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PRELIMINARY DRAFT; PLEASE DO NOT QUOTE

**U.S. Acquisitions of Canadian Firms and the Role of the Exchange Rate**

George J. Georgopoulos  
Division of Management  
University of Toronto at Scarborough

**Abstract**

The decline of the Canadian dollar relative to the U.S. dollar over the past 15 years has raised concerns that Canadian firms have been left vulnerable to takeovers by U.S. firms. Theory and empirical studies on cross border mergers and acquisitions (M&As) have generated mixed support for a link between exchange rates and M&As. This paper argues that exchange rate movements may affect acquisition M&As because acquisitions involve firm-specific assets which can generate returns in currencies other than that used for purchase. We use data on U.S. acquisitions in Canada across four-digit SIC industries from 1985 to 2001, and, along with the real exchange rate, account for factors such as industry level Canadian tariff rates, value added of U.S. industries, the number of Canadian M&As and the number of Canadian establishments. Maximum-likelihood estimates from fixed and random effects negative binomial models reveal that a Canadian dollar depreciation leads to U.S. M&As in Canada, but only involving target firms that possess firm-specific assets (high R&D firms). Tariff rates are not significant for such industries. The real exchange rate is not significant for U.S. M&As involving low R&D firms, whereas tariff rates are.

*Keywords:* Mergers and Acquisitions, Exchange Rate, Fixed and Random Effects Negative Binomial

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Correspondence to George Georgopoulos, Division of Management, University of Toronto at Scarborough, 1265 Military Trail, Scarborough, Ontario, Canada, M1C 1A4; Phone: (416) 287 7335; Fax: (416) 978 7363. Email (georgop@utsc.utoronto.ca).

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## 1. Introduction

The decline in the value of the Canadian dollar relative to the U.S. dollar over the late 1990s has raised concerns that Canadian firms are vulnerable for takeover by U.S. firms at “fire sale” prices. Data on the number of U.S. mergers and acquisitions (hereafter M&As) in Canada lend support to this claim. While the Canadian dollar declined in value over 1994-2000, the number of U.S. M&As increased from 260 in 1994 to 478 in 2000, with associated real transaction values of \$5.3 billion and \$24.1 billion respectively.

Increased cross border M&A activity raises concerns over the economic impact in the target nation. Cross border M&As lead to the transfer of ownership and control from domestic to foreign hands. This transfer may be accompanied by lay-offs and/or the reduction of production facilities. Cross border M&As also can be used to reduce competition in the domestic market. These issues are expressed in political discussions and the media, where the concerns become more pronounced when M&As are viewed as eroding national sovereignty. While these issues are important, this paper will instead focus on whether there is a link between the value of the Canadian dollar relative to the U.S. dollar and the number of U.S. M&As in Canada.

Theories on the link between exchange rates and cross border M&As provide ambiguous predictions. One view is that there is no link. While a Canadian dollar depreciation relative to the U.S. dollar makes Canadian assets relatively cheaper for acquiring U.S. firms, the returns from these Canadian asset are also denominated in Canadian dollars. Conversion into U.S. dollars at the higher rate of exchange of U.S. dollars for Canadian dollars offsets the cost reduction of the purchase. Therefore, there is no net impact of a Canadian dollar depreciation on cross border takeovers.

A limitation of the above theory is that the Canadian asset is viewed as a financial asset, such as a bond or stock, where the costs and revenues are generated in only one currency. If, on the other hand, the Canadian asset is a factor input that is transferable such as technology, it can produce output and revenues in another currency. Blonigen (1997) proposes such a theory, where the firm being acquired has an innovation or a firm-specific asset. His theory also relies on the assumption of market segmentation or imperfect markets for goods. In this context, the result is that after a depreciation of the Canadian dollar relative to the U.S. dollar, in the presence of imperfect goods markets, a U.S. firm will bid higher for a target Canadian firm with a firm-specific asset than a Canadian firm.

This paper adopts this theory and investigates the empirical link between U.S. M&As activity in Canada and the Canada-U.S. exchange rate. Specifically we employ random and fixed effects negative binomial approach to model count data on the number of U.S. acquisitions in Canada across four-digit SIC industries. Our explanatory variables include the industry specific real exchange rate, along with traditional determinants of U.S. M&As, such as the U.S. growth rate, U.S. industry value added, and Canadian tariff rates. Supply variables include the number of Canadian establishments and the number of Canadian M&As of Canadian firms. The data are at an annual frequency and cover the period 1985-2001.

The results from the full sample set reveal that the real exchange rate is a determining factor in explaining U.S. M&As. That is, a Canadian dollar depreciation leads to increased U.S. M&As in Canada.

To investigate the asset acquisition hypothesis, we split the sample into low R&D industries and high R&D industries, where it is assumed that high R&D industries are relatively more technologically endowed than low R&D industries. The high R&D sample set includes

traditional technologically based industries such as telecommunication equipment, and machinery and electronic parts.

The following results emerge. First, it is revealed that the real exchange rate is a statistically significant determinant for M&As in high R&D industries. That is, a Canadian dollar depreciation leads to increased U.S. M&As of high R&D industries in Canada. The estimated coefficient is substantially larger than in the full sample case. Furthermore, the tariff variable is insignificant. This is a theoretically plausible result, as the tariff rate should not factor into a foreign firm's decision to purchase a firm-specific asset.

Secondly, for low R&D industries, the real exchange rate is not statistically significant. Furthermore, the tariff rate is significant. These results are plausible. For firms with low or no firm specific assets, the main motive for foreign firms acquiring them is to gain market presence or power. As such, traditional determinants of FDI play a role, such as tariff rates.

The organization of the paper is as follows. Section 2 presents an overview on the determinants of Foreign Direct Investment (hereafter FDI), as cross border M&As is one form of FDI. Section 3 presents a literature review on the theoretical link between exchange rates and M&As. Section 4 presents summary statistics on the number and value of U.S. M&As in Canada. Section 5 outlines the econometric methodology and presents the determinants of cross border M&As and the data used in the empirical analysis. Section 6 presents the empirical results. Section 7 concludes and discusses further work.

## **2. Overview on the Determinants of FDI**

Strategies in which a corporation can expand internationally is through exporting,

licensing, and foreign direct investment.<sup>1</sup> Foreign direct investment (FDI) is investment made in an enterprise outside of the company's home country,<sup>2</sup> where the company has a minimum stake of 10% of the total equity of the foreign enterprise.<sup>3</sup> The key feature for these investments to be 'direct' is that the ownership of the resources transferred must remain with the investing company.<sup>4</sup>

FDI contributes to the expansion of a company's production outside of its national boundaries. The flow of funds could be used to either create its own affiliate, called greenfield acquisitions, to restructure existing firms, known as brownfield investments, or to merge or acquire existing firms.

Motives for FDI can be explained through Dunning's (1988) OLI framework, which outlines the advantages and conditions under which foreign direct investment will occur in light of the inherent disadvantages and higher costs of foreign production.<sup>5</sup> To motivate FDI, three

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<sup>1</sup> The process of corporate globalization typically begins with exporting, then licensing, followed by foreign direct investment. (Shapiro 2002). The former two avenues involve minimal investment, and profits are immediate relative to FDI.

<sup>2</sup> FDI is usually discussed in the context of the multinational corporation (MNC) or multinational enterprise (MNE) or transnational corporation (TNC). These terms all refer to the same phenomenon, that being both production and transactions are taking place in plants located in two or more countries, but under the supervision and general direction of the headquarters located in one country.

