EXCHANGE RATE PASS-THROUGH: EVIDENCE FROM THE CANADIAN PROVINCES

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Abstract

This paper examines variations in exchange rate pass-through across Canadian provinces and territories over the period from 1979 to 2006. Estimates of pass-through and its determinants are explored based on a standard two-stage empirical analysis. A special feature of this paper is that it introduces some provincial characteristics into the analysis and examines their effect on pass-through. I present evidence that inflation and its volatility significantly and positively affect pass-through and that the relationship between inflation and pass-through is non-linear. Other provincial characteristics are found to be significantly related with pass-though, but only in the early part of the sample.

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I. Introduction

In this paper I adopt a standard two-stage methodology to test for the presence of incomplete exchange rate pass-through to retail prices, and to examine primary determinants of the pass-through for ten provinces and two territories in Canada over the period from 1979 to 2006. Since the determinants of pass-through could be attributed to both macroeconomic and microeconomic factors, it is appropriate to adopt both macroeconomic and microeconomic perspectives in implementing the analysis. In contrast to present studies concerning pass-though, which only focus on the macroeconomic or microeconomic factors alone, this paper combines the macroeconomic and microeconomic views together to interpret pass-through movements to the domestic prices across Canadian provinces. I present evidence that inflation and its volatility significantly and positively affect pass-through and that the relationship between inflation and pass-through is non-linear. Some provincial characteristics are found to be significantly related with pass-though but only in the early part of the sample.

Many pass-through studies which examine the effects of monetary policies like Devereux and Yetman (2002) and Choudhri and Hakura (2005), argue that the degree of pass-through is sensitive to the monetary policy regime (e.g., inflation regime) and the persistence of the monetary shocks (e.g., the persistence of inflation shocks), based on cross-country data. According to these studies, a country with a high inflation rate tends to experience a high degree of exchange rate pass-through. This evidence is supported by many studies under the “cross-country” framework, but has not been examined under a “one country” framework. Thus, a relationship between pass-though and inflation under a “one-country” framework, is still very much left to be explored. In this paper, I use Canadian provincial data to examine whether inflation and inflation volatility positively and significantly affect the degree of pass-though under the “one-country” framework. A within-country study is as useful as a cross-country study on the relationship between inflation and pass-through because the former gives some control across the panel dimension since each disaggregated economy in a certain period under a “one country” framework would face same macroeconomic/monetary policy, federal taxes, and exchange rate changes.

We would expect a positive relationship between inflation and exchange rate pass-through based on the approach examining explicit price rigidities by Taylor (2000). In that model firms set their price for several periods in advance, and the frequency of their price adjustments are more sensitive to cost shocks if those cost shocks are perceived to be more persistent. Changes in the exchange rate and inflation are treated as cost shocks to the firms. If high inflation and high inflation volatility in a specific province are perceived to be persistent over a certain period by firms in that province, then pass-though would be high in that province due to high frequency of price adjustments.

With this reasoning in mind, I hypothesize that inflation and inflation volatility also should be positively associated with pass-through across Canadian provinces.

In addition, effects of the shift of the monetary regime on pass-through are also investigated in this paper. In early 1991, the central bank of Canada began to resort to an "inflation reduction targets" policy in response to the high inflation in previous periods. Because of this policy, the annual inflation rate was gradually decreased to 2 per cent by the end of 1995, and the average inflation rate over the period from 1991 to 2006 was somewhere around 2 per cent, much lower than the average inflation rate of 6 per cent over the period from 1979 to 1990. To capture the effect of this monetary regime shift on pass-through, I separate the full sample period (1979 to 2006) into two sub-periods: the period from 1979 to 1990 (high inflation regime) and the period from 1990 to 2006 (low inflation regime). Another advantage of splitting the entire sample period in this way is to minimize the effects of structural changes in some or all parameters of the model. One clarification should be made here, I use the period from 1990 to 2006 rather than the period from 1991 to 2006 as the second sub-period because many Canadian sectors appeared to have adjusted their costs and prices in response to the Canada-U.S. Free Trade Agreement (FTA) in 1990. Based on the evidence found by Devereux and Yetman (2002) and Choudhri and Hakura (2005), I would expect that Canadian provinces experience high pass-through during the period from 1979 to 1990 and low pass-through during the period from 1990 to 2006, as the inflation regime plays an important role in determining the degree of the pass-through.

Broadly speaking, each province is subject to its own specific characteristics such as the geographical distance to the United States, trade volumes with the States, income per capita and economic size of the province. This paper also seeks to explore the link between those provincial characteristics and exchange rate pass-through and use both macroeconomic and microeconomic factors to interpret the relationships.

Specifically, I use a similar approach to the one by Choudhri and Hakura (2006). In the first-stage analysis, the coefficients of pass-through for each Canadian province and territory are obtained by using provincial time-series data to estimate a domestic price regression model by provinces and territories. In addition, the hypothesis of incomplete pass-through is tested in this stage. In the second-stage analysis, cross-province regressions are employed to examine the determinants of variations in pass-through across provinces and territories.

Thus, the contribution of this paper is threefold. First, this paper attempts to examine the relationship between inflation and exchange rate pass-through under a “one-country” framework. Second, it includes some specific provincial features into the empirical analysis and explores whether those factors affect variations in pass-through across provinces. Lastly, it discusses the primary causes of pass-through by using both macroeconomic and microeconomic factors in the analysis.

The remainder of the paper is organized as follow. Section II discusses some related literature and provides further motivation for the study. In Section III, I conduct the first-stage and the second stage empirical analysis. Section IV concludes.

II. Related Literature

The link between exchange rate movements and price adjustments has been of interest to many economists for several decades. In early work, some economists expected that a 10 per cent increase in the exchange rate would decrease the price of imported goods by the same amount based on the theoretical formulation of purchasing power parity. In recent decades, however, exchange rate pass-through appears to be incomplete based on considerable theoretical and empirical studies. For example, some studies like Yang (1997) and Kardasz and Stollery (2001) show that exchange rate pass-through is incomplete, based on cross-industry studies within a “one-country” framework. Others, like Devereux and Yetman (2002), Choudhri and Hakura (2006), and Frankel, Parsley and Wei (2005), also find evidence of incomplete pass-through in their studies, but based on a “cross-country” framework.

Although incomplete exchange rate pass-through is verified by many studies, ultimate determinants of pass-through differ across studies. A debate on the causes of variations in exchange rate pass-through has recently been ignited. Some economists argue that the primary determinants of pass-through are microeconomic, and the extent of pass-through depends on various elements of market structure at the industrial level, such as the degree of product differentiation, the elasticity of demand, and the proportion of foreign firms in the domestic marketplace, relative to domestic firms. Yang (1997), for example, follows the extended Dixit-Stiglitz model to investigate the determinants of the pass-through, based on 87 U.S. industries over the period from 1980 to 1991. He finds that pass-through to imported prices is positively and significantly associated with the degree of product differentiation and negatively associated with the elasticity of marginal costs. In a similar vein, Kardasz and Stollery (2001) examine the primary determinants of pass-through, based on 31 Canadian industries over the period from 1972 to 1989. They argue that the extent of domestic pass-through increases with export share, the elasticity of substitution between imported and domestic goods (a measure of the degree of product differentiation), and domestic advertising intensity.[1]

Others, however, argue that the extent of the exchange rate pass-through is attributed primarily to monetary policy and the inflation rate. Devereux and Yetman (2002) borrow the Ball-Mankiw-Romer methodology to test the role of price rigidity in explaining variations in exchange rate pass-through across countries, based on

