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U. S. OUTWARD FOREIGN DIRECT INVESTMENT, SKILLS AND KNOWLEDGE-BASED ASSETS: DYNAMIC PANEL MODEL

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Abstract

This paper estimates a model of outward foreign direct investment (FDI) that includes endogenous knowledge variables based on U.S. manufacturing, finance, and service. The headquarter R&D activity of multinational companies (MNCs) quite naturally turns out to be a key variable determining outward FDI. Interestingly, the results illustrate that host-country R&D activities have a negative correlation with U.S. outward FDI. Skill differentials play a significant role in the manufacturing and service sectors but with different signs of the estimated coefficients. The results show structural differences among the industrial sectors and highlight the role played by policy target variables thereby revealing interesting policy implications.

Keywords: *Dynamic Panel Model, empirical analysis, FDI outflows, knowledge capital, R&D, wage differentials, skill differentials, United States.*

I. INTRODUCTION

US foreign direct investment (FDI) increased dramatically over the last decade, growing from $1,215 billion in l999 to $3,508 billion in 2009, a net increase of 189% (see Table 1). In comparison, between 1999 and 2009, aggregate U.S. exports expanded by 63% from $966 billion to $1,571 billion.[1] Dramatic changes occurred in the regional distribution of U.S. outward FDI as well (see Table 2). In 2009, Europe received 56% of U.S. outward FDI followed by Latin America and the Asian-Pacific region with 19% and 15%, respectively. During the same period (2009), Africa (1.3%) and the Middle East (1.1%) received the smallest shares of U.S. FDI outflows. Within the Asian-Pacific countries Australia (3.03%), Japan (2.95%), Singapore (2.19%), Hong Kong (1.44%), and China (1.41%), received the largest shares respectively.

Growth rates of outward FDI varied substantially as well among the regions (see Table 2). For example, U.S. outward FDI to the Asian-Pacific region grew at an annual rate of 16.83% between 1999 and 2009; with China and India exhibiting

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annual rates of 42.55% and 67.87% respectively. In contrast, FDI to the more developed Asian-Pacific economies of Australia (20.06%), Hong Kong (12.17%), Japan (8.80%), and New Zealand (2%) grew more slowly. While the growth of FDI to the whole of Africa (24.15%) and the Middle East (23.80%) has risen overtime, the absolute magnitudes are still minute relative to other regions. Furthermore, U.S. outward FDI to India and China grew by 679% and 426% respectively between 1999 and 2009 period, a dramatic increase; in Dollar terms, it grew by $16.2 billion and $40 billion respectively over the same period. Ongoing market-oriented liberalizations, particularly with respect to FDI policies, as well as domestic economic growth and macroeconomic stability in the latter two countries may account for the exceptional growth of U. S. FDI to the latter countries. In addition, both countries, who are members of the World Trade Organization (India since l995, and China since 2001), had liberalized FDI policies to meet the membership requirements.

The growth in U.S. outbound FDI creates policy dilemmas for both the source and recipient countries. For example, the literature describes both social benefits and costs associated with the rapid expansion of outbound FDI. MNCs engage in FDI activities at strategic location to consolidate long-term and short-term economic benefits. They can benefit from improved efficiency through the exploitation of economies of scale and lower input costs; from market access in locations where the size of the market, the rate of growth of the market, the proximity of the market to other markets are important; and from improved access to essential resources. Furthermore, outward FDI can provide enhanced global networking, and global vision. Nevertheless, outward FDI may divert new investment from the source country to host countries thereby reducing the potential for future domestic growth and employment opportunities. There are also fears expressed by some (Cowling and Tomlinson, 2000) that increased overseas production may result in the abandonment of a source country's input supply chain, leading to a "hollowing-out" of domestic industries.[2]

FDI's impact on a recipient depends on the country's capacity to assimilate the outside investment into the country's economic, social, judicial, and cultural infrastructure. Inflows of FDI have the potential to raise the demand for labor, facilitate the transfer of advanced technology, and stimulate economic growth. However, bottlenecks caused by inadequate human capital and infrastructure, regulatory, and cultural barriers can reduce these potential benefits. Detrimental employment and growth effects can also occur if foreign investment crowds out local firms resulting in job losses, and reductions in domestic investment.

Concerns about the balance between the benefits and costs of FDI have intensified interest in identifying the factors inducing outbound FDI and feasible policy options that might be used to maximize global benefits. Our study focuses on U.S. outward FDI in the context of a formal FDI function. The reduced-form equation of Barrell and Pain (1996) specifies FDI as a function of demand and factor prices. Our study extends their seminal contribution by (a) considering the impacts of endogenous technology and skill differentials on outward FDI, and (b) estimating

the outward FDI model for more sectors. The inclusion of knowledge-based variables in the outward FDI function incorporates the ideas advanced by Dunning (1988), Grossman and Helpman (1991), and Krugman (1995). We show that a) headquarter R & D activities and agglomeration are robust and key to U.S. outward FDI, b) host R & D activities are negatively correlated with U.S. outward FDI, c) the correlation of relative skill endowments with outbound FDI vary sector, (c) wage differentials are correlated with MNCs location decisions, but the result is not robust to changes in model specification, and (d) some MNC location decisions vary by sector. Our findings confirm some commonly held views on the motivations for US outward FDI; nevertheless, they also yield some surprising new insights and subtle policy implications.

