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European Innovations Dynamics and US Economic Impact: Theory and Empirical Analysis

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Summary: The analysis explains innovations in EU25 for the period 2006-2012, namely through R&D (relative to GDP), cumulated FDI inflows – relative to the host country capital stock - , joint internet intensity, broadband intensity and potential competition. For the first time we can offer a broad analysis of innovation dynamics in Europe that should be the basis not only for better supply-side policy in EU countries and growth policy, respectively, it also suggests a strong role of international digital communication for innovation dynamics. Moreover, the approach gives new important arguments in favor of the TTIP negotiations between the US and the EU.

Zusammenfassung: Die vorliegende Analyse erklärt Innovationen in der EU25 für den Zeitraum zwischen 2006 und 2012. Dazu werden F&E-Aufwendungen (im Verhältnis zum BIP), kumulierte ausländische Direktinvestitionen - bezogen auf den Kapitalstock des jeweiligen Gastlandes -, die gemeinsame Internetintensität, Breitband-Intensität sowie Direktinvestitionen im Ausland verwendet. Erstmals kann so eine breite Analyse der Innovationsdynamik in Europa erfolgen, die eine Grundlage nicht nur für eine bessere EU – Angebots- und Wachstumspolitik darstellt, sondern auch eine starke Rolle der internationalen digitalen Kommunikation für Innovationsdynamik nahe legt. Darüber hinaus liefert der neue Ansatz wichtige Argumente für das TTIP-Profekt zwischen den USA und der EU.

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1. Introduction

The dynamics of process innovations have received broad attention in the literature while much less attention has been devoted to product innovations. There are few exceptions in the advanced macroeconomic analysis; e.g. Welfens (2011) has presented a Mundell Fleming model with product innovations where such innovations stimulate consumption and exports; product innovations raise the equilibrium real output. As regards the economic relevance of innovations in a transatlantic perspective one may point out that the medium term trade and foreign direct investment (FDI) dynamics associated with the Transatlantic Trade and Investment Partnership project could go along with higher FDI and increased innovation intensity (Irawan and Welfens, 2014).

Patents are an obvious source for relevant data for innovation dynamics – but not all innovative products and services are covered by patents - and a considerable share of patents are related to process innovations; patents obtained by firms in the sector of machinery and equipment and also in transport equipment can be classified to a large extent as reflecting process innovations. Product innovations are rather difficult to define in a clear way. There is, however, a broad body of literature on the diffusion of product innovations (i.e. Gort and Konakayama, 1978; Gort and Klepper, 1982; Jovanovic and Lach, 1989; Agarwal and Bayus, 2002). Javanovic/Lach (1989) have shown that US output variance – relative to trend – is influenced by product innovations: roughly 20% of output variance is explained by product innovations.

Key issues in product innovations concern macroeconomic issues, namely to what extent output, the price level and the exchange rates are affected by product innovations. Typically, product innovations will be launched in lead markets in which the demand for novel products is relatively high – e.g. as a consequence of high per capita income - and where the responsiveness of consumers/users is considerable so that firms can benefit from a fast feedback from consumers/users (Beise, 2005). Effectively the demand side co-determines the first user advantages of firms.

Product innovations may typically be expected to play a strong role in leading OECD countries so that the US, EU countries, Switzerland, Norway, Japan, Korea and a few other countries should get particular attention with both respect to empirical aspects and to policy issues. In open economies there are three natural bridges across countries when it comes to product innovations:

- Trade among OECD countries will be relatively high as the real GDP of these countries is relatively high – however, there could be, of course, spatially determined trading patterns as is indicated by standard gravity modeling.
- Multinational companies will play a major role: In the case of horizontal foreign direct investment one may immediately expect that foreign subsidiaries will quickly launch similar product innovations as those launched in the markets of the parent country; hence FDI inflows from a leading OECD country into EU countries could be a driver of product innovations in EU countries. There are certain information transmission links that should be relevant for getting news on product/process innovations in the countries considered and in the US, respectively. To some extent we follow the logic emphasized by Jungmittag and Welfens (2009) who have

shown, in an augmented trade gravity modeling, that international telecommunications between countries i and j are highly significant for international trade dynamics of EU countries. In the modern digital age one may, however, focus rather on a joint internet variable.

