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The Long-Run Effect of Outward Foreign Direct Investment and Macroeconomic Variables on Domestic Investment: Evidence from World Major Economies Using Panel ARDL Approach

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Abstract
In this paper, we investigate relationship between outward foreign direct investment flows and domestic investment among thirteen world major economies over time period 1970-2013. From 1970-2013, had outward foreign direct investment flows along with macroeconomic control variables had significant long-term effects on domestic investment among world major economies. Following the latest dynamic techniques of panel data analysis of pooled mean group and dynamic fixed effect estimators proposed by Pesaran et al. (1999), we find strong evidence of positive impact of outward foreign direct investment flows on domestic investment. Pooled mean group estimator results show that one dollar increase in foreign direct investment outflows result in increase of Domestic investment by 0.49 dollars. Dynamic fixed effect result findings also strongly support positive impact of foreign direct investment outflows on domestic investment .i.e. (one dollar increase in foreign direct investment outflows result in increase of domestic investment by 0.87 dollars).Our result findings confirm that foreign direct investment outflows along with macroeconomic control variables have positive and significant impact on domestic investment. Dumitrescu Hurlin Panel Causality test results show that there is pairwise causality running between the variables.
Keywords: Outward FDI; Domestic investment; Cointegration; Panel Data

1. Introduction

Recent empirical and theoretical studies have mainly focused on the impact of foreign direct investment (FDI) inflows on economic growth (Lim, 2002; Hansen and Rand; 2006). Some studies (Zhang (2001), Liu *et al.* (2002) and Chakraborty and Basu (2002)) have explored the direction of causality between economic growth and FDI inflows. Although, there are numerous studies finding relationship between FDI inflows and economic growth, the number of studies finding relationship between outward foreign direct investment (OFDI) and economic growth is very limited. Macroeconomic relationship between OFDI and domestic investment is hardly researched except few studies by Herzer and Schrooten (2008), Desai et al (2005) and Feldstein (1994). Herzer and Schrooten (2008) have tried to explore the impact of outward foreign direct investment (OFDI) on domestic investment in two industrialized economies using time series data but it failed to take into consideration other important macroeconomic variables in the study. Infact, Domestic investment and OFDI are not only correlated with each other but also influenced by other macroeconomic variables such as exchange rate, inflation, trade regime, interest rate and consumption etc. Omission of important variables can result in biased estimates. Siliverstovs and Herzer (2006) report that statistical findings and Granger causality tests may not be valid if econometric model suffers from omission of important macroeconomic variables. Thus we tried to bridge this shortcoming in the previous studies by adding important control variables in the econometric model which help in defining accurate relationship between OFDI and DI.

The question of whether and how the outward foreign direct investment (OFDI) affects domestic output or domestic investment is the subject of public debate in industrialized economies. There is ongoing debate on whether or not outward foreign direct investment reduces domestic investment. Stevens and Lipsey (1992) concludes that OFDI and domestic investment by US multinational firms are substitutes.Desai *et al.* (2005) argue that a higher OFDI is associated with higher levels of domestic investment. OFDI allows firms to import raw material from foreign affiliates at less expensive rates and generate exports of intermediate goods used by foreign affiliates. Industry combines home production with firms abroad to reduce the cost of production, and economies of scale thus increase their domestic output and domestic investment. However, given that these studies have analyzed the effect of large multinational firms, they do not show comprehensive effect of OFDI on domestic investment when all (small, medium and large) firms increase their OFDI. Overall effect of OFDI on domestic investment is inconclusive and has become empirical issue.

Direction of causality between OFDI and Domestic investment can be mixed or vary from one country to another if countries are studied individually with time series data analysis because of the differences in the economic structures .Therefore, nature of relationship between variables can be country specific which may

depend on economic stability, trade openness and macroeconomic environment. This is very obvious when we look at the empirical literature on the direction of causality between Outward FDI and GDP per capita. Using time series data, Lee (2010) finds long-run positive unidirectional causality from OFDI to GDP per capita in case of Japan .In short run, there is no Granger causality relationship between outward FDI and GDP per capita. Herzer and Schrooten (2008) find using time series data that OFDI has positive long-run effects on domestic investment in case of US but in Germany, this complementary relationship exists in short run. OFDI substitutes domestic investment in Germany in the long-run.

