FIW Research Report N° 012 / Foreign Direct Investment
June 2008

A Panel Data Analysis on FDI and Exports

Falk, M., Hake, M.

Abstract

The present paper investigates the link between exports and the outward FDI stock using a panel of industries and seven EU countries for the period 1973-2004. In particular, we use the panel causality tests developed by Holtz-Eakin, Newey, and Rosen (1988). Estimates using system GMM estimators show that exports cause FDI but not vice versa. The long-run elasticity of the outward FDI stock with respect to exports is 0.78 and highly significant. Separate estimates by destination country yields the same result that exports cause outward FDI but the effect is only significant for the CEE countries and other developed countries (i.e. United States, Japan, Canada, Switzerland, Norway, etc.).

The FIW Research Reports show the results of the three thematic work packages ‘Export of Services’, ‘Foreign Direct Investment’ and ‘Competitiveness’, that were commissioned by the Austrian Federal Ministry of Economics and Labour (BMWA) within the framework of the ‘Research Centre International Economics” in November 2006.

WIFO
ÖSTERREICHISCHES INSTITUT FÜR WIRTSCHAFTSFORSCHUNG
AUSTRIAN INSTITUTE OF ECONOMIC RESEARCH

A Panel Data Analysis on FDI and Exports

Martin Falk, Mariya Hake

June 2008

Austrian Institute of Economic Research
Commissioned by Federal Ministry of Economics and Labour
Arbeitspaket N 2 Direktinvestitionen: Modul 1, Teilmodul 1.1 •
Projektkoordination: Yvonne Wolfmayr, Irene Langer
Internal review: Werner Hölzl

Abstract

The paper investigates the link between exports and the outward FDI stock using a panel of industries and seven EU countries for the period 1973–2004. In particular, we use the panel causality tests developed by Holtz-Eakin, Newey, and Rosen (1988). Estimates using system GMM estimators show that exports cause FDI but not vice versa. The long-run elasticity of the outward FDI stock with respect to exports is 0.78 and highly significant. Separate estimates by destination country yield the same result that exports cause outward FDI but the effect is only significant for the CEE countries and other developed countries (i.e., USA, Japan, Canada, Switzerland, Norway, etc.).

Please refer to: Martin.Falk@wifo.ac.at, Mariya.Hake@wifo.ac.at

2008/353-1/SF/WIFO project no: 2806

Medieninhaber (Verleger), Herausgeber und Hersteller: Österreichisches Institut für Wirtschaftsforschung,
Wien 3, Arsenal, Objekt 20 • Postanschrift: A-1103 Wien, Postfach 91 • Tel. (+43 1) 798 26 01-0 • Fax (+43 1) 798 93 86 • http://www.wifo.ac.at/ •
Verlags- und Herstellungsort: Wien

Verkaufspreis: 20,00 € • Kostenloser Download: http://www.wifo.ac.at/wwa/jsp/index.jsp?fid=23923&id=34229&typeid=8&display_mode=2

A Panel Data Analysis on FDI and Exports

Contents Page

A Panel Data Analysis on FDI and Exports

Martin Falk
Address: Arsenal Objekt 20, A-1030 Vienna
Phone: + 43-1-798 26 01 – 226
Fax: + 43-1-798 93 86
E-mail: Martin.Falk@wifo.ac.at

Mariya Hake (WIFO)
Address: Arsenal Objekt 20, A-1030 Vienna
Phone: + 43-1-798 26 01 – 226
Fax: + 43-1-798 93 86
E-mail: Mariya.Hake@wifo.ac.at

Das Wichtigste in Kürze

In vielen alten EU15-Ländern existieren unbegründete Ängste hinsichtlich der Auswirkungen der ausländischen Direktinvestitionen nach Mittel- und Osteuropa. Häufig wird argumentiert, dass ausländische Direktinvestitionen zu einem Rückgang der Exporte von den Herkunftsländern in die Zielländer führen und damit zu einem Produktionsrückgang und Beschäftigungsabbau im Herkunftsland. Bisherige empirische Untersuchungen, die zur Versachlichung der Diskussion beitragen können, kommen zu keinem einheitlichen Ergebnis. In dieser Studie wurde eine neue empirische Untersuchung zu dem Zusammenhang zwischen ausländischen Direktinvestitionen und Warenexporten durchgeführt. Die Analyse der Substitutions- bzw. Komplementaritätsbeziehung wurde für insgesamt sieben Zielländer in der EU15 auf Basis von Sektordaten für den Zeitraum 1973-2004 durchgeführt. In einem anschließenden Schritt wurde zwischen sechs verschiedenen Zielregionen differenziert (EU15, CEE, andere Industrieländer, Latinamerika, Asien ohne Japan). Dabei wurden die Exportdaten der OECD-Datenbank mit den UNCTAD-Daten zu den ausländischen Direktinvestitionen verknüpft. Die verwendete Methode beruht auf den Granger-Kausalitätstest für Paneldaten. Hauptergebnis ist, dass Exporte Granger-kausal für ausländische Direktinvestitionen sind, aber nicht umgekehrt. Das heisst, dass eine Zunahme der Exporte langfristig eine Steigerung der ausländischen Direktinvestitionen nach sich zieht. Umgekehrt führt eine Steigerung der ausländischen Direktinvestitionen nicht zu einer Steigerung der Exporte, aber auch nicht zu einer Reduzierung der Exporte. Für ausländische Direktinvestitionen nach Mittel- und Osteuropa gilt, dass ein Anstieg der Exporte zu mehr ausländischen Direktinvestitionen in diese Region führt, umgekehrt gilt aber ein neutraler Zusammenhang. Die Ängste, dass ausländische Direktinvestitionen nach Mittel- und Osteuropa Exporte vom Herkunftsland in diese Region ersetzen sind damit unbegründet.

