowledge. Aggregating across firms of a given sector gives a sectoral output function and further aggregating across sectors results in a macroeconomic production function. The aggregation of production functions can be quite cumbersome from an analytical point of view. From an economic perspective one faces the problem that factor shares should add up to unity. So in an economy which has only labor and capital as input the wage-income ratio plus the profit income ratio must add up to unity. With a linear-homogeneous production function – such as the Cobb-Douglas function  $Y=K^\beta L^\alpha$  (Y is output, K capital and L labor,  $\beta$  and  $\alpha$  are in the interval 0.1) – we indeed have the implication that  $\alpha=1-\beta$  and that  $\beta$  is the income share of capital owners who obtain  $rK$ . Under profit maximization and competition  $r$  is the real interest rate which is equal to the marginal product of capital  $Y_K$ .

## 2. Aspects of Process Innovations and Market Dynamics

The Cobb-Douglas production function has been a useful workhorse in theoretical and empirical economic analysis, and this includes simple approaches to technological progress (i.e., a Harrod-neutral progress which is labor augmenting – see the parameter A and the following refined production function).

$$(1) Y = K^\beta [AL]^{1-\beta}$$

Alternatively, one might assume Solow neutral progress which is capital augmenting (see the parameter B as well as the new production function):

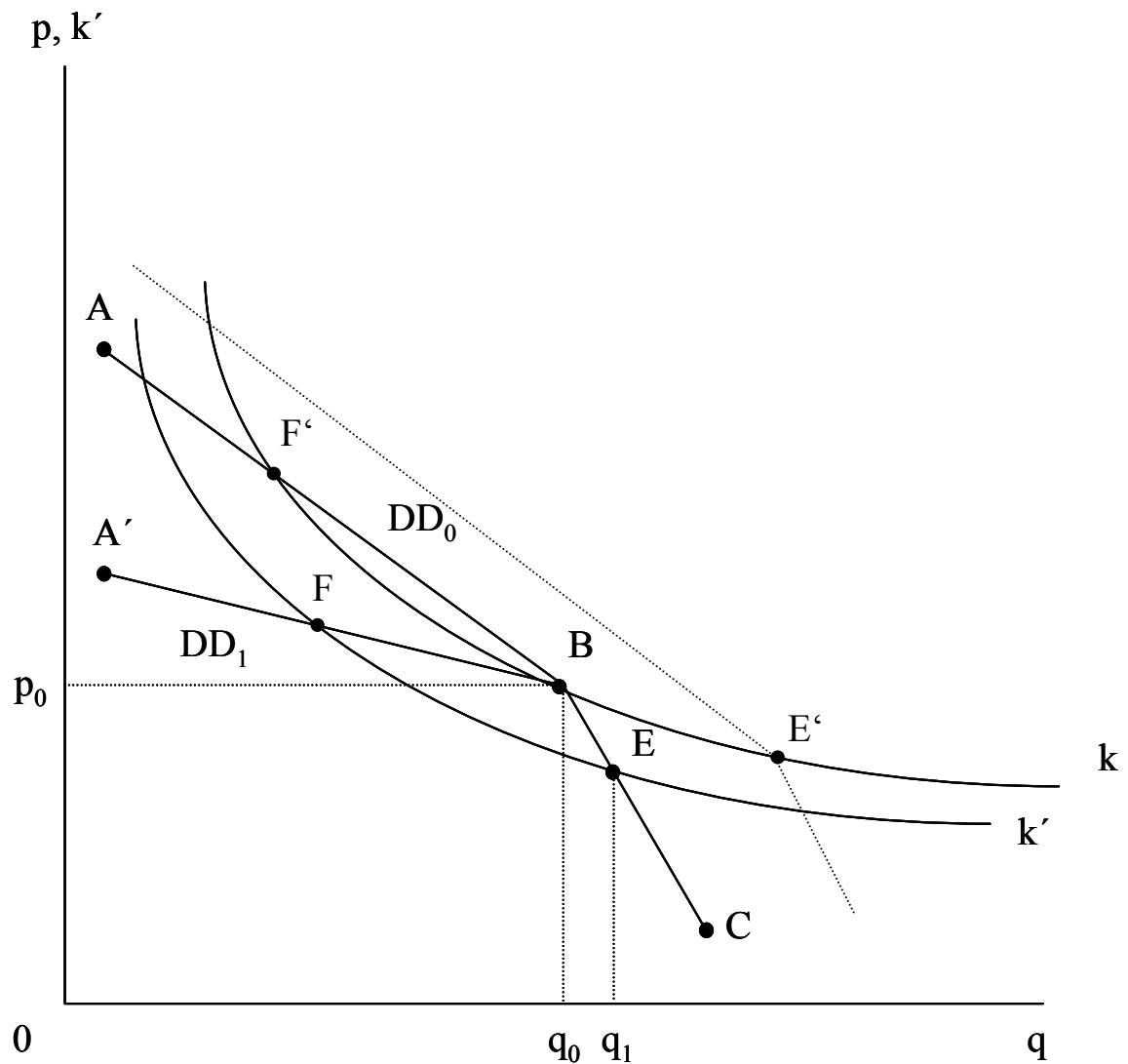
$$(2) Y = [BK]^\beta L^{1-\beta}$$

At first sight the (linear-homogeneous) Cobb-Douglas production function has a clear disadvantage since it does not allow for the identification of the nature of technological progress, e.g. Hicks neutral progress (K and L effectively are raised by equal percentages) vs. Harrod neutral vs. Solow neutral. From the perspective of analytical consistency the

