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Price Puzzles and the Exchange Rate

Thank you for having me here today.

I expect that in New Brunswick you are well aware that there are large and persistent gaps between the prices charged in the United States and in Canada for similar goods. Many Canadians feel the same way.

We can't blame Canadian consumers for being both puzzled and annoyed. Isn't free trade supposed to close this price gap? Shouldn't competitive market forces cause domestic and foreign prices to converge? And if prices can't move, shouldn't our flexible exchange rate adjust to offset any differences? And, finally, if neither prices nor the exchange rate are moving to close these gaps, is something wrong with the system?

These are good questions, and they deserve good answers. In my speech today, I'll try to provide them. But I face two challenges. First, there is a great deal that remains to be learned, so I won't be able to provide complete and conclusive answers. Second, I don't have enough time to adequately review everything that has been learned, so I'll have to hit the highlights.

Let's first get a sense of what we're dealing with.

How Egregiously Is the Law of One Price Being Violated?

Let's start with what things would look like in a perfect world.

In a fully competitive world, free of impediments to trade, one would expect to see what we economists call the law of one price (LOP) enforced. Cross-border arbitrage would ensure that the prices of identical goods sold at home and abroad, and expressed in a common currency, were the same.

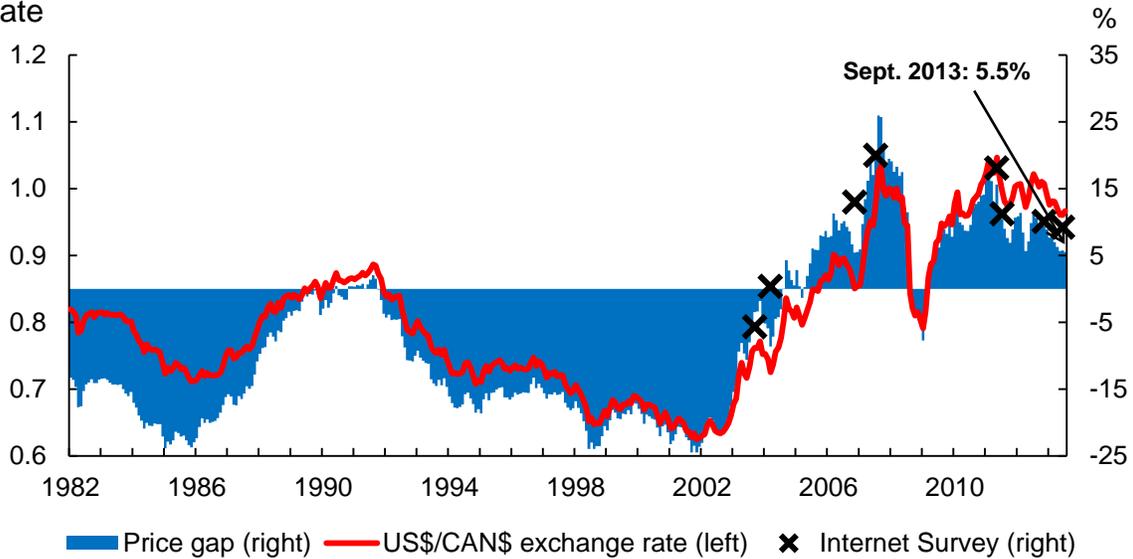
To what extent has this "law" been observed?

Chart 1 shows two different measures of the price gaps between Canada and the United States. The first compares the cost of living in the two countries over the past 30 years. This is a less-stringent condition than the LOP, since it doesn't test whether the same price is observed in Canada and the United States on

each and every good, but rather whether the general level of prices in the two countries is the same.

Chart 1: How much higher are prices in Canada?

The Canada-U.S. price gap follows quite closely movements in the exchange rate



Sources: Statistics Canada, U.S. Bureau of Labour Statistics and Bank of Canada

Last observation: September 2013

To do this, it compares the cost of a similar basket of consumer goods and services north and south of the border. If the levels of the aggregate consumer price indexes (CPIs) were found to be the same, adjusted for the US\$/Can\$ exchange rate, the blue shaded area in **Chart 1** would collapse to a single flat line and lie on the zero axis.¹ In other words, the purchasing power of the Canadian dollar in each country would have been equalized. For this reason, the relationship is often referred to as the purchasing-power-parity (PPP) condition.

