UNIVERSITY OF WUPPERTAL
BERGISCHE UNIVERSITÄT WUPPERTAL

EUROPÄISCHE WIRTSCHAFT
UND
INTERNATIONALE MAKROÖKONOMIK

Andre Jungmittag
Paul J.J. Welfens

Beyond EU-US Trade Dynamics: TTIP Effects Related to Foreign Direct Investment and Innovation

Diskussionsbeitrag 212
Discussion Paper 212

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

Andre Jungmittag
Paul J.J. Welfens

Beyond EU-US Trade Dynamics: TTIP Effects Related to Foreign Direct Investment and Innovation

February 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: F14, F43, O30, O47, O52
Key words: Knowledge production function, Innovation, FDI, TTIP, Empirical Analysis, EU

Summary: The international economic debate on the Transatlantic Trade and Investment Partnership (TTIP) has focused mainly on trade induced real income gains while the FDI related and innovation induced benefits have been largely neglected, although the EU and the US are leading FDI host countries and FDI source countries. Moreover, from a theoretical perspective a knowledge production function has to be considered in order to analyze FDI and innovation dynamics – and this can then be linked to output and economic growth, respectively. The panel data estimation of knowledge production functions for 20 EU countries between 2002-2012 shows clear empirical evidence that a rise of the FDI stock-GDP ratio will raise patent applications. Additionally, a higher per capita income – that could reflect trade related real income gains in the context of TTIP – also contributes to more patent applications. Time series data analysis for Germany indicates additionally that FDI induced higher innovation dynamics will raise output. Combining trade benefits and FDI/innovation related real income gains plus transatlantic macroeconomic interdependency effects a real income gain of nearly 2% should be expected for both Germany and the EU as a whole: considerably higher than what the official TTIP report for the European Commission has suggested. The approach developed has broad implications for deep regional integration (TPP, TTIP).

Zusammenfassung: Die internationale ökonomische Debatte über ein transatlantisches Freihandels-und Investitionsabkommen (TTIP) hat im Wesentlichen die handelsinduzierten Realeinkommensgewinne betrachtet, während Vorteilseffekte aus Direktinvestitionen und Innovationen vernachlässigt worden sind – obwohl sowohl die EU als auch die USA führende Quellen- und Zielländer von Direktinvestitionen sind. Darüber hinaus ist aus theoretischer Sicht eine Wissensproduktionsfunktion zu betrachten, um die Direktinvestitions- und Innovationsdynamik zu analysieren; diese kann dann verbunden werden mit Produktions- bzw. Wachstumseffekten. Die vorgelegte Paneldatenschätzung für eine Wissensproduktionsfunktion für 20 Länder zwischen 2002-2012 zeigt eine deutliche positive Evidenz für eine Verbindung von Direktinvestitionsbestand – relativ zum Bruttoinlandsprodukt – und Patentanmeldungen. Darüber hinaus ergibt sich, dass ein höheres Pro-Kopf-Einkommen – dies könnte handelsbedingte Realeinkommensgewinne im Kontext von TTIP abbilden – ebenfalls zu mehr Patentanmeldungen führen. Die Zeitreihenanalyse für Deutschland zeigt außerdem, dass höhere Innovationsdynamik wachstumsförderlich ist. Wenn man Handelsvorteile und die Realeinkommenseffekte aus Direktinvestitionen bzw. Innovationen verknüpft und zudem transatlantische makoökonomische Interdependenzeffekte einbezieht, dann ergibt sich ein realer Einkommensgewinn von etwa 2% für Deutschland bzw. die EU. Das ist deutlich höher als die Einschätzung der Europäischen Kommission im offiziellen TTIP-Bericht. Der hier entwickelte Ansatz hat weitegehende Implikationen für die Analyse „tiefer“ regionaler Integrationsprojekte wie TPP und TTIP.

The authors gratefully acknowledge research support and technical editing advice from Arthur Korus and David Hanrahan, EIIW. The usual disclaimer applies.

Prof. Dr. Andre Jungmittag, Economics and Quantitative Methods at the Frankfurt University of Applied Sciences
jungmitt@fb3.fra-uas.de

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

EIIW 2015 = 20 years of award-winning research

Beyond EU-US Trade Dynamics: TTIP Effects Related to Foreign Direct Investment and Innovation

Discussion Paper 212

Table of Contents

List of Tables

1. Introduction

The negotiations between the European Union and the US on a Transatlantic Trade and Investment Partnership (TPP) began in 2013 and are expected to be concluded after 2016. In many EU countries there is a broad discussion about the economic benefits of TTIP – particularly in Germany, Austria and Luxembourg where PEW surveys (2015) on TTIP attitudes suggest that a majority of the population in these countries is against TTIP; and in the US the regional trade project on a Trans-Pacific Partnership – TPP has been signed in 2015 – has also encountered massive political resistance. One key issue concerns the economic benefits for the countries involved. It is well known that the official EU study (FRANCOIS ET AL., 2013) on the TTIP-related benefits suggest a fairly low long run economic gain, namely 0.5% of GDP for the EU and 0.4% of GDP for the US. While it is true that Chapter 6 of the FRANCOIS ET AL. study is rarely mentioned, one may argue that this analysis indeed looked beyond pure trade creation effects, namely by asking how much transatlantic FDI flows would be raised if the transatlantic barriers to capital flows would fall by a quarter, namely down to the level of intra-EU capital flows; and the result was a rise in employment by US subsidiaries in the EU of about 11% and for EU subsidiaries in the US of about 10%. Taking additionally into account BEA data, according to which US subsidiaries in the EU have accounted in 2012 for about 3% of the EU's gross domestic product while that of EU subsidiaries in the US stand for a similar figure, the implication is that there could be another gain of 0.33% in the EU and of 0.30% in the US if labor productivity remains constant in these firms – and if there is no offsetting decline of employment in other firms (not standing for transatlantic foreign subsidiaries).

It is, however, clear that TTIP lets one expect a rise of labor productivity so that the implications of the findings of FRANCOIS ET AL. (2013) imply an output increase that should exceed that of employment in the subsidiaries. While the study of FRANCOIS ET AL. (2013) covers at least the main trade aspects and basic FDI perspectives, it is obvious that a broader analysis of FDI and innovation dynamics is not included. It is also not fully clear as to what extent reduction of non-tariff barriers brings about direct output gains through cost cutting by firms as a result of new - common transatlantic - norms. Subsequently, we will take a closer look at this issue and consider the empirical findings for Germany to be an important clue for potential effects for the EU as a whole.

The EU and the US are the main source countries of global foreign direct investment and they stand for two of the three main host countries (with the EU considered here as a quasi-country); they also stand for about 30% of triad patents and it is well known that FDI dynamics and patent applications are often positively linked. In the context of the EU-US Transatlantic Trade and Investment Partnership, one may expect that a rising inward foreign direct investment in EU countries could directly or indirectly affect real income. At first glance the inward FDI dynamics have three basic aspects:

- Inward FDI could be reduced in a transatlantic perspective, namely to the extent that reduced import tariffs in the EU (or the US) will weaken previous tariff-jumping motivation. Given the fact that import tariff levels in the US and the EU were about 3% at the start of the TTIP negotiations on both sides of the Atlantic, one may, however, expect this aspect to be rather weak. With non-tariff barriers estimated to amount to a tariff equivalent of about 17% in the EU (based on the

CEPR report and assuming that industry stands for 60% and services for 40% of trade) – and with similar levels in the US – one cannot rule out that NTB reductions could make this aspect somewhat temporarily relevant.

- With transatlantic investment barriers to be reduced additional transatlantic FDI inflows can be expected in EU countries – and higher EU FDI outflows to the US. A rise of transatlantic FDI might not only reflect lower barriers to international investment but could also stand for increasingly complex global value-added chains that are facilitated by modern information and communication technologies (ADB, 2015).
- FDI inflows from third countries can be expected in the context of TTIP and this to some extent is indeed the tariff-jumping argument in a modified perspective mentioned in the first aspect. For example, investors from China, ASEAN countries or Latin American countries can be expected to be interested in raising production in the EU (and the US), respectively. In oligopolistic industries one may expect additional inflows in the context of follow-the-leader FDI pattern.