<sup>3</sup> The 10% ownership of ordinary shares or voting power threshold is the requirement to classify such an investment as "direct" for most countries, including Canada and the U.S.

<sup>4</sup> Foreign indirect investment, or portfolio investment, involves only the transfer of money capital (bonds, stocks at a value of less than 10% of all stocks outstanding, and various money market instruments, where the the holdings of these instruments does not have significant influence on the issuer of the instruments or does not involve ownership or control of any enterprise.

<sup>5</sup> The costs of operating outside of a firm's country or region include informational costs on product and labour markets abroad, linguistic and cultural differences, and the costs of entering foreign networks. Although costs may be incurred if the firm instead chose to trade, they will nonetheless be substantially lower in a foreign country.

conditions are required. A firm must have an *ownership* advantage over other firms, such as a patent, a management advantage, or an intangible asset such as goodwill or reputation. Second, the foreign market must offer a *location* advantage, where it is more profitable to produce in the foreign country than to produce at home and export to the foreign country. Factors in this context encouraging foreign production include quotas, tariffs, lower factor prices, and transportation costs associated with trade. These two conditions alone do not preclude the firm from licensing a foreign firm to produce the product for the foreign market. For a firm to find it less costly to produce abroad than to engage in arms length market activities, there must be an *internalization* advantage. For example, offering a license to a foreign firm to produce in the foreign market could result in leakage of private information concerning the ownership asset. Also arms length activities could result in the foreign firm acting opportunistically as a result of an incomplete contract.<sup>6</sup> Hence significant transaction costs associated with arms length negotiations that are higher than the costs of producing abroad promotes vertical integration or in-house production in the foreign country.

This paper focuses on one form of FDI, cross border M&As. Cross border M&As offer two main advantages over greenfield investments. One advantage is greater speed in gaining market access or power. In an industry such as the Information Technology sector, product life cycles are short, and speed and timing is critical. Acquiring a firm will permit quicker access to any market.

A second advantage is access to proprietary assets. An asset may be an input that is not tangible or licensable, such as a scientific technology, a management or organizational skill

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<sup>6</sup> Arms length transactions involving relationship-specific assets may result in the “hold-up” problem.

and/or marketing expertise. This motivation is the main theme of this paper. Cross border M&As initiated for the purpose of acquiring assets may not be affected by traditional FDI factors, such as trade barriers. One non-traditional factor influencing cross border M&As for the purpose of acquiring an innovation asset is the exchange rate. As proposed by Blonigen (1997), in the presence of imperfect goods markets, if a foreign country's currency appreciates relative to the domestic country's currency, the foreign firm can purchase a firm-specific asset in the domestic country using the domestic currency, and use this asset to increase sales and revenues in the foreign market. Below we elaborate on this analysis and outline the literature on the exchange rate - FDI link.

Concerning modes of FDI and the effects on market concentration, a greenfield investment will increase competition in the domestic market as the number of participants has increased. The effects of a cross border acquisition on concentration depends on the degree of market presence of the foreign firm. If the foreign firm has no presence in the domestic market, an acquisition will not change market concentration or competition, at least in the short run. However if the foreign firm is already has market presence, acquiring its only rival outright certainly increases market concentration. A foreign firm, whether present or not in the domestic market, can increase its competition by acquiring a domestic firm and group of suppliers to corner the market of a particular input. In this paper we focus less on the effects of acquisitions on market concentration, and instead focus on foreign firms acquiring a domestic target firm to access a firm specific asset that is transferable.

### **3. Exchange Rate - FDI Link and Related Literature**

Explanations for exchange rate effects on FDI typically are divided among relative wage effects (Cushman 1985, 1989,<sup>7</sup> Caves 1989) and relative wealth effects (Froot and Stein 1991, Klein and Rosengren 1994). In the traditional relative wage effect explanation, FDI represents capital seeking relatively cheap labour. A depreciation of a country's currency is associated with an increase in its inward FDI. Relative wealth explanations rely on capital market imperfections that limit a firm's level of external financing. A domestic currency depreciation increases the foreign firm's wealth relative to the domestic firm, which in turn increases the amount it may bid on the domestic asset.

Caves (1989) explains that foreign investment becomes sensitive to the exchange rate in that costs vary with the configuration of the foreign investors' activities. A depreciation of the U.S. dollar reduces the cost of production in the U.S. Caves finds an empirical negative relationship between the lag value of the bilateral real exchange rate and inward FDI flows from 15 countries into the U.S. over 1978-1986.

Froot and Stein (1991) formally establish a link between the exchange rate and FDI. They present a model where imperfect capital markets and changes in relative wealth between domestic and foreign agents play a prominent role. Imperfect capital markets are due to the specific nature of the acquired asset. Unlike a "passive" investment portfolio of bonds or stocks, an "information intensive" investment, such as acquiring a firm, has informational asymmetries with respect to the realization of profits. In this scenario realized profits from the asset are costlessly seen only by the asset's owner, while creditors must absorb a positive

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<sup>7</sup> Another theoretical argument emphasizes the link between the *variability* or the forecast of the exchange rate and FDI. Studies in this framework include Cushman (1985, 1988) and Goldberg and Kolstad (1994). By contrast, the emphasis of our paper is on the effects changes in the *level* of the exchange rate on FDI.

monitoring cost to observe this profit. The existence of monitoring costs thus makes it impossible or costly for agents to finance a firm acquisition solely with externally obtained funds; some amount of internal financing is required. A higher level of net wealth available to finance such an investment will lower the total cost of capital. Froot and Stein (1991) present a stylized example illustrating relative wealth changes between a domestic and foreign firm when the exchange rate changes. For a given amount of internal funds denominated in each country's currency, a depreciation of the domestic currency will increase the relative wealth position of the foreign firm. In competing with the domestic firm for the acquisition of a domestic target firm, the foreign firm's cost of capital has decreased, raising its bidding price for the target firm. In general, more foreign firms will win the auctions for domestic target firms. This theory is a version of a view quite prominent in the Canadian press, that there are cost of capital advantages to U.S. firms as a result of a depreciation of the Canadian dollar.

Empirical results by Froot and Stein show that over 1977-1987, the exchange rate had a statistically significant negative effect on the value and number of transactions for mergers and acquisitions and for greenfield transactions. The authors looked at the influence of the real Canadian-U.S. exchange rate on overall FDI into Canada. Using only the real exchange rate and a constant as a regressor, the results showed that over 1972-1987, the real exchange rate was statistically significant.

While the relative wage and wealth effect both predict a negative relationship between the value of the currency and FDI, Klein and Rosengreen attempt to distinguish between the two. They regress the ratio of cross border M&As on the real exchange rate (ratio of U.S. price level to the price level of the foreign country), relative wages between the U.S. and the foreign country, and the ratio of the index of the value of the U.S. stock market to the index of the value

of the stock market of the foreign country. The first and third variables are proxies for relative wealth effects, whereas the second variable is a proxy for the relative wage effect. The results show statistically negative coefficients on the real exchange rate and relative stock indexes, whereas relative wages are not statistically significant. The relative wealth effect is thus the dominant influence.

Dewenter (1995) also investigates differential effects of the real exchange rate on acquisitions across industries. While the results show some evidence of industry differences, particularly for machinery manufacturing, the author suggests data on industry specific exchange rates and wealth may yield more robust results. This paper employs such variables.

Consistent with the relative wealth effects from Froot and Stein (1991), who suggest foreign firms will raise their bidding price in response to a domestic currency depreciation, Swenson (1993) and Harris and Ravenscraft (1991) show that U.S. (domestic) target shareholder wealth gains from cross border acquisitions are positively related to a domestic currency depreciation. Dewenter (1995) finds that a depreciating dollar is associated with a higher foreign takeover premia for U.S. targets than domestic premia.

