The Impact of Real Exchange Rate Movements on Service Sector Firms

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Abstract

There is a growing literature addressing the effect of exchange rate movements on the survival and performance of manufacturing firms. With international trade in services expanding tremendously, the international environment is also becoming increasingly important to service sector firms. To date, however, the implications of the international economy for firms in the service sector are vastly understudied. This paper sets out to investigate this important, yet unexplored, issue. We analyze the effects of industry specific real exchange rate movements on the profitability, survival, sales and leverage of Canadian service sector firms. We use firm level data from 1986 to 1997 combined with service trade data from 1990 to 2005. Our empirical results show that real appreciations of the Canadian dollar reduce firm probability of survival, sales and profitability while depreciations have the opposite effect. Leverage decreases with appreciations and increases with depreciations. This paper is among the first in the literature that analyze the impact of exchange rate movements on the behaviour of service firms. Overall, our findings suggest a significant exchange rate effect on service firms and the direction of which is similar to that for manufacturing firms.

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1. Introduction

Services have long been considered by economists and other observers of international commerce to be the proverbial non-traded good. Indeed, by conventional measures of openness services remain the most closed sector of the world economy. However, in part due to the technological changes that have made some services more "tradable", services have increased their importance in international trade. International trade and investment in the service sector has been growing rapidly over the past twenty years, with 2005 worldwide service exports valued at $2.4 trillion Canadian dollars.[1] . The growth in international outsourcing of some service activities has attracted considerable media attention in the developed world as white-collar workers in the service sector face increased international competition. At the same time, services have become the largest component of the "post-industrial" developed world economies. According to UNCTAD (2004, p. 97), services represent 72 percent of GDP in developed countries and 52 percent in developing countries. Moreover, services are crucial inputs into the production of most goods. Even if some services them selves are not traded, they may rely considerably on tradable inputs. This relationship with tradable inputs implies that service sector firms may be significantly, if indirectly, influenced by international economic conditions.

Given the important role of services in the economy, the dearth of studies on services is a major omission in the economics literature. There is an emerging literature on trade in services, but the implications of the international economy on the service sector firms have not been well developed in the literature and are not well understood. For example, we are not aware of any studies that have examined the impact of trade liberalization on the service sector in Canada. A number of studies have examined the impact of the Canada-US Free Trade Agreement (CUSFTA) and the subsequent North American Free Trade Agreement (NAFTA) on Canada's manufacturing sector – but none have considered the implications for the service sector. There is a similar absence of studies reflecting the implications of the exchange rate for service sector firms, the topic we address in this paper.

There are three main reasons that services have been overlooked in the literature. First, services have

[1] https://www.edc.ca/english/docs/news/2006/mediaroom_11409.htm

until recently been left off of the table in international trade liberalization. Therefore, it is natural to focus on understanding the impact on the manufacturing sector that was affected directly by tariff reductions. The second reason that services are ignored when looking at the impact of tariff reductions is that tariffs, and tariff data, typically do not exist for service industries. Third, many of the studies of the impact of trade policy are based on data from the manufacturing sector. Many of the data sources focus exclusively on manufacturing industries. Limiting investigation to manufacturing industries restricts our understanding of the impact of exchange rates to less than 30 percent of the economies of most developed countries. This is a major omission. Moreover, using US data Foote (1998) provides strong evidence that firm dynamics are very different in non-manufacturing sectors, underscoring the importance of investigating firms in the service sector directly.

While not focused on the service sector, there is a substantial literature concerning the effects of exchange rate fluctuations on trade volumes. Using aggregated data, Pozo (1992), Chowdhury (1993) and Parsley and Wei (1993) suggest that exchange rate volatility leads to *small* reductions in trade volumes. In contrast, using a more disaggregated approach, Bernard and Jensen (2004) attribute a *substantial* portion of the US export boom in the late 1980's and early 1990's to the depreciation of the US dollar and increasing foreign incomes. The importance of plant-level data is further underscored in Das, Roberts and Tybout (2007) who use Columbian data and find a similar relationship between exchange rates and exports, and in Bond, Tybout and Utar (2005) who find that macro-economic volatility (including exchange rate volatility) reduces average productivity by way of selection effects. Blalock and Roy (2007) consider firm-level data from Indonesia following the Asian currency crisis – and find that while *aggregate* exports did not boom following the devaluation, *entry* into the export market did rise.

In the industry-level research on the effects of the Canada-US free trade agreement, Gaston and Trefler (1997) and Beaulieu (2000) find an exchange rate effect in the labour market, while Head and Ries (1999) find an effect on the production scale and the number of plants. Although these industry-level studies provide some important insights, the studies are not able to capture the heterogeneous nature of industries. Baldwin and Gu (2003, 2004) and Trefler (2004), using the ASM, as well as Baggs (2005) and

Baggs and Brander (2006) using T2LEAP, make contributions to this literature on trade policy by exploring similar questions using microeconomic data. This work exemplifies the importance of using firm level data to disentangle complex effects on productivity, employment dynamics and the probability of firm survival and exit that cannot be captured using industry level data. None of these studies consider the service sector.

There is some evidence, however, that exchange rates have significant effects on the volume of service trade. In a model developed to forecast trade in services, Deardorff et. al. (2001), use a trade weighted exchange rate as one of three key variables driving trade in services. Hung and Viana (1995) find that depreciations in the US dollar in the late 1980's and early 1990's significantly contributed to the US trade surplus in service industries. Using data from the late 1990's, Freund and Weinhold (2002) use the exchange rate as a control variable in their study of the effects of internet use on trade in services. They find that appreciations of the US dollar tend to increase US service imports, though this effect is not strongly significant. In a related paper, Freund and Weinhold (2004), they find that a depreciation in the exporting country's currency relative to the US dollar increases exports while a depreciation in the importing country's currency decreases exports.