The specific interest of our research focus is to understand European innovation dynamics and the role of US companies for those Schumpeterian dynamics. This study focuses not only on process innovation but innovation in general as measured in EU Innovation Scoreboard. Subsequently we will take a look at first at theoretical considerations before the following sections present empirical findings and then the policy implications. The key insights in this paper are for EU countries that, besides past R&D (relative to GDP) cumulated inward FDI from the US – a country considered as leading in product innovations in many fields – , are highly significant for innovations in the EU; this is a new finding along with the result that "joint communication density", namely the internet density in EU host countries and in the US significantly contribute to innovations in the EU; moreover, the broadband density is an additional impact factor for innovations. This suggests again that ICT dynamics are often underestimated in Economics (Welfens and Perret, 2014). There also is evidence that potential competition plays a role for innovations.

All this has interesting implications for policymakers, but also for the dynamics of current account behavior of the euro area (and the US). From a Vernon-type product cycle trade approach one would clearly conclude that FDI inwards dynamics and OECD internet expansion dynamics have a strong impact on the current account position of the EU and the euro area, respectively. Since one may expect that innovation improve the current account position there is a double benefit of EU inward FDI inflows from the US: There is more long term current account financing and there are impulses for innovations and hence transitorily higher exports in the future.

2. Theoretical Aspects

Product innovations can stimulate demand in relevant markets and firms launching product innovations will typically fetch higher prices than firms offering only standardized products. If marginal production costs are given product innovations can be understood as an upward rotation of the demand curve – the saturation point is unchanged, but the prohibitive price is raised (e.g. as in the case of introducing color TV sets in an initial product setting with black and white TV sets). If there is only one firm that launches the product innovation the firm will have a monopoly position and it will enjoy transitorily high profits. As opposed to this particular product innovation setting, one also could consider a market with differentiated products: all firms provide particular products: From a microeconomic perspective a market with differentiated products – if that is what product innovation means – is characterized by an equilibrium in which the long run average cost curve is tangent to the demand curve. The quantity is lower and the price is higher than under perfect competition whose long run equilibrium is characterized by firms producing in the minimum of the average cost curve which itself is a point of the marginal cost curve (assuming positive marginal costs). Differentiated products could be particularly expected in a market with a wide oligopoly where the product of firm i will encourage firm j to also launch additional product innovations.

Product innovations can represent products that offer more inherent services, have a longer life time or offer specific prestige. For example new perfumes are not necessarily offering more services and rarely will they last longer, but a specific prestige could be associated with a certain brand name. The fact that the price of product innovations often are above the price of standard products often gives a certain exclusivity that is part of the "prestige utility" obtained by customers willing to use novel products. It is not clear whether or not the rise of the price for a product innovation – compared to a standard benchmark product – will raise more than utility of the consumers/user. If the utility is rising more than the price there is an analytical challenge with respect to calculating hedonic prices. To put this in a different perspective: If the quality of all products is raised through product innovations and prices increase less than utility, one may argue that the effective general price level has decreased so that a wave of product innovations in a specific setting of rather modest price increases will go along with a positive aggregate real income effect. In open economies this can also be relevant for partner countries with whom the innovative home country (country I) has trading relations or foreign direct investment links; alternatively, the innovative country could be country II, but again one may raise the question about the relevance of trade links and foreign direct investment links.

If product innovation concerns intermediate tradable products the importing country will benefit by the ability of firms selling final product – at home or in the world market – to fetch higher prices than before. Assuming that Schumpeterian rents are raising along the value-added chain, that is the final producer gets an over proportionate share of the increase in the export unit value (in case the novel final product is exported), countries that are specialized at the end of the value-added chain will have relatively large welfare gains from product innovations in the field of intermediate products. To the extent that intermediate product innovations come from offshoring, the respective multinational company is likely to get the whole Schumpeterian rent from the product innovation recorded for the final product. Here one has a certain problem with surveys among firms in the home country and abroad since product innovations recorded abroad could concern intermediate products for a final product assembled in country I – in this case the same product is covered under product innovations twice; to cope with this problem one would have to add the question whether the product innovation is mainly due to intermediate foreign product innovations, to both domestic product innovation activities and intermediate foreign product innovations or to domestic product innovation activities only.