Macroeconomic relationship between OFDI and domestic investment is hardly researched. Only exception are two studies done by Feldstein (1994) and Desai et al (2005), using aggregate cross country data. Feldstein (1994) conclude that one dollar increase in OFDI decreases domestic investment by one dollar. Main problem arises with cross-country studies that they assume similar economic conditions and structures across countries. However, institutions, economic policies and technology differ across countries. Thus, these studies can suffer from endogeneity issues.

In this paper, we have used a different approach to examine the impact of OFDI on domestic investment using pooled mean group estimate (PMG) and dynamic fixed effect estimator (DFE) on the basis of macroeconomics panel data analysis for 13 world major and dynamic economies. We want to bridge this shortcoming in the existing literature by exploring how OFDI affects domestic investment in world major economies by introducing new and interesting result findings. The main idea behind this paper is to analyze relationship and impact of OFDI on domestic investment based on theoretical model using recently developed panel pooled mean group (PMG), mean group (MG) and dynamic fixed effects (DFE) estimations of world major economies over the time span of 1970-2013. Our findings are as follows: (1) Foreign direct investment outflows along with macroeconomic control variables have positive and significant impact on domestic investment and (2) one dollar increase in foreign direct investment outflows results in increase of domestic investment by 0.49 dollars using pooled mean group estimator (3) Pairwise Dumitrescu Hurlin Panel causality test suggest that there is pairwise causality running between the variables.

The paper is organized as follows: section II describes the estimating model and the data, section III presents the empirical and statistical analysis and section IV is the conclusion.

2. Model and data

Panel data is multi-dimensional data comprises of observations of multiple phenomena obtained over multiple time periods for the same firms or individuals (Baltagi, 2005). Panel data has basic form as stated below;

$$DI_{it} = \alpha + X_{it}^{`} + \mu_{it} \qquad (1)$$

Where $i = 1,2,3,...,N$; $t = 1,2,3,...T$. DI_{it} *(DOMESTIC INVESTMENT)* is dependent variable. X_{it} is a k x 1 vector of explanatory variables (*OFDI,TRADE,INFLATION and GDPG*). In this study, we have used net OFDI (% GDP), Trade (% GDP), GDP Growth (annual %), Gross capital formation (%GDP) and Inflation, GDP deflator (annual %).OFDI and GDP are measured in current US dollars. We have used Gross capital formation (%GDP) proxy for domestic investment. Inflation, GDP deflator (annual %) is used proxy for inflation. DI is the domestic investment of country i in year t; OFDI is outward foreign direct investment of the country i in year t; and ε_{it} is the error term. The starting period of this data set is determined by earliest availability of date of the data. We used the net OFDI rather than the gross OFDI because the gross FDI figures reflect the sum of the absolute outflow and inflow values in the balance of payment financial accounts, and thus do not take into account disinvestment. Because the net outflows have negative values in some years, it is not possible to use logarithms. Thus, it is common practice in research to use the net FDI as a percentage of the GDP to derive economically interpretable results. Data on the net FDI outflows as a percentage of the GDP is taken from the UNCTAD FDI database. GDP, Trade (% GDP), GDP Growth (% annually), Gross capital formation (% GDP) and Inflation, GDP deflator (annual %) are taken from World Bank, World Development indicators Database. The sample consists of thirteen world major economies over the time period of 1970-2013.These countries are chosen because these are among the major OFDI suppliers in the world according to UNCTAD data. The countries included are Argentina, Australia, Brazil, Canada, France, India, Italy, Japan, Mexico, South Africa, South Korea, United Kingdom and the US. The list of world major economies that are not included because of missing data are China, Germany, Indonesia, Russia, Saudi Arabia and Turkey.