Abstract

The present paper investigates the link between exports and the outward FDI stock using a panel of industries and seven EU countries for the period 1973-2004. In particular, we use the panel causality tests developed by Holtz-Eakin, Newey, and Rosen (1988). Estimates using system GMM estimators show that exports cause FDI but not vice versa. The long-run elasticity of the outward FDI stock with respect to exports is 0.78 and highly significant. Separate estimates by destination country yields the same result that exports cause outward FDI but the effect is only significant for the CEE countries and other developed countries (i.e. United States, Japan, Canada, Switzerland, Norway, etc.).

JEL Classification: F10, F21

Keywords: exports, FDI, dynamic panel data methods

1. Introduction

The aim of the present paper is to empirically investigate the relationship between outward FDI and exports in a sample of seven EU member countries. There is a dual link between trade flows and outward FDI in the theory. On the one hand, it is assumed that investment by multinationals in other countries would substitute for their exports, and therefore, reduce employment and economic growth in the home country in the long-term. On the other hand, trade and outward FDI are appointed in order to be complements to each other in turn boosting and having a positive relationship on each other. Hence, the present paper aims at reconciling these contrary views for a sample of selected EU15 countries and attempts to explore whether the established relationship remains constant over the observed period.

First, the reciprocal relationship on the country level of the aggregated industry data for the period 1979-2004 is analysed and is not differentiated by partner countries. For that purpose, we analyse a sample of seven EU15 countries (Austria, France, Germany, Italy, Netherlands, Sweden, and the United Kingdom) by using panel data and the causality testing method as developed by Holtz-Eakin, Newey, and Rosen (1988). Second, we refine this analysis by providing separate regression results for each of the five major destination regions (i.e. CEE, EU15, Latin America, other developed countries and Asia). To our knowledge, this level of disaggregation considering the destination regions for FDI and exports in other empirical studies is so far under-researched. Hence, we aim herein to find out whether the target region affects the relationship between FDI and exports. The differentiation according to the target country of aggregated industry data in our study addresses a new aspect of the analysis as aggregated data cannot distinguish as to whether there are different effects considering various destination regions and industries.

The study is organised as follows. In section 2, we perform a literature review of a sample of both theoretical and empirical studies. The econometric methodology is presented in section 3, and the description of the data follows in section 4. The empirical results are shown in part 5. Finally, Section 6 concludes.

2. Literature review

2.1 Theoretical background

Economic theory does not identify an unambiguous relationship between FDI and trade. Seminal work by Mundell (1957), investigating the relationship between FDI and exports, rests upon the assumptions of the neoclassical Heckscher-Ohlin-Samuelson theory, where the flows of FDI depend on the differences in factor prices and factor endowments between countries. With international factors becoming mobile, these differences become smaller. Therefore, Mundell concludes that capital mobility driven by FDI constitutes a perfect substitute for exports. Additionally, other theories, as for instance the theory of internalisation (Williamson, 1975; Markusen and Venables, 1995) suggest that FDI substitute for exports as the OLI- conditions as developed by Dunning (1977) are supported and there are sufficient costs for external transactions such as exporting and licensing. Furthermore, Brainard (1993) states that the "proximity-concentration trade off", which was determined by the firm's fixed costs, transportation costs, and trade barriers, is the explanation for the substitutive link between FDI and trade.

Helpman et al. (2003) show that whether the relationship is complementary or subsidiary that it is an issue that depends on the type of FDI. The FDI could be of two different types: horizontal (MNEs have a subsidiary in every country of interest because of transport costs or just to be closer to the final customer) or vertical (MNEs locate each stage of the production process in different countries according to cost advantages). The models of "horizontal" FDI denote the predominant negative impact on exports and establish, therefore, a relationship of substitution. Markusen and Venables (1995) develop such a model considering countries that are different in factor endowments and technologies and discover that trade and FDI have a reverse (substitution) relationship as they become similar considering the relative factor endowments and technologies. Moreover, Markusen (1984) predicts a substitution relationship between horizontal FDI and exports, whereas horizontal FDI arises as a product of the interaction of plant-level activities and firm-specific activities (R&D, marketing, managerial services, etc.). Therefore, whether an MNE establishes an affiliate or tends to export depends on the trade costs (tariffs) on the one hand, and the costs of establishing a new firm near the customers on the other hand. Finally, as horizontal FDI tends to take place between countries that are similar in terms of factor endowment, income, and technologies, the model predicts a negative link between skill differences and horizontal FDI.