advantage of the Cobb-Douglas function is that partial output elasticities add up to unity if we follow the standard restrictions imposed which are indeed consistent with competition in goods markets and factor markets. There is also a caveat related to the implicit assumption of full employment and the efficient use of input factors. In the late 1990s the opening up of telecommunications markets in the EU obviously has contributed to efficiency gains in the telecommunications sector. Among OECD countries, Germany has achieved the highest contribution of ICT-producing services to aggregate productivity growth (PILAT et al., 2002). This top result, however, might partly be reflected by previous strong X-inefficiencies in the former (state-owned) monopoly operator. Nevertheless, in a medium and long term perspective growth accounting can be quite useful.

With innovations and technological progress one might raise some objections against the traditional assumptions with respect to competition since a temporary deviation from a perfect competition model can be expected in economies with Schumpeterian dynamics. Moreover, the existence of research efforts might even imply falling average and marginal costs. However, we argue here that one may approximate the standard neoclassical textbook world through a specific oligopoly structure in all or some industries. We assume a setting with oligoplistic markets and a Hitch-Sweezy price setting where there is asymmetric oligopolistic interdependency. We thus introduce Schumpeterian innovation dynamics in the standard Hitch-Sweezy approach. Firms follow the innovation leader when the price is reduced which implies a relatively steep effective demand curve below the equilibrium price (see the arch BC). If the leader raises the price above the equilibrium price, other firms in the sector will not follow so that the demand curve is relatively elastic at high prices, that is we have a kinked demand curve (arch A'B; if there is consolidation in industry and hence tighter interdependency which causes some firms to follow the leader in price increase we have arch AB instead of AB'). In such a setup the intersection of the demand curve with the average cost curve (k) determines an output volume which is close to the neoclassical optimum characterized by the equality of price and marginal costs: the difference between  $q_1$  and  $q_0$  indeed is very small. Shifts in the demand curve will bring about a new equilibrium, but again the Schumpeterian equilibrium point and the neoclassical situation would not differ much. This rather radical approximation of reality basically implies that a world with oligopolistic Schumpeterian competition can be modelled on the basis of a rather simple macroeconomic production function.

**Fig. 1: Schumpeterian Hitch-Sweezy Model of Oligopoly**



How can a simple neoclassical growth accounting approach shed light on the issue of technological progress? We will suggest a modification of the traditional approach which allows us to get a better understanding of technological dynamics.

### 3. A Quasi-Linear Homogeneous Production Function and Technological Progress

While many countries obviously recorded a much higher technological progress – dubbed multifactor productivity or total factor productivity – in the 1990s than in the 1980s, it is unclear as to what the reasons behind this acceleration in technological progress really are. According to OECD (2003, p. 52; for basic methodology see SCARPETTA et al. 2000), there was an acceleration in Ireland, Finland, Norway, Denmark, Sweden, Australia, Canada, United States and New Zealand, but there was a deceleration in the 1990s in the

Netherlands, Austria, Belgium, Italy, Japan, France, Germany and Spain. A key factor for the acceleration of technological progress might be the increasing use of information and communication technology (ICT), but there could be other factors as well. Furthermore, there is indeed a broad debate about the potential dynamics of productivity, innovation and growth in the literature (see e.g. AUDRETSCH/WELFENS, 2002; BARFIELD/HEIDUK/WELFENS, 2003; WELFENS, 2003; WELFENS, 2005). In 2001 ICT capital accounted for roughly 30% of the capital stocks in certain sectors in OECD countries, the share of ICT capital in the private business sector reached an average of 11% (OECD, 2003). ICT capital accumulation might go along with considerable capital-saving progress in some sectors, but there also is labor saving progress in other sectors (WELFENS, 2003). Let us take a closer look at a simple Cobb Douglas function to see which analytical problem we are facing here ( $\beta$  is the output elasticity of capital,  $1-\beta$  is the output elasticity of labor; B and A are parameters representing Solow neutral progress and Harrod neutral progress, respectively):

$$(3) Y = [BK]^\beta [AL]^{1-\beta}$$

Taking logarithms leads to

$$(4) \ln Y = \beta \ln B + \beta \ln K + (1 - \beta) \ln A + (1 - \beta) \ln L = \\ \beta \ln K + (1 - \beta) \ln L + \{\beta \ln B + (1 - \beta) \ln A\}$$

Based on this equation we can apply “growth accounting” in a simple way: the output is decomposed into capital, labor and a residual  $R' := \{\beta \ln B + (1 - \beta) \ln A\}$ . Thus empirical analysis based on time series or panel data analysis will deliver estimated elasticities – that is the elasticity  $\beta$  and  $(1-\beta)$  – plus a residual  $R'$ , where the latter cannot be split in a meaningful way. Indeed, the residual is a rather opaque variable. It is called total factor productivity but to which extent it is linked to capital or labor remains unclear which in turn leaves many ambiguities for policymakers and thus could lead to many pitfalls. One cannot rule out that during part of the sample period we have only Solow-type progress, while in a later period we have only Harrod neutral progress. The relative role of Solow-type progress and Harrod neutral progress in a given period naturally will determine the relative price of capital and labor, respectively; if the New Economy should be characterized by a relatively strong role of Solow-neutral progress a relative fall of the real interest rate could be expected.