Table 1
U. S. Foreign Direct Investment Abroad: 1999-2009
(Historical Cost Basis, Billions of Dollars)

2009	*Total*	*Mining*	*Manu-facturing*	*Whole-sale*	*Informa-tion*	*Finance*	*Services*	*HC*	*Others*
All Countries	3508.1	171.1	541.1	199.0	149.8	747.0	77.5	1279.9	342.7
Canada	259.8	18.8	65.0	21.8	6.4	43.0	5.7	58.2	40.9
Europe	1976.2	47.3	284.8	102.4	103.9	363.9	48.9	824.5	200.5
Latin America	678.9	39.8	69.8	32.9	10.3	220.2	2.3	286.7	16.9
Africa	44.8	25.0	3.5	1.3	0.2	2.4	0.4	7.8	4.2
Middle East	37.0	7.2	12.5	2.2	1.7	0.7	1.3	10.4	1.0
Asia	511.4	32.9	105.3	38.3	27.4	116.7	18.9	92.3	79.6
China	49.4	3.6	22.6	2.9	0.5	1.8	0.6	3.9	13.5
India	18.6	0.7	3.6	0.8	3.8	2.7	3.1	0.2	3.7
1999	*Total*	*Mining*	*Manu-facturing*	*Whole-sale*	*Informa-tion*	*Finance*	*Services*	*HC*	*Others*
All Countries	1216.0	72.5	327.3	86.3	50.1	239.6	30.0	*	387.7
Canada	119.6	11.9	47.7	8.1	2.4	27.2	1.2	*	20.0
Europe	627.8	21.0	163.5	47.4	32.9	89.5	15.1	*	250.2
Latin America	253.9	14.8	52.2	10.8	6.2	73.8	3.8	*	88.3
Africa	13.1	8.1	2.1	0.7	n.a.	n.a.	0.2	*	0.3
Middle East	11.0	2.0	3.6	0.3	n.a.	n.a.	1.1	*	1.8
Asia	190.6	14.7	58.3	18.9	6.2	47.8	8.6	*	27.0
China	9.4	0.8	5.8	0.4	0.0	0.0	0.3	*	2.1
India	2.4	-0.3	1.2	0.3	0.0	0.0	0.1	*	1.1

n.a. indicates not available. HC denotes nonbank holding companies.

* means that the data is included in the *Other* category. *Other* comprises all categories not listed in the table including depository institutions.

Table 2
U.S. Foreign Direct Investment Abroad (Historical Cost Basis)

Regions and Countries	*1999 (Billion $)*	*2009 (Billion $)*	*1999-2009 Percent Change*	*1999-2009 Annual Percent Change*	*Share in 2009 U.S. Outbound FDI (%)*
All Countries	1215.96	3508.14	188.51	18.85	
Africa	13.12	44.81	241.55	24.15	1.28
Canada	119.59	259.79	117.24	11.72	7.41
Europe	627.75	1976.22	214.81	21.48	56.33
Latin America	253.93	678.96	167.38	16.74	19.35
Mid East	10.95	37.01	238.01	23.8	1.06
Asia-Pacific	190.62	511.36	168.26	16.83	14.58
Australia	35.39	106.37	200.60	20.06	3.03
China	9.40	49.40	425.51	42.55	1.41
Hong Kong	22.76	50.46	121.71	12.17	1.44
India	2.39	18.61	678.66	67.87	0.53
Indonesia	8.40	16.01	90.49	9.06	0.46
Japan	55.12	103.64	88.03	8.80	2.95
Korea	7.47	26.95	260.62	26.08	0.77
Malaysia	6.22	13.49	116.75	11.69	0.38
New Zealand	4.85	5.82	19.87	2.00	0.17
Philippines	3.52	5.81	65.08	6.51	0.17
Singapore	20.67	76.86	271.94	27.18	2.19
Taiwan	6.74	19.53	189.65	18.98	0.56
Thailand	5.50	10.21	85.62	8.56	0.29
Other	2.19	8.20	274.38	27.44	0.23

Source: Columns 3 and 4 gathered from the U.S. Bureau of Economic Analysis; Columns 4-5 computed using data in columns 2 and 3.

II. RELATED STUDIES

An early study by Mundell (1957) determined that FDI tended to flow from countries with relative capital abundance to countries with relative capital scarcity. He concluded that factor endowments determine the pattern of FDI flows. Subsequently, Behrman (1972) expanded Mundell's model by adding more explanatory variables. According to Behrman, resource endowments, efficiency in resource usage, profitability of markets, and strategic location of the recipient country determine the flow of FDI. More recent studies, such as Dunning (l988), Grossman and Helpman (1991), Krugman (1995), Markusen (l995), and Venables (1996) augment the factor-endowments model with variables related to imperfect competition and the benefits of agglomeration. These studies emphasize the role of knowledge-based,

firm-specific assets in outward FDI flows. To Dunning, a combination of location and firm-specific ownership advantages determine the amount of foreign investment undertaken by MNCs. Location advantage comprises factor endowments and the ease of market access in the recipient country. Firm-specific ownership (monopolistic) advantages include such internally exploitable factors as trademarks, patents, and managerial skills that give MNCs a competitive advantage over firms in the recipient country.