The second measure in **Chart 1**, shown as a series of black Xs, reflects data that the Bank of Canada has been tracking since 2002. It compares the posted prices on the Internet of roughly 150 different goods in Canada and the United States.²

Although differences exist between the two measures, the picture that emerges in both cases is similar, and seemingly incriminating. The lines are not where they are supposed to be and the deviations from PPP are, as suggested earlier, large and persistent.

Two important points are worth noting here. First, for much of the past 30 years, prices in Canada have actually been significantly lower than those in the United States. This isn't to say that each and every price in Canada was lower over most of the sample period. Obviously, there is considerable variation among goods and services, but, in aggregate, prices were often much lower in Canada. Things have changed over the past 10 years, however.

The second point to note in **Chart 1** is that the price gaps appear to be highly correlated with the level of the U.S.-Canada exchange rate (the red line). Indeed,

while we might expect the exchange rate to act as a buffer, it seems to be driving prices in the two countries away from each other.

This raises several questions.

- Why does the exchange rate seem to be exacerbating price differences rather than offsetting them?
- Shouldn't the Canadian dollar depreciate if Canadian prices are generally higher than foreign prices, and appreciate if they are lower?
- Shouldn't the exchange rate be preserving competitiveness and correcting any trade imbalances that might arise if large deviations were allowed to persist?

In short, the question is: has the exchange rate been misbehaving?

Has the Exchange Rate Been Misbehaving?

The answer? It's complicated. First, many of the goods and services included in the price indexes are not traded (e.g., haircuts), so one would not expect their prices to be the same between countries. Second, there are many real-world frictions that prevent goods from trading freely. Transportation costs and other expenses related to the distribution and marketing of goods, once they arrive onshore, are often significant (especially in a country the size of Canada). These expenses can drive a substantial wedge between domestic and foreign prices. In addition, sizable trade barriers associated with tariffs and quotas do still exist, despite a general trend towards freer trade in the global economy. Finally, markets for certain goods are often less than perfectly competitive.

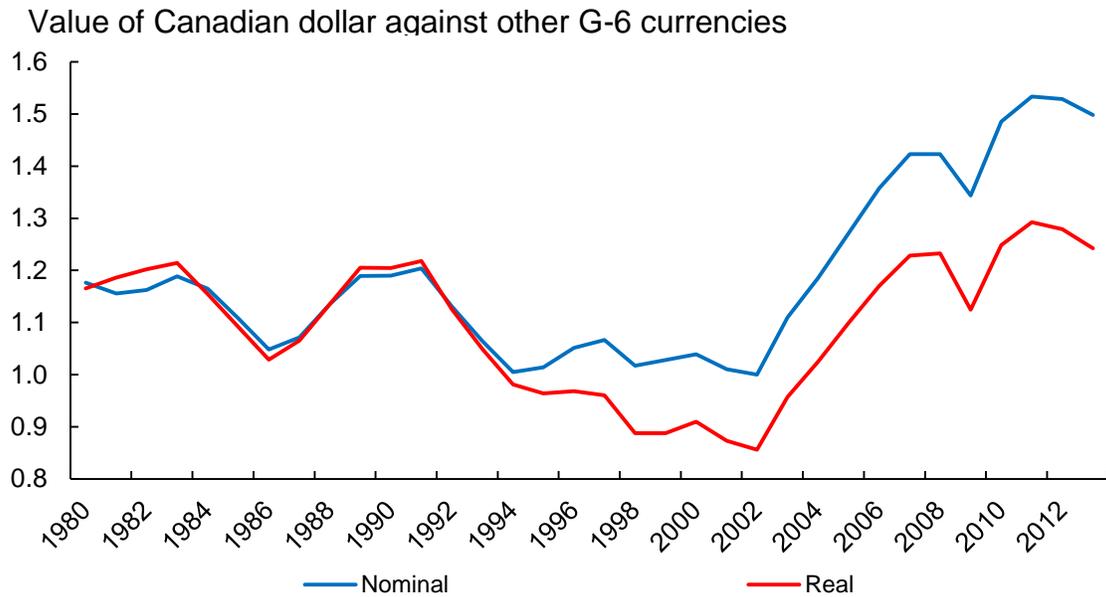
Although the frictions that I have just listed are important, and can explain why large level differences frequently exist between domestic and foreign prices, shouldn't exchange rates at least move in the right direction in response to any shift in prices?

