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**Canadian Direct Investment Abroad:  
What Role Do Differences in Technology  
Play in Vertical and Horizontal Direct  
Investment?<sup>1</sup>**

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<sup>1</sup> This paper has been adapted from its original version published in the "Seventh Annual Report on Canada's State of Trade".



# Canadian Direct Investment Abroad: What Role Do Differences in Technology Play in Vertical and Horizontal Direct Investment?<sup>2</sup>

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## Executive Summary

This paper's short analysis finds that Canadian Direct Investment Abroad (CDIA) is primarily vertically motivated rather than horizontally motivated, and that countries with technology levels closer to Canada's are more likely to receive CDIA. This result still holds when only CDIA into advanced economies is examined. Although preliminary, the significance of vertically motivated CDIA points to the importance of involvement in global supply chains to Canada's continuing prosperity.

## Canadian Direct Investment Abroad: What Role Do Differences in Technology Play in Vertical and Horizontal Direct Investment?

### 1. Introduction

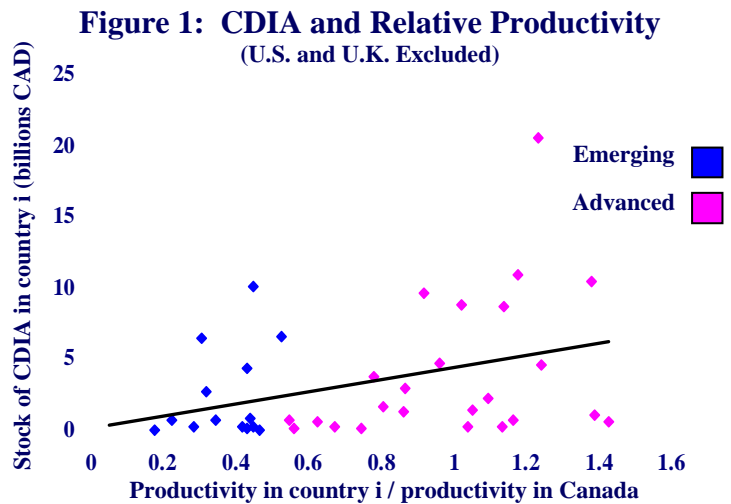
Canada's economy depends heavily on international trade, with imports and exports equivalent to 72 per cent of Canada's Gross Domestic Product (GDP) as of 2005. But trade is far from the only international connection of importance. Foreign direct investment, both inward and outward, also contributes to Canadian prosperity. Inward direct investment brings with it new technologies, capital, and ways of doing and organizing economic activity, while outward direct investment is essential for increasing Canadian integration into global supply chains and expanding export potential. This paper focuses on Canadian Direct Investment Abroad (CDIA) which, equivalent to 34 per cent of GDP in 2004, plays a substantial role in the well-being of the Canadian economy. The question posed is: how do differences in technology levels between countries affect the location of Canadian direct investment? Do Canadian firms seek out and capitalize on differences in resource endowments such as skilled labour, or do they seek to expand horizontally into foreign markets? Does having technology levels that are closer to Canada's amplify or dampen these motives to engage in direct investment in a given country?

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Direct investment can be split broadly into two types: vertical and horizontal. Vertical direct investment occurs when a firm fragments its production process internationally, locating different segments of that production process across different countries. This encompasses the labour-seeking, resource-extracting, and component-outsourcing types of foreign direct investment. Horizontal direct investment, on the other hand, occurs when a firm engages in the same production process in different countries; this covers the market-seeking and differentiated products motives. Vertical direct investment decisions are motivated by a desire to exploit the respective comparative advantages of different countries. These sort of investments allow firms to arrange their production based on where it is most efficient to locate each piece of the process. Horizontal direct investment, on the other hand, is motivated by impediments to the movement of goods and services, such as tariff barriers or high transportation costs, which create incentives to duplicate production abroad. But what role do technology differences between countries play in horizontal and vertical direct investment decisions? This section investigates the Canadian case.