Other studies recognize several additional factors influencing FDI. For instance, Feentra and Hanson (1997) suggest that low labor costs determine FDI. In contrast, Fung, *et al.* (2000) and Mody, *et al.* (1998) found no relationship between the two. Janicki and Wunnava (2004) show that trade openness, country risk, labor costs, and market size influence FDI. The impact of trade openness was also investigated by Katayama *et al.* (2005) and Park (2003) who show a negative relationship. Pantelidis and Kyrkilis (2003) suggest that market size (measured by real GDP) is one of the most important determinants of outward FDI for countries in the European Union; Mody and Krinsha (1998) exhibit a statistically significant relationship between market size and Japanese outward FDI while Kimino *et al.* failed to confirm this relation.

The studies by Love (2003), Love and Lage-Hidalgo (2000), and Barrell and Pain (1996) focus exclusively on U. S. outward FDI. Love found little support for the technology-sourcing hypothesis. Love and Lage-Hidalgo concluded that market size and relative factor costs determine U. S. investment in Mexico. Barrell and Pain found demand, labor cost, cost of capital, and exchange rates to be the primary determinants of U. S. outward FDI. While past attempts to elucidate the determinants of outward FDI have produced important insights, as noted in the discussion above, much ambiguity still remains. This paper attempts to clarify some of these issues by building on the work of Barrell and Pain (l996). Specifically, we use the conceptual framework advanced by Dunning (l988), Grossman and Helpman (1991), and Krugman (1995) to incorporate endogenous technology and skill differentials into a Barrell-Pain-type model.

III. FDI WITH ENDOGENOUS TECHNOLOGY

Our starting point is a multinational firm (MNC) that undertakes foreign direct investment in order to maximize the present value of its net worth. The firm faces downward sloping demand functions in both the home and recipient countries. Production occurs in both the home and recipient countries as expressed in equations (1) and (2).

$$Y_1 = AK^{\beta} (S_1 L_1)^{1-\beta} \tag{1}$$

$$Y_2 = AN^{\beta} (S_2 L_2)^{1-\beta} \tag{2}$$

where Y, A, K, S and L represent output (income), factor productivity, capital, skill endowments, and labor respectively. N is capital financed by FDI for use in the recipient country; it is equivalent to the stock of FDI in the recipient country. The

subscripts 1 and 2 denote the production and input values in the source and recipient countries, respectively. The factor productivity variable A is determined endogenously by knowledge-based assets created by the MNC as well as by knowledge accessed in host countries through its subsidiaries. What Dunning (1988), Grossman and Helpman (1991), Krugman (1995), Markusen (l995), and Venables (1996) refer to as firm-specific, knowledge-based assets can be applied to additional MNC affiliates with negligible additional costs. Patents, trademarks, superior technology, and organizational systems are examples of knowledge-based assets.

R&D activities by MNCs, both at headquarter and in the recipient countries, allow multinational firms to enhance the productivity and efficiency of their organizational systems. The MNC affiliates conduct R&D activities for various reasons including, but not limited to, the adaption of products and production processes to local conditions, and compliance with local regulations. Moreover, some studies (Cantwell and Piscitello, 2005; Love, 2003; Keller, 2002; Zanfei, 2000) find that outward FDI is motivated by the desire to acquire recipient-country technical capabilities and to gain strategic advantages from knowledge spillovers. We assume the knowledge-based productivity factor, A, is determined by the R&D activities of the parent company (R_1), its affiliate(s) in the recipient country (R_2), and R&D activities of recipient-country firms as well as other research entities in the host country (R_3). Thus,

$$A = A\left(\overset{+}{R_1}, \overset{+}{R_2}, \overset{+}{R_3}\right) \tag{3}$$

where the plus signs over the covariates indicate the direction of the partial derivatives with respect to A. Expressions (4) and (5) show the total cost functions for operations in home and recipient countries.

$$C_1 = W_1 L_1 + \upsilon_1 K \tag{4}$$

$$C_2 = W_2 L_2 + \upsilon_2 N \tag{5}$$

where C, W, and υ are total costs of production, wage rate, and price of capital (opportunity cost). The subscripts 1 and 2 signify the source and recipient countries, respectively. Equation (6) expresses the MNC's profit function (π).

$$\pi = \sum_{i=1}^{2} P_i Y_i - (W_1 L_1 + \upsilon_1 K + W_2 L_2 + \upsilon_2 N),\ i = 1,2 \tag{6}$$

where the P_i's are the product prices in source and host countries which depend on the demand functions in the two markets, $P_i = P_i(Y_i)$. $P_i(Y_i)Y_i$ is total revenue in the respective markets. Substituting equations (1) and (2) into equation (6) and differentiating it with respect to each of factor (L_1, K, L_2, and N) allows us to generalize the FDI function in terms of the normalized input prices and the remaining variables of the system as,

$$N = N(A, S_i, w_i, r_i), \quad i = 1, 2, \tag{7}$$

where $w_i = \frac{W_i}{P_i}$, and $r_i = \frac{\upsilon_i}{P_i}$.[3]

Expressing equation (7) in terms of relative skill, and input costs:

$$N = N(A, s^*, w^*, r^*) \tag{8}$$

where $s^* = s_2/s_1$, $w^* = w_2/w_1$, and $r^* = r_1/r_2$.