With higher foreign direct investment inflows – and hence a higher role of multinational companies, most of which are technology-intensive – in the European Union, one can focus on knowledge production functions and the role of (cumulated) FDI inflows on the production of new knowledge. The analytical concept of a knowledge production function is well established in the literature and indeed has been applied in various ways to industrialized countries (CHARLOT/CRESCENZI/MUSOLESI, 2015, FRITSCH, 2002, MARROCU/PACI/USAI, 2013); this concept assumes that new knowledge, approximated by patent applications for example, is based on a specific macroeconomic knowledge production function including researchers and FDI capital stocks as well as other variables. While looking at patent application is a common way to proxy new knowledge, one may emphasize that not all new knowledge is patented – possibly a declining share of it can be protected by patents in modern services economies. However, in a pragmatic empirical perspective patent applications are still crucial for analyzing knowledge progress in industrialized countries.

The paper is organized as follows. At first we take a brief look at some basic aspects of trade and productivity growth in regional trade liberalization approaches. Key insights from the literature are summarized. Next, a compact knowledge production function is developed in a new approach for an open economy and this represents the basic theoretical basis for the subsequent regression analysis which in turn allows to calculate the overall GDP effects for the EU; this will include trade effects, FDI and innovation effects plus the transatlantic macroeconomic spillover effect from the US GDP to the EU GDP. Finally, selected policy conclusions from the empirical findings are presented with some particular conclusions for the case of Germany. The order of magnitude that comes out as the grand total for the EU is about 2%. In principle, the methodology developed here could also be applied to the US on the basis of a Schumpeterian regional US model (with states instead of EU countries considered here). The policy conclusions stated in the end are not only picking up the key insights from the panel data estimation of the knowledge production function for 20 EU countries in the period 2002-2012. Rather there is also a need to consider not only the implications for the EU policy layer but for the national policy layer as well and to take into account that differences in intra-EU FDI and innovation dynamics

could considerably reinforce economic divergence within the European Union. One may also emphasize that policy reforms that enhance the respective national innovation system

2. Trade, FDI and Schumpeterian Dynamics: Framework for Innovation Dynamics and an Open Economy Knowledge Production Function

As regards the link between trade expansion and competition and real income, respectively, a brief look at the traditional literature is useful. There is a rather direct trade expansion-competition dynamics-real income effect that is related to modern trade theory in an oligopolistic setting – a case that is likely to be highly relevant in several sectors in an EU +US market perspective. The theoretical approach relevant here is ATKESON/BURSTEIN (2008), namely a model with an oligopolistic market setting and pro-competitive effect from trade. For any given producer the demand elasticity is declining in its market share and therefore its markup is increasing in its market share. The pro-competitive effect of trade means that the initial high markup dispersion – implying misallocation of resources – and the market power of hitherto dominant producers will be reduced and this implies a real income and a welfare gain, respectively; for this there is rich empirical evidence, e.g. for the case of Taiwan (EDMOND/MIDRIGAN/XU, 2015). As the authors rightly emphasize: As the market shares of the dominant producers are reduced, international trade will both reduce markups and also markup dispersion so that allocation efficiency is improved. In a transatlantic TTIP perspective, the implication is that the market entry of new firms from EU countries and third countries in the US and of new firms from the US and third countries in the European Union single market could bring about directly trade-related efficiency gains, higher Schumpeterian dynamics and real income gains, respectively. A key issue in open economies is how factor inputs are related to the innovation process and here the analytical focus has indeed to consider the knowledge production function.

Knowledge Production Function

The knowledge production function is a workhorse of modern innovation analysis and has been pushed by several innovative economists, including MACHLUP (1960), GRILICHES (1979) and – in a recent perspective – new research with a focus on Russia (PERRET, 2014) and US-focused research from the IMF (ABDIH/JOUTZ 2005). The knowledge production function explains knowledge, often proxied by the stock of patents, by specific inputs such as researchers, foreign direct investment (ANTONIETTI/BRONZINI/CAINELLI, 2015 on Italy, BOTTAZZI/PERI, 2003 on EU countries, CHEUNG/LIN, 2004 in a regional perspective on China) and other inputs. The subsequent knowledge function builds on WELFENS (2016) who has suggested that one should consider trade input effects, researchers' input and FDI inward stock effects as well as FDI outward effects:

- As regards the volume of exports X, there is a traditional argument about efficiency gains so that X/L (here L denotes population and labor, respectively) is considered to a natural element of the knowledge production function. A modern approach for an economy with heterogeneous firms is the model of MELITZ (2003) where the

mechanism for export-related productivity gains stems from the fact that opening up the economy lets the most productive firm(s) expand while the least productive firms in the export sector will close down. This implies that exports should stimulate the aggregate knowledge (A) as, say, approximated by patent applications. It will be assumed that the familiar equation X=xY* (* for foreign variables, 0<x<1) is holding.

- As regards the volume of imports J, one may argue that particularly technology-intensive intermediate inputs contribute to output gains as the empirical evidence of COE/HELPMAN (1995) suggests. It is, however, true that KELLER (2000) has raised some doubts about the Coe-Helpman approach which basically implied that a country that relies on strong intermediate import links with countries with relatively high increases in total factor productivity growth would obtain high output gains from higher imports in intermediate products. Here it will be assumed that imports per capital J/L are conducive to knowledge. It will, of course, have to be taken into account that J= jY - in line with standard import function (0<j<1).
- It will be assumed that the size of the research sector – reflecting direct research input – contributes to new knowledge.
- Moreover, one may assume that FDI stocks relative to output contributes to patents and knowledge, respectively; namely, since multinational companies in a world of economic globalization typically stand for technology-intensive production and considerable product innovation and process innovation dynamics organized through international production networks (DUNNING, 1977). The share of foreign ownership in country 1's capital stock will be denoted by α^* (finally, in the context of asset-seeking FDI outflows – with firms interested in acquiring new knowledge abroad and later transferring part of it back to the parent company – one may assume that the outward FDI stock variable also could play a role for international knowledge transfer).

If one considers a simple knowledge production function, one will have to consider (with L' denoting researchers): A'(X/L, J/L, L', FDI inward stock/Y) where it is specified (with K denoting the capital stock; parameters H>0, V'>0, V"">0, V>0):

(1) $A' = (X/L)^H (J/L)^{V'} (L')^{V''} (\alpha^*K/Y)^V$

Taking into account that X=xY* and J=jL we can write (with K for the capital stock in the economy, per capita income y:=Y/L):

(2) $A' = (x(Y^*/Y)y)^H (jy)^{V'} (L')^{V''} (\alpha^*K/Y)^V$

(3) $A' = x^H (Y^*/Y)^H j^{V'} y^{H+V'} L'^{V''} (\alpha^*K/Y)^V$

Hence knowledge is a positive function of x (export-GDP ratio), j (import-GDP ratio), Y*/Y, y, L' and the inward FDI stock-GDP ratio. A more compact function – as is used subsequently – will look at A'(L', y, α^*K/Y), which might be interpreted as a setup in which the number of researchers, trade intensity as proxied by per capita income, and the inward FDI globalization intensity (parameter α^*) play a critical role for knowledge and patent applications, respectively. From this perspective, the relative FDI inward stock which represents part of economic globalization intensity should indeed play a major role for creation of new knowledge. This type of knowledge production function has been developed in WELFENS (2016) and it can easily plugged into a macroeconomic production function; say (with Y denoting real output; 0<ß<1; A is the stock of

knowledge), a Cobb-Douglas function $Y=K^{ß}(AL)^{1-ß}$ or a CES function which is better suited for analyzing income distribution issues.

The analytical approach to understand deep integration projects such as the EU-US project of a Transatlantic Trade and Investment Partnership – potentially also the TPP project of the US with eleven partner countries from the Pacific Basin including Australia and Japan – indeed should go beyond the analysis of trade creation and trade diversion. Rather the FDI dynamics and the associated Schumpeterian innovation effects and the associated output effects should be studied also.