Unsurprisingly, the U.S. is far above any other country as the most important location for CDIA; the U.K., as well, is home to a substantial amount of CDIA. However, due to these high quantities of CDIA in the U.S. and U.K., it is difficult to see how CDIA is distributed in the other countries when those countries are included in a graph. Therefore, the U.S. and U.K. are omitted in Figure 1, which plots CDIA against productivity in the foreign country relative to that in Canada. Productivity is used as a proxy for countries' technology levels relative to Canada's.<sup>3</sup>



Data: Statistics Canada and The Conference Board and Groningen Growth and Development Centre, Total Economy Database, January 2006, <http://www.ggdc.net>. 2004 data.

In this graph, a spray pattern moving from left to right is visible. This indicates a positive relationship, as shown by the trend line, between CDIA and technology level, with higher technology levels associated with more total CDIA in a country. When the sample is split into advanced and emerging economies (as denoted in Figure 1 by the different coloured points) the same spray pattern manifests in both groups, but on different scales, with the quantities invested in advanced economies being substantially larger. Interestingly, if the groups are examined separately, the slope of the trend line is higher in the emerging economies. That is, having technology closer to Canada's is related to higher CDIA, and the importance of higher technology is relatively

<sup>3</sup> As described later in the paper, labour productivity, measured by output per hour, is used as a proxy for technology as described in Ihrig, Jane (2005), "The Influence of Technology on Foreign Direct Investment," *American Economic Association Papers and Proceedings*, Vol. 95, No. 2: 309-313.

greater in the emerging markets, compared to the advanced economies.<sup>4</sup> The pattern observed is interesting, but this positive relationship bears further investigation: there may be other factors at play here that are not visible in these graphs. Moreover, the graph does not distinguish between vertical and horizontally motivated foreign direct investment.

## 2. Model and Regressions

In an effort to better understand the role of technology differences in determining the location of Canadian direct investment, this section draws on the work of Ihrig (2005), applying the model developed therein to the case of Canada. The model is as follows:

$$\begin{aligned} & \text{Real direct investment from country } j \text{ to country } i \\ & = h_1 ( \text{sumgdp} ) + h_2 ( \text{sumgdp} \times \text{tech} ) + h_3 ( \text{gdpdiff} )^2 + v_1 ( \text{skilldiff} ) \\ & + v_2 ( \text{skilldiff} \times \text{tech} ) + v_3 ( \text{skilldiff} \times \text{gdpdiff} ) + \text{controls} \end{aligned}$$

where country  $j$  is Canada, and country  $i$  is the recipient country,  $\text{sumgdp}$  is the sum of Canada and the other country's real GDP,  $\text{tech}$  is defined as  $| (A_i/A_{\text{world}}) - 1 |$ , where  $A_i$  is labour productivity measured as output per hour, in country  $i$ , and  $A_{\text{world}}$  is the world average, based on an average of all countries available for that year,  $\text{gdpdiff}$  is the difference between the real GDP of Canada and the other country,  $\text{skilldiff}$  is the absolute value of the difference in skilled labour between Canada and the other country, with skilled labour measured as the proportion of people employed in professional, technical, and similar professions, relative to total employment, and  $\text{controls}$  consist of indices of trade costs and investment costs by country as well as a variable indicating the approximate distance between that country and Canada.

The first three terms in the model, which have  $h_n$  coefficients, are used to capture the horizontal motive for direct investment. The result for  $\text{sumgdp}$  is thus expected to be positive, as more horizontal direct investment is likely to occur between countries of larger economic size. Since  $\text{sumgdp} \times \text{tech}$  is used to capture the effect of technology on horizontal direct investment, the result for this term could be positive or negative, as technology could conceivably dampen or amplify the size of horizontal direct investment. Lastly,  $\text{gdpdiff}^2$  is expected to be negative, as it is expected that larger differences in GDP would decrease the motivation for horizontal direct investment. The following three terms, with coefficients  $v_n$ , attempt to capture the motive for vertical direct investment. The expectation is for the result on  $\text{skilldiff}$  to be positive, as vertical direct investment is motivated by a desire to take advantage of differences in endowments, such as more skilled labour or lower wage costs. As with the terms for horizontal direct investment,  $\text{skilldiff} \times \text{tech}$  is used to measure the amplifying or dampening effect of technology on vertical direct investment, and could be positive or negative. Lastly,  $\text{skilldiff} \times \text{gdpdiff}$  is expected to be negative.

<sup>4</sup> Note that this comment is based on a relatively small number of observations; a larger sample might obviate the comment.