As mentioned studies on cross border acquisitions of Canadian assets arose over concern that Canadian firms were left vulnerable from a downward trend of the value of the Canadian dollar relative to the U.S. dollar over the 1990s. Unfortunately the number of Canadian studies is sparse. Schembri (2002) plots the net annual value of acquisition flows (value of foreign acquisitions of Canadian assets less value of Canadian acquisition of foreign assets) over 1975-2000. The data show no overwhelming evidence of a positive trend over the 1990's. Aba and Mintz (2002) also show that there has not been a positive net value or number foreign acquisitions in Canada. They also reveal differences across sectors, where foreign

takeovers of Canadian firms is prevalent in the oil and gas sectors, while there has been a significant increase in the number of Canadian firms acquiring foreign firms in the finance, insurance and real estate sector. A shortcoming with both studies is that their analysis does not preclude the possibility that Canadian acquisitions of foreign firms may have resulted from a Canadian dollar appreciation relative to the associated countries. For example, the Canadian dollar generally appreciated relative to the English Pound, the German Mark and the French Franc and Japanese Yen over the latter part of the 1990's. A formal empirical model looking at exchange rate effects on acquisitions, while taking into account other factors, would be more convincing.

Lafrance and Tessier (2001) employ VAR analysis containing the Canadian inward FDI flows, the real exchange rate, and a measure of exchange rate volatility. Over 1970:1-2000:1 they find that the level of the real exchange rate Granger- causes inward FDI.<sup>8</sup> This result is not robust when the ratio of undistributed corporate profits to GNP is added to the VAR. A shortcoming of the Granger technique is that it does not provide an estimate of the direction or magnitude of the exchange rate-FDI relationship. Unfortunately the authors do not carry out impulse response analysis on these variables.<sup>9</sup>

Hejazi and Safarian (2002) explain Canada's inward FDI stock and trade patterns with 29 countries, employing the gravity model to explain inward FDI and an augmented gravity model to explain trade. The authors find no statistical relationship between the stock of inward

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<sup>8</sup> For the same VAR, they also report that real exchange rate volatility does not Granger-cause inward FDI.

<sup>9</sup> They do however provide impulse response results on the exchange rate variables and total domestic investment and domestic investment in machinery and equipment. The results lean towards an insignificant relationship between these two measures of investment and the exchange rate variables.

FDI and the exchange rate.

Blonigen (1997) provides theoretical and empirical evidence in support of a negative relationship between a domestic country's currency value and the amount of foreign acquisitions of domestic firms. This theory assumes that FDI is motivated by acquiring firm-specific assets. Unlike Froot and Stein's imperfect capital market assumption, Blonigen's argument relies on the assumption of imperfect goods markets, where the domestic firm does not have equal access to the foreign market in selling its products.

Suppose a U.S. and Canadian firm have equal opportunity to purchase a Canadian firm that has an innovation that is transferable. Assuming wealth for the U.S. firm is in U.S. dollars and wealth for the Canadian firm is in Canadian dollars, a Canadian currency depreciation will lower the costs of purchasing this firm for the U.S. firm, while the costs will remain the same for the Canadian firm. Since the asset is transferable, the U.S. firm can transfer that asset to the U.S. market, generating returns in U.S. dollars, while this option is unavailable for the Canadian firm due to unequal access to the U.S. market. Thus, discounted future profits increase for the U.S. firm, but not for the Canadian firm, leading to a higher bid price by the U.S. firm and increasing the likelihood of the U.S. firm acquiring the Canadian firm.

The assumption of imperfect goods market is not unreasonable, as U.S. firms generally have greater market presence and accessibility in U.S. markets relative to Canadian firms. This may be due to established networks in the form of buyer and seller relationships and distributional networks. Some of these relationships reflect strategic choices such as relationship-specific investments, where it is too costly to switch suppliers, especially for differentiated products. Greaney (2002) proposes that network effects can produce asymmetric trade and investment flows.

Another form of unequal access is the case where the U.S. firm is part of a cluster or agglomeration and the Canadian firm is not, where the U.S. firm's potential profitability from the acquired asset is thus higher due to knowledge spillovers from localized related industries and research centres. In general, a U.S. firm is more familiar with the workings of its own market relative to a Canadian firm, and hence its profitable opportunities will be higher. As such the potential Canadian target firm will be more valuable to the U.S. firm than to the Canadian firm in light of a Canadian dollar depreciation.

As noted with Swenson (1993), Harris and Ravenscraft (1991) and Dewenter (1995), foreign companies pay a premium in acquiring U.S. firms relative to U.S. companies. Feenstra (1998) suggests that this result may reflect foreign firms getting preferential treatment in their own country relative to U.S. firms, thus making the U.S. acquisition more valuable to the foreign firm. Further work involves measuring the abnormal returns from a U.S. acquisition of Canadian firms. A higher abnormal return from U.S. firms would reflect some positive degree of imperfect goods markets between U.S. and Canadian markets.

Entering foreign markets in order to gain information and experience that is expected to prove useful elsewhere suggests that FDI may in part be motivated by a desire to source technology, as supported by a few studies. Dunning (1995) suggests FDI is "pulled" towards centres of innovation as a means for the investor to acquire new skills. Kogut and Chiang (1991) found that Japanese investments in Europe and the U.S. were attracted to R&D industries, often in the form of M&As. Van Pottelsberghe and Lichtenberg (2001) show that a country's technological base and total factor productivity is increased more through outward FDI rather than inward FDI. We have also proposed that technology is transferred to the U.S. after the Canadian firm is acquired. This seems intuitive and is supported by two survey studies

by McFetridge (1987) and Caves (1996) that show that technology is quickly transferred to large markets.

Using an extensive data set, this paper attempts to add to the sparse literature on foreign acquisitions of Canadian firms. We focus on U.S. acquisitions, as an overwhelmingly number of foreign acquired Canadian firms are by U.S. companies. Below we outline the trend of U.S. M&A activity in Canada.

#### **4. Merger and Acquisition Trends in Canada**

According to the World Investment Report (UNCTAD 2000), cross border M&As are the major driving force in the recent increase in FDI. In 1999, cross border M&As increased by 35 percent. M&As now represent over one third of total FDI.<sup>10</sup> Approximately 97% of these transactions are acquisitions, while 3% are mergers. Between developed countries, approximately 85% of total FDI is in the form of cross border M&As. The report suggests that the rapid pace of technological change and the liberalization of foreign investment policies by numerous countries are the major driving factors of the increased number and value of M&As.

Table 1 presents data on U.S. M&As and U.S. greenfield investments in Canada. The data are from the Investment Review Division, Industry Canada.<sup>11</sup> They define a foreign acquisition to be a transaction where the foreign firm acquires at least 50% of the domestic

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<sup>10</sup> FDI includes only the amount of funds involved in the merger or acquisition, not the total value of the merger or acquisition transaction. The World Investment Report definition of an acquisition is any transaction that yields control of at least 10% of the target firm's assets or common shares. As noted below and in Appendix 1, our data reflects M&As where there is control of at least 50% of the target firm's assets.