Other theoretical contributions, however, show that outward FDI and trade might be complements. The model of Helpman (1984) implies that in the case of vertical FDI, there are complementarities between the trade flows of final goods from foreign affiliates to parent firms and intra-firm transfers of intermediate goods from parent firms to foreign affiliates. In general, the model suggests that vertical FDI is likely to occur between developed and developing countries. For example, a firm's presence on a foreign market with one product may increase the total demand for the entire line of products (Lipsey and Weiss, 1984). Another reason for complementarity could be that an investment by a manufacturer may increase the exports of inputs from the home market to the host market (Svensson, 1996).

Recent studies attempt to combine both horizontal and vertical motives for FDI (Carr et al., 1998).These models are referred to as knowledge-capital models and are based on three central assumptions. First, the location of knowledge-based assets could be spread geographically; second, knowledge-based assets yield higher skill intensity relative to production, and third, knowledge-based assets could be used in multiple plants. Accordingly, the models predict several combinations of vertical and horizontal multinationals and imply that horizontal FDI is more prevalent for countries with similar factor endowment and with high trade costs. In addition, vertical FDI arises when countries differ substantially in terms of factor endowments and when trade costs are low. Trade and FDI between developed countries, therefore, could be regarded as substitutes while FDI and trade between developed and developing countries are likely to be complements. Thus, the theoretical arguments do not provide, a priori, a clear-cut relation between outward FDI and exports. Both a substitution and complementary relationship are possible depending on various factors such as tariffs, type of goods, and type of FDI.

2.2 Empirical studies

On the one hand, if the empirical literature asserts a substitutive relation, exports are at least partially displaced by local sales at the foreign market and it could be detrimental to the production and employment in the investor's country. On the other hand, however, if outward FDI and exports have a complementary link, investing abroad benefits the home country's exports. Although the empirical results appear to be mixed, the majority of the studies predict a positive relationship between outward FDI and exports. The empirical literature can be divided according to the level of aggregation used. Therefore, it can be arranged into country-level studies, industry-level studies, firm-level studies, and product–level studies.

The analysis on the country level shows a dominant complementary effect. Clausing (2000) investigates the operations of US MNEs in 29 host countries from 1977-1994 and finds a strong positive influence of FDI on exports. This relation becomes even more pronounced when multinational activity and intra-firm trade are considered. In the analysis of Austrian FDI and exports, Pfaffermayr (1994, 1996) employs the Granger-causality procedure and obtains a significant positive causation in both directions. Eaton and Tamura (1994) also analyse the relationship. They thereby control for the country determinants such as income per capita, population, and the endowment of human capital of the partner country and find a strong complementary relationship. In contrast, Andersen and Hainaut (1998) find a complementary relationship for the USA, Japan, and Germany but not for the United Kingdom.

The empirical studies on the industry level have mixed results. Lipsey and Weiss (1981) show a positive relationship between US exports and FDI for 40 countries in 1970. They find that a dollar of additional affiliate sales leads to an increase from 2 to 78 cents of additional exports to the corresponding market. Marchant et al. (2002) also demonstrate a complementary relationship between FDI and trade for the US food processed industry in FTAA countries. Graham's (1996) findings generally support the complementary relation between the US outward FDI and US exports but he also finds confirmation of the substitution hypothesis. Furthermore, Brainard (1997) finds a strong confirmation for the "proximity-concentration trade-off" on the industry level for 27 US markets and identifies that when the income per capita of the partner country catches up to the US level, FDI tends to substitute for exports. Fontagné and Pajot (1997) find complementary effects between FDI flows and trade on the sectoral level. Furthermore, they appoint an even a larger impact of FDI on exports when the spillovers between sectors are taken into account. At the same time, Blonigen (2001) detects a substitution effect between the production of Japanese automobile parts in the US and the Japanese exports of automobile parts to the USA. Further, the relation between the production of Japanese automobiles (final goods) in the USA and Japanese exports of automobile parts turns out to be complementary. Türkan (2006) also identifies a strong complementary relation between US trade and FDI stocks of intermediate goods exports, whereas there is a slight negative relation between FDI and trade in final goods.

Considering the disaggregation on the firm level, Lipsey and Weiss (1984) determine strong complementary effects between the US production of intermediate goods in the host country and the US exports in the same region in 1970. They find out that a dollar of additional production in the host country induces 9 to 25 cents of additional exports from the home country.