3. Results

3.1 Panel unit root tests

We first estimated Equation (1). Levin et al. (2002) and Im et al. (2003) panel unit root tests suggest that our variables OFDI, DI and TRADE are non-stationary at levels and stationary at the first difference. OFDI, DI and TRADE are I(1) but GDP GROWTH(GDPG) and INFLATION are I(0). Thus, Our variables are not integrated of same order. Some variables are I(1) or I(0). To avoid the problem associated with conflicting results provided by conventional unit root tests-such as Levin *et al.* (2002) and Im *et al.* (2003) -When these tests are used jointly,

we use ARDL testing approach for co-integration in this study We use the Panel ARDL testing approach to co-integration developed by Pesaran(1997), Pesaran and Shin (1999) and Pesaran *et al*. (2001) to test for the existence of a long-run relationship. This test is based on autoregressive distributed lag (ARDL) framework. It is used here because Pesaran and Shin (1999) show that the OLS estimators of ARDL parameters are $\sqrt{n}$-consistent, where *n* is sample size and the estimators of the long-run coefficients are super-consistent in small sample sizes. Furthermore, this approach can be used irrespective of whether the variables are *I*(1), *I*(0) or mutually co-integrated. Due to low power and other problems associated with other cointegration techniques, the ARDL approach to cointegration has become popular in recent years. Many unit root tests are available. In this study, I have used only two of them, Levin et al. (2002) and Im et al. (2003). The results of unit root tests are reported in Table 1.Due to the confirmatory data analysis, the Levin et al. (2002) and Im et al. (2003) are performed jointly. Both tests are performed with intercept and no trend. The number of lags are selected based on Schwarz Information Criterion (SIC).

Table1. Panel unit root tests for dependent and independent variables

Unit root procedure	LLC	IPS	LLC	IPS
	Levels		First differences	
OFDI	3.9	1.77	-5.76***	-15.98***
	(1.00)	(0.96)	(0.00)	(0.00)
DI	-0.98	-1.13	-22.95***	-20.44***
	(0.16)	(0.12)	(0.00)	(0.00)
INFLATION	-4.26***	-4.61***	-18.95***	-19.55***
	(0.00)	(0.00)	(0.00)	(0.00)
GDP GROWTH	-16.20***	-14.37***	-23.74***	-25.74***
	(0.00)	(0.00)	(0.00)	(0.00)
TRADE	-0.31	1.28	-22.83***	-20.83***
	(0.37)	(0.90)	(0.00)	(0.00)

Notes: LLC, Levin, Lin and Chu; IPS, Im, Pesaran and Shin; p-values are in parentheses;***, ***, * indicate that the null hypothesis is rejected at 1, 5 and 10 percent, respectively.

To avoid the problem associated with conflicting results provided by conventional unit root tests-such as Levin *et al.* (2002) and Im *et al.* (2003) –Therefore, we use ARDL testing approach for co-integration in this study. We find multivariate long-run relationship between OFDI and DI by adding INFLATION, TRADE and GDP GROWTH (GDPG) as control variables in order to capture the country specific effects.

3.2. The PMG, MG AND DFE ESTIMATION METHODOLOGY

After testing the variables for stationarity, we apply recently developed dynamic panel data methodology. Pesaran et al. (1999) suggest two different estimators which are consistent when both T and N are large. The difference between these two different estimators is that pooled mean group estimator is consistent under assumption of long-run slope homogeneity while mean group estimator is more consistent under the assumption that both slope and intercepts are allowed to vary across country. An alternative estimator being set up under the assumption of homogeneity slope is dynamic fixed effects (DFE), in which slopes are fixed and the intercepts allow to vary across country. According to the study of Pesaran and Shin (1997), the following basic ARDL (*p;q*) model will be considered as main equation;

$$DI_t = \alpha_0 + \sum_{j=1}^{p} \lambda_{ij}\, DI_{i,t-j} + \sum_{j=0}^{q} \delta_{ij}^{`}\, X_{i,t-j} + \mu_i + \varepsilon_{it} \quad (2)$$

Where the number of groups $i = 1,2,\ldots N$; the number of periods $t = 1,2,\ldots\ldots, T$. X_{it} is a k x 1 vector of explanatory variables(*OFDI,TRADE,INFLATION,GDPG*); δ_{ij} are the k x 1 coefficient vectors; λ_{ij} are scalars*; and* μ_i is the group specific effect.