<sup>11</sup> In collecting the data, the Investment Review Division does not distinguish between acquisitions and mergers. However the Division suggested that over 95% of the transactions involve acquisitions.

firm's assets or voting shares.<sup>12</sup> A few patterns emerge from the data. The primary form of investment in terms of real dollar value is acquisition of existing Canadian assets, as opposed to new establishments or greenfield investments. Second, acquisitions fluctuate much more from year to year than the start ups of new establishments. Part of the fluctuation in acquisitions can be attributed to the occasional occurrence of very large acquisitions. The table also shows that the value of acquisitions increased significantly during the years 1987, 1989, and 1998-2001, periods that experienced transactions with a value of greater than \$1 billion. The data on the value of greenfield investments, on the contrary, is relatively stable, with the exception of the values in 1992 and 1993. Furthermore the value of the transactions is relatively small, where, although not reported here, only 12 of the new establishment transactions over the whole period had a value greater than \$100 million.

The data also show a significant increase in the value of M&As, beginning in 1995 and continuing up to 2001. Along with the increase in the number of acquisitions valued at greater than \$1 billion, there was also a significant increase in the number of transactions valued greater than \$100 million over this period. The number of transactions in this value range increased from 7 in 1994 to 17 in 1995 and increased steadily thereafter to 49 in 2001. Of particular interest is the value of the U.S.- Canada exchange rate over this period. Table 1 also shows that the Canadian dollar depreciated significantly from 1991 to 1992, and continued to do so over the latter part of the 1990's up to 2001. The statistics roughly suggest an association between the value of the Canadian dollar and the number and value of acquisitions. Furthermore

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<sup>12</sup> Note that other agencies define an M&A to be control of at least 10% of the target firm. The International Trade Division uses this minority-owned definition, and as such records the funds involved in acquiring 10% of the firm to calculate FDI values. The values in Table 1 on M&As record the value of the transaction, not the funds invested to acquire the firm.

it would be difficult to attribute the wide fluctuations in cross border M&As to relative changes in factor prices or transaction costs, as the latter two factors of FDI change gradually or infrequently.

It would be insightful to examine the sectors where most of the M&A activity is taking place. Table 2 reports the total number of U.S. M&As by target industry, where sectors with more than or equal to 30 M&As are only reported. The wholesale petroleum products sector experienced the most M&A activity, where 185 transactions took place over 1985-2001 (this is the only petroleum category in the wholesale industry). Casual observation shows that a fair amount of M&A activity occurred in the wholesale industry, which consists of SIC codes 5011-5999. Of the 35 reported codes, 11 are in the wholesale industry. Of the top 13 sectors, 6 are in wholesale, with most M&A occurring within the petroleum products wholesale industry. The high frequency of M&A in the wholesale industry may partially be explained by the high number of establishments in each SIC code. The last two columns in Table 2 show that for most of the wholesale industry codes, there were more than 2,000 establishments in 2001, where the industry average was 1,204 (see notes below Table 1).

Looking across all codes in Table 2, the number of establishments is not the only factor driving the frequency of M&As. There were 67 M&A transactions in codes 3192 and 7512, yet the number of establishments in each was substantially different. The same can be said of codes 7771 and 3799 which experienced 51 and 46 M&As respectively. Other examples are comparing the second and third reported codes in Table 2, and comparing the last two reported codes. There are thus other determinants of cross border M&As beyond the number of establishments.

One potential factor is the Canada-U.S. exchange rate. Overall the data show a high

degree of U.S. M&A activity over the second half of the 1990s. Over this period the Canadian dollar depreciated relative to the U.S. dollar. This suggest that the exchange rate may have some explanatory power. Below we present the statistical model and investigate the explanatory power of the exchange rate and other determinants of U.S. M&A activity in Canada.

## 5. Empirical Methodology and Specification

We model the number of U.S. mergers and acquisitions by employing the Random Effects Negative Binomial (henceforth RENegbin) model proposed by Hausman *et al.* (1984). As opposed to the Poisson model, the RENegbin model allows for the conditional expected value and the variance of the number of M&As to differ, i.e. allowing for “overdispersion”. Given the panel nature of the data used here, the RENegbin model allows dispersion to vary randomly across industries. We also present Hausman tests to determine whether the Fixed Effects Negative Binomial model is more appropriate.<sup>13</sup> Appendix I discusses the RENegbin model in more detail.

The dependent variable is the number of U.S. M&As of Canadian businesses at the 4-digit SIC level, excluding government services industries (codes 8111-8699). The data was taken from the Investment Review Division, Industry Canada. According to the Investment Canada Act, section 26, a merger or acquisition relates to a change in control, where control is defined as acquiring at least 50% plus one of common voting stocks, or above 50% of assets. For more details on the collection of these data and other variables, see the Appendix II.

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<sup>13</sup> Hausman *et al.* (1984) state that the RE Negbin model yields asymptotically more efficient estimators than their fixed effects model. For these results to be consistent, the industry-specific effects need to be uncorrelated with the regressors.

The regressors chosen generally follow Blonigen's (1997) regressor set.<sup>14</sup> The industry-specific real exchange rate is constructed using the nominal Canadian per U.S. exchange rate, and roughly 2-digit SIC price indexes for Canada and the U.S. Concordance tables were used to match Canadian 1980 SIC codes with U.S. 1987 SIC codes (Statistics Canada 1990). An increase in the industry specific real exchange rate reflects a real Canadian dollar depreciation and should be positively correlated with the dependent variable.

Cross border M&As may result from foreign firms avoiding tariffs and other restrictions that nations impose on imports. Cross border M&As are thus alternative strategies in penetrating a domestic market. We capture this policy effect by including effective Canadian tariff rates on U.S. imports at the 4-digit SIC level. We would expect a positive correlation between this variable and the dependent variable.

To account for U.S. demand for Canadian firm factors, we employ the U.S. growth rate of real U.S. GDP, and the share of value added of U.S. industry  $i$  at the 2-digit SIC level (again, concordance tables were used for this latter variable). These demand factors may be reflecting horizontal mergers as firms seek to achieve greater market power. The demand variables should be positively correlated with the dependent variable.

For supply variables, we include the total number of Canadian establishments at the 4-digit SIC level to account for sector size. The larger the sector size measured by the number of establishments, the higher the probability of a U.S. acquisition, *ceteris paribus*. To capture the

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<sup>14</sup> As will noted below, like this paper, he uses a similar real exchange rate, along with the two demand variables and the number of domestic M&As. Notable differences are his dependent variable being at the 3 digit level, whereas ours is at the 4 digit level. While Blonigen uses a protection variable from the World Bank, this paper uses tariff rates. Furthermore while this paper uses the number of establishments to capture sector size, Blonigen uses a time trend.

overall climate of merger and acquisition activity in Canada, we include the number of mergers and acquisition of Canadian firms by Canadian firms at the 4-digit SIC level. A positive climate of M&A opportunities in Canada should be reflected by a high amount of M&As by Canadian firms. A positive climate should also increase the probability of an acquisition by a U.S. firm. Thus there should be a positive correlation between the number of Canadian M&As and U.S. M&As. This supply variable should be positively correlated with the dependent variable.

Thus, the following is our testing specification:

$$\text{Prob}(USM\&As_{it}) = f( rer_{it}, tariff_{it}, USgrowth_t, USshare_{it}, CDN M\&As_{it}, CDNestab_{it} ) \quad (2)$$

where  $USM\&As_{it}$  is the number of U.S. M&As in Canada at the 4-digit SIC level,  $rer_{it}$  is the Canada-U.S. real exchange rate at the 2-digit SIC level,  $tariff_{it}$  is the effective tariff rate at the 4-digit SIC level,  $USgrowth_t$  is the growth rate of U.S. real GDP,  $USshare_{it}$  is share of value added of U.S. industry  $i$  at the 2-digit SIC level,  $CDN M\&As_{it}$  is the number of Canadian M&As at the 4-digit SIC level, and  $CDNestab_{it}$  is the number of Canadian establishment at the 4-digit SIC level. The data are at annual frequency and cover the period 1985-2001.