As regards the role of inward FDI inflows actual cumulated FDI relative to the capital stock should be a relevant driver of product innovations in the host country: With US multinational subsidiaries active in the EU countries (or other host countries) one may expect that innovative US companies – US multinationals in particular – will positively affect product innovations in host countries. However, considering the role of potential competition in some cases the presence of MNCs in host countries is not the only important factor – proxied by the stock of inward FDI relative to the capital stock – but potential competition could also stimulate product innovations. Assuming, in line with the role of FDI gravity models, that the distance to the headquarter country negatively affects FDI flows one can take distance to the leading OECD country as a proxy for potential competition.

Among the related body of literature relevant for product innovations there is a rather limited number of papers. Faber and Hesen (2004) is an important contribution as patents in 15 EU countries 1992-96 are shown to depend on product innovation sales; and both national innovation performance indicators are shown to largely depend on similar macro- and micro-economic conditions, however, they differ in additional explanatory variables of the national innovation system, namely governmentally regulated institutional conditions for patents and firm specific traits for sales of product innovations. In the subsequent analysis product innovations of EU countries are the key focus of analysis and 25 countries are covered for the period 2006-2012.

Innovation dynamics in EU countries are covered by the EU innovation scoreboard. The performance of the research and innovation of each EU country is measured using a composite index which is known as the Summary Innovation Index (SII). The Summary Innovation Index covers three main aspects (enablers; firm activities and outputs) and 8 innovation dimensions (human resources; open, excellent research system; finance and support; firm investment; linkages and entrepreneurship; intellectual assets; innovators; economic effects). In total, the composite index captures 25 indicators.

The subsequent table gives some insights into innovations dynamic across EU countries – there is indeed some variety of innovation dynamics. Note that the countries have been ordered by per capita income at purchasing power parity; naturally, one should expect innovations to play a rather important role in high income countries since the demand structure will be shaped by a high share of expenditures for differentiated products: the latter is often synonymous for innovations.

Table 1: Innovations Dynamics in Selected EU Countries (countries are ordered by per capita income – on the basis of purchasing power parity figures; 2012)

Country	2013	2012	2011	2010	2009	2008	2007	2006
EU	0.554	0.545	0.532	0.531	0.516	0.504	0.506	0.493
Luxembourg	0.646	0.627	0.593	0.601	0.616	0.594	0.593	0.57
Austria	0.599	0.599	0.583	0.571	0.597	0.583	0.527	0.516
Ireland	0.606	0.594	0.586	0.568	0.574	0.554	0.569	0.567
Netherlands	0.629	0.644	0.6	0.596	0.591	0.583	0.566	0.561
Sweden	0.75	0.752	0.746	0.739	0.737	0.732	0.729	0.732
Denmark	0.728	0.722	0.697	0.705	0.673	0.657	0.693	0.684
Germany	0.709	0.708	0.694	0.701	0.687	0.671	0.656	0.646
Belgium	0.627	0.627	0.612	0.605	0.597	0.594	0.601	0.588
Finland	0.684	0.685	0.685	0.676	0.67	0.66	0.631	0.63
France	0.571	0.579	0.57	0.567	0.541	0.53	0.523	0.517
United Kingdom	0.613	0.618	0.617	0.616	0.585	0.575	0.601	0.59
Italy	0.443	0.446	0.427	0.427	0.406	0.394	0.393	0.38
Spain	0.414	0.411	0.395	0.391	0.395	0.389	0.381	0.375
Cyprus	0.501	0.498	0.499	0.48	0.461	0.485	0.411	0.414
Slovenia	0.513	0.495	0.508	0.481	0.474	0.458	0.431	0.427
Czech Republic	0.422	0.405	0.416	0.411	0.374	0.369	0.39	0.374
Greece	0.384	0.38	0.372	0.37	0.379	0.375	0.349	0.353
Portugal	0.41	0.402	0.415	0.42	0.396	0.374	0.33	0.314
Slovakia	0.328	0.35	0.304	0.299	0.312	0.304	0.302	0.296
Estonia	0.502	0.488	0.474	0.453	0.452	0.411	0.382	0.388
Lithuania	0.289	0.271	0.26	0.24	0.239	0.233	0.254	0.241
Poland	0.279	0.268	0.282	0.272	0.276	0.265	0.275	0.263
Hungary	0.351	0.335	0.344	0.341	0.315	0.314	0.303	0.298
Latvia	0.221	0.234	0.228	0.216	0.209	0.195	0.188	0.174
Romania	0.237	0.229	0.258	0.24	0.257	0.242	0.219	0.208
Bulgaria	0.188	0.191	0.234	0.232	0.198	0.189	0.168	0.158