3. Regression Analysis: Panel Data Estimation for Knowledge Production Functions of 20 EU Countries in 2002-2012

Taking a subsequent look at 20 EU countries for the period 2002-2012 one can focus in an empirical analysis on the knowledge productions in the most important EU countries – with relevant data available. The subsequent panel data analysis includes time effects and fixed country effects where significant and allows identifying a significant impact of cumulated inward FDI on knowledge production where the countries' respective patent applications at the European Patent Office are considered. All variables used are in logs.

The explanatory variables are:

- RDPERS: personnel in research and development in the countries considered (source: OECD)
- RDEXPDOLLAR: R&D expenditures in constant prices and purchasing power parity, in US$ source: OECD).
- RDEXPEURO: R&D expenditures in constant prices and purchasing power parity, in euro (source: EUROSTAT).
- PGDPDOLLAR: GDP per capita in constant prices and purchasing power parity, USD (source: OECD).
- PGDPEURO: Real GDP per capita in euro (chained volume indices; source: EUROSTAT).
- FDISTOCK: Stock of inward foreign direct investment in the countries considered in euro (source: EUROSTAT).
- FDISTOCKQ: stock of FDI in the countries considered, expressed as share of GDP (source: EUROSTAT).

To the extent that variables are significant, the panel data estimates include fixed country and time effects.

In the first regression analysis, which includes as explanatory variables the number of researchers (R&D personnel at full time equivalent), the per capita GDP in $ (in constant prices and at purchasing power parity) and the inward FDI stock relative to GDP, all exogenous variables are significant and with a positive sign (see the subsequent tables); the fixed country effect is significantly positive for several countries: Austria, Belgium, Denmark, Finland, France, Germany, Italy, Netherlands, Spain, Sweden and the UK. The negative signs for the Czech Republic, Greece, Ireland, Luxembourg, Poland, Portugal, Slovakia and Slovenia indicate that some EU cohesion countries and some eastern European EU countries will have lower benefits than average (and Luxembourg with its

high share of banking and other services as well). For those countries with a rather low per capita income, a sustained long term convergence process could still bring similar benefits to those for most EU15 countries in the long run; adequate policy reforms in the innovation systems could be crucial here and also the optimization of government R&D promotion.

Table 1: Basic Knowledge Production Function for EU20 Countries

Dependent Variable: LOG(PAT?)
Method: Pooled Least Squares
Date: 01/14/16 Time: 17:10
Sample: 2002 2012
Included observations: 11
Cross-sections included: 20
Total pool (unbalanced) observations: 205

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-16.75261	1.936751	-8.649851	0.0000
LOG(RDPERS?)	0.354843	0.091091	3.895492	0.0001
LOG(PGDPDOLLAR?)	1.819009	0.194151	9.369062	0.0000
LOG(FDISTOCKQ?)	0.164400	0.074407	2.209453	0.0284
Fixed Effects (Cross)				
_AT—C	0.522542			
_BE—C	0.384865			
_CZ—C	-0.911734			
_DK—C	0.118808			
_FI—C	0.432950			
_FR—C	1.701492			
_DE—C	2.471143			
_GR—C	-1.365439			
_HU—C	-0.343212			
_IE—C	-1.054935			
_IT—C	1.424113			
_LU—C	-2.833316			
_NL—C	0.804435			
_PL—C	-0.270742			
_PT—C	-1.450550			
_SK—C	-1.585013			
_SI—C	-0.856756			
_ES—C	0.238784			
_SE—C	0.739902			
_UK—C	1.326632			

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.993230	Mean dependent var	6.740298
Adjusted R-squared	0.992411	S.D. dependent var	1.795015
S.E. of regression	0.156371	Akaike info criterion	-0.767790
Sum squared resid	4.450218	Schwarz criterion	-0.394964
Log likelihood	101.6984	Hannan-Quinn criter.	-0.616991
F-statistic	1213.621	Durbin-Watson stat	1.052678
Prob(F-statistic)	0.000000		

Table 2: Modified Knowledge Production Function (with real R&D expenditures) for EU20

Dependent Variable: LOG(PAT?)
Method: Pooled Least Squares
Date: 01/14/16 Time: 17:12
Sample: 2002 2012
Included observations: 11
Cross-sections included: 20
Total pool (unbalanced) observations: 210

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-12.44756	1.762885	-7.060905	0.0000
LOG(RDEXPDOLLAR?)	0.537839	0.081565	6.593998	0.0000
LOG(PGDPDOLLAR?)	1.345979	0.198476	6.781574	0.0000
LOG(FDISTOCKQ?)	0.114961	0.065142	1.764770	0.0792
Fixed Effects (Cross)				
_AT--C	0.419395			
_BE--C	0.338724			
_CZ--C	-0.807431			
_DK--C	0.182815			
_FI--C	0.411436			
_FR--C	1.276797			
_DE--C	1.907172			
_GR--C	-1.058098			
_HU--C	-0.244065			
_IE--C	-0.817255			
_IT--C	1.116557			
_LU--C	-2.001544			
_NL--C	0.764270			
_PL--C	-0.265500			
_PT--C	-1.338985			
_SK--C	-1.018895			
_SI--C	-0.557203			
_ES--C	0.091877			
_SE--C	0.569745			
_UK--C	1.026721			

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.994162	Mean dependent var	6.705092
Adjusted R-squared	0.993475	S.D. dependent var	1.795074
S.E. of regression	0.145005	Akaike info criterion	-0.921050
Sum squared resid	3.931939	Schwarz criterion	-0.554462
Log likelihood	119.7103	Hannan-Quinn criter.	-0.772852
F-statistic	1447.371	Durbin-Watson stat	1.213643
Prob(F-statistic)	0.000000		

To the extent that TTIP enhances trade which in turn is raising per capita GDP, one gets an indirect innovation effect via the impact on real per capita GDP. A rise of per capita GDP by 1 % will raise patent applications by 1.8%. If the TTIP-related per capita GDP increase (as a direct effect of enhanced trade dynamics) is put at about 0.5% - in line with the FRANCOIS ET AL. study - this would then imply a considerable induced rise of patent applications, namely 0.9%.

As regards the FDI inward stock variable, a rise of 1% translates into a rise of patent applications by 0.16%; hence roughly a six percent rise of the inward FDI stock-GDP ratio

would be necessary to bring about a 1% increase of the patent applications in the EU. If the output elasticity of the patent stock with respect to GDP is assumed to be 0.34 (this is the figure for Germany in BLIND/JUNGMITTAG/MANGELSDORF, 2011, p.14), a rise of the FDI stock GDP-ratio by 12% will raise patent applications by 2% and bring about a rise of real income by 0.67% through the enhanced patent stock. The assumption here is that the focus is on an equilibrium situation in which the growth rate of the new knowledge will be equal to the growth rate of the stock of knowledge.

An assumed increase of the EU's FDI inward stock-GDP ratio of 12% will bring another 0.67% increase of real GDP to which one would have to add another 0.9%x0.34= 0.31% from the trade-related direct per capita income effect so that the integration related real income gain is 0.5% + 0.67% + 0.31% = 1.48%. TTIP also is concerned with removing non-tariff barriers - e.g. in the form of different technical norms; if TTIP could help to create more common technical norms this also would add to higher GDP. In an econometric study for Germany BLIND/JUNGMITTAG/MANGELDSDORF (2011) find that the output elasticity of norms is 0.18 which is roughly 1/2 of the elasticity found for patents. If the number of common norms in the EU - and the US - could be increased through TTIP by 2% the real GDP in Germany (by assumption: similarly in the EU) would increase by 0.36% This aspect shows how important the reduction of non-tariff barriers actually is; it is well known that the US automotive industry and the EU automotive industry have been able to define considerable common ground in the field of future common norms in the negotiations in the context of the TTIP project so that the automotive industry indeed is a crucial industry for achieving more common transatlantic norms in the future and hence saving costs and raising output, respectively. By contrast the information obtained from leading German representatives of the sector machinery and equipment suggests that the non-uniform US norm system in machinery and equipment makes it rather difficult to define common transatlantic norms for this sector (with German and EU firms typically emphasizing the ISO norm approach). This clearly suggests that considerable efforts should be invested at the industry level to achieve more common transatlantic standards and norms, respectively.