Table 1: Studies on the relationship between outward FDI and exports

Author (year)	*Level of aggregation*	*Data*	*Method*	*Results*
Alguacil et al. (2002)	Country-level data Spain (FDI flows)	Quarterly Data 1970–1992	Time series, VAR with Granger causality	Positive long-term Granger causality from FDI to Exports
Bajo-Rubio and Montero-Munoz (1999)	Country-level data (Spain)	Quarterly Data 1977-1992	Cointegration, Granger causality tests	Long-run Granger causality from outward FDI to exports, no short-run effects
Blonigen (2001)	Product-level data (automobile parts)	1978 to 1994 Japanese automobile parts to US market	Time series, SUR regressions	Complementarity effect for vertical production relationships, otherwise substitution
Brainard (1997)	Industry-level data (27 countries)	1989	2SLS	Predominant substitution effect
Clausing (2000)	Country-level data (29 countries)	Two-panel data set, 1977-1994	Panel-data regression with and without fixed country effects based on gravity-type model	Complementary effect from FDI to exports, especially when intra-firm trade included
Fontagné and Pajot (1997)	Country-level data (21 countries)	Panel data set	Time Fixed Effects	Positive Effect of FDI on Exports, different magnitude for the various countries
Graham (1996)	Sector-level data US and Japan	1983, 1988, 1991	Gravity Model	Predominant complementary relation
Lipsey and Weiss (1981)	Industry-level data (14 countries)	1970	OLS	Complementary relationship
Lipsey and Weiss (1984)	Firm-level data	1970	OLS	Strong complementary relationship for intermediate goods, weaker for final goods, possible substitution effects for final goods
Marchant et al. (2002)	Industry data (US processed food industry)	Pooled data, cross-section and time-series data, 1989-1998	Full-information maximum likelihood (FIML) method	Complementary relationship
Oberhofer and Pfaffermayr (2007)	Firm-level data	19,079 companies, 10 countries, Amadeus database	Bivariate Probit Model with Maximum Likelihood approach	Complementary relationship
Pfaffermayr (1994)	Country-level data (Austria)	1969-1991	Time series, OLS, Granger causality tests	Complemetarity relationship from FDI to exports
Pffafermayr (1996)	Country-level (Austria)	1980-1994, Time-series cross sect. data	Dynamic fixed effects model, GMM estimation	Stable bi-directional complementarity results
Türkan (2006)	Product-level data (USA)	Panel Data, 1989-2003	Gravity Equations, Fixed Effects, Random Effects	Complementary effect for intermediate goods, slight substitution effects for finished goods

The relation becomes weaker though, and even negative, if the final goods are considered. In their recent empirical study for companies from 10 European countries, Oberhofer and Pfaffermayr (2007) submit a confirmation for the complementarity hypothesis in turn providing evidence for the

deterministic characteristics on the choice between FDI and exports and stating that firms use a combination of both FDI and exports to serve foreign markets. An abstract of the relevant empirical studies is shown in Table 1. Again, while there are theoretical reasons to suggest both substitution and complementary effects, empirical work in this area nearly invariably shows a net complementary relation between exports and foreign affiliates activity with the level of aggregation being one of the most important explanations for diverging results.

The investigation of the relation between FDI and trade that is diversified by destination country or region is an under-researched issue in the empirical literature. Some studies investigating the relationship between FDI and exports from developed to developing countries find them to be complementary. Furthermore, the same relation is found to be substitutive between developed countries. Nevertheless, the net empirical outcome shows, to a large extent, a complementary relation rather than a substitution effect. A small number of studies also analyse the issue of the relationship between FDI and trade considering various destination countries or regions. For instance, Fontagné and Pajot (1997) analyse the French and US FDI and trade on the industry level and find complementarity effects to be stronger in the case of the USA. Furthermore, they detect different effects for the various industries depending on the comparative advantages in the respective industry or sector that the investor countries have.

3. Empirical model

We analyse the empirical relationship between the outward FDI and exports by using the panel data causality testing method as developed by Holtz-Eakin et al. (1988). This estimation method is closely related to a method proposed by Anderson and Hsiao (1981). The test involves estimation of error correction equations:

$$\Delta \ln y_{it} = \alpha_1(\ln y_{i,t-1} - \beta_1 \ln x_{i,t-1}) + \delta_1 \Delta \ln x_{it} + \lambda_t + \varepsilon_{1it},$$
$$\Delta \ln x_{it} = \alpha_2(\ln x_{i,t-1} - \beta_2 \ln y_{i,t-1}) + \delta_2 \Delta \ln y_{it} + \lambda_t + \varepsilon_{2it}$$

where x denotes exports, y denotes the outward FDI stock and λ the time effects or alternatively the time trend. The parameters α_1 and α_2 denotes the error correction term. We use the error-correction term and the long-run coefficient to test long-run Granger-causality. In particular, the question of whether or not x causes y can be tested with the hypothesis:

$\alpha_1 = \beta_1 = 0$ $H_0(1)$: x does not Granger cause y in the long run,

$\alpha_2 = \beta_2 = 0$ $H_0(2)$: y does not Granger cause x the long run.