$$\Delta DI_{it} = \varphi_i(DI_{i,t-1} - \varphi^{`} X_{it}) + \sum_{j=1}^{p-1} \lambda_{ij}^{*} \Delta DI_{i,t-1} +) + \sum_{j=0}^{q-1} \delta_{ij}^{`*} \Delta X_{i,t-j} + \mu_i + \varepsilon_{it} \quad (3)$$

Where $\phi_i = -(1-\sum_{j=1}^{p} \lambda_{ij})$, $\theta_i = \sum_{j=0}^{q} \delta_{ij} / (1-\sum_k \lambda_{ik})$, $\lambda_{ij}^{*} = -\sum_{m=j+1}^{p} \delta_{im}$ $j=1,2,\ldots\ldots,p-1$.

and $\delta_{ij}^{*} = -\sum_{m=j+1}^{q} \delta_{im}$ $j=1,2\ldots\ldots\ldots,q-1$.

The parameter ϕ_i is the error-correcting speed of adjustment. If $\phi_i=0$, then there will be no evidence for long-run relationship. This variable is expected to be significantly negative so that variables show a return to long-run equilibrium. $\varphi^{`}$vector is of particular importance which contains the long run relationships between the variables. Pesaran, Shin, and Smith (1997, 1999) have proposed a PMG estimator that combines both pooling and averaging. This intermediate estimator allows the intercept, short-run coefficients, and error variances to differ across groups (as would the MG estimator) but constrains long-run coefficients to be equal across groups

(as would the FE estimators). Since equation (2) is nonlinear in the parameters, Pesaran, Shin and Smith (1999) develop a maximum likelihood method to estimate the parameters. Expressing the likelihood ass the product of each cross-section's likelihood and taking log yields (Blackburne III and Franke, 2007).

PMG estimator is used instead of Three Stage Least Squares (3SLS) and General method of Moments (GMM) because PMG is an intermediate estimator which involves pooling and averaging. This estimator allows the intercepts, short run coefficients, and error variances to vary across country, but constrains the long-run coefficients to be same (Pesaran et al., 1999) Furthermore, it has advantages over OLS and especially DOLS since it allows for differences in the countries for the short run dynamics. Long-run coefficients are constrained to be same.MG estimation method proposed by Pesaran and Smith (1995) is obtained from autoregressive distributed lag models for each unit consisting of (ARDL) long-term average by using coefficients of the long-term. The economy policies show their effects on application of macro and micro variables after a delay of specific time period. For instance, increase in interest rate or inflation will show its effect in economy after some time period. Thus in this study, ARDL method, which is a cointegration technique and introduced by Pesaran and Shin (1997) and Pesaran, Shin and Smith (2001), was used to analyze lagged values. We follow model specified by Pesaran et al. (1999) assuming one as optimal lag. We consider common ARDL (1,1,1,1,1) specification for all countries based on Schwarz Information Criterion (SIC).. That specification is reliable with strong balanced panel and large T. The data we use meet these assumptions.

3.3 THE PMG AND MG ESTIMATION RESULTS

The results of PMG and MG are given in table 2.Table 2 shows result of Hausman test conducted in order to test the hypothesis of the long run elasticity. Hausman test was also conducted to test the homogeneity in the long run. Results of Hausman test in Table 2 do not reject the null hypothesis. Thus, we conclude that Pooled Group Mean Estimation (PMG) is valid estimator. The results of pooled mean group estimator show that outward foreign direct investment (OFDI) has positive and significant impact on domestic investment in the long-run. PMG long-run coefficient results show that one dollar increase in outward foreign direct investment increases domestic investment by 0.49 dollars. The other control variables (TRADE and GDPG) have positive and highly significant effect on domestic investment in the long-run .i.e. (1 % increase in TRADE results in 0.19 % increase in domestic investment and 1% increase in GDP Growth (GDPG) results in 2.17 % increase in domestic investment).The results of error correction model in Table 3 suggest that there is positive but insignificant impact of outward FDI, TRADE and GPDG on domestic investment in short run. INFLATION has positive and significant impact on domestic investment in short run. Our result findings suggest that foreign direct investment outflows along with macroeconomic control variables have positive and significant impact on domestic investment in the long run using pooled mean group and dynamic fixed effect estimators.