Finally, one has to add to this the long run transatlantic income spillover effect which implies (using standard results from the EU's QUEST model), based on an assumed output increase of 2% in the US, that an additional 0.2-0.3% output increase will have to be added which brings the total real income gain so far to 2.1% for the EU20 countries considered here.

One may emphasize that the US output effects are unlikely to differ very much from that for the EU since the FRANCOIS ET AL. (2013) figure puts the trade related GDP increase at 0.4% - only slightly lower than the effect for the EU – and since transatlantic trade-GDP ratios for the EU and the US both stand at about 3% of GDP while the share of value added represented by European investors in the US was at 3% in 2012 (according to BEA figures) and that of US subsidiaries at the EU GDP in turn also was about 3% in 2012. While intermediate input intensity of the EU and the US differ slightly as shown by WELFENS/IRAWAN (2014), there is no reason to assume massive differences of the major benefit elements on both sides of the Atlantic. Moreover, there is a strong positive correlation between the total factor productivity growth of the EU and the US.

As the country dummy for Germany is positive, one may argue that the German population may expect an increase of about 2% of GDP through TTIP: For Germany this would imply a real income gain of about € 60 bill. – if one takes the GDP of 2015 as the point of reference – and with taxes and social security contribution rates standing at a combined 36%, general government will obtain additional revenues of € 22 bill.

TTIP Related Economic Benefits for EU Countries: Real Income Effects in Percent

- Trade related per capita income gain (FRAINCOIS ET AL., 2013): 0.5 percent
- Induced trade related per capita income gain with transmission to knowledge: 0.31 percent
- 12% increase of FDI-GDP ratio in EU: 0.67 percent
- 2% increase of – common – industry norms: 0.36 percent*
- Transatlantic income spillover from US (assumption GDP+ is 2%) to EU GDP: 0.25 percent
- Grand Total: 2.09%

** based on Germany's output elasticity (for the EU the effect might be somewhat smaller since the share of industry in Germany is above the EU average)*

While US FDI to the EU will increase after conclusion of TTIP, one may also consider that there could be some FDI diversion effects with respect to third countries so that the overall increase of the inward FDI stock-GDP ratio will not necessarily rise by the pure additional FDI inflows from the US. However, as already emphasized, one cannot rule out that not only higher FDI inflows from the US to the EU will be observed but complementary FDI inflows from third countries as well – following an adequately modified logic of tariff jumping here. From a theoretical and empirical perspective the imperfect capital market approach of FROOT/STEIN (1991) has suggested that the real exchange rate matters for foreign direct investment. If TTIP brings a depreciation of the US Dollar vis-à-vis the Euro and the British Pound, the US would attract higher FDI inflows – relative to GDP – due to the effect that an appreciation of foreign currencies raises equity capital of foreign bidders eager to engage in leveraged international mergers and acquisitions; FDI inflows into the EU would be weakened by the real appreciation of the Euro and the British pound. If, however, there is a Dollar appreciation, the US inflows would be dampened and those going to the UK and to the Eurozone would be raised. The exchange rate effects of regional trade integration and FDI dynamics in this context have so far not be considered in theoretical models, but the appendix sheds some light on this issue within a compact two country macro model.

If higher FDI inflows raise the patent application figures, there will be further economic dynamics. Higher patent applications in turn could stimulate more FDI inflows in the long run: Time series analysis for Germany and the UK by BARREL/PAIN (1999) in the context of the EU single market dynamics have shown such effects. With respect to TTIP a similar pattern may be expected.

Model 2 in Table 2 considers as an alternative to researchers the real R&D expenditures in $USD as explanatory variable. There is still a positive significant impact – with

significance levels falling slightly (one-sided at the 5% level, two-sided at the 10% level). Model 3 has replaced the per capita real $USD GDP in PPP figures by the corresponding figures in €EURO - the impact of the FDI inward stock relative to GDP is unchanged when compared to Table 1; this also holds for the other coefficients of the variables considered. Model 4 replaces the real R&D expenditures in $USD by the real expenditures in €EURO: with roughly the same results as in Model 2.

Table 3: Modified Knowledge Production Function (per capita GDP in $, purchasing power parity) for EU20

Dependent Variable: LOG(PAT?)
Method: Pooled Least Squares
Date: 01/14/16 Time: 17:18
Sample: 2002 2012
Included observations: 11
Cross-sections included: 20
Total pool (unbalanced) observations: 205

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-16.15965	1.883948	-8.577550	0.0000
LOG(RDPERS?)	0.355143	0.091158	3.895906	0.0001
LOG(PGDPEURO?)	1.816447	0.194324	9.347541	0.0000
LOG(FDISTOCKQ?)	0.164586	0.074469	2.210130	0.0283
Fixed Effects (Cross)				
_AT--C	0.268028			
_BE--C	0.101278			
_CZ--C	-0.401791			
_DK--C	-0.523151			
_FI--C	0.032875			
_FR--C	1.410926			
_DE--C	2.313064			
_GR--C	-1.291378			
_HU--C	0.518174			
_IE--C	-1.313453			
_IT--C	1.306225			
_LU--C	-3.253928			
_NL--C	0.531379			
_PL--C	0.585815			
_PT--C	-1.186308			
_SK--C	-0.930569			
_SI--C	-0.619820			
_ES--C	0.272321			
_SE--C	0.276426			
_UK--C	1.150189			

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.993219	Mean dependent var	6.740298
Adjusted R-squared	0.992400	S.D. dependent var	1.795015
S.E. of regression	0.156487	Akaike info criterion	-0.766295
Sum squared resid	4.456873	Schwarz criterion	-0.393470
Log likelihood	101.5453	Hannan-Quinn criter.	-0.615496
F-statistic	1211.797	Durbin-Watson stat	1.043812
Prob(F-statistic)	0.000000		

Table 4: Modified Knowledge Production Function (including real R&D expenditures in euro) for EU20

Dependent Variable: LOG(PAT?)
Method: Pooled Least Squares
Date: 01/14/16 Time: 17:19
Sample: 2002 2012
Included observations: 11
Cross-sections included: 20
Total pool (unbalanced) observations: 210

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-11.87191	1.706338	-6.957536	0.0000
LOG(RDEXPEURO?)	0.544525	0.082207	6.623847	0.0000
LOG(PGDPEURO?)	1.345515	0.198022	6.794765	0.0000
LOG(FDISTOCKQ?)	0.107931	0.065551	1.646522	0.1013
Fixed Effects (Cross)				
_AT—C	0.219228			
_BE—C	0.125677			
_CZ—C	-0.453155			
_DK—C	-0.253303			
_FI—C	0.115256			
_FR—C	1.047851			
_DE—C	1.761356			
_GR—C	-1.001768			
_HU—C	0.440353			
_IE—C	-1.000190			
_IT—C	1.035358			
_LU—C	-2.275746			
_NL—C	0.550888			
_PL—C	0.382176			
_PT—C	-1.126522			
_SK—C	-0.510722			
_SI—C	-0.411760			
_ES—C	0.113849			
_SE—C	0.223491			
_UK—C	0.828525			

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.994163	Mean dependent var	6.705092
Adjusted R-squared	0.993476	S.D. dependent var	1.795074
S.E. of regression	0.144986	Akaike info criterion	-0.921316
Sum squared resid	3.930892	Schwarz criterion	-0.554728
Log likelihood	119.7382	Hannan-Quinn criter.	-0.773119
F-statistic	1447.759	Durbin-Watson stat	1.208654
Prob(F-statistic)	0.000000		

Model 5 (with R&D personnel) and Model 6 (with R&D personnel substituted by real R&D expenditures in €EURO/at PPP) replace the inward FDI stock-GDP ratio by the nominal FDI stock figures; this operation has the natural caveat that nominal FDI stock figures could not be deflated by an adequate price level, but the coefficients are highly significant. In Model 6 the fixed time effects that affect all countries over time in a parallel fashion are also significant.