Building on the both the services trade literature and the work on how changing international conditions affect domestic firms, this paper examines how fluctuations in the real exchange rate affect the profits, survival, sales and leverage of service sector firms. These four dependent variables well documented to be significantly affected by both tariffs and exchange rates in manufacturing firms. Baldwin and Krugman (1989) suggest significant consequences of the exchange rate for both entry and exit. Papers by Baggs (2005), Pavcnik (2002), and Lewis-Bynoe, Griffith and Moore (2002) investigate the effect of trade liberalization on exit. Baggs et. al. (2008) found that domestic currency appreciations negatively affected the survival of manufacturing firms, as well as decreasing their sales. Mann (1986) demonstrates a significant relationship between profits and exchange rates, as does Clarida (1991) who finds that real exchange rate fluctuations have considerable implications for the profits of US manufacturing firms, even when controlling for output, costs and relative prices. Baggs and Brander

(2006) find significant effects of both tariffs and exchange rates for the profits and leverage of Canadian manufacturers.

We circumvent the absence of tariff data and the complexity of measuring trade liberalization for service firms, by considering exchange rates rather than tariffs. As in Feenstra (1989)[2], large exchange rate movements may be comparable to the effects of significant episodes of tariff changes by similarly altering the competitive position of domestic firms in the international economy. While tariffs and exchange rates are in many ways differentiated, in particular because tariff changes are often permanent while exchange rate fluctuations are transient, both change the competitive conditions of domestic firms relative to foreign competitors and accordingly offer a window into the implications of an increasing openness. We develop a trade-weighted real exchange rate using data on services sector exports and imports to identify their exposure to the fluctuations of different currencies.

We combine our trade-weighted real exchange rate with the T2LEAP data, an excellent longitudinal firm level dataset containing the tax records of *all* incorporated Canadian firms hiring employees, allowing us to pursue a comprehensive analysis of the service sector. This data includes all sectors of the Canadian economy, both public and privately held firms, and firms of all sizes and financial structures. Using this data, we examine the impact of large real exchange rate movements on the survival, sales, profits and leverage of firms in the service sector. Following from our study on the exchange rate and manufacturing firms in Canada, Baggs et al (2008), we also consider whether firms in the service sector respond differently to exchange rate movements than firms in the manufacturing sector.

In addition to the availability of excellent data, the use of Canadian firms in our study affords a number of advantages. First, we are fortunate to be able to combine our firm level service sector data with a period of time (1986-1997) in which the Canadian dollar experienced both sustained appreciations *and* depreciations of a similar magnitude. These fluctuations offer an excellent opportunity to examine the effects of large real exchange rate changes on service sector firms. Second, services are important to

[2] An exchange rate appreciation, for example, can be portrayed as the opposite of trade liberalization (tariff reductions) for exporters but generates effects similar to trade liberalization for import competing firms.

the Canadian economy and increasingly traded. Copeland (2002) indicates that 73 percent of Canadian employment is in the service sector. In 2005, services accounted for 16% of Canadian exports, and 18% of imports (by value)[3]. Service trade is also exhibiting considerable growth. Between 2000 and 2005, Canadian service sector exports grew by 12% and imports by 21%. Services are now the third largest export sector in Canada. The Canadian service sector is both substantial and relatively representative of other developed countries in terms of magnitude.

Our empirical results show that real appreciations of the Canadian dollar reduce firm profitability, probability of survival and sales while depreciations have the opposite effect. Leverage decreases with domestic currency appreciation and increases with depreciation. Overall, our findings suggest a significant effect on service firms, the direction of which is similar to that of manufacturing firms. The next section details our theoretical motivation and the third section describes the data. The empirical results are found in the fourth section and the fifth section concludes.

2. Theoretical Motivation

Given the increasing openness of the service sector, it is becoming gradually more reasonable to expect trade liberalization and exchange rate changes to affect service firms in manners similar to manufacturing firms. Theoretically, most models do not differentiate between manufacturing and services, they differentiate between "traded" and "non-traded". To the extent that services are indeed traded, they increasingly fall into the same theoretical structures as do manufacturing firms.

For any traded product, we might in general expect home currency appreciations to increase the amount of competition domestic firms face from (now cheaper) imports, and reduce their competitive edge in foreign markets as their exported products become relatively more expensive. Similarly, a domestic currency depreciation improves the competitive position of domestic firms both at home and abroad. This idea is formalized in Fung's (2008) model which builds on the Krugman (1979)

[3] In 2005 Canadian service exports were valued at $69,979 million Canadian dollars and imports at $79,141 million Canadian dollars. In the same year merchandise trade exports were valued at C$436,225 million and imports at C$380,809 million. For further details see: http://www.dfait-maeci.gc.ca/eet/pdf/Pfact_Services_Sep_2007a-en.pdf

monopolistic competition model by including an exchange rate variable. In this model, labour is assumed to be the only factor of production, and as a result, an appreciation of the domestic currency gives foreign firms a cost advantage in terms of domestic currency units. This intensifies the competition faced by domestic firms in both domestic and export markets, reducing the price they can charge.[4] Consequently, domestic firms must reduce their mark-up to remain competitive. Assuming all the costs are domestic, profits of domestic firms will also decrease. For some firms, this increase in competition and consequent fall in price and profits will lead them to exit. Accordingly, an appreciation in the domestic currency leads to a reduction in the number of domestic firms.