However, one may indeed use a linear-homogeneous production function while identifying the nature of progress to some extent; the assumption will be made that Solow-type capital augmenting technological progress is associated only with the use of ICT capital. Moreover, we develop our approach in the context of an implicit two sector production function (with  $K'$  denoting ICT-capital and  $K''$  non-ICT capital; overall input of capital is K and of labor is L) that the sectoral Solow progress factor depends on the “hybrid sectoral capital intensity” which is defined as  $K'/L$ . Thus we assume that sectoral Solow progress B in the sector using ICT capital depends on  $K'/L$  – the higher  $K'/L$  the higher is B and hence:

$$(5) Y = [B(K'/L)K']^\beta [K'']^{\beta''} [AL]^{1-\beta'-\beta''}$$

This production function basically says that output is higher, the higher the input of labor, ICT capital and non-ICT capital are and the higher the progress parameters A and B are, respectively – with B depending on the ratio of ICT capital to overall labor input. Once a steady state is reached B will be constant and thus this production function effectively is asymptotically a linear-homogeneous production function. The parameter  $B(K'/L)$  basically says that the ICT sector is characterized by capital-saving technological progress which indeed is found in various cases, e.g. the case of computer chips (Moore’s law says

that computing power of a chip will double within 3 – or more recently 2 – years) or in the case of fibre optical cables. Taking logarithms and differentiating with respect to time (with  $g$  denoting growth rate and  $E'$  the elasticity of  $B$  with respect to  $K'/L$ ), we get:

$$(6) \quad g_Y = \beta' [E' g_{K'/L} + g_{K'}] + \beta'' g_{K''/L} + (1 - \beta' - \beta'') g_A$$

Thus the growth rate of output is equal to the output elasticity of ICT capital per capita times  $\beta'[E'+1]$  plus the weighted (see  $\beta''$ ) growth rate of  $K''/L$  plus the growth rate of labor plus the weighted (weight is  $1-\beta'-\beta''$ ) growth rate of Harrod neutral progress.

$$(7) \quad g_Y = \beta' [E'+1] g_{K'/L} + \beta'' g_{K''/L} + g_L + (1 - \beta' - \beta'') g_A$$

#### 4. Implications for Empirical Analysis

The implication thus is that with respect to the sum of elasticities for  $K'$ ,  $K''$  and  $L$  empirical studies to be conducted should reveal that they do not add up to unity. Rather, they will exceed unity. In particular one should expect that the elasticity of output with respect to  $K'/L$  exceeds unity. In the approach presented one can indeed distinguish between Harrod neutral progress and Solow neutral progress. With the new specification suggested here we have an implicit endogenous growth approach. It still leaves open many issues, in particular we have no explanation for the Harrod progress rate which in an extended model might depend on such variables as the wage-interest ratio or the share of R&D in overall output.

We have developed a rather simple approach in which one can study different types of technological progress. Thus one may analyze a rather important unsolved issue of the 1990s, namely whether technological progress is both labor augmenting and capital augmenting. Indeed, at the bottom line we can identify the type of technological progress prevailing, and in empirical studies the choice of adequate subperiods can help to control for regime changes in technological progress. Moreover, one should apply such testing before embarking upon international panel data analyses.

## References:

- ARK, B. van; PIATKOWSKI, M. (2004), Productivity, Innovation and ICT in Old and New Europe, *International Economics and Economic Policy*, Vol. 1, 215-246.
- AUDRETSCH, D.; WELFENS, P.J.J., eds. (2002), *The New Economy and Economic Growth in the US and Europe*, Heidelberg and New York: Springer.
- BARFIELD, C.; HEIDUK, G.; WELFENS, P.J.J. (2003), *Internet, Economics Growth and Globalization*, Heidelberg and New York: Springer.
- JUNGMITTAG, A. (2004), Innovations, Technological Specialization and Economic Growth in the EU, *International Economics and Economic Policy*, Vol. 1, 247-274.
- OECD (2003), *ICT and Economic Growth*, Paris: OECD.
- PILAT, D.; LEE, F.; VAN ARK, B. (2002), Production and Use of ICT: A Sectoral Perspective on Productivity Growth in the OECD Area, *OECD Economic Studies*, No. 35.
- SCARPETTA, S.; BASSANINI, A.; PILAT, D.; P. SCHREYER (2000), *Economic Growth in the OECD Area: Recent Trends at the Aggregate and Sectoral Levels*, OECD Economics Department Working Paper No. 248, Paris.
- WELFENS, P.J.J. (2003), *Internet economics.net*, 2<sup>nd</sup> revised and enlarged edition forthcoming, New York 2005: Springer.
- WELFENS, P.J.J. (2005), *Innovations in Macroeconomics*, Heidelberg and New York: Springer.