Table 5: Modified Knowledge Production Function (including FDI stocks, real GDP per capita in Euro; fixed time effects significant)

Dependent Variable: LOG(PAT?)
Method: Pooled Least Squares
Date: 01/14/16 Time: 17:23
Sample: 2002 2012
Included observations: 11
Cross-sections included: 20
Total pool (unbalanced) observations: 205

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-10.17503	2.660382	-3.824650	0.0002
LOG(RDPERS?)	0.321715	0.106919	3.008950	0.0030
LOG(PGDPEURO?)	1.029031	0.253933	4.052366	0.0001
LOG(FDISTOCK?)	0.264791	0.041364	6.401404	0.0000
Fixed Effects (Cross)				
_AT--C	0.451870			
_BE--C	0.150762			
_CZ--C	-0.117752			
_DK--C	-0.198310			
_FI--C	0.223155			
_FR--C	0.942703			
_DE--C	1.857010			
_GR--C	-1.336617			
_HU--C	0.378829			
_IE--C	-1.015568			
_IT--C	0.891952			
_LU--C	-2.119431			
_NL--C	0.420483			
_PL--C	0.229157			
_PT--C	-1.358396			
_SK--C	-0.520682			
_SI--C	-0.275323			
_ES--C	-0.168292			
_SE--C	0.401912			
_UK--C	0.609319			
Fixed Effects (Period)				
2002--C	0.007630			
2003--C	0.099136			
2004--C	0.109009			
2005--C	0.064083			
2006--C	0.058532			
2007--C	-0.005833			
2008--C	-0.040857			
2009--C	-0.031994			
2010--C	-0.092863			
2011--C	-0.089422			
2012--C	-0.077421			

Effects Specification

Cross-section fixed (dummy variables)
Period fixed (dummy variables)

R-squared	0.994674	Mean dependent var	6.740298
Adjusted R-squared	0.993683	S.D. dependent var	1.795015
S.E. of regression	0.142672	Akaike info criterion	-0.910104
Sum squared resid	3.501103	Schwarz criterion	-0.375180
Log likelihood	126.2856	Hannan-Quinn criter.	-0.693740
F-statistic	1003.738	Durbin-Watson stat	1.163770
Prob(F-statistic)	0.000000		

Table 6: Modified Knowledge Production Function (including real R&D expenditures in euro) for EU20

Dependent Variable: LOG(PAT?)
Method: Pooled Least Squares
Date: 01/14/16 Time: 17:26
Sample: 2002 2012
Included observations: 11
Cross-sections included: 20
Total pool (unbalanced) observations: 210

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-6.910661	2.126963	-3.249074	0.0014
LOG(RDEXPEURO?)	0.574459	0.096928	5.926666	0.0000
LOG(PGDPEURO?)	0.618048	0.240575	2.569044	0.0110
LOG(FDISTOCK?)	0.227854	0.038574	5.906936	0.0000
Fixed Effects (Cross)				
_AT--C	0.392645			
_BE--C	0.162212			
_CZ--C	-0.219948			
_DK--C	0.060017			
_FI--C	0.303319			
_FR--C	0.550956			
_DE--C	1.255708			
_GR--C	-0.948358			
_HU--C	0.315520			
_IE--C	-0.693965			
_IT--C	0.646938			
_LU--C	-1.145114			
_NL--C	0.419028			
_PL--C	0.030470			
_PT--C	-1.256537			
_SK--C	-0.098500			
_SI--C	-0.011108			
_ES--C	-0.329448			
_SE--C	0.312466			
_UK--C	0.265825			
Fixed Effects (Period)				
2002--C	0.006841			
2003--C	0.098907			
2004--C	0.125799			
2005--C	0.081227			
2006--C	0.074593			
2007--C	0.014757			
2008--C	-0.030287			
2009--C	-0.051838			
2010--C	-0.109545			
2011--C	-0.106003			
2012--C	-0.104449			

Effects Specification

Cross-section fixed (dummy variables)
Period fixed (dummy variables)

R-squared	0.995383	Mean dependent var	6.705092
Adjusted R-squared	0.994548	S.D. dependent var	1.795074
S.E. of regression	0.132539	Akaike info criterion	-1.060555
Sum squared resid	3.109277	Schwarz criterion	-0.534580
Log likelihood	144.3582	Hannan-Quinn criter.	-0.847923
F-statistic	1192.518	Durbin-Watson stat	1.367294
Prob(F-statistic)	0.000000		

At the bottom line, the knowledge production function for EU20 countries considered here works well and clearly indicates both a positive impact of real per capita GDP and of FDI inward stocks. Thus we have quite interesting complementary findings to the study of FRANCOIS ET AL. (2013) that had already indicated benefits of 0.5% of GDP from trade and additional employment benefits – and thus an implicit GDP increase of 0.33% - from higher FDI inflows due to reducing transatlantic FDI barriers. One may add to this the induced innovation dynamics in the context of TTIP, namely based on the findings for the knowledge production function for 20 EU countries in 2002-2012. The panel regression analysis is robust with various specifications and clearly indicates that a higher per capita income and a rise of inward FDI figures will translate into more patent applications.

To the extent that TTIP brings enhanced modernization pressure on the supply side of all EU countries and the US, Germany's machinery and equipment export sector stands to have additional structural benefits which could further raise the real income effect for Germany so that about 2% seems to be a realistic order of magnitude. This also takes into account that the fixed country effects indicated that Germany stands to have above average innovation impacts in the cross country analysis shown here. For Germany, 2% of GDP implies an increase of about € 60 billion – based on a GDP of about € 3000 billion; the rise of the Eurozone real income would be about € 200 billion and for the EU an estimated rise of € 280 billion is an adequate figure. In an endogenous growth modeling perspective, the findings from the knowledge production function regressions suggest that TTIP could indeed generate considerable benefits for the EU countries in general and for Germany in particular.

Beyond the familiar trade effects, the indirect effects from foreign direct investment inflows and induced innovation effects should be considered. Thus the expected TTIP benefits for the EU countries are certainly larger than the CEPR study of FRANCOIS ET AL. (2013) has suggested. The regression analysis has shown that FDI stocks affect patent dynamics in EU countries and this TTIP-relevant channel should certainly not be neglected. The incentive to engage in more R&D aiming at obtaining more patents and first mover advantages in the international innovation race could be reinforced by TTIP through the expansionary impulse that TTIP has on intra-industrial trade; here one may expect, of course, trade creation, but at the same time the enhanced transatlantic competition and the falling rate of return on equity lets one expect that firms in countries with an advanced innovation system in Europe will show a Schumpeterian innovation response. This Schumpeterian product innovation response should indeed be strong both in the EU and in the US and the presence of US investors in the EU suggests that there will be transatlantic spillover effects as well; there should be a mirror mechanism in the US in which EU subsidiaries in certain sectors could also benefit from regional innovation spillovers and hence from higher R&D-sales ratios of major US competitors.

While the NAFTA project has largely been one that brought together two advanced economies with high endowments of capital and knowledge in the US and Canada plus Mexico's rich endowment of labor relative to capital and knowledge, TTIP would be the first regional integration approach in which two countries with very similar endowments of production factors meet: both the US and the EU are richly endowed with capital and knowledge – both have a high human capital intensity. One thus may expect that the skilled labor wage premium in both the EU and the US will fall transitorily, however, the expansion of multinational companies investments on both sides of the Atlantic and the

enhanced innovation race is likely to raise the long run demand for skilled labor so that the long run effect should be a rise of the skilled labor premium (the ratio skilled workers' wages to unskilled workers' wages). These and other implications could be studied within research extensions that would be useful for both the United States and the European Union. A broader analysis of transatlantic adjustment effects in the context of TTIP requires, of course, careful simulation analysis and key findings from various research groups (WELFENS/KORUS/ IRAWAN, 2014) suggest that both the EU and the US will benefit while outsider countries might face a real income decline; since the share of intermediate products of EU firms (producing in the European Union) is higher than that of US firms – producing in the United States – more third country partner firms of EU producers may be expected to benefit from the integration into the European value-added chain than industrial suppliers of US firms. Evaluating the economic benefit of TTIP requires to some extent to focus not only on GDP effects but rather on the effects on real national income. With cumulated inward FDI and cumulated outward FDI there will be dividends obtained from subsidiaries and part of profits obtained by subsidiaries from abroad will be transferred to the headquarter abroad (for a simple analytical framework for this aspect see appendix 2).