Substituting the value of A from (3) in (8), we get:

$$N = N(\overset{+}{R_1}, \overset{+}{R_2}, \overset{?}{R_3}, \overset{?}{s^*}, \overset{-}{w^*}, \overset{?}{r^*}) \tag{9}$$

where the signs over the covariates indicate the direction of the partial derivatives with respect to N, and ? implies ambiguity about the direction of change. Outward FDI is expected to increase with an increase in headquarters' and affiliates' knowledge-seeking activities (R_1 and R_2). The impact of knowledge-seeking activities by recipient-country agents (R_3) on U.S. outward FDI is difficult to predict. On the one hand, such activities enhance the knowledge base of an MNC affiliate through technology sourcing, thereby improving the productivity of the MNC; on the other hand, it is possible that an increase in a recipient-country's productivity and innovative prowess may dampen the need for inward FDI into the host country. Outward FDI is expected to fall with a rise in the wage differentials, w^*; i.e. a lower wage in host economies relative to source country wages is expected to increase outward FDI. A rise in the source interest rates relative to host interest rates, r^*, is expected to raise the opportunity cost of outbound FDI as well as cost of raising capital (from the source financial institutions) thereby reducing the level of outward FDI. However, for multinationals that raise funds from the financial institutions of host countries, a lower cost of borrowing in host economies (a rise in r^* as r_2 falls) could stimulate outbound FDI from source countries.

The skills differentials variable (s^*) indicates the level of host-country skill relative to the level of source-country.[4] The relationship between skill abundance and outward FDI raises the complex issue of factor intensities across different industries. For example, Yeaple (2003) notes that MNCs in skill-intensive sectors favor skilled-labor abundant host countries; but on the other hand MNCs in low skill intensive sectors prefer to invest in skill-scare countries. For this reason the parameter estimate of may s^* vary in sign among the economic sectors.

Equation (10) includes other factors that have been found to influence FDI decisions. The market size (y) of a recipient country has been found to have a positive influence on outward FDI. In this paper we use per capita real GDP of host countries relative to that of the U.S as a proxy for market size. Trade openness may have a negative or positive impact on FDI. Some times MNCs will be forced to undertake

outbound FDI in economies with high degree of trade restrictions to get around the restrictions; hence trade openness (T) and FDI are negatively correlated. On the contrary, in export-platform FDI, where the MNC affiliate exports most of its output to the global market MNC choose host countries with a greater degree of trade openness, reflecting a positive relationship between trade openness and FDI. Katayama *et al.* (2005), Janicki *et al.* (2004), and Park (2003) show that trade openness (*T*) reduces outward FDI.

$$N = N(\overset{+}{R_1}, \overset{+}{R_2}, \overset{?}{R_3}, \overset{?}{s^*}, \overset{+}{w^*}, \overset{?}{r^*}, \overset{+}{y}, \overset{?}{T}, \overset{+}{CC}, \overset{+}{N_{-1}}) \tag{10}$$

Furthermore, FDI is generally hampered by political instability, corruption, and inadequate enforcement of commercial laws.[5] For example, bribes to receive permits, licenses, or protection increase the cost of foreign investment. Corrupt agreements also increase risk when they are not enforceable in court. We postulate that FDI is positively related to an index of host country corruption containment (*CC*). Lastly, to account for the effect of agglomeration we include the lagged dependent variable in the model. We expect that MNCs cluster together to exploit agglomeration benefits. For example the data in Table 2 exhibits that Europe, already the largest recipient of U.S. FDI, was also the region with the largest gain in U.S. outward FDI in 2009.

IV. DATA AND METHODOLOGY

We approach outward FDI decisions from the prospective of three economic sectors: manufacturing, finance, and services. Finance excludes depository institutions. Services include information, professional, scientific and other services. The data sources for the variables listed in equation (10) are described in the appendix. We estimate the following equation:

$$N_{i,t} = \alpha N_{i,t-1} + X_{i,t}'\beta + \gamma_i + \varepsilon_{it} \tag{11}$$

where N is a measure of outbound FDI activity, X' is a vector of explanatory variables, the β is a vector of coefficients associated with X'. Respectively, γ_i and ε_{it} are disturbances associated with country specific effects and the error terms that vary across both countries and periods. With the exception of the interest rate variable, each variable is in natural log form. The lagged dependent variable makes the model a dynamic panel data model. The model was initially estimated applying a fixed effects method; the results obviously exhibited serial correlation. First, as discussed elsewhere in this paper, some of the explanatory variables in Equation (11) are not strictly exogenous suggesting that they are correlated with the error term. Second, the lagged dependent variable in the equation suggests serial correlation. GMM will be a more efficient estimator for this type of model (see Wooldridge, 2001 for details). We apply the Arellano-Bond type dynamic panel instruments. We use up to two lags of the R&D variables and one period lag of each remaining regressors, and a one period lag of expected profits[6] as instruments.

Orthogonal deviation transformation is used to remove the cross-section fixed effects, and a white weighting matrix to compute the weighting matrix.

Tables 3-5 exhibit the estimation results for the manufacturing, service, and finance sectors respectively. In each table, Columns 2 and 3 show the estimation results of the base model, and Columns 4 and 5 show the results of the model with the skill differentials. Data for the skill variable (S) were not available for all host countries; as a result it was omitted from the initial estimations (results of the base model). The estimations in Columns 4 and 5 were based on subsamples of host countries for which data on the skill variable were available.[7] The last two Columns of Tables 3 and 4 exhibit the results of the model specified using the overseas affiliate's value added as a proxy for outbound FDI activities. Since current FDI activities may not be captured in the gross stock of FDI measured on a historical cost basis, we included value-added by U.S. affiliates abroad as an additional measure of outbound FDI activities.[8] However, this additional measure of FDI activity is not applied for the finance sector because data on value-added was so spotty for this sector. The model is estimated using data for 30 host countries over the 1999-2006 period.[9] The estimation results are presented below.