Shouldn't we expect changes in the exchange rate to offset changes in prices, thereby limiting any further widening in the price gap and preserving a form of *relative* PPP?

So what is going on?

The main answer is that the exchange rate is driven by many forces other than differences in the overall level of domestic and foreign prices. If these broad price discrepancies were the only thing that mattered, the real exchange rate would be a flat line. In other words, the nominal exchange rate, adjusted for prices, would be constant. This is clearly not the case, however, as shown in **Chart 2**.

Chart 2: Most nominal exchange rate movements are real



Source: Bank of Canada calculations

Last observation: 2013

The blue line is the nominal exchange rate that we actually observe in the market. The red line is the real exchange rate, which adjusts the nominal rate for differences in domestic and foreign prices. As you can see, most of the movements observed in the exchange rate are real rather than nominal.

Although some of these movements are caused by temporary—and occasionally, speculative—forces, research at the Bank has shown that most of the broad trends in Canada's exchange rate are tied to other fundamental determinants that can't and shouldn't be suppressed.

What are these determinants? It is impossible to identify all of them, but three in particular stand out:

- (i) changes in Canada's terms of trade driven by changes in the relative price of energy;
- (ii) changes in the terms of trade driven by changes in the relative price of non-energy commodities; and
- (iii) changes in the Canada-U.S. interest rate differential.

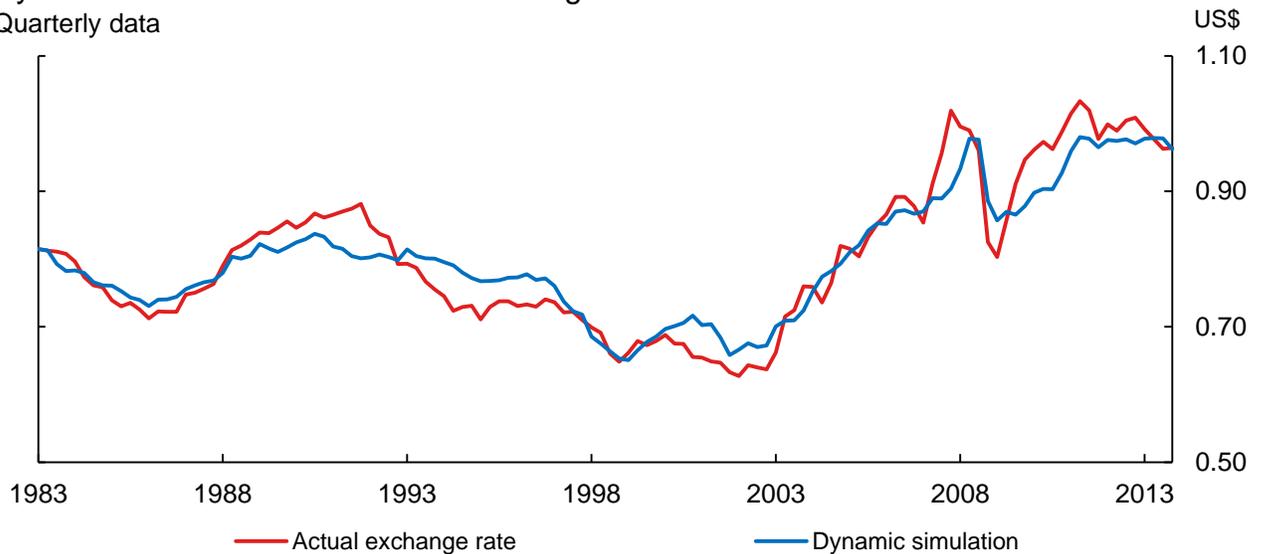
Results from a simple estimated model, which includes these three series as explanatory variables, are shown in **Chart 3**.³