Fung (2008) shows two opposing affects of an exchange rate appreciation on the sales of a surviving domestic firm (to both domestic and foreign markets). While the cost disadvantage faced by domestic firms causes each of them to sell less, the exit of some firms leaves the surviving firms with a larger market share. Consequently, from a theoretical perspective, the net effect of a currency appreciation on a surviving firm's total sales depends on the direction and relative magnitude of the changes in exports and domestic sales.[5] If the exit rate is low or the exiting firms are substantially smaller than the incumbent firms, the total sales of incumbent firms would be expected to decrease when domestic currency appreciates. If the exit rate is high or exiting firms are large, total sales might increase in response to appreciation, as market share gains from failing domestic competitors more than compensate for increased foreign competition.

Bernard, Eaton, Jensen and Kortum (BEJK, 2003 henceforth) construct a model with Ricardian technology that allows for heterogeneous firms and imperfect competition. In their simulation results calibrated to the US data, a dollar appreciation (which takes the form of a 10 percent increase in the US

[4] In Fung's (2008) model, the demand function is derived from a symmetric translog expenditure function used by Bergin and Feenstra (2000, 2001) and Feenstra (2003). In this model, the (positive) price elasticity of demand is positively related to the relative price of the good to its competing goods. Compared to the profit-maximizing conditions derived from CES utility function, the advantage of using this demand function is that it shows a pro-competitive reduction of mark-ups when facing a reduction in the price of competing goods.

[5] In the export market, it is more likely that the effects of the cost disadvantage for surviving firms may outweigh the effect of increased market shares, thus exports decrease. However, the effect on domestic sales may be ambiguous, depending on the relative magnitude of the cost disadvantage and market share effects.

wage), increases the cost of production resulting in a cost disadvantage for US plants, and this leads plants to exit. For the surviving plants, the substitution of relatively cheaper intermediate inputs for labour limits the reduction of the value of sales and makes firms appear to be more productive. The model also predicts a contraction of exports and an expansion of imports. Based on this model, exporters would face a reduction in both exports and domestic sales. Accordingly, the reduction in shipments induced by a currency appreciation is larger for exporters than non-exporters.

Testable Hypotheses

The theoretical considerations described above yield three hypotheses which we will explore empirically:

1) A domestic currency appreciation reduces the mark-up domestic firms charge, lowering their profits. A depreciation increases profits.
2) An appreciation of the domestic currency reduces a domestic firm's probability of survival, a depreciation increases the probability of survival.
3) A domestic currency appreciation (depreciation) has an ambiguous effect on a firm's total sales; however, if the exit (entry) rate is low or the exiting (entering) firms are smaller than surviving (incumbent) firms, it is more likely that appreciation (depreciation) may cause a reduction (increase) in total sales.

Note further, that if the exchange rate affects profitability it might also lead to adjustments in a firm's financial structure. For example, if a firm's profits increase as a result of a currency depreciation as in hypothesis 1 above, this might allow the firm to reduce its short run debts. If exchange rate changes are viewed as part of sustained trend affecting competition in a market, and therefore changing the perceived risk and return associated with that market, firms may make adjustments in the relative amount of debt and equity. The idea that leverage is responsive to profitability is documented both theoretically and empirically in, among others, Donaldson (1961), Myers (1984), Baker and Wurgler (2002), and Frank and Goyal (2008). Baggs and Brander (2006) explore the interaction between profits and leverage for the case of trade liberalization. In their analysis, tariff reduction induced variation in profits lead to significant

changes to leverage. Given the inherently similar consequences of domestic tariff reductions and domestic currency appreciations for product market competition, we might similarly expect that as exchange rate changes affect profitability, firms may absorb some of those effects by allowing debt and hence leverage to vary. This leads to our fourth testable hypothesis:

4) Domestic currency appreciation, by lowering profits, induces firms to allow debt and leverage to rise. Domestic currency depreciation, by raising profits, allows firms to reduce debt and leverage.

3 Data

3.1 Micro data

This paper examines the effects of exchange rate on the performance of service firms that are exposed to international trade in services. The limited availability of service trade data restricts our analysis to construction, communication, finance and insurance, real estate and insurance agent, business services, and part of other services.[6]

We have the good fortune of having access to the T2-LEAP data, a detailed micro-data set produced by Statistics Canada. This data set is ideal for analyzing the behaviour of service firms and testing our four hypotheses described in the previous section. It was created by linking two underlying sources of data: corporate tax information from "T2" tax forms, and the Longitudinal Employment Analysis Project (LEAP), which obtains its data from firm-specific payroll information filed with the Canada Revenue Agency (CRA). Firm names are removed and replaced with numerical identifiers to make the data set anonymous.

T2-LEAP is a longitudinal dataset that provides information on every incorporated Canadian establishment[7] that legally hires employees (and hence files payroll information with the CRA) AND, in

[6] Utility, central bank, and part of other services (such as membership organization services) are excluded from the analysis as these industries are not affected by economic conditions.

[7] An "establishment" is not necessarily equivalent to a "firm" as some large firms have more than one establishment, but the overwhelming majority of firms are single establishments and, correspondingly, the vast majority of establishments correspond to independent firms. We will use the term "firm" to represent the units in the data set from now on.

the same year, files a "T2" corporate income tax return. T2-LEAP covers the period 1984 through 1998, and for the purposes of this study data from 1986-1997 are used.[8] It provides annual firm-level data documenting the firm's employment level, profit, revenues, debt, equity, assets, location, and industry affiliation at the 3-digit Standard Industrial Classification-Establishment (SIC-E) level. The dataset contains almost the entire Canadian private sector as measured by either output or employment. Components of the economy that are omitted include non-incorporated enterprises and corporations that hired no employees.