Rejection of $H_0(1)$ and acceptance of $H_0(2)$ is interpreted as causality from x to y, while rejection of $H_0(2)$ and acceptance of $H_0(1)$ is interpreted as causality in the reverse direction. If both hypotheses are rejected, it is said that there is no feedback between the two variables. The key parameter of interest is the long-run impact of exports and FDI and vice versa.

Assuming that the residuals of the level equation are serially uncorrelated, the values of y lagging two periods or more can be used as instruments in the first-differenced equation. The estimation equation and moment conditions can be estimated by first-differenced GMM, which was developed by Arellano and Bond (1991). However, conventional GMM estimation exhibits a major drawback if the explanatory variables display persistence over time – as is the case for variables such as the FDI capital stock. In this case, their lagged levels may be rather poor instruments for their differences. Therefore, we use the system GMM estimator that was introduced by Blundell and Bond (1998), which combines the regression equation in first differences – instrumented with lagged levels of the regressors – with the regression equation in the levels, instrumented with lagged the differences of the regressors.

4. Data and descriptive statistics

The main data sources for our analysis are on the one hand a UNCTAD database, and on the other hand, the OECD STAN database that can be downloaded from http://www.sourceoecd.org. We use the outward FDI stock for 1979-2004 as measured in current US dollars (1000s). Exports are also measured in current US-dollars (1,000s). The outward FDI stock represents the historical cost values measures in 1,000 US-Dollars.

Table 2: Summary statistics (average growth rate in %)

NACE	*Δlog exports*	*Δlog FDI*	*NACE*	*Δlog exports*	*Δlog FDI*
	Austria			**Italy**	
15-16	0.088	0.136	15-16	0.072	0.110
17-19	0.033	0.086	17-19	0.044	0.139
20	0.039	0.191	24	0.078	0.073
21	0.044	0.112	27-28	0.065	0.131
24	0.072	0.126	29	0.066	0.120
25	0.003	0.102	34-35	0.066	0.144
26	0.027	0.292		**Netherlands**	
27-28	0.045	0.088	15-16	0.042	0.085
29	0.062	0.121	24	0.190	0.315
30-32	0.082	0.251	27-28	0.039	0.067
34-35	0.113	0.163		**Sweden**	
	France		15-16	0.085	0.135
15-16	0.044	0.057	20	0.010	0.032
17-19	0.043	0.057	24	0.114	0.146
20	0.061	0.197	34-35	0.063	0.062
24	0.068	0.101		**UK**	
25	0.063	-0.004	15-16	0.045	0.070
26	0.074	0.284	17-19	0.041	0.173
27-28	0.041	0.046	24	0.080	0.113
29	0.058	0.237	27-28	0.035	0.179
30-32	0.060	0.011	29	0.017	-0.046
34-35	0.078	0.156	30-32	0.065	-0.332
	Germany		34-35	0.066	0.151
15-16	0.056	0.095			
17-19	0.042	0.118			
20	0.074	0.070			
21	0.067	0.063			
22	0.059	0.207			
24	0.059	0.077			
25	0.070	0.125			
26	0.050	0.085			
27-28	0.044	0.047			
29	0.053	0.086			
30-32	0.080	0.081			
33	0.073	0.120			
34-35	0.078	0.134			

Source: UNCTAD and OECD databases, own calculations.

Table 2shows the descriptive statistics for the first part of the estimations where FDI and exports are not disaggregated by the destination country. As expected, we observe an increase in both exports and outward FDI in most industries and countries during the observed period.

To gain some insight into the relationship between exports and FDI we provide correlation coefficients based on their growth rates (see Figure 1 in the Appendix). We find that both variables are correlated with a coefficient of 0.13 and a p-value of 0.00. The data on outward FDI and exports that is used in the second part of the analysis is disaggregated by home country and destination region (Table 3). We have data on outward FDI stocks and exports for seven EU15 countries: Denmark, Finland, France, Italy, Germany, the Netherlands, and the United Kingdom as well as five destination regions: CEE, EU15, Latin America, the Caribbean, other developed countries, and Asia. Similarly to the first part, an increase of both exports and the outward FDI was able to be distinguished. The correlation coefficients (Table 4), broken up by destination regions, show a positive but mostly insignificant relationship (only the coefficient for Asia was significant at the 5% level).