[1] Note that Kardasz and Stollery (2001) find a negative relationship between the changes in pass-through and the degree of product differentiation, which is in contrast to Yang (1997).

cross-country data. According to their theoretical model and empirical analysis, they argue that the price rigidity plays a critical role in determining pass-though, and argue that the degree of price rigidity depends on the monetary policy regime and the persistence of macroeconomic shocks. In particular, firms in a country which experiences high inflation and inflation volatility would adjust their price more frequently, and pass-though would be higher in that country. Moreover, they point out that average inflation significantly and positively affects the degree of pass-through to the domestic price with a decreasing marginal effect of inflation—that is, when inflation rises above a certain threshold, further increases in inflation would have no effect on the pass-through. Similar to Devereux and Yetman (2002), Choudhri and Hakura (2005) also find strong evidence of a positive relationship between pass-through and inflation and suggest that inflation dominates other macroeconomic factors in determining the pass-through, based on their database covering 71 countries over the period from 1979 to 2000. The evidence from those studies concerning the effects of macroeconomic factors on the pass-through suggests that exchange rate pass-though could be influenced by the macroeconomic structure and environment and is partially determined by those factors.

Although the positive relationship between pass-through and the inflationary environment is supported by many studies, the evidence for this relationship is not conclusive. According to Campa and Goldberg's (2001) study in which the evidence on pass-through to import prices is examined for OECD countries, inflation and its volatility are shown to be positively related to pass-through to import prices, but microeconomic factors seem to have much more influence on pass-through changes. They argue that movement of pass-through to import prices reflects the price behaviour of foreign firms, and this behaviour may not be strongly associated with a domestic inflationary environment. This argument suggests that the investigation of pass-through to domestic prices might be more appropriate for testing the link between pass-through and the inflationary environment.

As I mentioned earlier, each province is subject to its own specific characteristics such as the geographical distance to the United States, trade volumes with the States, income per capita and economic size of the province. Much evidence from literature concerning the relationship between pass-through and microeconomic factors suggests that those provincial characteristics could potentially affect pass-through. According to Frankel, Parsley and Wei (2005), the distance variable is hypothesized to have a negative sign—that is, the more distant is a province from the United States, the less pass-through that province should have. Provincial trade volumes with the United States could be used to predict the degree of product differentiation (or the elasticity of substitution between imported and domestic goods) in the marketplace of that province, and we expect that the degree of product differentiation would be negatively related to trade volume.[2] Thus, a more open economy with large trade

[2] Since the elasticity of substitution between imported and domestic goods is an inverted measure of the product differentiation, it is increasing in trade volume.

inflows and outflows would have a higher degree of elasticity of substitution, and then experiences higher pass-through. This hypothesis is based on the evidence presented by Kardasz and Stollery (2001) suggesting that the extent of pass-through to the domestic price increases with the elasticity of substitution between imports and domestic goods in Canadian manufacturing industries.

In addition, the extent of openness is commonly used to proxy the degree of the competitiveness in the marketplace. Dornbusch (1987) predicts in his Cournot model that pass-though is larger in an industry which exhibits a higher degree of competitiveness. Hence, we expect that pass-through would be positively related to the openness in our Canadian provincial datasets.

Introducing average income per capita as one explanatory factor to the pass-through in the empirical analysis is primarily based on the theory of search friction proposed by Alessandria (2004). The main idea of the theory is that with low consumer search costs, firms have less incentive to pass cost changes due to monetary shocks or other sources into their prices as doing so would induce losses of a stock of consumers in the market for those firms. On the other hand, with high search costs consumers have a trade-off between searching for new substitutes and sticking with original products. In this framework, then, firms would pass relatively more cost changes due to the shocks into their prices if search costs are high. Hence one might expect that pass-through would be larger in a province where income per capita is higher due to higher opportunity costs of searching for consumers. To explore the question of whether these provincial characteristics affect pass-through in Canadian provinces and territories, the factors discussed here will be examined in the empirical analysis below.

III. Empirical Analysis

III.1. Data

In this study I adopt a two-stage estimation procedure, which is similar to the one used by Choudhri and Hakura (2006). In the first stage, time-series data are used to estimate a domestic price equation by Canadian provinces and territories. The second stage, which is based on the macroeconomic and microeconomic factors discussed in the previous section, consist of cross-province regressions designed to explain the cross-province variation in the estimated pass-through coefficients. My data set covers the entire period from 1979 to 2006, the sub-period from 1979 to 1990, and the sub-period from 1990 to 2006 for twelve Canadian provinces and two Canadian territories. The variables used in the empirical analysis, together with their sources, are presented in the Table 2. All nominal price data and exchange rate data used in the first-stage regressions are monthly series and daily series. I convert monthly series or daily series to the quarterly series simply by taking the average over each quarter. In addition, all explanatory variables used in the second-stage regressions take the form of logarithms.

III.2. Inflation Experience

Tables 1A through 1C summarize the characteristics of CPI inflation (expressed as annual rates) for the entire sample period: 1979-2006, and the sub-sample periods: 1979-1990 and 1990-2006, respectively. Comparing Table 1B and 1C, we find that average annual inflation rates and inflation volatility from 1979 to 1990 are significantly higher than from 1990 to 2006 both at the province and aggregate level.[3] This remarkable difference could be attributed to the introduction of inflation targeting monetary policy by the Bank of Canada in 1991. We expect this shift of monetary policy would lead to lower pass-through for each province in the following period (e.g. 1991-2006). Those patterns can be observed in the first-stage regressions below. We also note that there is some variation in inflation rates across provinces, although the differences are not large.

III.3. Pass-Through Regressions (First Stage)

For each province, I use the following log-linear equation to estimate pass-through:

$$logP_t = \alpha_1 + \alpha_2 t + \beta_1(L)logP_{t-1} + \beta_2(L)logE_t + \beta_3(L)logP^*_{t-1} + \nu_t, \quad (1)$$

[3] Most provinces experienced higher inflation and inflation volatility from 1979 to 1990. At the aggregate level, annual inflation rate and inflation volatility are around 5.76% and 0.0288, respectively for period 1979-1990; and roughly halved for the period from 1990 to 2006.

where P_t is the quarterly CPI for each Canadian province, E_t is the nominal U.S. Dollar exchange rate expressed in Canadian dollars, P_t^* is quarterly U.S. CPI, t is the time (quarter), and ν_t is the error term in quarter t. The addition of a lag dependent variable, $logP_{t-1}$ in the RHS of the equation is to capture persistence in prices. As mentioned by Kardasz and Stollery (2001), the inclusion of time t in the equation allows us to capture the effects on the price variable like productivity or other exogenous factors that may vary systematically with time in a fashion that differs among Canadian provinces, or between Canada and the United States. $\beta_1(L)$, $\beta_2(L)$ and $\beta_3(L)$ are lag polynomials, and the order of each lag polynomial is determined by Akaike information criterion (AIC) or Bayesian information criterion (BIC).[4] Equation (1) or variants of this equation have been widely used by many studies to estimate pass-through.

According to Choudhri and Hakura (2006), exchange rate pass-through to the CPI over N periods can be calculated by the integrated partial effect of one-unit increase in the log of the nominal exchange rate in period t on the log of CPI at period $t+N$, that is $\sum_{\tau=0}^{N-1} \partial logP_{t+\tau}/\partial logE_t$. Thus, the N-period pass-through can be estimated by using lag polynomials, $\beta_1(L)$ and $\beta_2(L)$, since the dynamic multiplier $\frac{\partial logP_{t+\tau}}{\partial logE_t}$ is equal to the coefficient of the $\tau'th$ term in the lag polynomial $\mathrm{B}(L) = \frac{\beta_2(L)}{[1-\beta_1(L)]}$.