An important advantage of the data is its comprehensive coverage of Canadian firms. It includes both manufacturing and service firms and both publicly-traded and (the more numerous) privately-held firms. While the services sector plays an important role in the Canadian economy, information on service firms is relatively scarce as compared to manufacturing firms. More importantly, T2-LEAP includes both the very largest publicly-traded firms and relatively smaller privately-held firms in Canada. The inclusion of smaller firms is particularly important for the study of services firms given that the majority of service firms are small. In our sample, more than half of the firms have fewer than five employees.[9] We are restricted to book values of debt, equity, and assets. As noted above, the frequency of the data is annual. All financial data is converted to real (1986) Canadian dollars using the Consumer Price Index (CPI).

T2-LEAP is ideal for identifying entry/exit because it consists of the universe of Canadian firms. In the T2-LEAP data we can identify the year of birth (should the firm enter post 1984) and the year of death (should the firm exit prior to 1998). We use the criteria set out in Baggs (2005) for identifying entrants and exits. Specifically, a panel of survivors and exiters is constructed using the T2-LEAP data as follows. The initial population of firms we consider are those firms which existed in 1986. The sample will be augmented in each consecutive year by removing exiting firms and adding new firms. A firm is removed from the sample in year t if year t is the year in which the firm files its *last* tax return (the

[8] The first (1984) and last (1998) years are dropped because they are partial years only. We use 1985 but when the data are lagged we end up with data from 1986-97.
[9] The mean firm has 18 employees and the median firm has just 4 employees.

T2SUF measure of exit) or if year *t* is the *last* year in which the firm employs workers (the LEAP measure of exit). If a firm falls into either of these categories, it is counted as exiting. If a firm has missing data for some year(s) but then reappears in later years, the years of missing data are dropped from our analysis but the firm is not counted as exiting. When the firm reappears in the data it is added back into our unbalanced panel, but not counted as an entrant.[10] A firm enters our sample in the *first* year it *both* employs workers and files a tax return.

3.2 Exchange Rate Movements

In order to estimate the effect of exchange rate movements on survival, the T2-LEAP data was linked to real exchange rate data at the 3-digit SIC level. The experience of Canada's flexible exchange rate regime over the 1980s and 1990s was tumultuous. Throughout this period the Canadian exchange rate underwent distinct episodes of large depreciations and appreciations. The bilateral Canada-US exchange rate depreciated in the early 1980s and reached an historic (at that time) low of US$ 0.69 on February 4, 1986. The Canadian dollar appreciated throughout most of the late 1980s until it peaked at US$ 0.89 on November 4, 1991. The exchange rate went through another prolonged depreciation and reached the (new) historic low of US$ 0.63 on August 27, 1998, before beginning a new cycle of appreciation.[11]

While the value of the Canadian dollar with respect to the US dollar is of substantial importance to the Canadian economy, exchange rate movements may affect each industry to differing degrees owing to variations in price movements and differing composition of the industry's major trade partners. In order to measure the industry-specific exchange rate effects, we construct industry-specific trade-weighted real exchange rates (TWRERs) using exchange rates, a price index specific to each country, and the volume of service trade data between Canada and its major trade partners. The details of the methodology to construct the trade weighted real exchange rate have been summarized in Baggs et al (2008). Generally, we constructed the traded weighted real exchange rate (TWRER) in three steps. First, we normalized the

[10] In the T2LEAP data set, each year approximately 2.8% of firms have missing data. The missing year phenomenon is likely caused by firms filing taxes late. Therefore, it is more appropriate to classify them as continuing firms.
[11] See Powell (2003).

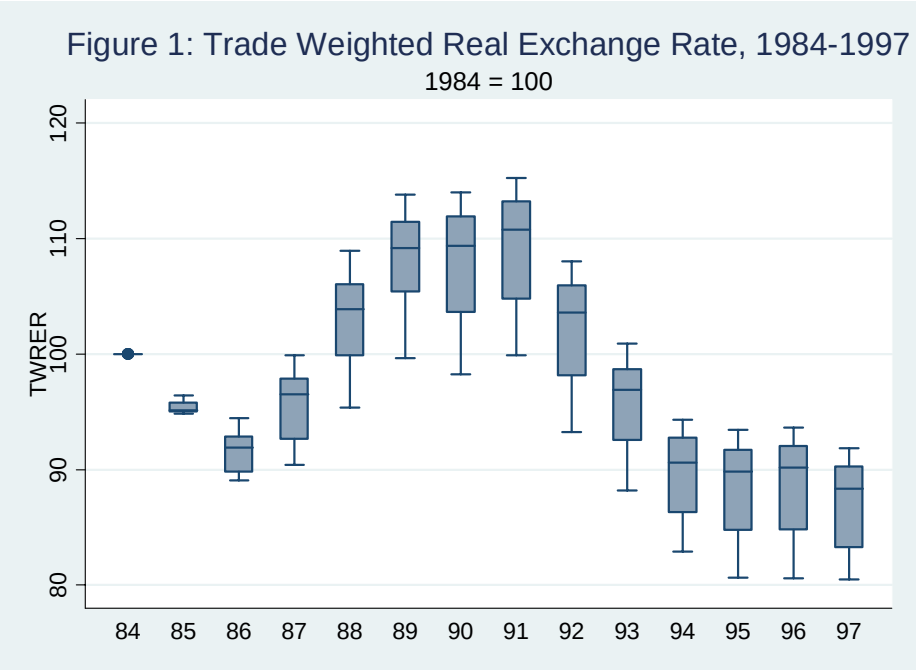
bilateral real exchange rates in order to avoid the unit problem in aggregation.[12] Second, we constructed industry specific weights based on the sum of exports and imports from 1990 to 2000 for each 3-digit industry's ten largest trading partners. The shares and trade partners vary by industry, but not by year. Finally, we constructed trade weighted real exchange rates weighted by the trade shares constructed in step two for each industry and year (1984-1997).