V. ESTIMATION RESULTS

R&D Activities

Results of the base model (Columns 2 and 3 in Tables 3-5) show positive and significant correlation between headquarter R&D activities (R_1) and U.S. outward FDI (at the 1% level). The estimated coefficients range between 0.59 and 0.60 (see Table 3) for the manufacturing sector, 0.54 and 0.61 (see Table 4) for the service sector, and between 1.06 and 0.98 (see Table 5) for the finance sector. In addition, each remaining column in Tables 2-3 shows a positive and statistically significant coefficient for R_1. These results show that head-quarters' R&D activities play a key role in stimulating U.S. outward FDI. Furthermore, the findings suggest that R&D activities can serve as a policy target to enhance productivity and foster innovations. The estimated coefficients associated with U.S. affiliate R&D activities (R_2) abroad range between 0.20 and 0.19 (see Table 3) for the manufacturing sector (both significant at the 1% level), and 0.13 and 0.14 (see Table 4) for the service sector (both significant at the 5% level). These results are consistent with Gassmann and Han (2004) who argue that by off-shoring R&D, U.S. firms can access large pools of well-educated labor, adapt products to local needs and tastes, and tap foreign knowledge bases. However, the parameter estimate of affiliate R&D activities is not statistically significant for the finance sector probably suggesting that U.S. overseas affiliates in the financial sector are not engaged in large scale R&D activities. The results illustrate that host-country R&D activities (R_3) have a negative and statistically significant impact on U.S. outward FDI for each of the three sectors examined. The parameter estimates range between -0.19 and -0.23 (see Table 3) for the manufacturing sector (significant at the 1% level), between -0.25 and -0.23 (see Table 4) for the service (significant at the 1% level), and between -0.30 and -

0.26 (see Table 5) for the finance sector (significant at the 10% and 5% levels respectively). The negative relationships exhibited by these results run counter to the technology sourcing hypothesis (Cantwell and Piscitello, 2005; Keller, 2002; Zanfei, 2000) which envisions FDI as a means of expropriating recipient technology. The results rather may be indicating that increased level of host-country technological activities reduces demand for U.S. outbound FDI activities; this could result for example if the increased R&D activities improve the competitive edge of firms in host countries.

Table 3
Parameter Estimates of U.S. Outbound Foreign Direct Investment Activities: Manufacturing Sector*

	FDI Position Abroad				*Value Added Abroad*	
Variable	*-1*	*-2*	*-3*	*-4*	*-5*	*-6*
OFDI$_{-1}$	0.46	0.43	0.31	0.31	—	—
	(10.0)***	(9.66)***	(6.64)***	(6.53)***	—	—
Value_Added$_{-1}$	—	—	—	—	0.35	0.35
	—	—	—	—	(8.66)***	(8.79)***
Headquarter R&D	0.59	0.60	1.26	1.27	0.98	0.99
	(4.43)***	(5.69)***	(12.5)***	(12.8)***	(14.0)***	(14.9)***
Affiliate R&D	0.20	0.19	0.09	0.10	0.04	0.04
	(4.31)***	(4.43)***	(2.51)***	(2.46)**	-0.99	-1.09
Host R&D	-0.19	-0.23	-0.68	-0.69	-0.59	-0.59
	(2.11)**	(3.76)***	(5.81)***	(5.85)***	(8.71)***	(8.89)***
Wage	0.21	0.22	-0.12	-0.12	0.06	0.07
	(3.82)***	(4.70)***	(2.07)**	(2.22)**	-1.31	-1.42
Interest Rate	-0.01	-0.02	0.00	—	0.01	0.01
	(4.27)***	(5.51)***	-0.68	—	(3.12)***	(3.23)***
Market Size	0.59	0.73	1.68	1.70	1.58	1.60
	-1.25	(1.94)**	(7.07)***	(7.05)***	(7.40)***	(7.61)***
Trade Openness	-0.44	-0.32	-0.10	-0.14	0.04	—
	(1.89)*	(2.01)**	-0.86	-1.27	-0.4	—
Exchange Rate	0	—	-0.01	-0.01	-0.01	-0.01
	-0.82	—	(6.44)***	(7.78)***	(8.80)***	(9.46)***
Corruption Con	0.64	0.74	0.65	0.67	0.84	0.85
	(1.82)*	(2.84)***	(3.39)***	(3.44)***	(6.26)***	(6.36)***
Skill	—	—	0.13	0.14	0.21	0.21
	—	—	-1.5	(1.71)*	(3.09)***	(3.14)***
J-Statistic	22	23	71	70	70	70
Instrument Rank						
Panel Observations	29	29	80	80	80	80
	144	144	119	119	119	119

* Estimation Method: Panel GMM; white diagonal instrument weighting matrix, white period instrument weighting matrix, and white period standard errors & covariance (d.f. corrected). The ***, **, and * indicate statistical significance at the one, five, and 10% levels, respectively.