Based on evidence presented in a large number of empirical studies, the price

[4] Both AIC and BIC are used to rank competing models. Given any two estimated models, the model with low AIC or BIC is preferred. The only difference between AIC and BIC is that the latter criterion penalize free parameters more strongly than does the former one. See Akaike (1973) for AIC details and see Schwarz (1978) for BIC details.

level and exchange rate usually are non-stationary variables and contain a unit root. To explore this problem for my time series data, I conduct a unit root test for the log price level series for each province and the United States, and test for the log exchange rate series as well. By the Dickey-Fuller test, I find that the null hypothesis, which indicates the existence of the unit root, is indeed not rejected for each series at 5 per cent significance level. This result implies that the price level series and exchange rate series are all non-stationary. As Nelson and Plosser (1982) point out, nonstationarity often has important implications, and the distributions of estimates and test statistics associated with regressors, which contain unit roots, may differ sharply from those associated with regressors that do not. To overcome the issue of nonstationarity in my dataset, I adopt a popular methodology, which is designed to deal with the nonstationarity of time series. I take the first difference on both sides of the equation (1), and the estimating equation becomes:

$$\Delta logP_t = \alpha_1 + \beta_1(L)\Delta logP_{t-1} + \beta_2(L)\Delta logE_t + \beta_3(L)\Delta logP^*_{t-1} + \omega_t. \quad (2)$$

I recheck the stationarity for the first differences of price series for each province and the United States and the exchange rate, and find that the null hypothesis is rejected at 5 per cent significance level for all time series. This suggests that the first differences of all the time series are stationary, and pass-through can be appropriately estimated by the first difference regression form rather than the level form.

The order of each lag polynomial, $\beta_1(L)$, $\beta_2(L)$ and $\beta_3(L)$ is determined by Akaike information criterion (AIC) or Bayesian information criterion (BIC). By using the BIC, I find that the model with zero order of lag polynomials is superior among a variety of alternatives.[5] Equation (2) can thus be reduced to the following form:

$$\Delta logP_t = \alpha_1 + \beta_1 \Delta logP_{t-1} + \beta_2 \Delta logE_t + \beta_3 \Delta logP^*_{t-1} + \omega_t. \quad (3)$$

This estimated equation with the degree zero of lag polynomials is consistent with most studies. These studies, like Devereux and Yetman (2002), Kardasz and Stollery (2001), and Yang (1997), all use a similar model with degree zero of lag polynomials. By estimating equation (3) using OLS, we obtain the instantaneous exchange rate pass-through, which is the estimated coefficient on $\Delta logE_t$, β_2. In addition, N-period pass-through can be approximated by the coefficients, β_1 and β_2 from the regression.[6]

Tables 3A-3C reports estimates and standard errors of the N-period pass-through for N=0, 1, 4, 20 for entire sample periods and the two sub-sample periods.[7] The N=0, N=1, N=4, and N=20 represent instantaneous, short, medium and long-run

5 The model with only zero lag exhibits lowest value of BIC among all potential models.

6 The N-period pass-through is approximated by the formula $\left[\frac{\beta_2}{1-\beta_1}\right](1-{\beta_1}^{N+1})$. If we suppose the period N is infinite, the long-run pass-though can be calculated by the formula $\left[\frac{\beta_2}{1-\beta_1}\right]$, which is commonly used by most studies, such as Yang (1997).

7 The standard errors of pass-through estimates for N=1 and N=4 are approximated by the standard error of $\left[\frac{\beta_2}{1-\beta_1}\right](1-{\beta_1}^{N+1})$, the standard errors for N=20 is approximated by the standard error of long-run pass through, $\left[\frac{\beta_2}{1-\beta_1}\right]$. The approximation of standard errors can be done by the Delta Method. For example, $Var\left(g(\boldsymbol{\beta})\right) = \boldsymbol{G}\, Var(\boldsymbol{\beta})\, \boldsymbol{G^T}$, where $g(\boldsymbol{\beta})$ is a nonlinear function of estimates, $\boldsymbol{\beta}$, $\boldsymbol{G}$ is a matrix with element $\partial g_i(\beta)/\partial \beta_i$ evaluated at $\boldsymbol{\beta}$, and $Var(\boldsymbol{\beta})$ is covariance matrix.

pass-through. From these tables, we see that average exchange rate pass-through estimate for each province rises as N increases, as would be expected. In Table 3A, all pass-through estimates are insignificant, and most of them have positive sign except estimates for PEI, Northwest Territory, and Yukon. The reason for the insignificance of those estimates might due to the existence of a structural break in the entire sample period. Since most estimates exhibit positive signs and variation among provinces, I retain those estimates for the cross-province analysis in the second stage. Although those estimates are insignificant, they may still have some implications for the second-stage analysis.

The Table 3B summarizes pass-through estimates for the sub-sample period: 1979-2006. In this table, most pass-through estimates are positive and significant except estimates for Saskatchewan, BC, Northwest Territory, and the Yukon. Compared with Table 3A, the average N-period pass-through estimates in this table are much larger than those over the entire sample. In addition, Table 3B reveals a wider range of variation in the pass-through estimates among provinces, relative to Table 3A. The pass-through varies from a low of 0.034 for Yukon to a high of 0.177 for New Brunswick.

Table 3C presents the pass-through estimates for the period from 1990 to 2006. Surprisingly, all estimates are negative and insignificant except the one for BC, and exist in a small range. The average N-period pass-through during this period is roughly -0.024, no matter for short run, medium run or long run. This average pass-through estimate is similar to the value of -0.05 with insignificance for Canada as a whole reported by Devereux and Yetman (2002).[8] I will drop these estimates from my second-stage analysis, since they might lead us to a wrong conclusion for determinants of variations in the pass-through among provinces.

III.4. Basic Evidence

From Table 1A and 2B, we find that the average inflation for the period from 1979 to 2006 is roughly 3.6 per cent, which is smaller than 5.8 per cent for the period from 1979 to 1990. Based on the evidence found by Choudhri and Hakura (2006), the higher is the average inflation during a specific period, the larger is the pass-through for that period. Our results from the comparison for the N-period pass-through estimates between the period 1979-2006 and the period 1979-1990 is consistent with the findings from Choudhri and Hakura (2006) and Devereux and Yetman (2002). Thus, we would expect that the average inflation rate is a primary explanatory variable in explaining variations in the exchange rate pass-through across Canadian provinces and territories.

From Table 1B and Table 1C, we find that the average inflation decreases significantly, from 5.8 per cent for the period 1979-1990 to 2.2 per cent for the

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[8] Devereux and Yetman (2002) use a similar model for the first-stage analysis. They use the lag of exchange rate instead, which is different from mine, and drop the dependent variable with lag one (e.g. $\Delta \log P_{t-1}$) as the explanatory variable in their regression model for estimating the pass-through.

period 1990-2006, and corresponding average short-run and long-run pass-though rates drop from 0.099 and 0.178 to -0.024 and -0.026, respectively. This result suggests that effects of shift in the monetary regime play an important role in exchange rate pass-through changes. To verify the critical role of inflation, and to examine other potential determinants for variations of the pass-through across provinces, the second-stage regression is introduced in the following section.