Data on volume of service trade by service type and country is from the Balance of Payment Division from Statistics Canada.[13] We use the volume of trade (sum of imports and exports) from 1990 to 2000 to identify Canada's top 10 trade partners for each industry and construct the trade shares. We then concord the service types with Standard Industry Classification so that we can link the trade weighted real exchange rate to the firm-level data at SIC 3-digit level.

Figure 1 presents the trade weighted real exchange rate from 1984 to 1997. Similar to the pattern observed in trade in manufacturing goods, the US is the important import source as well as export destination. Large weight on trade with the United States makes the overall pattern of movements of trade weighted real exchange rate similar to the bilateral Canada/US exchange rate: appreciation from 1987 to 1991 followed by a depreciation. Note that the exchange rate variable is based on the average value for the year. The firm data, as described above, are based on observations over the year.

[12] We follow Head and Ries (1999) and Bernard and Jensen (2004) and normalize the real exchange rates for each country using 1984 as the base year. The unit problem is that bilateral exchange rates have different units and those with large units will have a larger weight. For example in 1997 the US exchange rate was 0.0082 US $ per Japanese yen and was 1.64 US $ per British pound. It does not make sense to simply average across these different units to compute an effective exchange rate.

[13] Special thanks are extended to the Balance of Payment Division for accessing the service trade data. The data is from a series of surveys on the imports and exports of commercial services and spans from 1990 to 2005.



Our firm-level data set has over 1,203,212 firm-year observations. Table 1 contains descriptive statistics for three samples of firms. The first column is comprised of statistics for the complete sample of 1,203,212 firm-year observations. The second column contains only surviving firm-years and the third contains firms exiting at some point between 1986 and 1997. A total of 45,190 observations exited over this period. Column 4 indicates whether the mean value of each variable is significantly different for the population of survivors as compared to exiters, at the 5% level. We find that on average, exiting firms are significantly younger, smaller and have higher leverage than their surviving counterparts. They operate in more concentrated industries with lower rates of growth. The TWRER and labour productivity (in terms of sales per worker) is not statistically different for survivors and exiters. The difference in mean TWRER between exiters and survivors is 0.05. Surprisingly, the exiters faced a slightly lower TWRER and had higher labour productivity as compared to the survivors. On average, the difference between exiters and survivors are small in age and concentration ratio. Exiters are younger by 0.1 years and the concentration ratio is only very slightly higher for exiters -- a difference of 0.018. However, the difference in the number of employees and leverage is large. The mean leverage of exiters is higher by approximately 1.00 and the average employment of exiters is half as many as the employment of survivors. In the next

section we turn our attention to a more formalized model to test the implications of exchange rate movements for firm survival.

Table 1 – Descriptive Statistics

	All Firms	Survivors	Exits	Survivors and Exits significantly different at the 5% level?
Number of Observations	1203212	1158022	45190	
Mean TWR exchange rate	94.54	94.55	94.50	No
Mean Enterprise Age (truncated at 14)	6.45	6.45	6.35	Yes
Mean Number of Employees	18.54	18.89	9.50	Yes
Mean Assets	$11785	$12111	$3418	Yes
Mean Sales per Worker	$119000	$119000	$120000	No
Mean Leverage	0.805	0.768	1.756	Yes
Mean Annual Industry Sales Growth	4.38%	4.38%	4.25%	Yes
Mean four firm concentration ratio	0.195	0.195	0.213	Yes

4 Empirical Analysis

In this section, we empirically examine the effects of exchange rate movements on firm profitability, survival, sales, and leverage, as predicted in our four hypotheses above.

4.1 Profits

The first hypothesis specified in section 2 deals with the exchange rate effect on firm profits: An appreciation of Canadian dollar reduces the mark-up domestic firms are able to charge and accordingly lowers profits, a depreciation has the opposite affect. Owing to data limitation, we are unable to construct the *economic* profit. Here, we use the *accounting* profit as reported in the T2LEAP data as a proxy. The equation estimated can be specified as follows:

$$\ln profit_{ft} = \beta_1 + \beta_2 \ln ER_{it} + \gamma x_{ft-1} + \theta y_{it-1} + \tau_t + \varepsilon_{ft}, \quad (1)$$

where $\ln profit_{ft}$ is the logarithm of profit. In view of the skewness of profits it is appropriate to use the

(natural) logarithm of profits as the dependent variable. $\ln ER_{it}$ is the logarithm of the industry-specific trade-weighted real exchange rate. x_{ft-1} is a vector of firm characteristics that including age, size and productivity and τ_t is a time trend. y_{it-1} a vector of industry or more aggregate level control variables including real interest rate, industry sales growth and Canadian GDP growth rate. Firm size is indicated by size category and it is determined by the number of employees.[14] Our profit data is truncated for two reasons. First, because taking the natural log of profits is not feasible for profits less than or equal to zero, and second, because of reporting issues for firms with non-positive profits. Since the underlying source data is firm tax records, most firms with negative profits have simply recorded a "zero" on their tax forms as they have no *taxable* profits. A small number of firms do report negative profits. Accordingly, we are unable to identify if recorded "zero" profits are indeed zero, or are in fact a loss, resulting in the only consistent profit data being for firms with *positive* profits. We account for this in two ways. First, in column 1 of Table 2, estimation is with OLS. Second, in columns 2 and 3, a Tobit estimation procedure is used, where the natural log of profits for firm-years with zero or negative profits are coded as "0", and the Tobit lower limit is set to "0" to account for the bundling of all negative profits as zeros.

Consistent with our first hypothesis, the results show a negative relationship between a higher value of the domestic currency and profits, implying that a currency appreciation reduces firm profits and a depreciation increases profits. Turning attention to other variables, we find that larger, older and more productive firms have higher profits. At the industry level, firms have higher profits if their industries are more concentrated and if their industries have higher rates of sales growth.[15] We also include industry fixed effects. We control for the business cycle and macroeconomic shocks using the lagged annual growth of Canadian GDP, real interest rates and a time trend. Profits increase with GDP growth and decrease with the interest rate.