Table 3: Average growth rates of exports and outward FDI stock (%)

Country	*Exports*	*Outward FDI stock*	*# of obs*	*Country*	*Exports*	*Outward FDI stock*	*# of obs*
		CEE				**Other developed countries**	
Denmark	0.029	0.137	15	Denmark	0.082	0.088	15
Finland	0.022	0.370	19	Finland	0.698	1.099	1
France	0.219	0.196	90	France	0.048	0.192	102
Germany	0.208	0.392	51	Germany	0.059	0.064	56
Netherlands	0.155	0.353	40	Italy	0.098	0.049	71
United Kingdom	0.152	0.231	45	Netherlands	0.033	0.020	43
		EU15		United Kingdom	0.090	-0.027	53
Denmark	0.064	0.092	15			**Asia**	
Finland	0.018	0.126	26	Denmark	0.028	0.094	15
France	0.041	0.092	159	Finland	0.001	0.201	7
Germany	0.040	0.078	42	France	0.060	0.084	95
Italy	0.064	0.192	74	Germany	0.097	0.194	97
Netherlands	0.017	0.101	63	Netherlands	0.070	0.127	46
United Kingdom	0.031	-0.030	65	United Kingdom	0.028	0.070	46
		Latin America and the Caribbean					
Denmark	-0.085	0.124	15				
France	0.044	0.139	116				
Germany	0.078	-0.024	56				
Italy	0.014	0.081	78				
Netherlands	0.050	0.102	75				
United Kingdom	0.014	0.167	62				

Source: UNCTAD and OECD databases, own calculations.

Table 4: Correlation coefficients, disaggregation by target country

	Coeff.	*p-value*	*# of obs*
CEE	0.040	0.518	260
EU15	0.078	0.100	444
Latin America and the Caribbean	0.028	0.581	402
Other developed countries	0.052	0.338	326
Asia	0.128	0.025	306

5. Empirical results

We explore the Granger-causality relationships between exports and outward FDI in a bivariate setting. The first two tables summarise the results of the estimation of aggregated data (not differentiated by partner country) of the FDI – exports relationship and vice versa. Table 5 shows the estimated coefficients from the fixed-effects regression. As expected, the logarithm of exports is highly significant and positive (0.40). It is noteworthy that no lagged endogenous of FDI on exports and vice versa are included, so that the static equation should represent a long-run relationship.

Table 5: Fixed effects results (dependent variable: log outward FDI stock)

	Coeff.		*t-value*
ln exports	0.40	***	3.09
year	0.10	***	14.18
constant	-204.8	***	-16.13
Number of observations	947		
Groups (sector and country)	54		
R^2	0.60		

The fixed effects estimator tends to be biased and inconsistent when estimating dynamic models. Hence, we employ the system GMM-estimator. The results from the dynamic panel data models are shown in Table 6. The equations are estimated using the one-step system GMM method with t-values and test statistics that are asymptotically robust to general heteroscedasticity and corrected for a small sample bias. The system GMM results use 947 observations on 7 EU15 countries and up to 15 industries from 1973-2004. We conducted two types of diagnostic tests for the empirical models (Table 6). Firstly, we conducted tests of first- and second-order serial correlations in the residuals. The AR (2) test statistics of the residuals do not reject the specification of the error term. Secondly, in looking at the Sargan tests, we see that the p-value of the regression relating FDI to exports does not indicate a decisive rejection of the model's over identifying restrictions. In contrast, for the impact of FDI on exports we find that the instruments are invalid.

The results of the dynamic panel data estimations show that exports have a strong positive effect on the outward FDI stock. The long-run elasticity is approx. 0.78, whereas the short run elasticity is 0.59. The error correction coefficient is negative (-0.061) and statistically significant at the 1% level, indicating that there is an equilibrium relationship in the long-run. However, the speed of adjustment is quite low, indicating a large degree of persistence. In contrast, we find a statistical significant long-run impact of the FDI stock on exports.

Table 6: Dynamic panel data estimates of the link between exports and FDI

	dep var: Δ log exports				*dep var. Δ log outward FDI*		
	Coeff.		t-value		Coeff.		t-value
log exports (t-1)	-0.002		-0.75	log outw. FDI (t-1)	-0.061	***	-4.15
log outward FDI (t-1)	0.002		0.63	log exports (t-1)	0.047	**	2.61
Δlog outward FDI	0.030	**	4.38	Δlog exports	0.592	***	4.34
time effects	yes			time effects	yes		
constant	-1.871	*	-1.92	constant	-9.236	***	-2.91
Wald test log exports (t-1)=log outward FDI (t-1)=0 (p-value)	0.23				0.00		
long run coefficient outward FDI					0.775	***	2.98
Number of observations	947				947		
AR 1 test (p-value)	0.000				0.000		
AR 2 test (p-value)	0.067				0.075		
Sargan test of overid. restrictions:	0.000				0.968		
Difference-in-Sargan tests	0.000				0.999		

Notes: ***, ** and * denote significance at the 1%, 5%, and 10% levels. The table shows the results of (one-step) system GMM estimators. t-values are robust to heteroscedasticity and are corrected for the small sample bias using Windmeijer's correction.