III.5. Cross-Province Regressions (Second Stage)

In this section, I will undertake a cross-province analysis to further examine the role of inflation on exchange rate pass-through and to explore other potential determinants in explaining pass-through variation across provinces. I only consider the period from 1979 to 2006 and the period from 1979 to 1990, since the pass-through estimates for these two periods are positive with a range of variations among the provinces. Specifically, I will focus on the analysis on the pass-through variations, and its determinants for the period from 1979 to 1990, as most of the pass-through estimates for this period are robust.

Devereux and Yetman (2002) have found that average inflation and its standard deviation have significant and positive effects on the extent of the pass-through. Moreover, they advance that the exchange rate pass-through is positively related to the average inflation rate with a non-linear relationship due to the presence of menu costs. In other words, further increases in the average inflation would have no effects on the pass-through, when the inflation rises above a certain threshold. Choudhri and Hakura (2006) and Frankel, Parsley and Wei (2005) also find significantly positive effects of average inflation on the pass-through. Hence, I adopt their findings, and include average inflation, average inflation squared (a measure of non-linear relationship between inflation and pass-through), and the inflation standard deviation in my second-stage regression model.

Figures 1A and 1B show the associations between inflation and the pass-through for all provinces for the period from 1979 to 2006 and from 1979 to 1990, respectively. These figures suggest that pass-through is positively correlated with inflation rates across provinces for the period from 1979 to 2006 and the period from 1979 to 1990. Moreover, the correlation is much stronger for the period from 1979 to 1990, relative to the period from 1979 to 2006. To further examine this pattern, I also present the Spearman correlation coefficients for the pass-through estimates and inflation, which are reported in Table 4. I find that pass-through is positively correlated with inflation, which is consistent with Figure 1A and Table 1B. These findings could reflect the important role of the effects of inflation on the exchange rate pass-through.

Besides the three explanatory variables discussed above, I also consider four additional variables. These variables are distance, income per capita, openness, and size, and they represent provincial characteristics. The addition of these variables allows us to examine pass-through differentials across provinces induced by their own characteristics. As a result, the second-stage regression model is specified as,

$$PT_i(N) = \gamma_1 + \gamma_2 AINF_i + \gamma_3 AINF_i^2 + \gamma_4 SDINF_i + \gamma_5 DIST_i + \gamma_6 INCOME_i + \gamma_7 OPEN_i + \gamma_8 SIZE_i + \varepsilon_i, \quad (4)$$

where $PT_i(N)$ is the estimated N-period pass-through for province i, $AINF_i$ is the average inflation, $AINF_i^2$ is the average inflation squared, $SDINF_i$ is the standard deviation of the inflation, $DIST_i$ is the great-circle distance from Canadian provincial capitals to New York City, $INCOME_i$ is the income per capita, $OPEN_i$ is the openness measured by trade volume, $SIZE_i$ is the economic size measured by GDP, and ε_i is the error term. All explanatory variables take the form of logarithm, and are summarized in the Table 2.[9]

Tables 5A and 5B show OLS estimates for equation (4) for N=0 (short run) and N=20 (long run) over the entire period from 1979 to 2006.[10] In these tables, I also present estimates of simple regressions of $PT(N)$ on each explanatory variable separately. As I simply regress the pass-through estimates on each explanatory

[9] Most studies, like Devereux and Yetman (2002), and Frankel, Parsley and Wei (2005), take average exchange rate changes and its volatility as two important explanatory variables in their empirical analysis, since they find that those two variables significantly and positively affect the exchange rate pass-through; however, those variables are excluded from my regression model, as monetary shocks are expected to be the same across provinces within the "one-country" framework.

[10] Since the estimates of the equation (4) for N=1 is similar to it for N=0, and estimates for N=4 is similar to it for N=20, they are not reported here.

variable, we can find from Table 5A that both average inflation and its standard deviation are significantly and positively related with short-run pass-through, as we expect. The average inflation squared variable, however, has a significantly negative effect on the pass-through, suggesting that average inflation is related to the pass-through with a nonlinear relationship, and indicating further increases in the inflation have no effect on pass-though when inflation rises to a certain threshold. Those findings are consistent with those from Devereux and Yetman's (2002) cross-country study.

In addition, $OPEN$ and $SIZE$ are highly significant, and positively associated with pass-through. From the perspective of microeconomic views, openness could proxy the degree of elasticity of substitution between domestic goods and imported goods, and the size of an economy represents the degree of the competitiveness in the market. The more open is an economy, the larger the degree of substitution between imported goods and domestic produced goods would be in that economy; and the larger is the economy, the more competitiveness is its market. Kardasz and Stollery (2001) use the ratio of average imports to the Canadian market to proxy the elasticity of substitution for each Canadian industry, whereas I use the ratio of trade volumes of each province to the total trade volumes of Canada. They find that exchange rate pass-through increases with the elasticity of substitution between imports and domestic produced goods. Although my study focuses on the provincial level rather than the industrial level, the measure of the degree of product differentiation is similar one to another, and thus I believe that the positive effects of the openness in my study is consistent with the robust relationship between the elasticity of substitution and the pass-through found by Kardasz and Stollery (2001).

The positive effects of $SIZE$ found by this study is also of right sign. Dornbusch (1987) advances in his Cournot model that the pass-through is larger when an economy has larger proportion of foreign firms in its market, relative to domestic firms, or appears to be more competitive. This finding has been verified in many other pass-through studies. According to those studies, pass-through is more complete as the market become more competitive. In general, the degree of competitiveness and proportion of the foreign firms (e.g. U.S. firms) in the Canadian marketplace are positively correlated with the size of the provinces. The possible reason for this is that large provinces like Ontario, Quebec, Alberta, and BC are more integrated with the U.S. economy due to their geography and close economic ties with the United States. Hence the proportion of U.S. firms in their marketplaces is larger, and the markets in these provinces tend to be more competitive. We can observe from Table 3A that pass-through estimates for those provinces are relatively higher than the others. I believe that higher exchange rate pass-through in those large provinces is partly due to the positive size effect. This would imply that the positive sign of $SIZE$ found by this study is convincing, at least at this specific period: 1979-2006.

Frankel, Parsley and Wei (2005) also find the same robust relationship between economic size and pass-through to the CPI across countries, but argue that such a relationship is of the wrong direction: large economies appear to experience more pass-through. They believe that the pass-through is negatively related with the size effects, that is, the larger is the country, the lower the pass-through, and vice-versa. Although the view of negative size effects might be appropriate for some countries, it could not be generalized to all countries as a whole, since each country has different characteristics such as, market structure, monetary regimes, tariff barriers, and income per capita. The extent of pass-through is determined by those characteristics in a fashion that differs across countries. Kardasz and Stollery (2001) suggest that empirical evidence of pass-through determinants found in specific samples over a certain period may not generalize to other countries and time periods. Thus, I believe the size effects are distinct among countries and time periods, depending on specific characteristics within a certain time period. Separate OLS regressions against the distance and income per capita over the entire period from 1979 to 2006, which are also presented in the Table 5A, do not show any significant relationship between those two explanatory variables and the short-run pass-through estimate (N=0), but the distance variable coefficient is of the right sign.

The use of separate simple OLS regressions against each explanatory variable is mainly due to concerns about multicollinearity between those variables. Multicollinearity could potentially make it difficult to isolate the effects of those explanatory variables in equation (4), and might lead to an incorrect conclusion.

Correlations between each explanatory variable are reported in tables 6A and 6B, and we can see that average inflation is strongly correlated with its standard deviation, income per capita, openness, and size. In addition, openness, income per capita and size are also correlated with each other. As would be expected, none of the estimates from Table 5A exert a significant effect on the short-run pass through when all explanatory variables are used in the equation (4), with or without constant term.