In column 3, we investigate the possibility of a differing exchange rate effect for firms with different

[14] There are four size categories (size = 1, 2, 3, or 4). Size = 1 if the number of employees is below 10; size = 2 if between 10 and 50; size = 3 if between 50 and 100 and = 4 if above 100.
[15] To prevent an endogeneity problem, in the firm-level regressions, the industry sales are defined as the sum of sales of all the firms in this industry except firm *f*.

productivity levels by including a term interacting the exchange rate with labour productivity. Surprisingly, the results indicate that the negative effect of currency appreciation is *more* pronounced for more productive firms. One possible explanation is that more productive (and larger) firms serve larger markets and are subject to more intensive international competition while less productive (and smaller) firms serve the local market and their profits are accordingly less affected.

Table 2 – Firm Profits
Dependent Variable: ln(profit)

	1	2	3
Trade Weighted Exchange Rate (increase=appreciation of C$), level: year *t*	-1.405** (0.037)	-3.562** (0.102)	-1.590** (0.412)
Exchange Rate*Productivity =Trade Weighted ER*Labour productivity			-0.448** (0.090)
Labour Productivity $=\ln(sales_{t-1}/alu_{t-1})$	0.625** (0.004)	1.676** (0.012)	3.711** (0.405)
Firm Size = 1 if $alu_{t-1} \leq 10$, =2, if $10 < alu_{t-1} \leq 50$; = 3 if $50 < alu_{t-1} \leq 100$; = 4 if $alu_{t-1} > 100$	0.807** (0.011)	1.460** (0.020)	1.460** (0.020)
Age = ln(age in years)	0.131** (0.005)	0.345** (0.013)	0.345** (0.013)
Industry Sales Growth % growth in sales from yr t-1 to yr t, 3-digit sic	0.259** (0.011)	0.562** (0.031)	0.560** (0.031)
Industrial Concentration 3-digit CR4 (year t-1)	1.224** (0.045)	3.353** (0.125)	3.364** (0.125)
GDP growth rate =Canadian GDP growth (year t-1)	3.205** (0.098)	5.419** (0.257)	5.399** (0.256)
Real Interest Rate =Canadian prime rate in year t	-0.007** (0.002)	-0.002 (0.004)	-0.002 (0.004)
Time Trend =1 if year=87, =11 if year=97	YES	YES	YES
Industry Fixed Effects two-digit SIC dummy variables	YES	YES	YES
R^2/Log Likelihood	0.275	-1723983	-1723951
Observations	1247349	1315231	1315231
Estimation Method	OLS	Tobit	Tobit

**= significant at 1%, * = significant at 5%, ^ = significant at 10%.
Robust standard errors (corrected for clustering at the firm level) are in parentheses.

4.2 Survival

Having found a significant effect of the exchange rate on profits, we test our second hypothesis concerning the effect of the exchange rate on survival using the following estimating equation:

$$P(survive_{ft}) = \Phi(\beta_1 + \beta_2 \ln ER_{it} + \gamma x_{ft-1} + \theta y_{it-1} + \tau_t), \quad (2)$$

where *f* indexes firms and *i* industries. $survive_{ft}$ is a 0-1 dummy indicating whether enterprise *f* was still alive at the end of year *t* and estimation is by probit. Control variables are as specified for equation (1), with the addition of lagged leverage at the firm level. Standard errors are robust clustered by firm. The results of this estimation can be found in Table 3.

In all four specifications, the trade weighted real exchange rate is negatively and significantly related to firm survival. In the first and third columns the exchange rate is measured in levels, and in the second and fourth columns it is measured as the change in level. Accordingly, our results indicate that both higher levels and appreciations of the Canadian dollar significantly reduce the probability of survival for Canadian service sector firms. This is consistent with our second hypothesis. Survival also is positively associated with firm labour productivity and size, and negatively associated with leverage and age. The age result is quite surprising. At the industry level, a firm is more likely to survive if its industry is experiencing higher sales growth, though this is not particularly significant, and if it operates in an industry where the four largest firms account for a smaller share of total sales. The real interest rate is insignificant in determining survival when the level of the exchange rate is considered, but negative and significant when the change is used. In addition, we also find that the growth of Canadian GDP is positively associated with survival.

To explore the possibility that firm responses to exchange rates are heterogeneous based on their other attributes, the third and fourth columns interact the exchange rate with labour productivity. The interaction is positive, and significant for the change in the exchange rate (column 4), indicating that appreciations reduce the probability of survival, but this effect is smaller for firms with higher labour productivity. This result is similar to arguments in the trade liberalization literature, see for example

Table 3 – Firm Survival

Dependent Variable: =1 if firm survives to end of year t, 0 otherwise, **Estimation Method:** Probit