## 6. Empirical Results

Columns 1 and 2 in Table 3 present Random Effects Negbin estimates of the determinants of U.S. M&As in Canada. Column 1 shows the results across a balanced panel of all non-government industries, consisting of 849 classifications. All of the coefficients have correct signs. Furthermore, with the exception of the industry share variable, all of the estimates

are statistically significant at the 5% level as shown by the p-values.

Below the reported coefficient estimates we record a likelihood ratio test which compares the RE Negbin or panel estimator with the Negbin model or pooled estimator. The test statistic rejects the null hypothesis of the pooled estimator or the Negbin estimator with constant dispersion. Although not reported, we performed a likelihood ratio test on the alpha parameter to determine whether the data can be modeled by a Poisson process. A value of zero for the alpha parameter implies that the data is generated by a Poisson process, or no overdispersion, which is a special case of the Negbin model. For this and all specifications, the Poisson model is rejected in favour of the Negbin model.<sup>15</sup>

Column 2 shows results from excluding the share variable. Again, all the coefficients have correct signs, and are all statistically significant. There is strong evidence that growth in U.S. real GDP is highly correlated with increased U.S. M&As in Canada. Supply side factors, such as the size of the sector and the degree of M&A activity level proxied by the number of Canadian M&As, are also statistically positively correlated with U.S. M&As. There is also evidence of tariff jumping. Finally, the real exchange rate is statistically significant when we estimate across all industries. Although not reported here, the results are robust when the nominal interest rate is used.<sup>16</sup>

To test whether the industry-specific effects are correlated with the regressors, we compare the random effects estimates to the fixed effects estimates using a Hausman (1978) test. We report the Hausman test at the bottom of column 1, which tests the specifications in column

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<sup>15</sup> The test results and estimates of the alpha parameter are available upon request.

<sup>16</sup> The results from using the nominal exchange rate are available upon request.

1 and 3. This test is distributed as  $\chi^2$  under the null hypothesis of no correlation between the industry specific effects and the regressors. The test statistic equals 41.77, reflecting inconsistent parameter estimates and thus a rejection of the random effects model in favour of the fixed effects model. Column 3 shows the estimated results are similar to the random effects estimates, as all the variables but industry share are significant, and all the significant variables have correct signs. Column 4 excludes the industry share variable, where the results are similar to column 2. Using the nominal exchange rate, the fixed effects model yields similar results. Overall the specifications show the real exchange rate to be a significant determinant of U.S. M&As in Canada.

To distinguish between acquisitions occurring due to the asset acquisition effect or the wealth effect proposed by Froot and Stein (1991), we split the data set according to the degree of R&D intensity. High R&D industries are more likely to have technology related firm-specific assets. According to the asset acquisition hypothesis proposed by Blonigen (1997) these industries are expected to experience a higher number of cross border M&A activity in the presence of a foreign currency appreciation, as domestic firm specific assets that are transferable are now relatively less costly to acquire. We classify high R&D industries as those whose ratio of R&D expenditures to GDP are greater than the ratio of R&D to GDP for Canada, that being 2% (World Competitiveness Report 2001). The industries with ratios greater than 2% are reported at the bottom of Table 4. Most of these are in the manufacturing sector and are the traditional R&D industries, such as telecommunication equipment, and electronic parts and equipment. Business service industries are also in this category.

Column 1 in Table 4 presents the from the high R&D industry data set. At the bottom of the table the Hausman test shows that the random effects model is the correct model, as the

industry specific effects are uncorrelated with the regressors, yielding consistent estimates. Focusing on column 1, again all the coefficients have correct signs. The value added share variable is insignificant, as are the U.S. growth and tariff rate variables. The latter result is intuitively sensible, as a tariff barrier is not a factor for a foreign firm engaging in an M&A transaction solely to acquire a firm specific asset. The insignificant estimated coefficient on the tariff barrier reflects this. The insignificance of the value added and growth variables may reflect that these two variables are factors for horizontal integration, or firms wishing to expand market scale to achieve sufficient economies of scale. These two variables are not factors explaining the acquisition of firm-specific assets, or vertical integration.

More importantly, the coefficient on the real exchange rate is significant and almost twice the magnitude compared with the full sample estimate from the random effects model, 0.889 vs. 0.489. Columns 2 and 3 show the results from separately dropping the insignificant variables *USshare*, *tariff*, and *USgrowth*. Column 3 presents the final results, where the estimate of the coefficient on the real exchange rate becomes more precise and its magnitude is larger. The likelihood ratio tests are also recorded, showing that the Negbin model can be rejected in favour of the RE Negbin model. Furthermore, although not reported here, the results show significant values for the alpha parameter, reflecting overdispersion and invalidating the Poisson model. Results from using the nominal exchange rate remain robust. We also present the fixed effects estimates in columns 4-6, where again the results are similar to the random effects model.

Table 5 shows the results from the sectors characterized by a low intensity of R&D. The Hausman test rejects the null hypothesis of no correlation between industry specific effects and the regressors, although again the results between the two estimation procedures are

similar. Focusing on column 4, of importance is that the real exchange rate is statistically insignificant. This is consistent with our asset acquisition hypothesis, where there is no interest in acquiring a firm if this firm does possess a technology that will create revenues in the foreign country in the face of an appreciation of the foreign currency and imperfect goods markets. Note also that the tariff rate is now significant. For these industries, the suggested motive for cross border M&As is to gain access to a new market or exploit economies of scale, both of which are inhibited by tariffs.

Notwithstanding the insignificant coefficient, the magnitude of the coefficient on the real exchange rate is substantially lower than the high R&D case and the full sample. Columns 5 and 6 show the results from omitting the insignificant variables. We see that the real exchange rate remains statistically insignificant. Column 6 report the statistically significant estimates.

Again the likelihood ratio tests reveal that the RE Negbin model is appropriate as opposed to the Negbin model. The results again show a significant alpha value, invalidating the Poisson model. The results are similar when the nominal exchange rate is used.

To summarize, the results strongly show that the exchange rate is a factor for cross border M&As of firms with high levels of R&D, associated with high levels of technology. For these firms tariff rates are not statistically significant. This is expected when the primary motive for an M&A is to acquire a firm-specific asset. For industries with low levels of R&D, the exchange rate does not play a role. The results suggest that M&A activity in these sectors occur for foreign firms to gain market access or to increase market power. Traditional FDI factors driving this motive, such as tariffs and foreign country growth in real GDP, show to be statistically significant.

As an alternative to splitting the full data set into high and low R&D firms, we can

improve the efficiency of the parameter estimates by employing the full data set and include dummy variables for the high R&D industries. Specifically, in Table 6, an intercept dummy variable, *dummy*, taking on a value of 1 for high R&D industries is included to test whether the expected mean value of cross border M&As of high R&D industries differs from low R&D acquisitions. Furthermore we include a dummy variable that interacts with the real exchange rate; the variable *rerdummy* is the product of the real exchange rate and the dummy variable that takes on a value of 1 for high R&D industries. This allows for testing whether the real exchange rate has a differential response on the acquisition of high vs. low R&D industries.