Source: Innovation Union Scoreboard database, 2014

2.1 MNCs and International Technology Transfer

Multinational companies are typically assumed to represent technology-intensive production and ownership-specific advantages, respectively (Dunning, 1980). MNCs often are active in Schumpeterian manufacturing industries that are characterized by high innovation dynamics – this might refer to product innovations or process innovations. The services sector is becoming an increasing part of the international outsourcing and offshoring business of EU MNCs (Copenhagen Economics, 2010). With US MNCs investing in EU countries one will expect a direct transatlantic technology transfer effect and hence a positive direct innovation effect in the EU, at the same time there will be pressure on domestic European firms in the EU single market to come up with more product and process innovations as a reaction of rising US foreign direct investment in Europe; the key issue is how the alternatives pre-innovation profits and post-innovation profits are affected by the respective FDI decisions. In some industries oligopolistic interdependence could reinforce international technology transfers and spillover mechanisms (where game-theoretical approaches could be considered). Part of international trade in technology is visible from the relevant information in the trade statistics that include payments for royalties and the buying of foreign patents. It is well known that international technology markets are very imperfect and therefore intra-company transfer of knowledge – read intra-MNC technology trade - is dominating international technology trade. As regards international royalty statistics in the EU one should, however, consider special problems that are related to tax legislation and special tax treatment of royalties in such countries as the Netherlands and Ireland where inward FDI figures are often influenced by such aspects; a related case is Luxembourg.

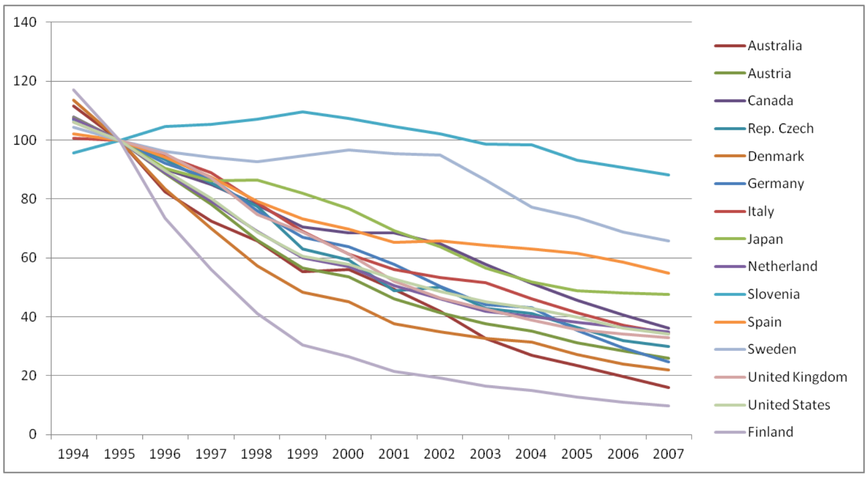
2.2 Role of EU FDI Abroad

For the EU the US is the most import location of cumulated outward foreign direct investment (Copenhagen Economics, 2010). It is fairly clear that EU investment in the US is mainly asset-seeking foreign direct investment – e.g. the case of EU pharmaceuticals that invest in transatlantic mergers and acquisitions in the innovative US biotechnology sector. Thus one may expect that EU outward FDI to the US could positively contribute to innovativeness of the respective EU host country since advanced knowledge from US firms acquired will be transferred to the EU parent company; to the extent that there are knowledge spillovers in the US the transatlantic technology transfer could be broader than simply concerning the proprietary technology of European subsidiaries in the US.