This result is different from the one found by Choudhri and Hakura (2006). They find that the average inflation dominates the other explanatory variables like openness, inflation variance and exchange rate variance, and is the only variable that exerts significant and positive effect, as they control all other variables. The possible reason for the difference in results might be smaller sample size and stronger multicollinearity existing in my regression model.

In this study, I also run a similar regression model used by Devereux and Yetman (2002) to check the sensitivity of estimates of average inflation and inflation squared.[11] Surprisingly, all estimates are not significant when I include a constant term in the model, but are significant at the 10 per cent level with the wrong sign for average inflation while excluding the constant term. One possibility for obtaining the unexpected sign on the average inflation coefficient could be due to a matter of

[11] Devereux and Yetman (2002) regress the pass-through estimates on three explanatory variables: the average inflation, inflation square and variance of exchange rate change. They find the estimate of the average inflation is positive and significant at 1% level, and the estimate of the inflation squared is negative and significant at 1% level, as would be expected. The only difference between my model and the model used by Devereux and Yetman (2002) is that the variance of exchange rate is excluded in this study since it is expected to be the same across provinces within a “one-country” framework.

outliers in the observations. The significant negative sign of inflation squared obtained in this alternative regression model, nevertheless, verifies the existence of a non-linear relationship between average inflation and pass-through, and indicates that average inflation positively affects the pass-through with a decreasing marginal effect of inflation.

Table 5B gives OLS estimates of the equation (4) for N=20 (long run), and we can find from this table that the results are similar to those for N=0 (short run) given in Table 5A. The only difference in results is that each significant explanatory variable affects the long-run pass-through with a larger magnitude than for the short-run pass-through. Based on the results from tables 5A and 5B, average inflation, the standard deviation of inflation, openness and size appear to significantly and positively affect the short-run and long-run pass-through over the period from 1979 to 2006, and the relationship between the average inflation and the exchange rate pass-through (both short run and long run) is found to be non-linear in this period. It is worthwhile to note that I do not find the effect of inflation on the pass-though based on Canadian provincial data over the period from 1979 to 2006 to be as strong as in other cross-country studies.[12] My regression results indicate that in the period from 1979 to 2006, a 10 per cent increase in average inflation would increase the short-run pass-through by 0.006, and the long-run pass-through by 0.01 in Canadian provinces. Such extremely low exchange rate pass-through could be attributed to the low volatility in the inflation rate across Canadian provinces in my sample.

[12] For example, Devereux and Yetman (2002) find extremely strong effects of inflation on the short-run pass-through based on cross-country data, and the coefficient of inflation estimates is more than 1. Choudhri and Hakura (2006) also find strong effects of inflation on both short-run and long-run pass-through based on the cross-country data, and the coefficients of inflation estimates are greater than 0.5 for both short run and long run.

The estimates of equation (4) for N=0 and N=20 over the period from 1979 to 1990 are shown in tables 5C and 5D. The simple separate regressions on each explanatory variable indicate that average inflation significantly and positively affects the short-run and long-run pass-through with a non-linear relationship between inflation and the pass-through. As would be expected, the effects of the standard deviation of the inflation on the short-run and long-run pass-through are positive and significant. The big differences between estimates for the period from 1979 to 1990 and the period from 1979 to 2006 are that effects of openness and size on the pass-through in the period from 1979 to 1990 are not significant, and are of the wrong sign. In addition, distance is significantly and negatively associated with the pass-through in this period. The economic intuition for the negative distance effects is that the more geographically close to the United States are the Canadian provinces, the more integrated the market of Canadian provinces and the market of the States are, and the more competitive is the marketplace of the provinces. As a result, pass-through would be high in the province which is close to the States due to a higher degree of competitiveness in its marketplace.

To explore the robustness of distance effects to alternative calculations of distance, I also chose a west coast city, Los Angeles and a midwest city, St. Louis, as destination cities of the United States for my estimations. The regression results show that the estimates of distance based on those alternatives are still robust and of the right signs. This reflects that distance matters for pass-through during the period from 1979 to 1990, while I do not find this evidence over the entire period from 1979 to 2006. The possible reason for the difference in results is due to the fact that the Canadian-US Free Trade Agreement (FTA) was implemented after 1990. In absence of the FTA before 1990, the border effects would be greater, number of varieties imported by the provinces with proximity to the United States would be much more than those distant provinces, and thus the extent of elasticity of substitution between imported and domestic goods in these closed provinces is much higher, relative to others. In this case, pass-through in the close provinces would be larger than those distant ones, indicating that distance is an important determinant over the period from 1979 to 1990. As shown by many trade papers, the border effects gradually diminish in Canada after the FTA in 1990. Based on this evidence, I believe that the distance effects on the pass-through over the period after 1990 will no longer be significant.

Compared with the estimates from equation (4) for the period from 1979 to 2006, the estimates of average inflation and its standard deviations for the short run and long run for the period from 1979 to 1990 are much larger than those for the period from 1979 to 2006. This is what we should expect, since for provinces with high average inflation and inflation volatility in the period from 1979 to 1990, there should be larger pass-through for each province over that period in general. This result supports the view that the selection of an inflation regime has an influence on exchange rate pass-through from the perspective of macroeconomic views. Intrinsically, the average inflation and its volatility are critical factors in explaining the variations in pass-through across the provinces.

IV. Conclusions

This paper examines how domestic price (CPI) changes respond to changes in the exchange rate for a sample of ten Canadian provinces and two Canadian territories over the period from 1979 to 2006. My empirical results lead to the following conclusions. First, exchange rate pass-through is incomplete, and varies across provinces and territories within a small range over the entire sample period and two sub-sample periods. Second, the average inflation and its volatility are found to be significantly and positively related to the degree of pass-through in both the short-run and long-run. In particular, the relationship between inflation and pass-through (both long-run and short-long) is non-linear, which is consistent with evidence supported by Devereux and Yetman (2002). In addition, the effects of inflation and its volatility on long-run pass-through are relatively larger than those on short-run pass-through, as would be expected. Third, this paper suggests that some provincial characteristics matter for the degree of pass-through for a given period across provinces. Size and openness tend to have significant and positive effects on pass-through over the period from 1979 to 2006, but no such effects over the period from 1979 to 1990. Fourth, there is no evidence that income per capita is associated with pass-though in any period, indicating that the theory of consumer search friction is not supported by the Canadian provincial data. Last, the distance effect is found to be robust, but only before the period when the Canada-U.S. Free Trade Agreement (FTA) is in place.

Although these conclusions appear to hold for the Canadian provincial data over the entire period from 1979 to 2006 as well as for the sub-period from 1979 to 1990, they may not be generalized to other countries and time periods since monetary policy regimes, economic environments and market structures in a specific country for a given period differ from one to another. This suggests that the investigation of exchange rate pass-through still leaves much for readers to explore. This paper, nevertheless, gives some empirical foundations and implications for future studies on exchange rate pass-through.