## 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.euroeiiw.de>

- No. 1 **Welfens, P.J.J.:** Telecommunications in Systemic Transformation, January 1995.
- No. 2 **Welfens, P.J.J.; Graack, C.:** Telecommunications in Western Europe: Liberalization, Technological Dynamics and Regulatory Developments, January 1995.
- No. 3 **Welfens, P.J.J.:** Achieving Competition in Europe's Telecommunications Sector, February 1995.
- No. 4 **Addison, J.T.:** The Dunlop Report: European Links and Other Odd Connections, May 1995.
- No. 5 **Addison, J.T.; Blackburn, McKinley L.:** A Puzzling Aspect of the Effect of Advance Notice on Unemployment, May 1995.
- No. 6 **Welfens, P.J.J.; Graack, C.:** Deregulierungspolitik und Wettbewerb in Netzindustrien: Bedeutung und Optionen für osteuropäische Transformationsländer, May 1995.
- No. 7 **Addison, J.T. Chilton, J.B.:** Models of Union Behavior, June 1995.
- No. 8 **Graack, C.:** EU-Telecom Markets and International Network Alliances: Developments, Strategies and Policy Implications, August 1995.
- No. 9 **Welfens, P.J.J.:** Koordinationserfordernisse der EU-Infrastrukturpolitik, November 1995.
- No. 10 **Hillebrand, R.:** Umweltpolitik in föderalen Systemen - eine kritische Analyse der EU-Umweltpolitik, December 1995.
- No. 11 **Addison, J.T.; Schnabel, C.; Wagner J.:** On the Determinants of "Mandatory" Works Councils in Germany, December 1995.
- No. 12 **Welfens, P.J.J.:** Towards Full Employment and Growth in the European Union, December 1995.
- No. 13 **Welfens, P.J.J.:** Wirtschaftspolitische Kompetenzverteilung in der Europäischen Union, December 1995.
- No. 14 **Welfens, P.J.J.:** Privatization, Efficiency and Equity, January 1996.
- No. 15 **Hartwig, K.-H.; Welfens P.J.J.:** EU and Eastern Europe: Western European Integration and Eastern European Transformation, May 1996.
- No. 16 **Welfens, P.J.J.:** Konsequenzen einer Osterweiterung für die EU und deren Reformbedarf, May 1996.
- No. 17 **Graack, C.:** Structure of the Telecoms Sector and Degree of Internationalization in Europe and Russia, July 1996.

- No. 18 **Bogai, D.:** Werkstatt der Deutschen Einheit? Wirtschaft und Arbeitsmarkt in der Region Berlin-Brandenburg, October 1996.
- No. 19 **Graack, C.:** Internationale Aspekte der Telekommunikationswirtschaft: Liberalisierung, internationale Tarifmechanismen und Wohlfahrtseffekte, October 1996.
- No. 20 **Jungmittag, A.; Welfens P.J.J.:** Telekommunikation, Innovation und die langfristige Produktionsfunktion: Theoretische Aspekte und eine Kointegrationsanalyse für die Bundesrepublik Deutschland, October 1996.
- No. 21 **Welfens, P.J.J.; Guth M.:** EU-Strukturpolitik in Deutschland: Entwicklung, Effizienzüberlegungen und Reformoptionen, October 1996.
- No. 22 **Welfens, P.J.J.; Graack C.:** Telekommunikationsmärkte in Europa: Marktzutrittschancen und Privatisierungsprobleme aus Sicht der Neuen Politischen Ökonomie, October 1996.
- No. 23 **Welfens, P.J.J.:** Die Position Deutschlands im veränderten Europa: Wirtschaftliche und reformpolitische Perspektiven, November 1996.
- No. 24 **Hartmann, P.:** Foreign Exchange Vehicles Before and After EMU: From Dollar/Mark to Dollar/Euro?, November 1996.
- No. 25 **Jungmittag, A.; Welfens P.J.J.:** The Political Economy of EMU and Stabilization Policy, May 1997.
- No. 26 **Hölzler, H.:** Privatisierung und Einführung von Wettbewerb in Rußland, January 1996.
- No. 27 **Welfens, P.J.J.:** Small and Medium-sized Companies in Economic Growth: Theory and Policy Implications in Germany, May 1997.
- No. 28 **Bogai, D.:** Europäische Arbeitsmarktpolitik und nationale beschäftigungspolitische Initiativen, May 1997.
- No. 29 **Welfens, P.J.J.:** Research & Development Policy and Employment, June 1997.
- No. 30 **Sinclair, A.:** Liberalising the Electricity Supply Industry in Western and Eastern Europe: Lessons for Russia, July 1997.
- No. 31 **Graack, C.:** Infrastructure Investments and Regulation in Telecommunications, July 1997.
- No. 32 **Welfens, P.J.J.; Schwarz A.:** Die Rolle des Staates in der Sozialen Marktwirtschaft bei Globalisierung der Wirtschaftsbeziehungen, August 1997.
- No. 33 **Welfens, P.J.J.; Wiegert R.:** Transformation Policies, Regulation of Telecommunications and Foreign Direct Investment in Transforming Economies, July 1997.
- No. 34 **Welfens, P.J.J.:** Internationalization of Telecoms, Deregulation, Foreign Investment and Pricing: Analysis and Conclusions for Transforming Economies, July 1997.
- No. 35 **Schwarz, A.:** Subventionspolitik in den mittel- und osteuropäischen Transformationsländern: Gegenwärtige Strukturen, Probleme und Transparenzdefizite, September 1997.
- No. 36 **Welfens, P.J.J.; Hillebrand R.:** Globalisierung der Wirtschaft: Wirtschaftspolitische Konsequenzen des internationalen Standortwettbewerbs, September 1997.
- No. 37 **Stiller, H.:** Material Intensity of Transportation and Implications for Sustainable Mobility in Europe, September 1997.
- No. 38 **Gerstberger, T.; Graack C.:** Competition and Deregulation in the Japanese Telecommunications Network Industry, September 1997.