2.3 Terms of Capital

An interesting point for comparison of international FDI concerns major international differences in certain asset prices. Land prices will naturally differ and international price differences partly will reflect relative per capita income positions (calculated on the basis of purchasing power parity), however, capital goods prices also can differ considerably as is obvious from the differences in the ICT capital goods deflator over time; e.g. looking at that deflator – with 1995=100 – one can see that in the EU the price decline until 2007 was rather low in Slovenia while the price index has witnessed a very strong decline in Finland as the EU KLEMS database shows. Thus a 10 million euro investment of a US or Japanese or Korean multinational company in Portugal, Spain, Germany, Italy or the UK could go along with different real FDI inflows. Denoting the capital stock price index as P"I for country i (1, 2,…n: host countries of FDI) and country j (source country of FDI) one may assume that the ratio P''_i/P''_j has a negative impact on real FDI inflows in country i. That price ratio may be dubbed the terms of capital. However, we will not discuss these considerations in a broader context here, but the concept of the terms of capital should be quite useful for research in international FDI dynamics.

Figure 1: ICT Capital Price Index in Selected EU Countries (1995=1)



Note: ICT Capital Price Index for Finland covers only IT capital
Source: EU-KLEMS

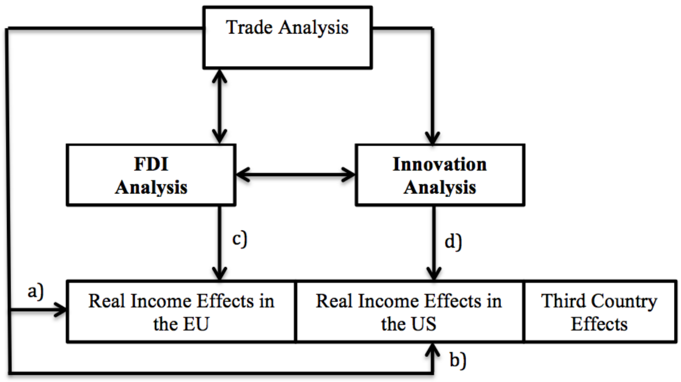
2.4 Growth Perspectives in Open Economies (application e.g. on TTIP)

Standard analysis on TTIP has focused on trade and real income effects on both sides of the Atlantic. However, there is a clear need to go two steps further, namely to consider the role of innovation dynamics and foreign direct investment. E.g. how ill innovation performance of EU countries we influenced by TTIP? A basic perspective is obtained from a regression analysis of the innovation performance indicator of the EU which should – from a theoretical analysis – depend on the ratio of R&D-GDP (with a time lag) and FDI inflows from the US; a similar model could be considered for innovation performance of the US/US states. In addition the internet dimension has to be analyzed, namely through a "joint internet variable".

Traditional analysis of Free Trade Areas considers trade dynamics and the respective effects on real income in the countries involved; for example in the case of the envisaged TTIP (Transatlantic Trade and Investment Partnership) between the European Union and the USA. However, such analysis only partly covers a broader perspective which should indeed also take into account the effects of foreign direct investment in the FTA countries. FDI and trade indeed are linked with each other – and FDI in turn is related to innovation dynamics. As regards the link between trade and FDI: if there is trade liberalization between the EU and the US, there will be less need for tariff-jumping through foreign direct investment on both sides of the Atlantic. At the same time, growing intra-industrial trade will intensify price competition so that there are incentives for firms to try escaping this more intensive competition, namely, by means of more product innovations – some of which will typically be accompanied by process innovations. It is well known that more patent applications per capita will stimulate higher FDI inflows which will go along with positive income effects in the host countries (through technology transfer on the one hand; on the other hand – in the case of greenfield investment – through capital accumulation). Thus a triangular analytical perspective is appropriate. Thus far, such a perspective has not been implemented in modeling of TTIP so that only part of economic benefits has been covered, namely, the trade effects. A simple way to cope with the analytical challenges is to combine a trade gravity equation with an FDI gravity equation where the latter should take into account the role of innovation dynamics/revealed patent positions, respectively. The links c) and d) have so far rarely been studied in the literature and certainly not in the context of TTIP. Only such broader analysis would give an adequate picture of the economic welfare effects in the US and in the EU.