Table 2. Pooled mean group (PMG) and mean group (MG) estimates

	PMG estimates		MG estimates		Hausman Test
	Coefficient	t-ratio	Coefficient	t-ratio	P-Value
OFDI	0.4875***	2.41	-0.2650	-0.35	
TRADE	0.1934***	4.64	-0.2329	-1.10	Prob> Chi2=0.4634
INFLATION	0.0004	0.13	-0.0061	-0.02	
GDPG	2.7174***	9.34	-4.7174	-1.33	

***,** and * indicate significance at 1%, 5% and 10% level of significance.

Table 3. ECM for pooled mean group and mean group estimates

	PMG estimates			MG estimates		
	Coefficient	S.E.	t- ratio	Coefficient	S.E.	t-ratio
DOFDI	0.2705	0.1744	1.55	0.0880	0.2199	0.40
DTRADE	0.0068	0.0231	0.30	0.0094	0.0210	0.44
DINFLATION	0.0609***	0.0231	2.63	0.0504***	0.0195	2.58
DGDPG	0.0486	0.0317	1.53	0.0096	0.0260	0.37
ECT	-0.1220***	0.0148	-8.19	-0.1971***	0.0638	-3.09
CONSTANT	0.5673***	0.0156	3.74	1.5389	1.2870	1.20

***,** and * indicate significance at 1%, 5% and 10% level of significance.

3.4. DFE AND MG ESTIMATION RESULTS

The results obtained from dynamic fixed effects (DFE) and mean group (MG) estimators are reported in table 4.With respect to those provided by pooled mean group estimates, the results of DFE again satisfy the theoretical assumptions. Hausman test was conducted to test the homogeneity in the long run. Results of Hausman test in Table 4 do not reject the null hypothesis. Thus, we conclude that dynamic fixed effect (DFE) is valid estimator.

The results of dynamic fixed effect estimator show that OFDI has positive and highly significant impact on domestic investment in the long-run .i.e. (One dollar increase in outward FDI increases domestic investment by 0.87 dollars). The macroeconomic control variables (TRADE and GDPG) have positive and highly significant effect on domestic investment in the long-run .i.e. (1 % increase in TRADE results in 0.16 % increase in domestic investment and 1% increase in GDP Growth results in 2.85 % increase in domestic investment).The dynamic fixed effect (DFE) result findings are highly robust and not significantly different from those obtained with Pooled Mean Group estimator. The results of error correction model reported in Table 5 are not significantly different from those obtained previously with Pooled Mean Group estimator. Dynamic fixed effect result findings also support positive and significant impact of foreign direct investment outflows along with macroeconomic control variables on domestic investment in the long run.

Table 4 Dynamic fixed effects (DFE) and mean group (MG) estimates

	DFE estimates		MG estimates		Hausman Test
	Coefficient	t-ratio	Coefficient	t-ratio	P-Value
OFDI	0.8663***	1.96	-0.2650	-0.35	
TRADE	0.1562***	2.81	-0.2329	-1.10	Prob> Chi2=0.5183
INFLATION	0.0011	0.45	-0.0061	-0.02	
GDPG	2.8489***	6.49	-4.7174	-1.33	

***,** and * indicate significance at 1%, 5% and 10% level of significance.

Table 5. ECM for dynamic fixed effect and mean group estimates

	DFE estimates			MG estimates		
	Coefficient	S.E.	t-ratio	Coefficient	S.E.	t-ratio
DOFDI	0.0216	0.1744	1.55	0.0880	0.2199	0.40
DTRADE	0.0170	0.0231	0.30	0.0094	0.0210	0.44
DINFLATION	0.00002	0.0231	2.63	0.0504***	0.0195	2.58
DGDPG	-0.0080	0.0317	1.53	0.0096	0.0260	0.37
ECT	-0.1139***	0.0148	-8.19	-0.1971***	0.0638	-3.09
CONSTANT	0.6044***	0.0156	3.74	1.5389	1.2870	1.20