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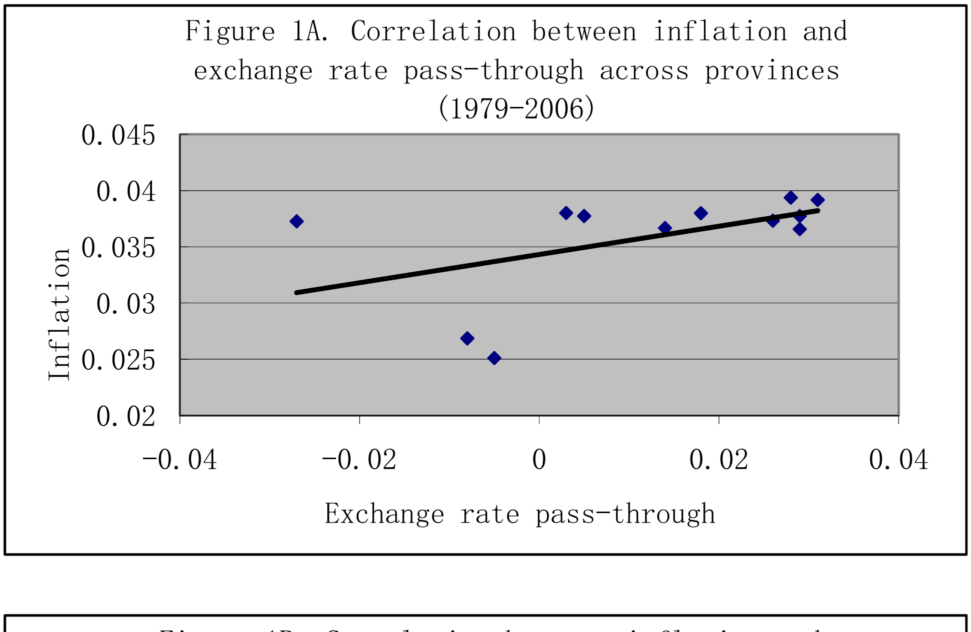

Figure 1A. Correlation between inflation and exchange rate pass-through across provinces (1979-2006)

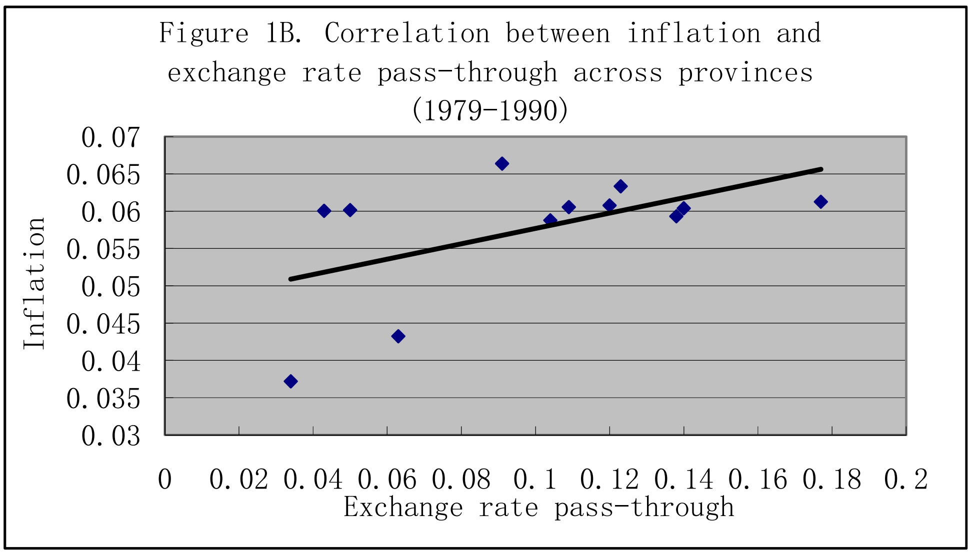

Figure 1B. Correlation between inflation and exchange rate pass-through across provinces (1979-1990)

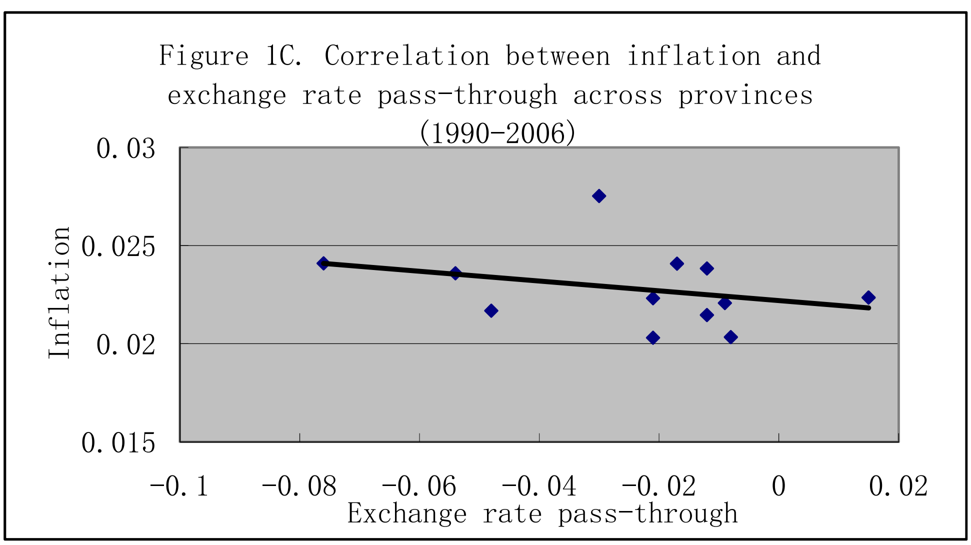

Figure 1C. Correlation between inflation and exchange rate pass-through across provinces (1990-2006)

Table 1A

Characterics of inflation for each provinces:period 1979-2006

provinces	Mean anuual inflation	Maximum	Minimum	Standard deviation
Newfoundland	3.6665%	13.3627%	0.1848%	3.2901%
PEI	3.7258%	13.5691%	-0.4538%	3.2207%
Nova Scotia	3.7737%	11.8829%	0.6030%	2.9265%
New Brunswick	3.7314%	12.3003%	0.5432%	3.0273%
Quebec	3.7730%	12.4314%	-1.3566%	3.2539%
Ontario	3.9169%	12.0782%	0.0410%	3.0215%
Manitoba	3.7980%	11.1487%	1.2550%	2.6226%
Saskatchewan	3.8001%	11.7665%	1.0275%	2.7297%
Alberta	3.9372%	12.9243%	1.1079%	3.0310%
BC	3.6565%	14.2300%	0.2430%	3.1774%
NorthWest Territory	2.6846%	6.0384%	-0.1083%	1.6881%
Yukon	2.5099%	6.5210%	0.6703%	1.4489%
Average	3.5811%	11.5211%	0.3131%	2.7865%

Table 1B

Characterics of inflation for each provinces:period 1979-1990

provinces	Mean anuual inflation	Maximum	Minimum	Standard deviation
Newfoundland	6.0395%	13.3627%	2.3642%	3.8771%
PEI	5.8782%	13.5691%	2.0496%	3.6139%
Nova Scotia	6.0775%	11.8829%	3.2053%	3.1083%
New Brunswick	6.1265%	12.3003%	2.8229%	3.1336%
Quebec	6.3332%	12.4314%	3.7406%	3.3440%
Ontario	6.6371%	12.0782%	4.0897%	2.8976%
Manitoba	6.0546%	11.1487%	3.6962%	2.6790%
Saskatchewan	6.0050%	11.7665%	2.7732%	2.9835%
Alberta	5.9315%	12.9243%	2.6725%	3.7290%
BC	6.0153%	14.2300%	2.9579%	3.7203%
NorthWest Territory	4.3241%	5.3453%	2.9646%	0.7932%
Yukon	3.7202%	5.0453%	2.8364%	0.6830%
Average	5.7619%	11.3404%	3.0144%	2.8802%