	1	2	3	4
ΔTrade Weighted Exchange Rate (increase=appreciation of C$), year t-year t-1		-0.446** (0.055)		-1.636** (0.200)
Trade Weighted Exchange Rate (increase=appreciation of C$), level: year t	-0.247** (0.033)		-0.375** (0.096)	
ΔExchange Rate*Productivity =ΔTrade Weighted ER*Labour productivity				0.289** (0.047)
Exchange Rate*Productivity =Trade Weighted ER*Labour productivity			0.031 (0.022)	
Labour Productivity $=\ln(sales_{t-1}/alu_{t-1})$	0.092** (0.002)	0.093** (0.002)	-0.049 (0.100)	0.096** (0.002)
Leverage $=\ln(leverage_{t-1})$	-0.132** (0.003)	-0.132** (0.003)	-0.132** (0.003)	-0.132** (0.003)
Firm Size $= 1$ if $alu_{t-1} \leq 10$, $=2$; if $10 < alu_{t-1} \leq 50$; $= 3$ if $50 < alu_{t-1} \leq 100$; $= 4$ if $alu_{t-1} > 100$	0.144** (0.004)	0.144** (0.004)	0.144** (0.004)	0.144** (0.004)
Age =ln(age in years)	-0.035** (0.003)	-0.035** (0.003)	-0.035** (0.003)	-0.035** (0.003)
Industry Sales Growth % growth in sales from yr t-1 to yr t, 3-digit sic	0.016 (0.012)	0.022^ (0.012)	0.016 (0.012)	0.023* (0.012)
Industrial Concentration 3-digit CR4 (year t-1)	-0.306** (0.021)	-0.294** (0.020)	-0.307** (0.021)	-0.296** (0.020)
GDP growth rate =Canadian GDP growth (year t-1)	-0.250* (0.143)	0.324** (0.114)	-0.246* (0.122)	0.346** (0.114)
Real Interest Rate =Canadian prime rate in year t	-0.002 (0.002)	-0.015** (0.003)	-0.002 (0.002)	-0.015** (0.003)
Time Trend =1 if year=87, =11 if year=97	YES	YES	YES	YES
Industry Fixed Effects two-digit SIC dummy variables	YES	YES	YES	YES
Log Likelihood	-270899	-270894	-270898	-270871
Observations	1315231	1315231	1315231	1315231

**= significant at 1%, * = significant at 5%, ^ = significant at 10%.

Robust standard errors (corrected for clustering at the firm level) are in parentheses.

Melitz (2003), where increased competition from falling tariffs leads to the exit of firms with lower productivity. Given that currency appreciations act to hamper the competition position of domestic firms in both the domestic and foreign markets, this result is qualitatively similar. We see lower productivity firms less able to survive in an environment where currency appreciation gives foreign firms a cost advantage. Note that the demise of low productivity firms in the face of appreciation increases the average productivity within an industry and may contribute to a productivity improvement at the industry level. This is again analogous to the trade liberalization induced industry level productivity improvement described in Melitz and Ottaviano (forthcoming), and in Bernard et. al. (2003).

4.2 Sales

The third hypothesis deals with the effect of the exchange rate on firm sales. Given that the exit rate in the Canadian service sector is low,[16] it is likely that the influence of the exchange rate on the relative cost of domestic products as compared with foreign will dominate and therefore a real appreciation will reduce the sales of non-exiting firms. A real depreciation is expected to have the opposite effect. We investigate the implications of currency movements for firm sales by applying the following estimating equation to an un-balanced panel of surviving firms[17]:

$$\ln sales_{ft} = \beta_1 + \beta_2 \ln ER_{it} + \gamma x_{ft-1} + \theta y_{it-1} + \tau_t + \varepsilon_{ft}, \qquad (3)$$

To avoid an endogeneity problem, where industry sales growth is used as a control variable, it is measured using the total sales of the industry minus the sales of firm *f*. We have estimated equation (3) using OLS using both the logarithm of sales and change in log sales as dependent variables. The results are reported in Table 4.

[16] The average annual exit rate for the service firms in the sample is 5%.

[17] Our sample is an unbalanced panel including all firms that survive to the end of a given year. If a firm exits in year *t*, it will not be included in our analysis in year *t* or in subsequent years, but will be included in year *t-1* and previous years. Including the sales of firms in the year in which they exit is problematic because of partial year reporting (we can not differentiate between an exiting firm that operated for one week in year *t* or 51 weeks in year *t*).

Table 4 – Firm Sales

	lnsales	Δlnsales
	1	2
ΔTrade Weighted Exchange Rate (increase=appreciation of C$), year *t*-year *t-1*		-0.257** (0.015)
Trade Weighted Exchange Rate (increase=appreciation of C$), level: year *t*	-0.052** (0.020)	
Leverage =ln(leverage $_{t-1}$)	0.085** (0.002)	0.030** (0.001)
Firm Size = 1 if $alu_{t-1} \leq 10$, =2; if $10 < alu_{t-1} \leq 50$; = 3 if $50 < alu_{t-1} \leq 100$; = 4 if $alu_{t-1} > 100$	1.568** (0.005)	0.000 (0.001)
Age =ln(age in years)	0.058** (0.003)	-0.093** (0.001)
Industry Sales Growth % growth in sales from yr t-1 to yr t, 3-digit sic	0.107** (0.006)	0.128** (0.004)
Industrial Concentration 3-digit CR4 (year t-1)	0.378** (0.021)	0.093** (0.006)
GDP growth rate =Canadian GDP growth (year t-1)	3.201** (0.054)	1.720** (0.032)
Real Interest Rate =Canadian prime rate in year t	-0.021** (0.001)	-0.012** (0.001)
Time Trend =1 if year=87, =11 if year=97	YES	YES
Industry Fixed Effects two-digit SIC dummy variables	YES	YES
R^2	0.439	0.022
Observations	1239294	1239294
Estimation Method	OLS	OLS

**= significant at 1%, * = significant at 5%, ^ = significant at 10%.
Robust standard errors (corrected for clustering at the firm level) are in parentheses.

Our results show a negative and significant effect of appreciation on the sales of surviving firms, which is consistent with the predictions of Fung's (2008) model when the exit and entry rates are low. This suggests that, when the Canadian dollar appreciates, the revenue lost due to foreign competition and lower prices outweighs any possible gain in market share as a result of exit. Conversely, during periods of depreciation, incumbent firms are able to expand their sales, despite increased entry. This is consistent

with Forbes (2002) who finds that firms in countries that have experienced devaluations have higher output and operating profit growth and with Baggs et al (2008) who find a negative effect of currency appreciation on the sales of Canadian manufacturing firms. Note that we find a significant negative effect of both a higher level of the Canadian dollar on the level of sales (column 1), and a larger appreciation on the change in sales (column 2).