A small panel data set of these variables is used, covering four years (2001-04) and 49 countries. The regression uses the fixed effects method, which takes into account the fact that there are differences across countries and/or time periods in the data, caused by variables that are not included in the model. First, the entire sample of data is used. CDIA<sup>5</sup> is regressed upon the terms in the model indicated above. But the motivations for investing in developed nations may be quite different from the factors driving investments into emerging economies. Therefore the sample is additionally split into two groups<sup>6</sup>—advanced economies and emerging market economies—and the regressions are run again. The smaller numbers of observations in these latter two regressions reduces the explanatory power, but some useful results are obtained nonetheless. Results are displayed in Table 1. Since the U.S. is home to such a large amount of CDIA, regressions for the full and split sub-samples were run with the U.S. omitted. But the model seems to become unstable when this is done, with only two variables remaining significant (at the 5 per cent level) in the full sample, one in the advanced economy sub-sample, and none in the emerging economies sub-sample. These results are therefore not reported here.

Interestingly, the results for Canada differ from what Ihrig (2005) finds for the U.S. This is perhaps surprising, given that both Canada and the U.S. are advanced economies and share many similar characteristics as well as a fairly high level of economic integration. Ihrig finds support for horizontal direct investment from the U.S. to the full sample of countries and to advanced economies

also. She only finds support for vertical direct investment from the U.S. in the case of emerging market economies. In Canada’s case, however, the results in Table 1 support vertical direct investment in the full sample rather than horizontal. The results for CDIA

Table 1: Fixed Effects Regressions for Canadian Direct Investment Abroad

Variable	All countries	Advanced economies	Emerging market economies
sumgdp	-0.07** (0.02)	-0.09** (0.03)	0.03 (0.03)
sumgdp × tech	0.22** (0.04)	0.23** (0.04)	-0.03 (0.07)
gdpdiff <sup>2</sup>	0.00** (0.00)	0.00** (0.00)	0.00 (0.00)
skilldiff	8.40* (4.20)	12.88 (7.11)	-0.19 (2.10)
skilldiff × tech	-13.18* (6.47)	-18.76 (11.08)	0.67 (3.44)
skilldiff × gdpdiff	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
No. observations	131	93	38
R <sup>2</sup>	0.90	0.91	0.14
Note: regressions were conducted using STATA. Standard errors are reported in parentheses. * statistically significant at the 5 per cent level ** statistically significant at the 1 per cent level			

<sup>5</sup> Note that similar regressions were conducted with FDIC as the dependent variable; however, most variables registered as insignificant; therefore, the results are not reported here. Further work would have to be done in order to explain these insignificant results.

<sup>6</sup> Countries are split into advanced and emerging based on the listings in the International Monetary Fund’s World Economic Outlook Database. Ihrig’s definition of advanced economies as countries in the OECD as of 1994 omits some countries that the IMF definition includes, such as Singapore and Taiwan.



to emerging markets are too weak to comment upon, but those for the advanced economies do not support horizontal direct investment either.

The result for the horizontal direct investment term of  $sumgdp$  is the opposite of what was expected: the coefficient is negative, indicating that as the economic size of the country-pair increases, CDIA decreases. This is the opposite of what Ihrig found for the U.S., which was that the larger the sum of the two economies' GDPs, the greater the U.S. direct investment. Returning to Canada's case,  $sumgdp \times tech$  has a positive coefficient, which indicates that the closer the recipient country's technology is to the world average, the less horizontal direct investment it receives from Canada. So possessing technology closer to Canada's has a dampening effect on horizontally motivated CDIA. The result for the third horizontal direct investment term,  $gdpdiff^2$ , is zero, which is the same result that Ihrig finds for the U.S. Overall, these results do not support the horizontal direct investment motive. As similar results are found in the advanced economies regression, the same can be said of that sub-group.

The results for the vertical direct investment terms, on the other hand, are supportive of that motive in CDIA. For the full sample, the coefficient on  $skilldiff$  is positive, indicating that the bigger the skill difference between Canada and the other country, the larger the CDIA. Interestingly, this result is found in the sub-sample of advanced economies as well. The effect of technology on this, as captured by  $skilldiff \times tech$ , is negative, meaning that the closer the recipient country's technology is to the world average, the more vertical direct investment it receives; thus, better technology has an amplifying effect. The last term,  $skilldiff \times gdpdiff$  is small and statistically insignificant, as it is in Ihrig (2005). Unfortunately, when the sample is split, none of the results for the emerging market economies are significant, and the results for the last three variables of the advanced economies sample—those that capture the vertical direct investment motive—are not significant either. Nonetheless, though they cannot be relied upon, they do suggest that the sample for advanced economies follows the same pattern as the full sample: supportive of vertical direct investment from Canada but not horizontal.