- No. 39 **Welfens, P.J.J.:** Wirtschaftspolitische Flankierungserfordernisse des Euro-Starts, November 1997.
- No. 40 **Aslund, A.:** The Political Economy of Systemic Transformation and Institution-Building, November 1997.
- No. 41 **Guth, M.:** Regionale Beschäftigungspakte im Rahmen der EU-Strukturpolitik: Hintergrund und Einordnung, November 1997.
- No. 42 **Jungmittag, A.; Welfens P.J.J.:** Politische Ökonomie der Europäischen Währungsunion und Stabilitätspolitik, January 1998.
- No. 43 **Welfens, P.J.J.:** Labor Costs, Unemployment and Innovation, February 1998.
- No. 44 **Addison, J.T.; Audretsch, D.B.; Gries, T.; Grupp H.; Welfens, P.J.J.:** Economic Globalization, Innovation and Growth, April 1998.
- No. 45 **Welfens, P.J.J.:** Euro, Währungsunion und EU-Binnenmarkt, April 1998.
- No. 46 **Addison, J.T., Schnabel, C.; Wagner J.:** Works Councils in Germany: Their Effects on Firm Performance, March 1998.
- No. 47 **Addison, J.T.; Portugal, P.:** Short- and Long-Term Unemployment, March 1998.
- No. 48 **Welfens, P.J.J.:** Trade and Optimum Import Tariffs: A Note in the Context of Foreign Direct Investment, June 1998.
- No. 49 **Bohn, F.:** Monetary Union and the Interest-Exchange Trade-off, July 1998.
- No. 50 **Welfens, P.J.J.:** Exchange Rate Policy for the Euro: Theory, Strategic Issues and Policy Options, July 1998.
- No. 51 **Addison, J.T.; Portugal P.:** Job Search Methods and Outcomes, July 1998.
- No. 52 **Jungmittag, A.; Welfens P.J.J.:** Telecommunication, Innovation and the Long-Term Production Function: Theoretical Analysis and a Cointegration Analysis for West Germany 1960-1990, August 1998.
- No. 53 **Welfens, P.J.J.:** Eastern EU Enlargement: Problems, Conflicts and Policy Options, September 1998.
- No. 54 **Welfens, P.J.J.:** Die russische Transformationskrise: Monetäre und reale Aspekte sowie Politikoptionen, November 1998.
- No. 55 **Graack, C.; Welfens, P.J.J.:** Internationaler Technologiewettbewerb, Arbeitsmarktdynamik und Unternehmensgründungsdynamik bei Standortkonkurrenz, September 1998.
- No. 56 **Welfens, P.J.J.:** Liberalisierung der Energiewirtschaft in Deutschland und EU-Partnerländern, Januar 1999
- No. 57 **Welfens, P.J.J.:** The Russian Transformation Crisis: Origins, Analysis and New Policy Requirements, January 1999
- No. 58 **Komulainen, Tuomas:** Currency Crisis Theories – Some Explanations for the Russian Case, May 1999
- No. 59 **Welfens, P.J.J.:** Internet Market Dynamics in Germany: From a small Market towards a Strategic Sector of the Economy, May 1999
- No. 60 **Wiegert, R.:** Der russische Bankensektor im Prozeß der Systemtransformation, Juni 1999
- No. 61 **Vogelsang, M.:** How to rescue Japan: Proposal of a staggered VAT reform. Draft, May 1999
- No. 62 **Welfens, P.J.J.:** The Start of the Euro, International Relations and Inflation, April 1999