As the results in Table 6 show, the intercept dummy is not significant, reflecting an insignificant difference of the expected mean values of the number of acquisitions between high and low R&D industries. Of importance is the performance of the exchange rate- dummy interacting variable, *rerdummy*. The p-value shows it is marginally significant at the 5% level of significance, and the value of the coefficient is high and similar to the value in Table 4. Furthermore the real exchange rate variable *rer*, which captures this variable's effect on the acquisition of low R&D industries, is insignificant. Overall these results are consistent with the results in Tables 5 and 6 and confirm that the real exchange rate matters for acquisitions only in high R&D industries.

## **7. Concluding remarks and extensions**

Data on U.S. M&As and greenfield transactions in Canada over 1985-2001 revealed increased M&A activity over the latter half of the 1990s, with a relatively downward trend in greenfield investments. Over this period the Canadian dollar depreciated substantially relative to the U.S. dollar. This evidence suggested a potential link between the Canada-U.S. exchange

rate and the number of U.S. M&As in Canada. A potential theory that explains this link is proposed by Blonigen (1997), which relies on the assumption of imperfect goods markets and the possession of firm specific assets by the target firm.

We employed fixed and random effects negative binomial models to model count data on the number of U.S. M&As in Canada. The results from the full sample set showed that the real exchange rate was a determining factor in explaining U.S. M&As, taking into account other FDI determinants.

We then split the sample into low R&D industries and high R&D industries, where the latter sample included traditional R&D industries such as telecommunication equipment, and machinery and electronic parts. The results showed that the real exchange rate was statistically significant for M&As in high R&D industries, where the estimated coefficient was substantially larger than in the full sample case. Furthermore, the tariff variable was insignificant. This is a theoretically plausible result, as the tariff rate should not factor into a foreign firm's decision to acquire a firm possessing an innovative asset. For the low R&D industries, the real exchange rate was not significant, whereas the tariff rate was. These results are plausible; given little if any firm specific assets held by these firms, the main motive for foreign firms to acquire them is to gain market presence or power. As such traditional determinants of FDI play a role, such as tariff rates. Using an intercept dummy and interactive exchange rate- dummy variable in the full data set, the results showed again that the real exchange rate matters for acquisitions of only high R&D industries.

While this paper focuses on establishing an empirical link between U.S. M&As and the exchange rate, it would be instructive to touch on a few policy implications. The loss of control over such high-value added industries, with their associated positive spillover effects, has a

potentially significant economic impact in the domestic country. The size of the impact depends on whether the innovation or firm specific asset is entirely relocated. To the extent that domestic production is not halted after the takeover, welfare may not be reduced. If all of the asset is transferred and production facilities in Canada cease, welfare will reduce. The effects are pronounced for technologically endowed assets, as significant spillover effects are associated with such assets. Studies have shown that Canada's economy lacks in high-end or product innovative manufacturing industries, which may be a significant contributor to the Canada-U.S. productivity gap (Trefler, 1999; Statistics Canada 2001; Martin and Porter 2001).

In an environment with a low value of the Canadian dollar relative to the U.S. dollar, there may be incentive problems in initiating or starting up research or innovative intensive projects, as these ventures may eventually be acquired by U.S. firms. Furthermore it will be difficult to rationalize government spending and subsidization to these firms given they are vulnerable for takeover during periods of continuous Canadian currency depreciations. While this paper focuses on the exchange rate as a determining factor of cross border M&As, monetary authorities should then take note of the negative consequences of a currency depreciation, as this factor contributes to the loss of ownership of Canadian R&D intensive industries.

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**Table 1. U.S. Mergers and Acquisitions and Greenfield Investments in Canada<sup>1</sup>**

Year	Nominal Exchange Rate (U.S/Cdn)	U.S. M&As in Canada						U.S. Greenfield Investments Canada <sup>3</sup>	
		Total Transactions		Transactions > 100M		Transactions > 1000M		Number	Value <sup>2</sup>
		Number	Value <sup>2</sup>	Number	Value <sup>2</sup>	Number	Value <sup>2</sup>		
1985	0.7323	208	6,086,041	7	4,209,099	1	C	139	230,789
1986	0.7196	412	10,396,612	18	6,938,278	0	C	213	424,484
1987	0.7541	433	17,659,991	20	13,360,664	2	C	163	201,501
1988	0.8125	359	5,439,512	11	211,6843	0	C	152	390,443
1989	0.8446	398	12,855,391	14	9,767,383	2	C	127	285,529
1990	0.8570	345	5,515,546	8	3,106,014	1	C	124	240,140
1991	0.8728	368	3,241,699	5	1,248,111	0	C	114	179,408
1992	0.8273	282	6,178,111	10	4,013,924	1	C	73	1,464,925
1993	0.7751	228	3,743,365	7	2,099,607	0	C	99	1,294,313
1994	0.7322	260	5,310,870	7	2,861,008	0	C	74	560,196
1995	0.7286	326	8,740,581	17	6,033,314	0	C	74	456,880
1996	0.7334	458	9,765,657	26	5,840,992	0	C	83	256,807
1997	0.7222	327	11,281,140	25	8,143,760	2	C	45	336,522
1998	0.6741	548	18,333,127	31	13,125,862	4	7,38,5856	88	558,902
1999	0.6730	519	26,747,290	47	21,955,195	4	11,662,314	72	331,388
2000	0.6733	478	24,060,046	42	19,525,766	6	10,027,668	59	467,494
2001	0.6456	352	39,656,830	49	36,120,052	10	26,684,663	62	192,949

C: Confidential;<sup>1</sup> The Investment Review Division defines a foreign acquisition to be a transaction at least 50% of the firm's assets or voting shares are acquired.

<sup>2</sup> \$000 Cdn, deflated by the Consumer Price Index <sup>3</sup> Over the full period, only 12 transactions had a value greater than \$100 million. Investment Review Division, Industry Canada

Table 2. Total Number of U.S. Mergers and Acquisitions by Industry (1985-2001)

SIC code	U.S. M&As	Descriptor	Establishments	
			1990	2001
5111	185	petroleum products, wholesale	1728	2835
5743	151	electrical machinery, equipment and supplies	1012	2596
3199	116	other machinery and equipment industries n.e.c.	472	1899
7799	109	other business services n.e.c.	6414	11423
5793	90	professional machinery, equipment and supplies, wholesale	760	2064
5731	85	industrial machinery, equipment and supplies, wholesale	1683	5514
4999	77	other utility industries	699	1955
1699	67	other plastic products industries n.e.c.	343	1542
3192	67	construction and mining machinery and materials handling equip. industry	208	1140
7512	67	operators of non-residential buildings	3177	9875
5971	62	industrial and household chemicals, wholesale	543	1414
9911	59	industrial machinery and equipment rental and leasing	584	1653
5791	58	office and store machinery, equipment and supplies, wholesale	989	2488
3359	56	other communication and electronic equipment industries	154	404
3259	54	other motor vehicle accessories, parts and assemblies industries	59	340
7791	52	security and investigation services	488	2116
7771	51	management consulting services	10738	25271
3799	46	other chemical products industries n.e.c.	136	478
3999	46	other manufactured products industries	1073	2448
5622	45	plumbing, heating and air cond. equip. and supplies, wholesale	631	1746
9731	45	funeral homes	277	1305
7752	41	offices of engineers	3449	10653
3912	40	other instruments and related products industry	148	605
7792	40	credit bureau services	48	105
9921	39	automobile and truck rental and leasing services	912	1995
5722	36	mining machinery, equipment and supplies, wholesale	263	931
5529	35	other motor vehicle parts and accessories, wholesale	1054	3374
919	34	other service industries incidental to crude petroleum and natural gas	719	3603
3352	34	electronic parts and components industry	173	579
5219	33	other foods wholesale	867	2936
2819	32	other commercial printing industries	2225	4227
6599	32	other retail stores n.e.c.	2380	4360
9999	32	other services n.e.c.	3078	3857
3255	30	motor vehicle wheel and brake industry	11	80
5621	30	hardware, wholesale	633	1737

Note: Focusing on industries for which acquisitions occurred, the mean, standard deviation and variance was 10, 18.4 and 342.2 respectively. Across all industries, the mean, standard deviation, and variance was 4.4, 13.1, and 170.1 respectively. The average number of establishments in 1990 and 2001 was 512 and 1,204 respectively.