Finally, the results of that exercise could be plugged into a macroeconomic production function so that one can calculate welfare effects related to real GDP (Y) and real GNP (Z) dynamics, respectively. The latter requires focusing on Y and Y* (* for foreign variables) and the shares of foreign ownership (α is the share of foreign ownership the capital stock K of country I, α^* is country I investors' share in K. Assuming a production function Y=Kß(AL)1-ß and abroad Y*=K*ß*(A*L*)(1-ß*) and competition in goods and factor markets, it must hold that the share of capital income in country I is equal to ß and in country II equal to ß*. It holds (with q*:=eP*/P where P is the price level and e the nominal exchange rate in price notation) that Z = Y(1 - α*ß) + αß*Y*q*.

Figure 2: Dependent and Independent Variables in the Empirical Model



3. Empirical Analysis: New Findings

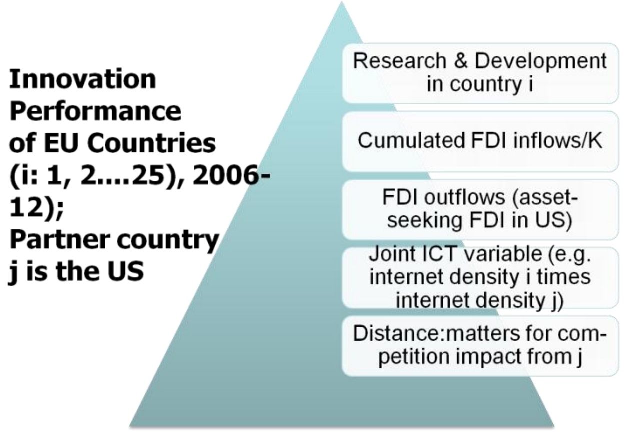
As discussed in the previous section, innovation can be determined by several factors. The basic hypothesis here is that innovations are a positive function of lagged R&D relative to GDP, the US FDI inward stock relative to the host country capital stock and a joint communication variable (internet density of the host country times US internet density);

the latter is a proxy for communication channels about innovations, where several aspects could be relevant for innovations – there could be an awareness affect and international social network effects that are typical for popularity waves or fads in high per capita income markets. It is obvious that past research and development – relative to gross domestic product – should have a positive impact on innovations.

The presence of foreign investors in host countries is assumed to encourage innovations since the subsidiaries of foreign investors coming from the US (or other advanced OECD countries) are assumed to represent ownership-specific advantages (Dunning, 1980), particularly technological advantages. Moreover, domestic firms will face pressure to launch more own innovations in a setting with monopolistic competition – and hence ongoing innovations - in many markets. One cannot rule out that a dominant position of foreign investors in the host country could undermine competition and innovations, respectively, but in most EU countries this should not be an issue of concern. Very small countries could, however, be a problem here. How strong is the demand for innovations? This could depend on specific demand characteristics, e.g. per capita income and the median age of the population – the latter should have a negative effect on innovations, namely as one will expect older strata of the population to be more "conservative" with respect to buying new products. Here the role of international communication is emphasized on the one hand, on the other hand the US is considered to be the main source of global product innovations; hence a joint internet communication variable – reflecting the news impact of information & communication technology – is considered in the regressions. Moreover, the paper also considers the quality of communication services by introducing a joint broadband internet variable in the regression.

In the theoretical chapter, the paper has defined that one should also consider the role of potential competition which can be proxied by the distance. As our focus will be on EU countries on the one hand, and since the US is considered to be the leading OECD country on the other, we can take the distance ij (EU countries are i=1, 2…28; the US is country j), the distance between EU countries and the US is expected to have negative impact on the innovation as in the standard gravity model (see the details in Figure 2).