- No. 63 **Sutela, P.:** Overcoming the Russian Transformation Crisis: Selected Issues and Policy Options, June 1999
- No. 64 **Bohn, F.:** The Italian Case: A Parable for the Eastern Enlargement of the EMU, July 1999
- No. 65 **Meyer, B.; Welfens, P.J.J.:** Innovation – Augmented Ecological Tax Reform: Theory, Model Simulation and New Policy Implications, September 1999
- No. 66 **Gavrilenkov, E.:** Crisis in Russia: Selected Problems of the Macroeconomic Performance, September 1999
- No. 67 **Steinsdorff, S. v.:** Wie demokratisch ist Rußland? Dezember 1999
- No. 68 **Pelzel, R.:** Internationalisierung der Telekommunikation, eine Vergleichsanalyse für USA, Großbritannien und Deutschland, Dezember 1999
- No. 69 **Serebryakov, G.:** Structural Change and Econometric Prospective, January 2000
- No. 70 **Bohn, F.:** Political Instability, Inflation, and International Loans, February 2000
- No. 71 **Welfens, P.J.J.:** The EU and Russia: Strategic Aspects of Transformation and Integration, April 2000
- No. 72 **Jungmittag, A.:** Techno-Globalismus: Mythos oder Realität?, Juli 2000
- No. 73 **von Westernhagen, N.:** The Role of FDI in the Transition Process of Selected CIS and Eastern European Countries, September 2000
- No. 74 **Welfens, P.J.J.; Hollants, J.; Kauffmann, A.:** Mittelständische Unternehmen und das Internet: Perspektiven in Deutschland, Oktober 2000
- No. 75 **Jungmittag, A.; Welfens, P.J.J.:** Auswirkungen einer Internet Flatrate auf Wachstum und Beschäftigung in Deutschland, März 2000
- No. 76 **Addison, J.T.:** Is Community Social Policy Beneficial, Irrelevant, or Harmful to the Labor Market Performance of the European Union?, September 2000
- No. 77 **Welfens, P.J.J.:** Modern Exchange Rate Theory and Schumpetrian Economic Analysis: New Approach and Application to the Euro, June 2000
- No. 78 **Guth, M.:** From technology policy for regions to regional technology policy towards a new policy strategy in the EU, December 2000
- No. 79 **Welfens, P.J.J.; Kauffmann, A.; Vogelsang, M.:** Evaluationsbericht: Das Internet strategisch richtig nutzen, Februar 2001
- No. 80 **Welfens, P.J.J.:** Transatlantische Wachstumsunterschiede, Euro-Schwäche und Finanzpolitik, Mai 2001
- No. 81 **Jungmittag, A.; Welfens, P.J.J.:** Effects of an Internet Flat Rate on Growth and Employment in Germany, February 2001
- No. 82 **Welfens, P.J.J.:** Transatlantic Growth Differentials, ICT Dynamics, Fiscal Policy and the Fall of the Euro, July 2001
- No. 83 **Wiegert, R.:** Financial Sector and Human Capital in a Long-Term Growth Perspective: The Case of Russia, July 2001
- No. 84 **Addison J.T.:** Principles of Market-Oriented Labor Market Policies; July 2001
- No. 85 **Jungmittag, A.; Welfens, P.J.J.:** Europäische Telekomliberalisierung und Außenhandel: Theorie, Gravitationsansatz und Implikationen, Juni 2001
- No. 86 **Ponder, J.K.:** Telekommunikationssektor in Polen: Entwicklungen, Investitionsperspektiven und Regulierung, Oktober 2001

- No. 87 **Jungmittag, A.; Welfens P.J.J.:** Liberalization of EU Telecommunications and Trade: Theory, Gravity Equation Analysis and Policy Implications, October 2001
- No. 88 **Bohn, F.:** Powerful Groups and Corruption, December 2000
- No. 89 **Welfens, P.J.J.:** Aggregation in a Two-Sector Growth Model: A Modified Solow Approach with Cobb-Douglas Production Functions, September 2001
- No. 90 **Welfens, P.J.J.:** Stabilization and Growth: A New Model, October 2001
- No. 91 **Addison, J.T.:** Principles of Market-Oriented Labor Market Policies, March 2002
- No. 92 **Jungmittag, A.:** Innovationsdynamik in der EU: Konvergenz oder Divergenz?, Eine Zeitreihen-Querschnittsanalyse, Februar 2002
- No. 93 **Welfens, P.J.J.; Wiegert, R.:** Reform des Bankensektors und Stabilität in Rußland, November 2001
- No. 94 **Welfens, P.J.J.:** Mittelfristige Herausforderungen für Euroland: Stabilität, EU-Osterweiterung, Wachstum; November 2001
- No. 95 **Welfens, P.J.J.:** Constitutional Issues and the Quality of Political Competition: Analysis and Implications for a Future EU Constitution, April 2002
- No. 96 **Jungmittag, A.:** Innovation Dynamics in the EU: Convergence or Divergence?, A Cross-Country Panel Data Analysis, June 2002
- No. 97 **Welfens, P.J.J.:** I&K-Technologie, Produktivität und Wachstum: Transatlantische Analyseperspektiven und wirtschaftspolitische Optionen, Juli 2002
- No. 98 **Jungmittag, A.; Welfens, P.J.J.:** Telecommunication, Internet, Innovation and Growth in Europe and the US, August 2002
- No. 99 **Welfens, P.J.J.:** Finanzpolitik zwischen Wachstumsschwäche und Maastrichter Vertrag / Stabilitätspakt: Ausgabenschwerpunkte neu setzen und kluge Steuerreform, September 2002
- No. 100 **Gavrilencov, 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 **Borbély, 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 **Borbély, 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.; Borbély, 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, October 2004
- No. 128 **Welfens, P.J.J.:** Savings, Investment and Growth: New Approaches for Macroeconomic Modelling, January 2005
- No. 129 **Pospieczna, P.:** The application of EU Common Trade Policy in new Memberstates after Enlargement – Consequences on Russia's Trade with Poland, November 2004
- No. 130 **Pospieczna, P.; Welfens, P.J.J.:** Economic Opening up of Russia: Establishment of new EU-RF Trade Relations in View of EU Eastern Enlargement, November 2004
- No. 131 **Welfens, P.J.J.:** Significant Market Power in Telecommunications: Theoretical and Practical Aspects, September 2004
- No. 132 **Welfens, P.J.J.:** A Quasi-Cobb Douglas Production Function with Sectoral Progress: Theory and Application to the New Economy, May 2005