### 3. Interpretation

As mentioned earlier, it is from one perspective surprising that the results for Canada differ from those for the U.S. However, the U.S. is the world's dominant economic power, and home to numerous large firms engaging in foreign direct investment—that is, multinational enterprises. Ihrig's findings of support for U.S. horizontal direct investment are therefore understandable, as larger firms are more likely to have the resources to duplicate production abroad.

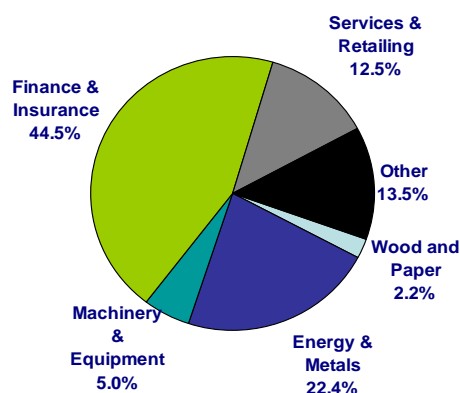
But what about Canada's case? Why does the evidence point towards vertical rather than horizontal direct investment?





First, consider the distribution of Canada's foreign direct investment by industry, as shown in Figure 2. CDIA is dominated by the Finance and Insurance category, which comprises nearly half (45 per cent) of the stock of CDIA. Investments in Energy and Metals follow at 22 per cent, reflecting the importance of resource-seeking direct investment. These two categories alone comprise two-thirds of all CDIA, and both fit with the motive for vertical direct investment. Certainly not all CDIA in these categories is vertical, but the vertical logic fits: firms seeking to optimize production across different countries can locate business processes such as finance and insurance overseas, or choose to invest in raw materials such as energy and metals that they require for their businesses.<sup>7</sup>

**Figure 2: Distribution of CDIA by Industry**



Data: Statistics Canada, 2005 data.

Secondly, lower transportation costs, the rapid and continuing development of information and communications technology, and lower trade and investment barriers, have helped drive the international fragmentation of production and thus the growth of global value chains worldwide. In this context, finding support for CDIA being motivated vertically rather than horizontally makes sense, as Canadian firms work to stay abreast of global competition by fitting into and making use of global value chains. But how do the different technology levels found across countries fit into these decisions?

If technology is thought of as another factor of production similar to the standard ones, then the motive for vertical direct investment would say that firms seek differences in labour, capital, and technology, when deciding where to invest. The results found here do not support that view for Canada. Instead of technology differences amplifying the effect of *skilldiff* on CDIA, it is having technology closer to the world average that is linked to more CDIA. Thus the suggestion is that Canadian firms look for differences in labour and capital, but similarities in technology. It is not clear from this brief analysis why precisely this is the case, but there are a variety of potential explanations. Firms might need production methods to be able to translate appropriately to the foreign country, which would require a similar level of technology. Higher technology levels in the recipient country might allow better coordination with offices the investing country. And higher technology levels might also be correlated with other factors not investigated here, which could affect incentives for CDIA.

<sup>7</sup> Although differences in skilled labour are not a perfect proxy for country differences in other endowments such as natural resources, a lower abundance of skilled labour would make it more difficult to exploit those endowments, and thus increase the likelihood of investment in those fields.

This short highlight section does not fully explore the question of how differing technology levels in recipient countries affect horizontal and vertical foreign direct investment; however, it provides a preliminary look at the effects on CDIA, and perhaps a starting point for further research.<sup>8</sup> Overall, support is for vertical direct investment driving CDIA, and higher technology levels having a positive effect upon that motive for investment.

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<sup>8</sup> The addition of more years of data, for example, might serve to address the lack of significance in some of the results. A better proxy for the variable used in the section for vertical direct investment might also be useful, as skilled labour is an imperfect proxy for other differences in endowments.