Table 1C

Characterics of inflation for each provinces:period 1990-2006

provinces	Mean anuual inflation	Maximum	Minimum	Standard deviation
Newfoundland	2.1683%	6.2165%	0.1848%	1.4017%
PEI	2.4097%	7.5603%	-0.4538%	1.9425%
Nova Scotia	2.3591%	6.0692%	0.6030%	1.4860%
New Brunswick	2.2320%	6.5136%	0.5432%	1.5711%
Quebec	2.1464%	7.3146%	-1.3566%	1.7076%
Ontario	2.2077%	4.7839%	0.0410%	1.2014%
Manitoba	2.3834%	5.1275%	1.2550%	1.0493%
Saskatchewan	2.4083%	5.2007%	1.0275%	1.0799%
Alberta	2.7531%	5.8166%	1.1079%	1.4891%
BC	2.2355%	5.4473%	0.2430%	1.4089%
NorthWest Territory	2.0304%	6.0384%	-0.1083%	1.5072%
Yukon	2.0335%	6.5210%	0.6703%	1.4131%
Average	2.2806%	6.0508%	0.3131%	1.4382%

Table 2
Variables Description

Stage One Regressions

P_t	Canadian consumer price index, 1992=100, CANSIM II Database
P_t^*	US Consumer price index, 1982-1984=100, CANSIM II Database
E_t	Canadian dollars per US dollar, average of noonday rates, CANSIM II Database
t	Time

Stage Two Regressions

AINF	Average inflation rate, CANSIM II Database
SDINF	Standard deviation of average inflation rate, CANSIM II Database
DIST	Distance, calculated by great circle formula using latitude and longitude of each capital city of Canadian provinces, and a big city from the United States (e.g. East Coast: New York city, Middle Coast: St. Louis, West Coast: Los Angeles)
INCOME	Provincial income per capita deduct tax/Canadian income per capita, CANSIM II Database
OPEN	Provincial trade volumes/Total trade volumes of Canada, CANSIM II Database
SIZE	Provincial GDP/Canada GDP, CANSIM II Database

Table 3A

Estimates of exchange rate pass-through for Canadian Province: Period 1979-2006

Province	Exchange rate pass-though for			
	N=0	N=1	N=4	N=20
Newfoundland	0.0140	0.0183	0.0201	0.0202
	(0.0325)	(0.0426)	(0.0471)	(0.0472)
PEI	-0.0270	-0.0296	-0.0299	-0.0299
	(0.0369)	(0.0404)	(0.0407)	(0.0407)
Nova Scotia	0.0050	0.0061	0.0064	0.0064
	(0.0345)	(0.0423)	(0.0445)	(0.0445)
New Brunswick	0.0260	0.0336	0.0367	0.0368
	(0.0345)	(0.0450)	(0.0450)	(0.0450)
Quebec	0.0290	0.0461	0.0656	0.0706
	(0.0295)	(0.0450)	(0.0601)	(0.0629)
Ontario	0.0310	0.0478	0.0645	0.0677
	(0.0270)	(0.0420)	(0.0583)	(0.0621)
Manitoba	0.0180	0.0218	0.0228	0.0228
	(0.0292)	(0.0356)	(0.0374)	(0.0374)
Saskatchewan	0.0030	0.0041	0.0046	0.0046
	(0.0274)	(0.0370)	(0.0421)	(0.0423)
Alberta	0.0280	0.0326	0.0336	0.0336
	(0.0390)	(0.0458)	(0.0472)	(0.0473)
BC	0.0290	0.0399	0.0461	0.0465
	(0.0294)	(0.0404)	(0.0469)	(0.0472)
Northwest Territory	-0.0080	-0.0097	-0.0101	-0.0102
	(0.0328)	(0.0397)	(0.0416)	(0.0416)
Yukon	-0.0050	-0.0049	-0.0049	-0.0049
	(0.0345)	(0.0337)	(0.0338)	(0.0338)
Average	0.0119	0.0172	0.0213	0.0220

Note: * (**) (***) represents significance at 10% (5%) (1%) level.

Table 3B

Estimates of exchange rate pass-through for Canadian Province: Period 1979-1990

Province	Exchange rate pass-though for			
	N=0	N=1	N=4	N=20
Newfoundland	0.1400***	0.1966*	0.2324*	0.2349***
	(0.0553)	(0.0746)	(0.0902)	(0.0921)
PEI	0.1040*	0.1403*	0.1589*	0.1589*
	(0.0583)	(0.0779)	(0.0902)	(0.0912)
Nova Scotia	0.1200**	0.1806**	0.2345**	0.2424**
	(0.0492)	(0.0733)	(0.1021)	(0.1099)
New Brunswick	0.1770***	0.2067***	0.2127***	0.2127***
	(0.0613)	(0.0721)	(0.0767)	(0.0768)
Quebec	0.1230***	0.1948***	0.2756***	0.2957**
	(0.0453)	(0.0704)	(0.1050)	(0.1204)
Ontario	0.0910*	0.1322*	0.1632*	0.1664*
	(0.0512)	(0.0737)	(0.0940)	(0.0972)
Manitoba	0.1090*	0.1298*	0.1347*	0.1347*
	(0.0609)	(0.0756)	(0.0813)	(0.0813)
Saskatchewan	0.0430	0.0598	0.0700	0.0706
	(0.0539)	(0.0744)	(0.0869)	(0.0878)
Alberta	0.1380**	0.2161**	0.2995**	0.3180*
	(0.0669)	(0.1037)	(0.1519)	(0.1702)
BC	0.0500	0.0862	0.1448	0.1805
	(0.0469)	(0.0799)	(0.1331)	(0.1692)
Northwest Territory	0.0630	0.0753	0.0783	0.0784
	(0.0701)	(0.0840)	(0.0880)	(0.0880)
Yukon	0.0340	0.0426	0.0455	0.0455
	(0.0523)	(0.0658)	(0.0707)	(0.0708)
Average	0.0993	0.1384	0.1708	0.1783

Note: * (**) (***) represents significance at 10% (5%) (1%) level.

Table 3C

Estimates of exchange rate pass-through for Canadian Province: Period 1990-2006

Province	Exchange rate pass-though for			
	N=0	N=1	N=4	N=20
Newfoundland	−0.0480	−0.0454	−0.0455	−0.0455
	(0.0389)	(0.0356)	(0.0357)	(0.0357)
PEI	−0.0760	−0.0675	−0.0683	−0.0683
	(0.0441)	(0.0389)	(0.0393)	(0.0393)
Nova Scotia	−0.0540	−0.0465	−0.0474	−0.0474
	(0.0410)	(0.0343)	(0.0351)	(0.0351)
New Brunswick	−0.0210	−0.0239	−0.0244	−0.0244
	(0.0402)	(0.0452)	(0.0459)	(0.0459)
Quebec	−0.0120	−0.0149	−0.0158	−0.0158
	(0.0358)	(0.0440)	(0.0465)	(0.0566)
Ontario	−0.0090	−0.0101	−0.0103	−0.0103
	(0.0290)	(0.0322)	(0.0326)	(0.0326)
Manitoba	−0.0120	−0.0094	−0.0099	−0.0099
	(0.0283)	(0.0222)	(0.0233)	(0.0233)
Saskatchewan	−0.0170	−0.0252	−0.0319	−0.0327
	(0.0302)	(0.0315)	(0.0316)	(0.0316)
Alberta	−0.0300	−0.0236	−0.0248	−0.0248
	(0.0433)	(0.0337)	(0.0354)	(0.0354)
BC	0.0150	0.0126	0.0129	0.0129
	(0.0318)	(0.0268)	(0.0275)	(0.0275)
Northwest Territory	−0.0210	−0.0222	−0.0223	−0.0223
	(0.0342)	(0.0361)	(0.0362)	(0.0362)
Yukon	−0.0080	−0.0063	−0.0066	−0.0066
	(0.0383)	(0.0303)	(0.0317)	(0.0317)
Average	−0.0244	−0.0235	−0.0245	−0.0246

Note: * (**) (***) represents significance at 10% (5%) (1%) level.