## EIIW Economic Policy Analysis

- No. 1 **Welfens, P.J.J.:** Globalisierung der Wirtschaft und Krise des Sozialstaats: Ist die Wirtschaftswissenschaft am Ende?, April 1997
- No. 2 **Welfens, P.J.J.:** Nach der D-Mark kommt die E-Mark: Auf dem Weg zur EU-Währungsunion, Juli 1997
- No. 3 **Welfens, P.J.J.:** Beschäftigungsförderliche Steuerreform in Deutschland zum Euro-Start: Für eine wachstumsorientierte Doppelsteuerreform, Oktober 1998

Fordern Sie den EIIW Newsletter an: [www.euroeiiw.de](http://www.euroeiiw.de)

Please subscribe to EIIW Newsletter: [www.euroeiiw.de](http://www.euroeiiw.de)

### Weitere Beiträge von Interesse: Titels of related interest:

WELFENS, P.J.J.; ZOCHE, P.; JUNGMITTAG, A.; BECKERT, B.; JOISTEN, M. (2005), Internetwirtschaft 2010, Perspektiven und Auswirkungen, Heidelberg und New York: Springer.

APOLTE, T.; CASPERS, R.; WELFENS, P.J.J. (2004), Ordnungsökonomische Grundlagen nationaler und internationaler Wirtschaftspolitik, Stuttgart: Lucius & Lucius.

GAVRILENKOV, E.; WELFENS, P.J.J.; WIEGERT, R. (2004), Economic Opening Up and Growth in Russia, Heidelberg and New York: Springer.

MC MORROW, K.; RÖGER, W. (2003), The Economic and Financial Market Consequences of Global Aging, Heidelberg and New York: Springer.

WIEGERT, R. (2003), Transformation, Wachstum und Wettbewerb in Rußland, Heidelberg und New York: Springer.

PETZOLD, L. (2003), Infrastruktureform in Transformationsländern, Lohmar: EUL-Verlag.

LANE, T., ODING, N., WELFENS, P.J.J. (2003), Real and Financial Economic Dynamics in Russia and Eastern Europe, Heidelberg and New York: Springer.

BARFIELD, C.E., HEIDUK, G., WELFENS, P.J.J. (2003), Internet, Economic Growth and Globalization, Perspectives on the New Economy in Europe, Japan and the USA, Heidelberg and New York: Springer.

GRIES, T., JUNGMITTAG, A., WELFENS, P.J.J. (2003), Neue Wachstums- und Innovationspolitik in Deutschland und Europa, Heidelberg und New York: Springer.

D. CASSEL; P.J.J. WELFENS (Hrsg., 2003), Regionale Integration und Ostererweiterung der Europäischen Union, Stuttgart: Lucius & Lucius.

ADDISON, J.T., WELFENS, P.J.J. (2003), Labor Markets and Social Security, Heidelberg and New York: Springer.

WELFENS, P.J.J., WIEGERT, R. (2002), Transformationskrise und neue Wirtschaftsreformen in Russland, Heidelberg und New York: Springer.

- WESTERNHAGEN, N. VON (2002), *Systemic Transformation, Trade and Economic Growth*, Heidelberg and New York: Springer.
- AUDRETSCH, D.B., WELFENS, P.J.J. (2002), *The New Economy and Economic Growth in Europe and the US*, Heidelberg and New York: Springer.
- WELFENS, P.J.J. (2002), *Internet*, Heidelberg and New York: Springer.
- BUNTE, H.-J., WELFENS, P.J.J. (2002), *Wettbewerbsdynamik und Marktabgrenzungen auf Telekommunikationsmärkten*, Heidelberg und New York: Springer.
- JUNGMITTAG, A., WELFENS, P.J.J. (2002) *Internet, Telekomliberalisierung und Wirtschaftswachstum*, Heidelberg und New York: Springer.
- SCHWARZ, A. (2001), *Subventionen in Mittel- und Osteuropa*, Lohmar: EUL-Verlag.
- PELZEL, R.F. (2001), *Deregulierte Telekommunikationsmärkte*, Heidelberg und New York: Springer.
- WELFENS, P.J.J. (2001), *Stabilizing and Integrating the Balkans*, Heidelberg and New York: Springer.
- WELFENS, P.J.J. (2001), *Internationalization of the Economy and Environmental Policy Options*, Heidelberg and New York: Springer.
- WELFENS, P.J.J. (2001), *European Monetary Union and Exchange Rate Dynamics*, Heidelberg and New York: Springer.
- GAVRILENKOV, E., WELFENS, P.J.J. (2000), *Restructuring , Stabilizing and Modernizing the New Russia*, Heidelberg and New York: Springer.
- TILLY, R., WELFENS, P.J.J. (2000), *Economic Globalization, International Organizations and Crisis Management*, Heidelberg and New York: Springer.
- JUNGMITTAG, A., REGER, G., REISS, T. (Eds., 2000), *Changing Innovation in the Pharmaceutical Industry. Globalization and New Ways of Drug Development*, Heidelberg and New York: Springer.
- GRAACK, C., WELFENS, P.J.J. (1999), *Technologieorientierte Unternehmensgründungen und Mittelstandspolitik in Europa*, Heidelberg und New York: Springer.
- GRAACK, C., GRINBERG, R., WELFENS, P.J.J., YARROW, G. (Eds., 1999), *Towards Competition in Network Industries – Telecommunications, Energy and Transportation in Europe and Russia*, Heidelberg and New York: Springer.
- ADDISON, J.T., AUDRETSCH, D.B., GRIES, T., GRUPP, H., WELFENS, P.J.J. (1999), *Globalization, Economic Growth and Innovation Dynamics*, Heidelberg and New York: Springer.
- WELFENS, P.J.J. (1999), *EU Eastern Enlargement and the Russian Transformation Crisis*, Heidelberg and New York: Springer.
- WELFENS, P.J.J. (1999), *Globalization of the Economy, Unemployment and Innovation*, Heidelberg and New York: Springer.
- TILLY, R., WELFENS, P.J.J. (1999), *Economic Globalization, International Organizations and Crisis Management*, Heidelberg and New York: Springer.
- WELFENS, P.J.J. et al. (eds., 1998), *Competition in Network Industries: Telecommunications, Energy and Transportation in Europe and Russia*, Heidelberg and New York: Springer.
- PALKINAS, P.; EICHHORN, B., WELFENS, P.J.J. (eds., 1998), *Europäische Währungsunion: Argumente und Fakten zur Euro-Debatte*, Frankfurt/Main.
- GLOEDE, K., STROHE, H.B. WAGNER, D., WELFENS, P.J.J. (eds., 1998), *Systemtransformation in Deutschland und Rußland: Erfahrungen, ökonomische Perspektiven und politische Optionen*, Heidelberg und New York: Springer.