Table 4
Parameter Estimates of U.S. Outbound Foreign Direct Investment Activities: The Service Sector*

	FDI Position Abroad				*Value Added Abroad*	
Variable	*-1*	*-2*	*-3*	*-4*	*-5*	*-6*
$OFDI_{-1}$	0.69	0.65	0.57	0.59	—	—
	(10.58)***	(16.1)***	(8.46)***	(9.84)***	—	—
$Value\_Added_{-1}$	—	—	—	—	0.38	0.38
	—	—	—	—	(8.62)***	(9.23)***
Headquarter R&D	0.54	0.61	0.77	0.7	1.74	1.73
	(4.30)***	(6.33)***	(4.72)***	(5.79)***	(7.51)***	(9.06)***
Affiliate R&D	0.13	0.14	-0.07	-0.07	0.23	0.24
	(2.40)**	(2.41)**	-1.43	-1.35	(2.39)**	(2.57)***
Host R&D	-0.25	-0.23	-0.12	—	-0.32	-0.36
	(2.79)***	(3.18)***	-0.7	—	(1.67)*	(2.22)**
Wage	-0.13	-0.11	-0.2	-0.2	-0.15	-0.15
	(2.18)**	(1.98)**	(4.77)***	(4.53)***	-1.57	(1.67)*
Interest Rate	0.00	—	-0.002	—	-0.02	-0.02
	(0.10)	—	(0.82)	—	(2.55)***	(2.50)***
Market Size	0.36	—	0.87	0.71	-0.56	-0.54
	-0.82	—	(2.00)**	(1.93)**	-1.17	-1.3
Trade Openness	-0.10	—	0.34	0.28	-0.08	—
	-0.37	—	(1.99)**	(1.93)**	-0.31	—
Exchange Rate	-0.003	-0.003	-0.004	-0.004	-0.01	-0.01
	(2.45)**	(3.43)***	(2.98)***	(3.10)***	(4.56)***	(5.02)***
Corruption Con	-0.26	—	-0.83	-0.9	-0.07	—
	(0.82)	—	(2.67)***	(3.20)***	(0.17)	—
Skill	—	—	-0.74	-0.76	0.97	0.97
	—	—	(7.66)***	(8.55)***	(5.06)***	(6.77)***
J-Statistic	71	71	64	64	67	67
Instrument Rank						
Panel Observations	75	75	80	80	80	80
	119	120	104	104	119	119

*Estimation Method: Panel GMM; white diagonal instrument weighting matrix, white period instrument weighting matrix, and white period standard errors & covariance (d.f. corrected). The ***, **, and * indicate statistical significance at the one, five, and 10% levels, respectively.

Skill Differentials

The estimated coefficients of the skill differentials (level of host skill relative U.S. skill) are exhibited in Columns 4 through 7 (Tables 2 to 3). Skill differentials are positively correlated with U.S. manufacturing outbound FDI activities. The estimated coefficient ranges between 0.14 and 0.21 (see Table 3) suggesting that U.S. manufacturing outbound FDI is skilled labor seeking. Similarly, Columns 6

Table 5
Paremeter Estimates of U. S. Outbound Foreign Direct Investment Activities: The Finance Sector*

	FDI Position Abroad			
Variable	*(1)*	*(2)*	*(3)*	*(4)*
$OFDI_{-1}$	0.51	0.43	0.15	0.19
	(6.52)***	(6.42)***	(2.61)***	(3.40)***
$OFDI_{-2}$	1.06	—-	0.29	0.27
	—-	—-	(3.31)***	(3.51)***
Headquarter R&D	—	0.98	2.38	2.64
	(4.76)***	(4.96)***	-1.55	(2.80)**
Affiliate R&D	0.08	—-	0.08	0.18
	(0.96)	—-	(0.89)	(2.45)**
Host R&D	-0.30	-0.26	-1.02	-0.69
	(1.81)*	(2.33)**	(1.91)*	-1.22
Wage	-0.29	-0.24	0.35	-0.26
	(2.55)***	(1.99)**	-0.73	-0.86
Interest Rate	-0.03	-0.04	-0.01	-0.04
	(1.89)*	(3.25)***	-0.21	(3.52)***
Market Size	0.42	—-	0.25	—-
	(0.93)	—-	(0.11)	—-
Trade Openness	-0.05	—-	-0.32	-0.33
	(0.16)	—-	(0.38)	(0.68)
Exchange Rate	-0.002	-0.001	-0.01	-0.01
	(1.67)*	(5.55)***	-1.6	(1.68)*
Corruption Con	0.4	—-	2.23	1.7
	(1.07)	—-	(1.70)*	(2.24)**
Skill	—-	-0.04	0.45	0.38
	—-	(3.25)***	-0.56	-0.67
J-Statistic	60	71	12	16
Instrument Rank				
Panel Observations	75	77	24	26
	135	125	89	89

*Estimation Method: Panel GMM; white diagonal instrument weighting matrix, white period instrument weighting matrix, and white period standard errors & covariance (d.f. corrected). The ***, **, and * indicate statistical significance at the one, five, and 10% levels, respectively.

and 7 of Table 3 indicate that value added and skill differentials are positively correlated: a one percent rise in relative host skill is associated with 0.21% rise in the value added of U.S. affiliates abroad. The positive correlation between value added and host favorable skill differentials imply that a higher level of host country relative skill results in higher value added for U.S. multinationals abroad.