Source: Investment Review, Industry Canada; Canadian Business Patterns, Statistics Canada.

**Table 3. Determinants of Number of U.S. Mergers and Acquisitions in Canada, 1985-2001, Random and Fixed Effects Negative Binomial Model**

Dependent Variable: Number of U.S. Mergers and Acquisitions in Canada, 1985-2001

Variables	Random Effects		Fixed Effects	
<i>rer</i> (real exchange rate)	0.489 (0.045)	0.508 (0.038)	0.654 (0.008)	0.638 (0.009)
<i>tariff</i> ( average tariff rate on U.S. imports)	1.86 (0.022)	1.88 (0.021)	3.23 (0.001)	3.20 (0.001)
<i>USgrowth</i> (growth rate of U.S. real GDP)	0.053 (0.002)	0.052 (0.002)	0.050 (0.004)	0.050 (0.00)
<i>USshare</i> (value added of U.S. industry)	0.039 (0.383)	-	-0.033 (0.494)	-
<i>CDNM&amp;As</i> (number of Canadian M&As)	0.022 (0.001)	0.023 (0.001)	0.023 (0.001)	0.023 (0.001)
<i>CDNestab</i> (number of establishments)	0.0001 (0.002)	0.0001 (0.001)	0.0001 (0.009)	0.0001 (0.01)
constant	0.358 (0.003)	0.405 (0.001)	0.402 (0.002)	0.358 (0.001)
Hausman test <sup>1</sup>	41.77*	22.16*		
Likelihood ratio test <sup>2</sup>	3740**	3761**		
Observations	12172	12172	6800	6800

Note: The p-values are in parenthesis

<sup>1</sup> Hausman (1978) test, where the null hypothesis is no correlation between the industry specific events and the regressors; \* rejection of the null hypothesis

<sup>2</sup> The likelihood ratio test compares the panel or RE Negbin estimator with the pooled or Negbin estimator.

\*\*Likelihood ratio test has a p-value less than 0.001, rejecting the Negbin estimator model in favour of RE Negbin estimator

**Table 4. Determinants of Number of U.S. Mergers and Acquisitions in Canada for High R&D Industries in Canada,<sup>3</sup> 1985-2001, Random and Fixed Effects Negative Binomial Model**

Dependent Variable: Number of U.S. Mergers and Acquisitions in Canada, 1985-2001

Variables	Random Effects			Fixed Effects		
<i>rer</i> (real exchange rate)	0.884 (0.048)	0.985 (0.021)	1.028 (0.007)	0.879 (0.059)	1.05 (0.015)	1.21 (0.001)
<i>tariff</i> (average tariff rate on U.S. imports)	1.05 (0.498)	1.17 (0.448)	-	1.07 (0.506)	1.36 (0.388)	-
<i>USgrowth</i> (growth rate of U.S. real GDP)	0.042 (0.170)	0.041 (0.186)	-	0.042 (0.164)	0.040 (0.188)	-
<i>USshare</i> (value added of U.S. industry)	0.061 (0.469)	-	-	0.098 (0.347)	-	-
<i>CDNM&amp;As</i> (number of Canadian M&As)	0.013 (0.096)	0.015 (0.060)	0.014 (0.082)	0.011 (0.169)	0.014 (0.088)	-
<i>CDNestab</i> (number of establishments)	0.0001 (0.032)	0.0001 (0.004)	0.0001 (0.002)	0.0001 (0.101)	0.0001 (0.012)	0.0001 (0.001)
constant	0.544 (0.025)	0.615 (0.006)	0.742 (0.001)	0.544 (0.025)	0.588 (0.008)	0.684 (0.001)
Hausman test <sup>1</sup>	2.14	1.46				
Likelihood ratio test <sup>2</sup>	698 **	699**	698**			
Observations	1785	1785	1785	1428	1428	1428

Note: The p-values are in parenthesis

<sup>1</sup> Hausman (1978) test, where the null hypothesis is no correlation between the industry specific events and the regressors ; \* rejection of the null hypothesis

<sup>2</sup> The likelihood ratio test compares the panel or RE Negbin estimator with the pooled or Negbin estimator.

\*\* Likelihood ratio test has a p-value less than 0.001, rejecting the Negbin estimator model in favour of RE Negbin estimator

<sup>3</sup> 4-digit industries in the following 2-digit groups: 29-Primary Metal Industries, 31- Machinery Industries ,

32-Transportation Equipment Industries , 33-Electrical and Electronic Products Industries , 36-Refined Petroleum and Coal Products Industries , 37-Chemical and Chemical Products Industries , 39-Other Manufacturing Industries, 77-Business Service Industries

**Table 5. Determinants of Number of U.S. Mergers and Acquisitions in Canada for Low R&D Industries in Canada,<sup>3</sup> 1985-2001, Random and Fixed Effects Negative Binomial Model**

Dependent Variable: Number of U.S. Mergers and Acquisitions in Canada, 1985-2001

Variables	Random Effects			Fixed Effects		
<i>rer</i> (real exchange rate)	0.269 (0.370)	0.280 (0.349)	-	0.449 (0.136)	0.467 (0.117)	-
<i>tariff</i> (average tariff rate on U.S. imports)	2.01 (0.040)	2.02 (0.038)	1.79 (0.054)	4.01 (0.001)	4.02 (0.001)	3.61 (0.001)
<i>USgrowth</i> (growth rate of U.S. real GDP)	0.058 (0.005)	0.059 (0.005)	0.069 (0.001)	0.055 (0.008)	0.056 (0.007)	0.068 (0.001)
<i>USshare</i> (value added of U.S. industry)	-0.049 (0.249)	-	-	-0.111 (0.012)	-0.112 (0.010)	-0.113 (0.008)
<i>CDNM&amp;As</i> (number of Canadian M&As)	0.031 (0.001)	0.029 (0.001)	0.379 (0.001)	0.034 (0.001)	0.036 (0.001)	0.037 (0.001)
<i>CDNestab</i> (number of establishments)	0.0001 (0.179)	0.0001 (0.146)	-	0.0001 (0.698)	-	-
constant	0.407 (0.003)	0.343 (0.007)	0.396 (0.001)	0.449 (0.002)	0.450 (0.002)	0.541 (0.001)
Hausman test <sup>1</sup>	51.87*					
Likelihood ratio test <sup>2</sup>	28187 **	2820**	2848**			
Observations	10387	10387	10387	5372	5372	5372

Note: The p-values are in parenthesis

<sup>1</sup> Hausman (1978) test, where the null hypothesis is no correlation between the industry specific events and the regressors ; \* rejection of the null hypothesis

<sup>2</sup> The likelihood ratio test compares the panel or RE Negbin estimator with the pooled or Negbin estimator.