Table 4

Spearman correlations of exchange rate pass-through and average inflation rate

Sample	Spearman correlations			
	N=0	N=1	N=4	N=20
Period 1979-2006	0.46	0.43	0.40	0.40
Period 1979-1990	0.50	0.46	0.53	0.51
Period 1990-2006	−0.38	−0.38	−0.42	−0.42

Table 5A
Regression estimates: entire period (1979-2006)

	Dependent variable										
	Exchange rate pass-through at N=0 (short run)										
Constant	0.216*	0.110*	0.123*	0.056	0.075	0.048*	0.048***	4.639		89.464	
	(0.115)	(0.056)	(0.067)	(0.055)	(0.044)	(0.008)	(0.008)	(6.205)		(220.086)	
AINF	0.061*							2.624	−0.064*	54.938	0.148
	(0.034)							(3.595)	(0.032)	(134.786)	(0.383)
$AINF^2$		−0.009*						0.370	−0.018*	8.414	0.039
		(0.005)						(0.519)	(0.010)	(20.603)	(0.107)
SDINF			0.031*							−0.071	−0.022
			(0.017)							(0.144)	(0.667)
DIST				−0.006						0.002	0.006
				(0.007)						(0.014)	(0.009)
INCOME					0.022					−0.068	−0.047
					(0.006)					(0.128)	(0.099)
OPEN						0.010**				0.021	0.033
						(0.002)				(0.048)	(0.033)
SIZE							0.010**			−0.008	−0.021
							(0.002)			(0.054)	(0.038)
Adjusted R^2	0.21	0.16	0.18	−0.03	0.17	0.69	0.65	0.12	0.37	0.34	0.71

Note: *(**)(***)indicate significance at 10% (5%) (1%)level.

Table 5B

Regression estimates: entire period (1979-2006)

	Dependent variable										
	Exchange rate pass-through at N=20 (long run)										
Constant	0.350*	0.180*	0.215*	0.152*	0.038	0.085***	0.086***	7.649		57.141	
	(0.193)	(0.094)	(0.116)	(0.084)	(0.011)	(0.010)	(0.011)	(10.411)		(230.858)	
AINF	0.098*							4.327	−0.104*	35.176	0.018
	(0.052)							(6.031)	(0.054)	(141.383)	(0.392)
$AINF^2$		−0.014						0.611	−0.029*	5.417	0.068
		(0.008)						(0.871)	(0.116)	(26.211)	(0.109)
SDINF			0.054*							−0.026	0.005
			(0.032)							(0.151)	(0.068)
DIST				−0.018						−0.006	−0.004
				(0.011)						(0.015)	(0.009)
INCOME					0.120					−0.059	−0.046
					(0.075)					(0.133)	(0.102)
OPEN						0.018***				0.026	0.033
						(0.003)				(0.050)	(0.034)
SIZE							0.019***			−0.004	−0.012
							(0.003)			(0.057)	(0.039)
Adjusted R^2	0.19	0.15	0.15	0.11	0.15	0.82	0.78	0.10	0.40	0.74	0.90

Note: *(**)(***) indicate significance at 10% (5%) (1%) level.

Table 5C
Regression estimates: sub-period (1979-1990)

	Dependent variable										
	Exchange rate pass-through at N=0 (short run)										
Constant	0.507**	0.295**	0.251*	0.343***	0.097***	0.094**	0.091**	−1.593		111.629	
	(0.198)	(0.095)	(0.073)	(0.111)	(0.014)	(0.032)	(0.033)	(5.469)		(450.666)	
AINF	0.142*							−1.260	−0.197**	82.909	1.168
	(0.069)							(3.651)	(0.063)	(330.011)	(1.766)
$AINF^2$		−0.024*						−0.233	−0.056**	15.396	0.483
		(0.011)						(0.606)	(0.022)	(60.215)	(0.627)
SDINF			0.041*							−0.147	−0.027
			(0.020)							(0.532)	(0.182)
DIST				−0.033**						−0.062	−0.060
				(0.015)						(0.075)	(0.062)
INCOME					−0.142					−0.370	−0.099
					(0.091)					(1.163)	(0.328)
OPEN						−0.005				0.094	0.082
						(0.009)				(0.158)	(0.125)
SIZE							−0.006			−0.044	−0.066
							(0.010)			(0.189)	(0.139)
Adjusted R^2	0.23	0.23	0.24	0.26	0.14	−0.09	−0.07	0.16	0.87	−1.31	0.80

Note: *(**)(***)indicate significance at 10% (5%) (1%)level.

Table 5D

Regression estimates: sub-period (1979-1990)

	Dependent variable										
	Exchange rate pass-through at N=20 (long run)										
Constant	1.096**	0.617**	0.550***	0.566**	0.200***	0.241**	0.242**	−0.583		245.142	
	(0.364)	(0.174)	(0.124)	(0.235)	(0.030)	(0.058)	(0.060)	(10.094)		(558.274)	
AINF	0.320**							−0.802	−0.412**	181.313	1.806
	(0.127)							(6.740)	(0.116)	(408.810)	(2.256)
$AINF^2$		−0.053**						−0.186	−0.122**	33.654	0.093
		(0.021)						(1.119)	(0.040)	(74.592)	(0.801)
SDINF			0.101***							−0.028	0.235
			(0.033)							(0.659)	(0.233)
DIST				−0.052**						−0.110	−0.106
				(0.032)						(0.093)	(0.079)
INCOME					−0.016					−0.839	−0.244
					(0.191)					(1.441)	(0.419)
OPEN						0.012				0.059	0.032
						(0.016)				(0.196)	(0.160)
SIZE							0.013			0.097	0.049
							(0.018)			(0.234)	(0.177)
Adjusted R^2	0.32	0.33	0.43	0.13	−0.12	−0.05	−0.05	0.26	0.87	−0.05	0.91

Note: *(**)(***) indicate significance at 10% (5%) (1%) level.

Table 6A

Correlations between explanatory variables:Period 1979-2006

	AINF	SDINF	DIST	INCOME	OPEN	SIZE
AINF	1.00					
SDINF	0.94	1.00				
DIST	-0.14	-0.25	1.00			
INCOME	0.68	-0.27	0.27	1.00		
OPEN	0.52	0.00	-0.13	0.75	1.00	
SIZE	0.51	-0.01	-0.10	0.78	1.00	1.00

Table 6B

Correlations between explanatory variables:Period 1979-1990

	AINF	SDINF	DIST	INCOME	OPEN	SIZE
AINF	1.00					
SDINF	0.94	1.00				
DIST	-0.69	0.32	1.00			
INCOME	0.26	-0.20	0.33	1.00		
OPEN	0.72	-0.17	-0.12	0.73	1.00	
SIZE	0.70	-0.20	-0.12	0.77	0.99	1.00

Table 6C

Correlations between explanatory variables:Period 1990-2006

	AINF	SDINF	DIST	INCOME	OPEN	SIZE
AINF	1.00					
SDINF	-0.05	1.00				
DIST	0.51	-0.35	1.00			
INCOME	0.41	-0.32	0.21	1.00		
OPEN	-0.15	-0.32	-0.13	0.75	1.00	
SIZE	-0.12	-0.31	-0.10	0.77	1.00	1.00