Third countries are likely to benefit from TTIP in the long run if the combined EU-US output effect is rather large and if TTIP negotiations should bring about rules of origin that help suppliers from developing countries to benefit from TTIP induced economic dynamics in the US and the EU. The EU and the US might consider to help firms from developing countries to achieve the enhanced standards that are likely to emerge in the context of TTIP in the combined area EU+USA (trilateral initiatives might even be useful here: e.g. the German GIZ organization plus USAID could team up to help firms from developing countries to achieve the new more ambitious standards in a TTIP-based transatlantic integrated market). It should not be too difficult to achieve a global win-win-win situation on the basis of carefully designed new cooperation approaches. The critics of TTIP in Germany and other EU countries have long argued that TTIP brings small benefits and is detrimental to developing countries, but this argument is not really convincing if one takes into account the new findings of FDI related and innovation based extra benefits under TTIP.

At the bottom line one may also recommend that governments in the US and in EU countries will take a careful look at innovation spillovers – if TTIP leads to intensified innovation spillovers within the EU (or the US) it would be adequate that government raises R&D subsidies in order to internalize such additional spillovers. The fact that the R&D-GDP ratio of the EU is clearly lower than that of the US could be a starting point to once more take a critical view on innovation dynamics in the European Union. Secondly, the transatlantic R&D-GDP gap might suggest that TTIP-induced dynamics will help EU countries to catch up technologically with the United States. Since US subsidiaries stand for about 3% of overall value-added in Europe it is clear that there are special opportunities for the US to indirectly benefit from enhanced innovation and growth dynamics in Europe. At the same time, the fact that European firms' subsidiaries stand for about 3% of US GDP implies that European subsidiaries in the US are well positioned to benefit from a further rise of US R&D-expenditures in the United in the context of TTIP. Whether or not TTIP will enhance techno-globalization, as a rather new phenomenon (JUNGMITTAG, 2016) that stands for more international joint R&D projects as well as for the international

outsourcing and offshoring of part of the R&D process in leading OECD countries, will have to be seen.

The time series analysis for Germany (see Appendix 1) shows that there is a long run impact of FDI on innovation and that there is a link between innovation and output growth. There is no direct link between the FDI-GDP ratio and output growth. As regards the link between patent applications and the trend FDI-output ratio, there is a significant impact: Higher FDI raises patent levels and higher patents stimulate output. While one cannot be sure that the links are the same for the other EU countries, one may point out that Germany stands for 25% of the EU's GDP and the regional splitting up of value-added chains of Germany companies in the EU imply that other EU countries will have positive output effects from the supply side as well; demand side effects related to higher exports could also be crucial. Further research could look into similar questions for France, the UK, Italy, the Netherlands, Belgium and Spain as well as other EU countries.

4. Implications and Policy Conclusions

The study presented gives a theoretical framework for an open economy knowledge production function and it is the first empirical analysis of EU20 countries with respect to FDI and innovation dynamics; this then is the natural analytical framework for understanding the Schumpeterian TTIP benefits that can be expected in the long run. These Schumpeterian benefits are higher than the pure trade creation effects analyzed by FRANCOIS ET AL. (2013). For deep integration schemes such a complementary Schumpeterian analysis is indispensable.

The analysis presented suggests that an intensified Schumpeterian competition in two leading global open economies, namely the EU and the US, will bring about major economic benefits in the context of TTIP. Higher foreign direct investment is a crucial element of these benefits which have to be added to the traditionally trade-related welfare analysis. Foreign direct investment can be expected to rise relative to GDP once TTIP brings about a reduction of transatlantic investment barriers and once the enhanced transatlantic intra-industrial trade stimulates firms in both the US and the EU to become more engaged in research and development and hence in multinational innovation dynamics. As regards the EU, one may expect considerable additional benefits from higher innovation dynamics and a higher level of patent applications. The empirical findings for the knowledge production function for 20 EU countries has clearly shown evidence that more researchers, a higher FDI inward stock-GDP ratio and a higher per capita income – itself raised by the trade creation effects of TTIP – will raise patent applications. These in turn will raise the production potential and long run real GDP, respectively. The estimation derived for the EU is a benefit of about 2% of GDP in this Schumpeterian perspective of TTIP which is four times the figure of the FRANCOIS ET AL. (2013) study for the European Commission; this study was, however, related largely to trade aspects - this is too narrow a view on a deep integration project such as TTIP. It should also be emphasized that the study presented here is much in contrast to the study of IFO (2013a) that has argued that TTIP would raise US output by 13.4% and Germany's output by 4.7% - these figures are highly implausible.

From a policy perspective, the enlarged integrated transatlantic markets will stimulate the creation of bigger firms, particularly multinational companies, so that one may anticipate more international mergers and acquisitions – plus some additional greenfield investments by MNCs in the US and the EU, respectively. The competition-enhancing effects of TTIP that are crucial for more Schumpeterian dynamics and hence innovation related economic welfare gains could be endangered if the degree of competition falls below a critical level. From this perspective, it is quite important that stronger transatlantic cooperation between the US and the EU in the field of competition policy will be organized. So far this topic has not been addressed in a transatlantic economic policy dialogue.

As regards Germany, France, the UK and many other EU countries, there is also a considerable challenge in the field of raising the share of skilled workers. The expansion of foreign direct investment and innovation dynamics, respectively, will raise the demand for skilled labor. While it is true that the short-term effect of TTIP brings together two countries that are richly endowed with human capital, so that the skilled labor premium will decline transitorily, it is obvious that the long run Schumpeterian dynamics of TTIP will raise the relative labor demand for skilled labor – here the conclusion is in contrast to the IFO (2013b) analysis that has emphasized that the wage ratio of unskilled labor/skilled labor will increase.

The high relevance of FDI inflows for Europe – and their role on innovation dynamics – suggests that EU countries' governments should take a closer look at the national innovation system while the European Commission would be wise to consider crucial aspects of cooperation, EU budget priorities and prospects for regional innovation spillovers. There is a broad literature on regional knowledge production functions and also crucial results with respect to Europe and the US. The European Commission would be wise to encourage member countries to modernize their respective national innovation systems and to increase their attractiveness with respect to foreign direct investment inflows. Moreover, the EU's structural funds could get a more pro-innovation direction.

It should not be difficult to integrate some key aspects of TTIP into the QUEST model and to get additional insights on the macroeconomic medium term effects of the TTIP project. The macroeconomic transatlantic spillover effects should not be neglected in the analysis and it is also clear that taking into account the overall real income effects of TTIP there will be trade creating effects for third countries.

There is one clear and important conclusion for Germany, namely that long run TTIP benefits are much higher than has been discussed so far. If the TTIP discussion could only become less emotional than was observed in 2014/2015, there should be brighter political perspectives to get broader support for TTIP in the public debate. This paper has made a crucial contribution to the economic analysis.

References

Abdih, Y.; Joutz, F. (2005), Relating the Knowledge Production Function to Total Factor Productivity: An Endogenous Growth Puzzle, IMF Working Paper 05/74, International Monetary Fund, Washington D.C..

Antonietti, R.; Bronzini, R., Cainelli, G. (2015), Inward foreign direct investment and innovation: evidence from Italian provinces, Working Paper No. 1006, Banca d'Italia, Rome.

Asian Development Bank (2015), Asian Economic Integration Report: How Can Special Economic Zones Catalyze Economic Development?, Asian Development Bank, Manila.