Turning our attention to control variables, for the level of sales, we find a positive association between older and larger firms and sales. For the change in sales, firm size is insignificant and age is negatively related to sales growth.[18] Interestingly, we see that firms with higher leverage have higher sales and higher growth in sales, implying that firms may expand sales by raising debt. At the industry level, sales and change in sales are positive associated with industry level sales growth and industrial concentration. Both sales measures are also positively related to GDP growth and negatively related to increases in the interest rate.

4.4 Leverage

Finally, we examine the effect of the exchange rate on firm leverage (hypothesis 4). Results in subsection 4.1 indicate that higher values of the Canadian dollar causes a reduction in firm profits, and by reducing the availability of retained earnings to finance operations, this reduction in profits may lead firms to increase their debt and hence leverage. This hypothesis is tested by estimating equation (4):

$$leverage_{ft} = \beta_1 + \beta_2 \ln ER_{it} + \gamma x_{ft-1} + \theta y_{it-1} + \tau_t + \varepsilon_{ft}. \quad (4)$$

Column 1 of Table 5 reports the reduced-form regression results. In column 1, the firm, industry and macro level control variables used are similar to the ones used in previous regressions. The coefficient estimate for the exchange rate is negative and significant, indicating that a real currency appreciation causes a reduction in leverage. This result differs from our hypothesis. A possible cause is that a home

[18] Since we can only measure productivity using labour productivity (sales per worker), endogeneity issues prevent us from including labour productivity as an independent variable when sales is the dependent variable.

currency appreciation intensifies product market competition, which reduces profits and causes firms to be less aggressive in their decisions regarding leverage. Firms facing a fierce competitive environment may be hesitant to take on more debt as it may make them financially vulnerable.

Table 5 – Firm Leverage
Dependent Variable: leverage

	1	2
Profit = ln(profit)		0.093** (0.029)
Trade Weighted Exchange Rate (increase=appreciation of C$), level: year *t*	-0.141** (0.051)	
Labour Productivity $=\ln(sales_{t-1}/alu_{t-1})$	-0.090** (0.015)	-0.148** (0.022)
Firm Size = 1 if $alu_{t-1} \leq 10$, =2, if $10 < alu_{t-1} \leq 50$; = 3 if $50 < alu_{t-1} \leq 100$; = 4 if $alu_{t-1} > 100$	-0.030** (0.007)	-0.105** (0.024)
Age = ln(age in years)	-0.076** (0.007)	-0.088** (0.007)
Industry Sales Growth % growth in sales from yr t-1 to yr t, 3-digit sic	0.019 (0.015)	
Industrial Concentration 3-digit CR4 (year t-1)	0.124** (0.044)	0.013 (0.055)
GDP growth rate =Canadian GDP growth (year t-1)	-0.510 (0.313)	-0.795* (0.347)
Real Interest Rate =Canadian prime rate in year t	0.001 (0.003)	0.002 (0.003)
Time Trend =1 if year=87, =11 if year=97	YES	YES
Industry Fixed Effects two-digit SIC dummy variables	YES	YES
R^2	0.001	--
Observations	1243382	1243382
Estimation Method	OLS	2SLS

**= significant at 1%, * = significant at 5%, ^ = significant at 10%.
Robust standard errors (corrected for clustering at the firm level) are in parentheses.

Since we hypothesize that the implications of the exchange rate for leverage occur indirectly, or via the effect the exchange rate has on profits, in the second column of Table 5 we estimate the effect of

the exchange rate on leverage using a two-stage least square (2SLS) approach. In the first stage, the logarithm of profit is instrumented using the exchange rate and industry sales growth. In the second stage, the predicted value of profits is included as one of the independent variables. The results show a positive and significant effect of profit on leverage, indicating that more profitable firms tend to raise leverage and debt. This result differs from the Baggs and Brander's (2006) findings using Canadian manufacturing firms, indicating differing firm behaviour between manufacturing and service firms. Similar to the profits regressions in subsection 4.1, un-cited first-stage results show a negative exchange rate effect on profits. Combine the first and second stage results, our findings show that a real appreciation reduces firm profit and lower profits cause a reduction in leverage, possibly because firm behaviour becomes more conservative.

The control variables in both columns behave similarly, with more productive, larger and older firms having lower levels of leverage, the interest rate and industry sales growth being insignificant in determining leverage, and GDP growth having a modest negative effect on leverage. The interest rate result is somewhat surprising as we might have expected a significant impact of interest rate levels on debt choices.

5. Conclusions

In this paper, we find significant implications of real exchange rate fluctuations for firms in the Canadian service sector. In the case of survival and sales, these effects are similar to those found for the manufacturing sector, with appreciations in the domestic currency reducing survival, particularly for less productive firms, and lowering the sales of non-exiting firms. Exchange rate fluctuations also significantly affect the profits and leverage of service sector firms, though these implications differ from those for manufacturing firms in some dimensions.

These significant findings are of particular note as the service sector has often been excluded from studies of international economics based on the argument that they are non-traded and hence should be unaffected. This paper suggests that even though the service sector remains among the "least traded"

sectors of the economy, it is still significantly impacted by exchange rate fluctuations.

This paper provides much needed empirical research on the influence of large real exchange rate movements on plant (firm) survival, sales, profitability and leverage. Since it is among the first micro-level empirical studies on this topic, results from this paper not only can be of the interest of academic researchers but also can be potentially valuable for policy makers when evaluating the long-run impact on the service sector of the large depreciation of the Canadian dollar in the last decade and of the recent appreciation.

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