\*\* Likelihood ratio test has a p-value less than 0.001, rejecting the Negbin estimator model in favour of RE Negbin estimator

<sup>3</sup> All industries less high R&D industries (see footnote 3 in Table 4 for the high R&D industries)

**Table 6. Determinants of Number of U.S. Mergers and Acquisitions in Canada, 1985-2001, Random and Fixed Effects Negative Binomial Model , Dummy Variables**

Dependent Variable: Number of U.S. Mergers and Acquisitions in Canada, 1985-2001

<b>Variables</b>	<b>Random Effects</b>	<b>Fixed Effects</b>
<i>rer</i> (real exchange rate)	0.265 (0.360)	0.387 (0.182)
<i>tariff</i> ( average tariff rate on U.S. imports)	1.672 (0.036)	3.256 (0.001)
<i>Usgrowth</i> (growth rate of U.S. real GDP)	0.053 (0.002)	0.051 (0.003)
<i>USshare</i> (value added of U.S. industry)	-0.022 (0.578)	-0.072 (0.097)
<i>CDNM&amp;As</i> (number of Canadian M&As)	0.022 (0.001)	0.022 (0.001)
<i>CDNestab</i> (number of establishments)	0.0002 (0.002)	0.0002 (0.013)
constant	0.321 (0.014)	0.417 (0.003)
<i>dummy</i>	0.561 (0.233)	0.188 (0.429)
<i>rerdummy</i>	0.743 (0.030)	0.897 (0.054)
Hausman test <sup>1</sup>	34.47*	
LR Test <sup>2</sup>		8.32*
Number of Observations	12172	6800

Note: The p-values are in parenthesis

<sup>1</sup> Hausman (1978) test, where the null hypothesis is no correlation between the industry specific events and the regressors; \* rejection of the null hypothesis

<sup>2</sup> Likelihood ratio test where the null hypothesis is that the coefficients on the dummy variables are zero. \* rejection of the null hypothesis

### Appendix I: Random Effects Negative Binomial Model

The Poisson distribution is widely used in analyzing count data where the dependent variable is discrete and defined for non-negative integers corresponding to the number of events occurring in a given interval (Hausman *et al.*, 1984).

We model the number of U.S. mergers and acquisitions. The Poisson probability function may be expressed as follows:

$$Prob(y_{it}) = (e^{-\lambda_{it}} \lambda_{it}^{y_{it}}) / y_{it}! \quad (1)$$

where  $y_{it}$  is the number of acquisitions of M&As of firms in the SIC code  $i$  in period  $t$ , and  $\lambda_{it}$  is the conditional mean and variance. Standard procedure is to make  $\lambda_{it}$  to be an exponential function of the explanatory variables

$$\lambda_{it} = \exp(X_{it}\beta)$$

The coefficients are estimated by maximizing the log-likelihood function of the Poisson model.

As noted this model has the property that the conditional expected value and variance are equal. This condition is violated in many data sets. To overcome this condition, the negative binomial (hereafter Negbin) model has been developed for cross-sectional data (Cameron and Trivedi, 1986). It allows for the second conditional moment to differ from the

first. In many economic applications it is not uncommon to find the variance to exceed the mean. This implies ‘overdispersion’ in the data. Overdispersion may have two explanations. First, it might be caused by unobserved heterogeneity. Second, the data generating process might be such that there is interdependence between the occurrence of successive events. In the presence of overdispersion, employing the Poisson model will lead to an estimated variance-covariance matrix that is biased downwards, yielding incorrectly small estimated standard errors of the parameter estimates and overstated  $t$ -statistics.

The Negbin model allows for heterogeneity in the mean function by introducing an additional stochastic component to  $\lambda_{it}$  :

$$\lambda_{it} = \exp(X_{it}\beta + \varepsilon_{it})$$

where  $\varepsilon_{it}$  captures unobserved heterogeneity and is uncorrelated with the explanatory variables, and  $\exp(\varepsilon)$  follows a Gamma distribution.

A major concern with the standard Negbin model is that it does not take into account the panel nature of the data used here. The Negbin model pools the data where it constrains the dispersion to be constant across all panels. In contrast we allow heterogeneity across panels or industries by employing the random effects Negbin model proposed by Hausman *et al.* (1984).<sup>18</sup> In this model the dispersion varies randomly from industry to industry.

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<sup>18</sup> Hausman *et al.* (1984) state that the RE Negbin model yields asymptotically more efficient estimators than their fixed effects model. For these results to be consistent, the industry-specific effects need to be uncorrelated with the regressors.

Specifically, the Poisson parameter  $\lambda_{it}$  follows a gamma distribution with parameters  $(\gamma, \delta)$ . For the variation across industries, we allow each industry  $i$  to have its own  $\delta_i$  such that  $1/(1+\delta_i)$  is distributed as a Beta random variable with the shape parameters  $(a, b)$ .<sup>19</sup> For any industry  $i$ , the dispersion (variance divided by mean) is equal to  $1 + \delta_i$ . As is standard, we set  $\gamma_{it} = \exp(X_{it} \boldsymbol{\beta})$ . We also present Hausman test results and fixed effects results.

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<sup>19</sup> The Beta distribution will be symmetric if  $a = b$ , and can be U-shaped or hump-shaped.

## Appendix II: Data Sources

$USM&As_{it}$ : U.S. mergers and acquisitions with and of Canadian businesses. The source for this data is the Investment Review Division, Industry Canada. The data record the transactions involving U.S.-owned businesses merging or acquiring Canadian-owned business in Canada. According to the Investment Canada Act, section 26, a merger or acquisition relates to a change in control, where control is defined as acquiring at least 51% of common voting stocks or assets.

The act requires every non-Canadian to file a Notification or an Application for Review with Investment Review, Industry Canada, each time a non-Canadian plans to or actually commences a new business activity in Canada (greenfield investment) or acquires a Canadian business. Review Applications are necessary for relatively large transactions (excess of \$218 million for WTO members and \$5 million for non-WTO members), where the Minister of Finance determines whether the investment is permitted. Authorities at Investment Review contact the potential investors within a specified period after the submission of forms to determine whether the transaction was implemented. The recorded acquisition data reflects those applications where the investment was actually carried out. All the notifications are recorded in the data, but there is no follow up process of the notifications; there may thus be an upward bias on the number of investments in this category. However authorities at Investment Review estimate that the vast majority of Notifications are submitted after the investment has taken place.

The data does not distinguish between mergers and acquisitions.

$rer_{it}$  : the Canada-U.S. real exchange rate at the 2-digit SIC level. The nominal exchange rate data  $e$  is from CANSIM I and are annual averages. The 2-digit U.S. industry price data are from the Bureau of Labour Statistics, Industry Prices. The Canadian prices are from CANSIM I, Industrial Product Indices.

$tariff_{it}$ : is the effective tariff rate at the 4-digit SIC level. This is equal to the ratio of the value duties collected on U.S. imports at the 4-digit SIC level to the value of U.S. imports at the 4-digit SIC level. The source is the International Trade Division, Statistics Canada

$Usgrowth_t$  : growth rate of U.S. real GDP, CITIBASE.

$Usshare_{it}$  : share of value added of U.S. industry  $i$  at the 2-digit SIC level, which was constructed using the share of GDP of industry  $i$  to total GDP. U.S. Bureau of Economic Analysis, GDP by Industry.

$CDNestab_{it}$  : the number of Canadian establishment at the 4-digit SIC level. Canadian Business Patterns, Statistics Canada.

$CDNM\&As_{it}$ : Canadian mergers and acquisitions with and of Canadian businesses. Thomson Financial Securities Data Company (SDC Platinum Database). These data conform to the Investment Review definition of control (51% of control over common voting shares or assets). Unlike the Investment Review data, the data is based on published sources recording announced investments. Given the press coverage focuses only on large transactions, the data may not capture all mergers and acquisitions in Canada.