Atkeson, A.; Burstein, A. (2008), Pricing-to-Market, Trade Costs, and International Relative Prices, American Economic Review, vol. 98, 1998-2031.

Barrell, R.: Pain, N., (1999), Domestic institutions, agglomerations and foreign direct investment in Europe, European Economic Review, Elsevier, vol. 43(4-6), 925-934.

Blind, K.; Jungmittag, A. (2008), The impact of patents and standards on macroeconomic growth: a panel approach covering four countries and 12 sectors, Journal of Productivity Analysis, vol. 29, 51-60.

Blind, K.; Jungmittag, A.; Mangelsdorf, A. (2011), Der gesamtwirtschaftliche Nutzen der Normung (The Economic Benefits of Standardization), DIN.

Bottazzi, L.; Peri G., (2003), Innovation and spillovers in regions: Evidence from European patent data, European Economic Review, vol. 47, 687-710.

Charlot, S,; Crescenzi, R.; Musolesi, A. (2014), Econometric modelling of the regional production function in Europe, Journal of Economic Geography, online, 1-33.

Cheung, K.; Lin, P. (2004), Spillover effects of FDI on innovation in China: Evidence from the provincial data, China Economic Review, Vol. 15, 25-44.

Coe, D.T.; Helpman, E. (1995), International R&D Spillovers, European Economic Review, Vol. 39, 859-887.

Dunning, J.H. (1977), Trade, location of economic activity and the MNE: A search for an eclectic approach. The International Allocation of Economic Activity, 395-418, Springer.

Edmond C.; Midrigan, V.; Xu D. Y., (2015), Competition, Markups, and the Gains from International Trade, American Economic Review, vol. 105(10), 3183-3221.

Francois, J. et al. (2013), Reducing Transatlantic Barriers to Trade and Investment, London: CEPR (for the European Commission).

Fritsch, M. (2002), Measuring the Quality of Regional Innovation Systems: A Knowledge Production Function Approach, International Regional Science Review, Vol. 25(1), 86-101.

Froot, K.A.; Stein, J.C. (1991), Exchange Rates and Foreign Direct Investment: An Imperfect Capital Markets Approach, Quarterly Journal of Economics, 1191-1217.

Griliches, Z. (1979), Issues in Assessing the Contribution of Research and Development to Productivity Growth," Bell Journal of Economics, vol. 10, 92-116.

Ifo (2013a), Dimensionen und Auswirkungen eines Freihandelsabkommens zwischen der EU und den USA – Studie im Auftrag des Bundesministeriums für Wirtschaft und Technologie, Endbericht (Dimensions and Effects of a Free Trade Agreement between the EU and the US – study for the Ministry of Economic Affairs of the German government), Munich.

Ifo (2013b), Bertelsmann Stiftung (2013), Bundesländer, Branchen und Bildungsgruppen, Wirtschaftliche Folgen eines Transatlantischen Freihandelsabkommens (THIP) für Deutschland, Mikroökonomische Analyse (written by Felbermayr, G.; Lehwald, S., Schoof, U.; Ronge, M.), Bertelsmann Stiftung, Gütersloh.

Jungmittag, A. (2016), Techno-Globalisierung (Techno-Globalization), contribution to the project „EU-Strukturwandel, Leitmärkte und Techno-Globalisierung“, Hans-Böckler-Stiftung, Düsseldorf, forthcoming.

Keller, W. (2000), Geographic Localization of International Technology Diffusion, NBER Working Paper No. 7509, National Bureau of Economic Research, Cambridge, MA.

Machlup, F. (1979), Stocks and Flows of Knowledge, Kyklos, Vol. 32, Issue 1-2, 400–411.

Marrocu, E.; Paci, R.; Usai, S. (2013), Knowledge production function and proximities: Evidence from spatial regression models for the European region, WP4/01 SEARCH Working Paper, SEARCH.

Mc Morrow, K.; Orlandi, F.; Raciborski, R.; Roeger, W.; Vandermeulen, V.; in'tVeld. J.; Vogel, L. (2016), Medium term economic dynamics of the Euro Area, International Economics and Economic Policy, Volume 13, Issue 1, 27-43.

Melitz, M.J. (2003), The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity, Econometrica, vol. 71, 1695-1725.

Pew Research Center (2015), Is Europe on board for a new trade deal with the U.S.?, online: http://www.pewresearch.org/fact-tank/2015/01/29/is-europe-on-board-for-a-new-trade-deal-with-the-u-s/.

Pesaran, M.H.; Shin, Y, Smith, R.J. (2001), Bounds testing approaches to the analysis of level relationships, Journal of Applied Econometrics, Vol. 16, 289-326.

Perret, J.K. (2014), Knowledge as a Driver of Regional Growth in the Russian Federation, Heidelberg and New York: Springer.

Welfens, P.J.J. (2011), Innovations in Macroeconomics, 3rd revised and enlarged edition, Heidelberg and New York: Springer.

Welfens, P.J.J. (2016), Schumpeterian Macroeconomic Production Function for Open Economies: A New Endogenous Knowledge and Output Analysis, EIIW Paper No. 211, Europäisches Institut für internationale Wirtschaftsbeziehungen (EIIW) an der Bergischen Universität Wuppertal.

Welfens, P.J.J.; Irawan, T. (2014), Trade and Foreign Direct Investment: New Theoretical Approach and Empirical Findings for US Exports and European Exports, EIIW Paper No. 204, Europäisches Institut für internationale Wirtschaftsbeziehungen (EIIW) an der Bergischen Universität Wuppertal, forthcoming in International Economics and Economic Policy.

Welfens, P.J.J.; Korus, A.; Irawan, T. (2014), Transatlantisches Freihandels- und Investitionsabkommen (Transatlantic Trade and Investment Partnership), Stuttgart: Lucius.

Welfens, P.J.J.; Korus, A.; Irawan, T. (2014), Transatlantisches Freihandels- und Investitionsabkommen (Transatlantic Trade and Investment Partnership), Stuttgart: Lucius.

Appendix 1: FDI Patent Output Nexus for Germany

In the following, we used the bounds testing approach of Pesaran/Shin/Smith (2001) to analyze the relationships between FDI to GDP ratio, patent applications at the European Patent Office (EPO) and GDP growth for Germany in the period from 1991 to 2014.

The FDI to GDP ratio is calculated as the trend development of the net inflows of FDI (equity capital) to GDP ratio (FDI_TRENDQ). PAT_TOT are the total German patent applications at the EPO. Furthermore, we differentiated between patents owned solely by German residents (PAT_DOM) and patent applications owned partly or completely by foreigners (PAT_FOW). Finally, WBIP is the growth rate of real GDP in percent.

The detailed results are shown in the following tables. Of special interest are the long-run coefficients in the cointegration equations calculated from the autoregressive distributed lag (ARDL) models. They show, on the one hand, the long-run impact of an increase of the trend FDI to GDP ratio on the patent applications and, on the other hand, of the patent applications on GDP growth.