For the service sector, the coefficient of the skill differentials variable in Columns 4 and 5 (in Table 4) is negative (-0.74, and -0.76 respectively, each statistically

significant at the 1% level). The negative sign hints that the demand for U. S. professional, scientific and technical services decline as the host skill relative to U. S. skill improves. Columns 6 and 7 (Table 4) show that relative host country level of skill and value added are positively correlated; the estimated coefficient is 0.97 (significant at the 1% level). This contradictory sign on the coefficient of the skill differentials for the service sector may be suggesting that value added is not a very close proxy for FDI position but rather simply a result of the production technology of U. S. affiliates indicating a direct relationship skill. For the finance sector, the coefficient of the skill variable is not statistically significant; this result indicates that that the U.S. outbound financial services FDI is not motivated by skill differentials, but rather by other factors such as the exchange rate, interest rate differentials, and head quarter R&D activities.

These findings provide two major insights. First, where U. S. outward FDI is positively correlated with relative host level of skill, U.S. skilled and semi-skilled labor may face increased competition from workers in host countries. Second, policy authorities may target tertiary education and other skill enhancing programs as a long-term policy tool to influence U. S. FDI activities.

Control Variables

Wage Differentials: For the base model (Columns 2 and 3 of Tables 2-3), the estimated coefficients of the wage differentials (host country real wage rate relative to U. S. real wage rate) are positive significant for the manufacturing sector and negative and significant for the other two sectors. The positive coefficient sign is not as expected by the theory; however when skill differentials are introduced in the model, we got the expected sig n (in Columns 4 and 5) suggesting that the wrong sign may have been due to missing relevant variable. However, looking at the estimated coefficients of the wage differential in each of the tables and columns we can see that our empirical evidence does not support a robust relationship between wage differentials and U.S. outbound FDI activities. These results suggest that that other factors, rather than relative low wages in host countries play a more significant role in influencing U.S. outward FDI decisions. This result contradicts Feentra and Hanson (1997) but is consistent with Fung *et al.* (2000) and Mody *et al.* (1998).

Interest Rate Differentials: The base model estimates show that the coefficient of the Interest rate differentials (U.S. real interest rates relative to host real interest rates) are negative and statistically significant for the manufacturing and finance sectors (with coefficients that range between -0.01 to -0.02 for the manufacturing sector and -0.03 to -0.04 for the finance sector). The negative relationships indicate that U.S. multinationals see relative U.S. interest rates as an opportunity cost of outbound FDI in the latter to sectors (a rise in relative U.S. interest rate results in lower FDI). For the manufacturing sector, when we use value added as a measure of FDI activities, the coefficient of the interest rate differentials is positive. This is consistent with the theory that this variable is treated by multinationals as the cost of capital in production decisions. Table 4 shows that for the service sector, the

estimated coefficient of the interest rate differentials is not statistically significant in the base model (Columns 2 and 3), and the skills augmented model (Table 4, Columns 4 and 5); but, it is significant and negative (-0.02) in the model where value added is considered as the dependent variable (Columns 6 and 7). The negative coefficient suggests that indicating that a 1% rise in U.S. interest rates relative to host-country rates reduces U.S. outward FDI in this sector by 0.02%. Overall, the results show some relationship between interest rate differentials and outbound FDI activities, but the direction of influence is not universal. Policy aimed at influencing FDI activities have to pay special attention in using interest rates differentials as a policy tool as to its direction of influence and the sectors involved.

Market Size: Consistent with the findings of Barrell and Pain (1996), Chakrabarti (2001), and Yeaple (2003), our results suggest that market size attracts U.S. manufacturing outward FDIs; the coefficient is positive and statistically significant in each of the estimation but Column 3 (see Table 3). For the service sector the coefficient is positive, but is statistically significant only in Columns 4 and 5 (see Table 4). The results failed to confirm a statistically significant relationship between market size and U.S. outbound FDI; suggests that market size is not as important to the finance sector as it would be to the manufacturing and service sectors.

Trade Openness: In line with Katayama *et al.* (2005), Janicki, *et al.* (2004), Park (2003), and Yeaple (2003), the results of the base model suggest that trade openness () has a negative relationship with manufacturing outward FDI confirming the "tariff-jumping hypothesis." It implies that host-country trade restrictions motivate U.S. manufacturers to undertake outbound direct investments; this would be particularly true for host countries with large and growing markets. The estimated coefficients of trade openness in the base model are not statistically significant for the finance and service sectors. For the estimation results for the service sector is statistically significant while the remaining coefficients in Columns 4 through 5 (for each table) are statistically insignificant. Overall the results failed to exhibit a robust relationship between trade openness and outbound FDI.

Degree of Corruption Containment: Each of the coefficient estimates of the corruption containment index (*CC*) is positive and statistically significant for the manufacturing sector. Similar findings were presented by Habib and Zurawicki (2002). Similarly, the coefficient is statistically significant for the finance sector in the skill augmented model (Columns 4 and 5 in Table 5). These findings suggest that host-country policies aimed at limiting corruption may attract FDI inflows. The coefficient associated with the service sector in Columns 4 and 5 is statistically significant but the sign is not as expected by the theory. The negative sign implies corruption containment policies may discourage U.S. FDI inflows in the host countries.