***,** and * indicate significance at 1%, 5% and 10% level of significance.

Pairwise Dumitrescu Hurlin Panel causality test

In Table 6, the causality of the relationship between Outward FDI, *TRADE, INFLATION and GDPG* and domestic investment is analyzed by Pairwise Dumitrescu Hurlin Panel causality tests. Having determined the results of the table 6, we reject the null hypothesis H_0 .We conclude that there is causality running between foreign direct investment outflows(OFDI) and domestic investment(DI). In Table 6, result findings also confirm that there is bi directional causality running between Domestic investment (*DI*) and TRADE, Domestic investment (*DI) and* GDPG, as well as Domestic investment and INFLATION. Thus, there is pairwise causality running between the variables as reported in Table 6.

TABLE 6: Pairwise Dumitrescu Hurlin Panel Causality tests (Sample: 1970-2013, lags: 1)

Null Hypothesis:	W-Stat.	Zbar-Stat.	Prob.
OFDI does not homogeneously cause DI	0.497	-1.292	0.1961
DI does not homogeneously cause OFDI	2.781	4.022	0.0006
TRADE does not homogeneously cause DI	1.637	1.361	0.1734
DI does not homogeneously cause TRADE	1.525	1.100	0.2711
INFLATION does not homogeneously cause DI	2.886	4.267	0.0002
DI does not homogeneously cause INFLATION	2.580	3.555	0.0004
GDPG does not homogeneously cause DI	2.611	3.626	0.0003
DI does not homogeneously cause GDPG	4.736	8.572	0.0000
TRADE does not homogeneously cause OFDI	4.204	7.335	2.E-13
OFDI does not homogeneously cause TRADE	2.932	4.375	1.E-05
INFLATION does not homogeneously cause OFDI	1.679	1.459	0.1446
OFDI does not homogeneously cause INFLATION	1.215	0.377	0.7055
GDPG does not homogeneously cause OFDI	0.889	-0.378	0.7048
OFDI does not homogeneously cause GDPG	3.898	6.621	4.E-11
INFLATION does not homogeneously cause TRADE	1.917	2.013	0.0441
TRADE does not homogeneously cause INFLATION	2.102	2.442	0.0146
GDPG does not homogeneously cause TRADE	1.161	0.25329	0.8000
TRADE does not homogeneously cause GDPG	4.624	8.31232	0.0000
GDPG does not homogeneously cause INFLATION	6.514	12.7092	0.0000
INFLATION does not homogeneously cause GDPG	1.174	0.28440	0.7761

4. Conclusion

This paper has examined long run impact of outward foreign direct investment flows along with macroeconomic control variables on domestic investment among world major economies over time span 1970-2013 .Economic policies show their effect on the application of macro and micro variables after a delay of some time span. For instance, investment made today will show its effect in the future periods or increase in interest rate will show its effect in the economy in future periods. Therefore, this paper is used to analyze lagged values of Panel ARDL approach proposed by Pesaran, Shin and Smith (2001) and Pesaran and Shin (1997). Our pooled mean group (PMG) estimator results show that one dollar increase in OFDI results in increase of domestic investment by 0.49 dollars in the long run. Dynamic fixed effect (DFE) result findings also strongly support positive impact of OFDI on domestic investment .i.e. (one dollar increase in OFDI results in increase of domestic investment by 0.87 dollars). Following the explanation by Desai et al (2005) and Herzer and Schrooten (2008), our estimated results suggest that higher OFDI is associated with higher level of domestic investment in world major and dynamic economies. Thus, decision to invest scarce resources abroad boosts domestic investment among large and dynamic economies where foreign direct investment outflows are very high. In sum, our result findings strongly comply with Desai et al (2000), which suggest that OFDI is highly positively associated with domestic investment when FDI outflows are high. Our pooled mean and dynamic fixed effect result findings strongly suggest that foreign direct investment outflows along with macroeconomic control variables (TRADE and GDP Growth) have positive and significant impact on domestic investment in the long run among world major economies.

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