Figure 3: Dependent and Independent Variables in the Empirical Model



The data for the regression analysis is taken from several sources, such as Eurostat, AMECO database, World Development Indicator, Innovation Union Scoreboard Database

2014 and CEPII. Unfortunately, the data for several variables are not available for all EU countries. Moreover, there are some changes in the calculation of the Summary Innovation Index (SII) across years of publication. In this paper, we use the latest publication, Innovation Union Scoreboard (IUS) 2014 Database. To sum up, we have 175 observations for 25 EU countries during the period 2006-2012 in our regression model. The list of countries and the relevant variables are indicated in Table 2 and Table 3 respectively.

Table 2: List of Countries

Austria	Denmark	Hungary	Luxembourg	Slovakia
Bulgaria	Estonia	Ireland	Netherlands	Slovenia
Croatia	Finland	Italy	Poland	Spain
Cyprus	France	Latvia	Portugal	Sweden
Czech Republic	Germany	Lithuania	Romania	United Kingdom

Table 3: Data

Variable	Definition	Source	Unit
Innovation	Composite Innovation Index	IUS Database 2014	Index
R&D per GDP (t-2)	Total Intramural R&D expenditure per GDP in period t-2	Eurostat	Percent
FDI inward per capital stock	FDI inward (stock) from US per Capital-stock	FDI inward (stock) from US (Eurostat) Capital stock (AMECO)	
Internet	Internet user per 100 people in the EU multiply by Internet user per 100 people in the US	WDI	Natural logarithm
Broadband	Fixed broadband internet subscribers per 100 people in the EU multiply by Fixed broadband internet subscribers per 100 people in the US	WDI	Natural logarithm
FDI outward per capital stock	FDI outward (stock) to US per Capital-stock	FDI outward (stock) from US (Eurostat) Capital stock (AMECO)	
Distance	The distance between the EU countries and the US	CEPII	Natural logarithm

The diagnostic tests of the standard regression approaches (pooled, fixed effect, and random effect) suggest that the standard regression suffers from auto-correlation and heteroskedasticity. Moreover, the further test statistics also suggest that the model with time fixed effect is more preferable. Thus, the paper presents the innovation model with time effect which is estimated by using the Panel Corrected Standard Error (PCSE) and the Feasible Generalized Least Square (FGLS) method.

Table 4 presents four alternative models of innovation. Generally, the results are consistent with our hypothesis. The coefficients of all independent variables from both approaches, across four alternative models, are roughly equal. The coefficient of lagged R&D-GDP ratios (lag is two years) is 0.112 under PCSE (Model I) and FGLS (Model III) in the approach without the FDI outward variable; the coefficient is highly significant. If we consider the model with FDI outward variable as independent variables, the coefficient of lagged R&D-GDP ratios is slightly lower, as much as 0.096 under PCSE (Model II) and 0.100 under FGLS (Model VI). It is noteworthy that the PCSE regression results have a high R-squared, namely about 0.88.

Table 4: Regression results with and without FDI outward per capital stock

Variable	PCSE		FGLS	
	I	II	III	IV
R&D per GDP (t-2)	0.112*** (0.011)	0.096*** (0.009)	0.112*** (0.007)	0.100*** (0.006)
FDI Inward per capital stock	0.852* (0.391)	0.633 (0.342)	1.021*** (0.244)	0.740** (0.254)
Internet	0.070* (0.035)	0.080* (0.033)	0.069** (0.022)	0.073*** (0.020)
Broadband	0.054* (0.023)	0.057** (0.019)	0.052*** (0.013)	0.051*** (0.013)
FDI Outward per capital stock		0.942** (0.308)		0.922** (0.282)
R-squared	0.875	0.897		
Time effect	YES	YES	YES	YES
N	175	161	175	161

Note: * p<0.05, ** p<0.01, *** p<0.001

The US FDI inward variable is expected to have a positive and significant impact on innovation (except in Model II). The magnitude of the coefficient is between 0.7 – 1.0. This also implies the potential positive impact of the Transatlantic Trade and Investment Partnership project. The coefficients of both communication variables (internet and broadband) are positive and statistically significant. In terms of the magnitude, internet is expected to have stronger positive impact on product innovation relative to broadband. Lastly, the FDI outward stock relative to the capital stock (of the home country) is also positive and significant in all model specifications - with a lesser number of observations, due to data availability problems.