- AUDETSCH, D.B., ADDISON, J.T. GRUPP, H., WELFENS, P.J.J. (1998), Technological Competition, Employment and Innovation Policy in OECD Countries, Heidelberg and New York: Springer.
- ADDISON, J.T., WELFENS, P.J.J. (eds., 1998), European Labor Markets and Social Security, Heidelberg and New York: Springer.
- GRAACK, C. (1997), Telekommunikationswirtschaft in der Europäischen Union: Innovationsdynamik, Regulierungspolitik und Internationalisierungsprozesse, Heidelberg: Physica (award-winning book).
- WELFENS, P.J.J., WOLF, H. (ed., 1997), Banking, International Capital Flows and Growth in Europe, Heidelberg and New York: Springer.
- BÖRSCH-SUPAN, A., VON HAGEN, J., WELFENS, P.J.J. (eds., 1996,1997), Springers Handbuch der Volkswirtschaftslehre, Band 1 und 2, Heidelberg und New York: Springer.
- WELFENS, P.J.J., YARROW, G. (eds., 1996), Telecommunications and Energy in Systemic Transformation, Heidelberg and New York: Springer.
- GRAACK, C., WELFENS, P.J.J. (1996), Telekommunikationswirtschaft: Deregulierung, Privatisierung und Internationalisierung, Heidelberg und New York: Springer: (award-winning book).
- WELFENS, P.J.J. (ed., 1996), European Monetary Integration, 3<sup>rd</sup> edition, Heidelberg and New York: Springer.
- WELFENS, P.J.J. (ed., 1996), Economic Aspects of German Unification, 2. rev. and enlarged edition, Heidelberg and New York: Springer.
- TILLY, R., WELFENS, P.J.J. (eds., 1995), European Economic Integration as a Challenge to Industry and Government, Heidelberg and New York: Springer.
- WELFENS, P.J.J. (1995), Grundlagen der Wirtschaftspolitik, Heidelberg und New York: Springer.
- JASINSKI, P., WELFENS, P.J.J. (1994), Privatization and Foreign Direct Investment in Transforming Economies, Aldershot: Dartmouth/Gower.
- WELFENS, P.J.J. (1992), Market-oriented Systemic Transformation in Eastern Europe. Problems, Theoretical Issues and Policy Options, Heidelberg and New York: Springer.
- KLEIN, M., WELFENS, P.J.J. (eds., 1992), Multinationals in the New Europe and Global Trade, Heidelberg and New York: Springer.
- WELFENS, P.J.J. (1990), Internationalisierung von Wirtschaft und Wirtschaftspolitik, Heidelberg und New York: Springer.
- BALCEROWICZ, L., WELFENS, P.J.J. (1988), Innovationsdynamik im Systemvergleich. Theorie und Praxis unternehmerischer, gesamtwirtschaftlicher und politischer Neuerung, Heidelberg: Physica.





EUROPEAN INSTITUTE FOR INTERNATIONAL ECONOMIC RELATIONS  
EUROPÄISCHES INSTITUT FÜR INTERNATIONALE WIRTSCHAFTSBEZIEHUNGEN



[www.euroeiiw.de](http://www.euroeiiw.de)

**BERGISCHE UNIVERSITÄT  
WUPPERTAL**

EUROPÄISCHE WIRTSCHAFT UND  
INTERNATIONALE MAKROÖKONOMIK



Gaußstr. 20, D-42119 Wuppertal  
[www.uni-wuppertal.de](http://www.uni-wuppertal.de)

**UNIVERSITÄT POTSDAM**

EUROPÄISCHE WIRTSCHAFT UND  
INTER-NATIONALE  
WIRTSCHAFTSBEZIEHUNGEN



August-Bebel-Straße 89, D-14482 Potsdam  
[www.uni-potsdam.de](http://www.uni-potsdam.de)