Table 7 and Table 8 show the estimation results of the relationship between FDI and exports for each of the five destination regions. Overall, the results are consistent with the more aggregated model that is presented above. We do not find a significant long-run impact of the outward FDI capital stock on exports in any of the destination regions. In contrast, we find a positive significant impact of exports on outward FDI for two country groups (i.e. CEEC and Other Developed Countries) (see Table 8). This again implies that exports Granger cause FDI in the long-run. The long-run elasticities for CEE and other developed countries are 0.41 and 0.61. As final robustness checks, we exclude those data points whose standardised residuals fall outside the interval from -2 to 2. This reduces the sample between 4 and 12 observations. However, the results do not change when outliers are excluded.

Table 7: GMM estimates on exports according to destination region

	dependent variable Δ log exports											
	CEE			*EU15*			*Latin America*			*Oth. dev. countr.*			*Asia*		
	Coef.		t	Coef.		t	Coef.		t	Coef.		t	Coef.		t
log exports (t-1)	-0.06	*	-1.74	-0.02	**	-2.19	-0.03	**	-2.61	-0.06	**	-2.01	-0.01		-1.19
log outward FDI (t-1)	0.00		0.03	0.01		1.10	0.01		1.33	0.02		1.49	0.01		0.79
Δlog outward FDI	-0.02		-0.76	0.02		0.57	-0.01		-0.48	-0.01		-0.67	0.08	**	2.06
time effects	yes			yes			yes			yes			yes		
constant	0.92	**	2.22	0.40	***	3.82	0.49	***	3.15	1.02	**	2.44	0.31	**	2.03
Wald test log exports (t-1)=log outward FDI (t-1)=0 (p-value)	0.15			0.03			0.02			0.01			0.13		
AR(1) test (p-value)	0.08			0.11			0.11			0.17			0.06		
AR(2) test (p-value)	0.17			0.10			0.10			0.38			0.57		
Number of observations	260			444			402			341			306		
Number of groups	38			48			41			39			40		

Notes: See Table 6.

Table 8: GMM estimation on outward FDI according destination country

	dependent variable Δ log outward FDI											
	CEE			*EU15*			*Latin America*			*Oth. dev. countr.*			*Asia*		
	Coef.		t	Coef.		t	Coef.		t	Coef.		t	Coef.		t
log outward FDI (t-1)	-0.14	***	-3.50	-0.09	***	-2.78	-0.10	***	-3.45	-0.12	***	-4.45	-0.05	**	-2.27
log exports (t-1)	0.06	**	2.06	0.04		1.64	0.00		0.15	0.07	*	1.98	0.02		0.99
Δlog exports	-0.07		-0.70	0.17		0.49	-0.03		-0.40	-0.06		-0.83	0.18	**	2.69
time effects	yes			yes			yes			yes			yes		
constant	-0.13		-0.33	0.32		1.03	0.59		1.33	-0.42		-0.80	0.13		0.36
Wald test log outward FDI (t-1) =log exports (t-1)=0 (p-value)	0.00			0.01			0.01			0.00			0.02		
long run elasticity	0.41			0.41			0.04			0.61			0.50		
AR(1) test (p-value)	0.01			0.01			0.00			0.00			0.00		
AR(2) test (p-value)	0.52			0.72			0.55			0.72			0.82		
Number of observations	260			444			402			341			306		
Number of groups	38			48			41			39			40		

Notes: See Table 6.

6. Conclusions

The present paper examines the link between FDI and exports by using the Holtz- Eakin panel causality tests. To our knowledge, this is the first study that investigates whether the relationship between exports and outward FDI differ across destinations. For that purpose we use exports and data on the outward FDI stock for seven EU15 countries from 1973-2004. The results provide strong evidence that exports cause outward FDI but not vice versa. These results are to some extent consistent with the recent empirical studies that find a bi-directional relationship, meaning that outward FDI and trade tend to be complements rather than substitutes. We also find a significant one-directional causality from exports to outward FDI for the CEE countries, other developed regions the EU15 countries, whereas the latter is only significant at the 10% level. In contrast, there is no significant relationship between exports and FDI for the destination region Asia and Latin America. Hence, the destination region of outward FDI and exports for the observed countries proves to be important and has an impact on whether FDI and trade are complements or neutral to each other. Future work should explore whether the relationship remains robust when further determinants such as GDP and country size are included. Another interesting issue is whether the relation remains the same when we compare R&D-intensive industries and non-R&D-intensive industries. A further task could be to consider other variables of foreign activity, such as FDI flows, before drawing definitive conclusions.

7. References

Alguacil, M. and Orts, V. (2002), 'A Multivariate Cointegrated Model Testing for Temporal Causality between Exports and Outward Foreign Investment: the Spanish Case', Applied Economics, 34, 119-132.

Anderson, T. W. and Hsiao, Ch. (1981), 'Estimation of dynamic models with error components', Journal of the American Statistical Association, 589-606.

Andersen, P. S. and Hainaut, P. (1998), 'Foreign Direct Investment and Employment in the Industrial Countries', Bank for International Settlements Working Paper, 61.

Arellano, M. and Bond, S. (1991), 'Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations', Review of Economic Studies 58, 277-297.