As previously mentioned, this study also considers the potential competition in the presence of MNCs in the host countries which is proxied by distance. Table 5 shows that the proxy of potential competition is significant and consistent with our hypothesis only in Model VII. It is noteworthy that the coefficient for the FDI inward variable is smaller once we introduce the distance variable, but this in turn is consistent with the logic of traditional FDI gravity models; thus, however, it is not fully clear to what extent the distance variable reflects an FDI-related impact or rather a pure potential competition impact.

Table 5: Regression results with distance as proxy of potential competition

Variable	PCSE		FGLS	
	V	VI	VII	VIII
R&D per GDP (t-2)	0.111**	0.096***	0.109***	0.099***

	* (0.010)	(0.009)	(0.007)	(0.007)
FDI Inward per capital stock	0.834* (0.402)	0.626 (0.339)	0.935*** (0.238)	0.729** (0.254)
Internet	0.060 (0.034)	0.079* (0.035)	0.070** (0.022)	0.071*** (0.021)
Broadband	0.049* (0.022)	0.057** (0.020)	0.042** (0.014)	0.049*** (0.014)
Distance	-0.114 (0.067)	0.004 (0.055)	-0.161* (0.067)	-0.027 (0.059)
FDI Outward per capital stock		0.918** (0.335)		0.874** (0.291)
R-squared	0.877	0.898		
Time effect	YES	YES	YES	YES
N	175	161	175	161

Note: * $p<0.05$, ** $p<0.01$, *** $p<0.001$

A rather parsimonious specification – without the distance variable and FDI Outward per capital stock– shows highly significant results in the FGLS regression (Model III) and, in the PCSE (Model I) regression, the analysis is also quite satisfactory. If the impact of US cumulated inward FDI in other regions of the world has a similar impact on host countries' innovation dynamics – e.g. in Asia or Latin America – and if in turn innovation dynamics explain a considerable part of output variance relative to trend, the global direct impact of US innovation dynamics would be much higher than traditionally thought. Here additional research should be conducted.

4. Policy Conclusions

It is fairly obvious that policymakers in low per capita income countries of the EU could try to encourage product innovations strongly, not least in order to improve the current account position. For all euro crisis countries, plus Italy and France, these considerations seem to be particularly relevant. Countries could try to stimulate FDI inflows from the US and in this respect not only national measures are to be considered but also the potential impact of the Transatlantic Trade and Investment Partnership project. Moreover, it would be wise to invest more in digital networks and to encourage the broad use of fixed and mobile internet services in EU countries. In addition, policymakers could consider options for stronger R&D promotion in many EU countries, however, not in those where government R&D expenditures have exceeded that of the private sector for years (e.g. Portugal). It is highly implausible that the optimum R&D promotion would imply government R&D expenditures to exceed that of the private sector. In many leading OECD countries the split between the private sector and the government sector is roughly 2:1.

There are additional insights to be obtained from spatial regression analysis which is beyond the scope of the analysis presented here. To the extent that innovations in country i have a positive spillover effect on country i' governments should consider a joint R&D promotion program. Jointly financing R&D is quite an exception to the rule in the EU, only some supranational R&D projects are financed from Brussels, the national policy layer clearly dominates R&D promotion.

To the extent that venture capital financing is important for young innovative firms one may emphasize that the lack of venture capital funding in many EU countries could also be considered as a barrier to higher R&D-GDP ratios and thus to higher future innovation dynamics. An interesting question for future research is to what extent the current account is shaped by relative innovation dynamics. In the context of the Vernon (1966) approach one may expect that more innovations – relative to the rest of the world – should improve the current account position. If more data on innovations for Europe and Asia become available one will have an interesting new research agenda for this issue, including the role of US FDI flows to European and Asian countries. It is also obvious that the TTIP negotiations between the EU and the US could have much higher benefits than the existing contributions in the literature – with a dominant focus on trade dynamics – suggest. Transatlantic trade and investment partnership could stimulate transatlantic foreign direct investment and thus reinforce innovation dynamics that, in turn, will have considerable impact on output growth.

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