ARDL Cointegrating And Long Run Form
Dependent Variable: LOG(PAT_TOT)
Selected Model: ARDL(3, 4)
Date: 12/13/15 Time: 18:43
Sample: 1991 2014
Included observations: 18

Cointegrating Form

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DLOG(PAT_TOT(-1))	0.380421	0.209324	1.817379	0.1025
DLOG(PAT_TOT(-2))	0.352503	0.227223	1.551349	0.1552
D(FDI_TRENDQ)	-0.564981	0.235094	-2.403218	0.0397
D(FDI_TRENDQ(-1))	0.432614	0.403103	1.073209	0.3111
D(FDI_TRENDQ(-2))	0.280669	0.418241	0.671071	0.5190
D(FDI_TRENDQ(-3))	-0.607450	0.291035	-2.087204	0.0665
CointEq(-1)	-0.393621	0.109569	-3.592447	0.0058

Cointeq = LOG(PAT_TOT) - (0.2114*FDI_TRENDQ + 9.8180)

Long Run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
FDI_TRENDQ	0.211412	0.124799	1.694012	0.1245
C	9.818013	0.109821	89.399843	0.0000

ARDL Cointegrating And Long Run Form
Dependent Variable: LOG(PAT_FOW)
Selected Model: ARDL(1, 0)
Date: 12/13/15 Time: 18:42
Sample: 1991 2014
Included observations: 21

Cointegrating Form

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(FDI_TRENDQ)	0.100220	0.085669	1.169852	0.2573
CointEq(-1)	-0.163985	0.026844	-6.108744	0.0000

Cointeq = LOG(PAT_FOW) - (0.7796*FDI_TRENDQ + 7.5964)

Long Run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
FDI_TRENDQ	0.779587	0.135097	5.770584	0.0000
C	7.596391	0.147449	51.518666	0.0000

ARDL Cointegrating And Long Run Form
Dependent Variable: LOG(PAT_DOM)
Selected Model: ARDL(3, 4)
Date: 12/13/15 Time: 18:39
Sample: 1991 2014
Included observations: 18

Cointegrating Form

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DLOG(PAT_DOM(-1))	0.428916	0.202565	2.117426	0.0633
DLOG(PAT_DOM(-2))	0.349017	0.228239	1.529172	0.1606
D(FDI_TRENDQ)	-0.604663	0.218966	-2.761447	0.0221
D(FDI_TRENDQ(-1))	0.552578	0.378729	1.459032	0.1786
D(FDI_TRENDQ(-2))	0.219288	0.410018	0.534826	0.6057
D(FDI_TRENDQ(-3))	-0.596437	0.280159	-2.128923	0.0621
CointEq(-1)	-0.406363	0.108579	-3.742550	0.0046

Cointeq = LOG(PAT_DOM) - (0.1923*FDI_TRENDQ + 9.6631)

Long Run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
FDI_TRENDQ	0.192282	0.111591	1.723097	0.1190
C	9.663079	0.100006	96.624793	0.0000

ARDL Cointegrating And Long Run Form
Dependent Variable: WBIP
Selected Model: ARDL(3, 1)
Date: 12/14/15 Time: 11:20
Sample: 1991 2014
Included observations: 18

Cointegrating Form

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(WBIP(-1))	0.870345	0.264296	3.293070	0.0064
D(WBIP(-2))	0.442853	0.190262	2.327596	0.0382
DLOG(PAT_TOT)	29.968469	5.803115	5.164203	0.0002
CointEq(-1)	-2.064178	0.349165	-5.911749	0.0001

Cointeq = WBIP - (1.9864*LOG(PAT_TOT) -19.0533)

Long Run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(PAT_TOT)	1.986431	1.166087	1.703502	0.1142
C	-19.053337	11.786939	-1.616479	0.1320

ARDL Cointegrating And Long Run Form
Dependent Variable: WBIP
Selected Model: ARDL(3, 0)
Date: 12/14/15 Time: 11:34
Sample: 1991 2014
Included observations: 18

Cointegrating Form

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(WBIP(-1))	0.852022	0.318306	2.676739	0.0190
D(WBIP(-2))	0.416746	0.219792	1.896088	0.0804
DLOG(PAT_TOT, 2)	19.717012	9.355590	2.107511	0.0551
CointEq(-1)	-2.034773	0.509069	-3.997046	0.0015

Cointeq = WBIP - (8.2407*DLOG(PAT_TOT) + 0.9878)

Long Run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DLOG(PAT_TOT)	8.240707	3.760163	2.191582	0.0472
C	0.987787	0.243031	4.064447	0.0013

In a nutshell, the key findings from the regression analysis for Germany on the FDI-patent-output nexus are as follows (based on the net inflow FDI-GDP ratio which had an average value of 0.84% - with a minimum of -0.39% and a maximum of 1.51%):

- There is no direct link between the FDI-GDP ratio and output growth.
- As regards the link between patent applications and the trend FDI-output ratio, there is a significant impact: Using the long run coefficient, a rise of the trend FDI-GDP ratio by 0.1 percentage points will raise patent applications by 2.1%. If one makes a distinction between patents owned (or co-owned) by foreigners and patents of domestic residents, a rise of the trend FDI-GDP ratio by 0.1 percentage points will raise the former by 7.8% and the latter by 1.9%.

The long run relation between output growth and patent applications is also considered: If one assumes a rise of patent applications by 2.1%, the long run link between GDP growth and the level of patent applications (in logs) suggests a contribution of output growth of 0.042 percentage points while the long run link between output growth and first differences of patent applications (again in logs) suggests an output contribution of 0.17 percentage points. Thus a rise of the trend FDI to GDP ratio by 0.6 percentage points would indirectly lead to an output increase of 1 percentage point for Germany.

Appendix 2: Considerations in the context of making a distinction between expansion of GNP and GDP

Much of the standard arguments about the pros and cons of TTIP are stated within the framework of looking at the effects of GDP in the EU and the US, respectively. To the extent that GDP is perhaps less interesting than the real gross national product, one has indeed to look at the question of EU economic benefits not simply from a European perspective but has to include the US economic dynamics explicitly. This can be easily seen from the subsequent definition of national income (Z) which, of course, is composed of real GDP (Y) and an element of foreign GDP (see equations 1' and 2'): net profits obtained from abroad become a crucial element of analysis in a world with inward FDI and outward FDI. It should be noted that the real exchange rate also plays a role so that, for example, a real depreciation of the Euro will raise the real national income of people in the euro zone.

Moreover, theoretical aspects of international macroeconomic interdependence in the context of both trade and foreign direct investment are crucial and in the literature FDI typically is neglected although the critical distinction between gross domestic product and gross national income is of key importance: Consumption, imports and exports should naturally be assumed to be proportionate to real income (Z) and not to gross domestic product (Y). Hence a transatlantic macro perspective should clearly put the analytical focus on the relevant economic categories. One should point out that in a demand-determined income framework the adequate theoretical macro perspective on the transatlantic economic interdependence is partly linked to real gross national income in the EU and the US, and not as much on real gross GDP which has already been emphasized by WELFENS (2011) where the distinction between GDP and GNP is considered in the simple framework of Cobb-Douglas production functions plus competition in goods and factor markets. Assuming a Cobb-Douglas production function in each of the two countries considered, namely $Y=K^{ß}(AL)^{1-ß}$ in the home country (country 1) and $Y^*=K^{*ß^*}(A^*L^*)^{1-ß^*}$ in country 2 (* denoting foreign variables), we can write for Z and Z*, respectively (α denoting the share of capital owned by foreign investors in country 2; α* denoting the share of capital owned by foreign investors in country 1; and q*:=eP*/P where e is the nominal exchange and P the price level):

(1') $Z = Y(1 - \alpha^*\beta) + \alpha\beta^* Y^* q^*$

(2') $Z^* = Y^*(1 - \alpha\beta^*) + \alpha^*\beta\, Y/q^*$

Here gross national income is Y plus real net profit transfers from abroad - profits of country 2 subsidiaries amount to α*ßY in country 1 provided there is competition in goods and factor markets. Considering goods market equilibrium conditions in the home country and the foreign country – while assuming a specific investment function (with net investment I= br + b'(ßY/K – ß*Y*/K*) plus other terms; b and b' are positive parameters) and that real consumption C and real imports J are proportionate to real income in both countries and that exports X are proportionate to foreign real income – not to GDP as many standard models suggest - we get a new equation for international economic interdependency in a world with multinational companies as can be derived fairly easily. If one covers the intensity of trade by the export-GDP ratio X/Y:= x and the import-GDP

ratio q*J/Y:= j – with X and J denoting real exports and q* the real exchange rate – one can understand that the international output multipliers dY/dY* and dY*/dY for the case of two large economies are influenced both by trade intensity and the FDI globalization indicators α and α*. To the extent that regional trade integration is coupled with a decline of international capital flows – and also taking into account some theoretical aspects of links between trade and FDI dynamics as well as innovation dynamics – a demand-determined medium term international output multiplier is important for understanding TTIP or TPP. In addition to a medium term approach a long term macro modeling is required which reflects a growth approach in an open economy with FDI.

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

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