Bajo-Rubio, O. and Montero-Munoz, M. (1999), 'Foreign Direct Investment and Trade: A Causality Analysis', Working Paper of the University of Navarra, No. 9902.

Blonigen, B. (2001), 'In search of substitution between foreign production and exports', Journal of International Economics, 53, 81-104.

Blundell, R. and Bond, S. (1998), 'Initial Conditions and Moment Restrictions in Dynamic Panel Data Models', Journal of Econometrics 87, 115-143.

Brainard, S. L. (1993), 'A simple theory of multinational corporations and trade with trade-off between proximity and concentration', NBER Working Paper, No. 4269, Cambridge, MA.

Brainard, S. L. (1997), 'An Empirical Assessment of the Proximity-Concentration Trade-Off between multinational Sales and Trade', American Economic Review, 87 (4), 520-544.

Carr, D. L., Markusen, J. R., and Maskus, K. E. (1998), 'Estimating the Knowledge-Capital Model of the Multinational Enterprise', NBER Working Paper, No. 6773, October, Cambridge, Mass.

Clausing, K. A. (2000), 'Does Multinational Activity Displace Trade', Economic Inquiry, 38(2), 190-205.

Dunning, J. H. (1977), 'Trade, Location of Economic Activity and the Multinational Enterprise: A Search for an Eclectic Approach' in Ohlin, B., Hesselborn and Wijkman, P. M. (eds), 'The International Allocation of Economic Activity', Macmillan, London, 395-418.

Eaton, J. and Tamura, A. (1994), 'Bilateralism and Regionalism in Japanese and US Trade and Direct Foreign Investment Patterns', NBER Working Paper, No. 4758, Cambridge, MA.

Fontagné, L. and Pajot, M. (1997), 'Relationships between Trade and FDI Flows within two Panels of US and French Industries', Working Paper of the University of Paris 1.

Fontagné, L. (1999), 'Foreign Direct Investment and International Trade: Complements or Substitutes?', OECD STI Working Paper, 1999/3.

Graham, E. M. (1996), 'On the Relationships among Direct Investment and International Trade in the Manufacturing Sector: Empirical Results for the United States and Japan', Working Paper of the Institute of International Economics, Washington D.C.

Grubert, H. and Mutti, J. (1991), 'Taxes, Tariffs, and Transfer Pricing in Multinational Corporate Decision Making', Review of Economics and Statistics, 73, 2, 285-293.

Helpman, E. (1984), 'A simple theory of international trade with multinational corporations', Journal of Political Economy, 92, 451-471.

Helpman, E., Melitz, M. and Yeaple, S. R. (2003), 'Export versus FDI', NBER Working paper, No. 9439, Cambridge, Mass.

Holtz-Eakin, D., Newey, W. and Rosen, H. (1988). 'Estimating Vector Autoregressions with Panel Data', Econometrica, 56(6),1371-1395.

Lipsey, R. E. and Weiss, M. Y. (1981), 'Foreign Production and Exports in Manufacturing Industries', Review of Economic and Statistics, 63, 488-494.

Lipsey, R. E. and Weiss, M. Y. (1984), 'Foreign Production and Exports of Individual Firms', Review of Economics and Statistics 66, 304-308,

Marchant, M. A., Manukyan, T. and Koo, W. (2002), 'International Trade and Foreign Direct Investment: A Focus on the Free Trade Area of the Americas', Journal of Agricultural and Applied Economics, 34, 289-302.

Markusen, J. R. (1984), 'Multinationals, multiplant economies and the gains from trade', Journal of International Economics, 16, 205-226.

Markusen, J. R. and Venables, A. J. (1995), 'Multinational Firms and the New Trade Theory', NBER Working Paper, No. 5036, Cambridge, Mass.

Mundell, R. (1957), 'International Trade and Factor Mobility', American Economic Review, 47 (3), 321-335.

Oberhofer, H. and Pfaffermayr, M. (2007), 'FDI versus Exports, Substitutes or Complements? A Three Nations Model and Empirical Evidence', Paper presented on the ETSG 2007.

Pfaffermayr, M. (1994), 'Foreign Direct Investment and Exports: A Time Series Approach', Applied Economics, 26 (4), 337-351.

Pfaffermayr, M. (1996), 'Foreign Outward Direct Investment and Exports in Austrian Manufacturing: Substitutes or Complements, Weltwirtschaftliches Archiv, 132, 501-522.

Svensson, R. (1996), 'Effects of Overseas Production on Home Country Exports: Evidence Based on Swedish Multinationals', Weltwirtschaftliches Archiv, 132,304-329.

Türkan, K. (2006), 'Foreign Outward Direct Investment and Intermediate Goods Exports: Evidence from USA', Paper presented on the ETSG 2006, http://www.etsg.org/ETSG2006/papers/Turkcan.pdf.

Williamson, O. (1975), 'Markets and Hierarchies: Analysis and Antitrust Implications', Free Press: New York.

8. Appendix

Figure 1: Correlation coefficients (pooled data)