Previous FDI Activity: For each sector the lagged value of FDI, , is statistically significant and positive confirming an agglomeration effect.

VI. SUMMARY AND POLICY IMPLICATIONS

The purpose of this study is to provide further evidence on the determinants of outward FDI. The study is unique in its consideration of the endogeneity of knowledge capital embedded in R & D activities combined relative skill endowments among countries. Moreover, in contrast to just focusing on the manufacturing sector, as other studies have done, this study examines the determinants of outward FDI for three sectors (manufacturing, finance, and services). This distinction is important because we found that the determinants of FDI vary by sector.

Our results reveal that headquarter R&D activities are the key driver of U.S. outbound FDI hinting their importance for technological leadership, productivity growth and innovations. The estimated coefficients for headquarters-R&D are robust to differences in sectors, sample size, and proxies used to measure outward FDI. These results suggest that headquarter R&D activities may serve as a useful policy instrument for influencing outward FDI and enhancing domestic technological progress. Our results call for short-term policies such as subsidies and tax incentives aimed at stimulating domestic R&D and long-term policies including investments in education and economic infrastructure aimed at enhancing R&D capabilities. Our policy recommendation is consistent with the America Competes Act of 2005 which targets education in science, technology, engineering and mathematics for the purpose of strengthening R&D capabilities.

We did not find a robust relationship between the R&D activities of U.S. overseas affiliate and U.S. outward FDI suggesting that the relatively significant R&D activities are undertaken mainly at the headquarter. Interestingly, the results of our base model, and a majority of the remaining results show that host-country R&D activities have a negative impact on U.S. outward FDI; these results imply that technological progress in host countries may reduce the demand for U.S. investment flows. Although it is not surprising for technology leaders such as the U.S., these results run counter to the technology-sourcing theory which posits that firms invest abroad to access host-country technology.

U.S. skill endowments play a significant role in U.S. outward FDI for the manufacturing and service sectors. The positive correlation between the skill differentials and manufacturing FDI suggests that U.S. skilled workers in the latter sector face overseas competition. For the service sector, the results exhibit a negative correlation between FDI and the relative host-country level of skill suggesting that the higher the relative skill of host workers, the lower would be the demand for the professional, scientific and technical services of U.S. multinationals in the host economy. The results indicate that policy authorities in both the host and source economies may target tertiary education and training projects to influence FDI flows. Although, not robust, our results support the hypothesis that relative host country labor costs and FDI are negatively correlated. Thus, host-country policies targeting international wage differentials may be effective in attracting U.S. FDI flows. In addition, our results also hint that relative interest rates and exchange

rates may be used as policy targets to influence FDI flows. The results underscore the importance of market size for the manufacturing FDI connoting that host-country policies aimed at expanding market access, for example through regional free trade arrangements, may succeed in attracting U.S. FDI flows. Our study failed to support a strong relationship between trade openness and U.S. outward FDI.

Finally, besides the short-run economic and efficiency gains, outbound FDI potentially provides enhanced global vision, and networking; these are crucial for long-term economic progress. On the other hand, there is also growing concern over its potential for "hollowing-out" U.S. domestic industry and the rise in the unemployment of U.S. workers. It is possible that as U.S. multinationals offshore their production, they also replace the domestic supply chain with host country supply chain thereby weakening the backward-forward linkages in the U.S. Further research is needed to study these potential negative impacts and the associated policy options.

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Appendix 1
Data Sources

Variable	*Proxy*	*Source for Raw Data*
U.S. Outbound FDI	U.S. FDI abroad; value added by U.S. affiliates abroad	BEA (2009). http://www.bea.gov/international/index.htm#iip
Headquarter R&D	Parent company R&D expenditures	BEA (2009). http://www.bea.gov/international/ii_web/timeseries1.cfm?econtypeid=1&dirlevel1id=2
Affiliate R&D	R&D expenditures of affiliates abroad	BEA (2009). http://www.bea.gov/international/ii_web/timeseries1.cfm?econtypeid=1&dirlevel1id=2
Host Country R&D	Total R&D personnel (by country)	UNESCO (2009). http://stats.uis.unesco.org/unesco/TableViewer/tableView.aspx?ReportId=1779
Wages	Wages per hour for the manufacturing sector	LABORSTA (2009). http://laborsta.ilo.org
Interest rates	Lending rates	International Financial Statistics Database. (series code : 60L..ZF and 60P..ZF)
Profit	Net income of U.S. affiliates abroad	BEA (2009). http://www.bea.gov/international/ii_web/timeseries1.cfm?econtypeid=1&dirlevel1id=2)
Real GDP	Per capita Real GDP	Penn World Tables (2009). y. http://pwt.econ.upenn.edu/php_site/pwt63/pwt63_form.php
Openness	Openness	Penn World Tables (2009). openk. http://pwt.econ.upenn.edu/php_site/pwt63/pwt63_form.php (
Exchange Rates	Exchange Rates	Penn World Tables (2009). XRAT. http://pwt.econ.upenn.edu/php_site/pwt63/pwt63_form.php
Corruption Containment	Index of Corruption Containment	World Bank (2009) Governance Indicators (http://info.worldbank.org/governance/wgi/sc_country.asp
Skills	total graduates in tertiary programs	NESCO (2009). Total graduates in all programs. Tertiary. http://stats.uis.unesco.org/unesco/TableViewer/tableView.aspx