But this begs another question. If movements in the real exchange rate are responsible for the price gaps reported in **Chart 1**, why don't officials simply intervene to stabilize the value of the real exchange rate and push Canadian and U.S. prices into proper alignment? The short answer is: it wouldn't work. These movements are driven by fundamental forces of demand and supply that can't be suppressed forever. They will simply re-emerge.

Chart 3: Variables driving the U.S.-Canada-exchange rate

Dynamic simulation vs. historical exchange rate

Quarterly data



Source: Bank of Canada calculations

Last observation: 2013Q4 to date

As an example, let's say that domestic prices were seen to be higher than foreign prices. One way of fixing this would be to lower the exchange rate (i.e., cause it to depreciate). This could be done by lowering interest rates and easing monetary policy. However, if this pushed the economy beyond its capacity limits and created excess demand, it would simply generate domestic inflation.

What would happen then?

Canadian prices would rise faster than foreign prices. We would be chasing our tail. The same would be true with the directions reversed—that is, if we tried to correct a negative price gap by raising the exchange rate. The real exchange rate ultimately reasserts itself and moves to the level that is consistent with all the fundamentals that are at play.

Does this mean that exchange rates and aggregate prices bear no relationship to one another? Does it undercut the arguments in favour of a flexible exchange rate regime?

Macroeconomic Evidence of Long-Run PPP and Exchange Rate Pass-Through

The short answer is no. There is evidence that, over time, exchange rates tend to move in a manner consistent with PPP. Moreover, it is a two-way street. Prices at home and abroad are affected by movements in the exchange rate—a process referred to as exchange rate pass-through (ERPT). In other words, prices affect exchange rates and exchange rates affect prices. These variables are not only connected, but more importantly, they move in the desired direction. At times, however, it is not easy to observe them.

Most of the early empirical work in this area looked at broad macroeconomic variables for evidence of PPP and ERPT. For the ERPT tests, this typically involved running simple reduced-form equations.

A price index, such as the CPI, or a broad measure of import prices (denominated in the currency of the importer), would be put on the left-hand side of the equation, as a dependent variable, with the exchange rate and other control variables on the right-hand side, as explanatory variables. Using this formula, researchers expected to observe a coefficient on the exchange rate somewhere between zero and 1. A value of 1 would represent complete pass-through, while a value of zero would indicate no pass-through. Since the conditions necessary for complete pass-through, such as perfect competition and the absence of any trade barriers or other economic frictions, were unlikely to be satisfied, something between these two extremes was anticipated.

In practice, researchers found that, for most countries, the pass-through coefficient was extremely small. This was especially true in the short run, since prices take time to adjust.

Imported products, and the domestic goods and services that compete with them, were usually found to be more sensitive to exchange rate movements. For this reason, one would expect to see a stronger relationship when looking at import prices alone as opposed to the entire CPI. Even here, however, the evidence was often relatively weak.

There are a number of possible explanations for this. First, the estimated coefficients were likely biased towards zero because of econometric problems that arise whenever one uses a simple reduced-form equation to estimate a relationship that is inherently endogenous. Since prices and the exchange rate are believed to influence each other's behaviour, an obvious simultaneity bias exists.

Second, it is also possible that effective countercyclical monetary policy and the adoption of an explicit inflation target in countries such as Canada have made it harder to observe ERPT. Some researchers have argued that a credible inflation target makes prices less sensitive to exchange rate movements in the short run because producers are reluctant to adjust prices unless they are sure the exchange rate changes are going to persist.

Efforts to identify and quantify the effects of ERPT in Canada have faced an additional challenge, however, one that is beyond the countercyclical influence of monetary policy. Until recently, the absence of a reliable data series for most import prices meant that researchers had to use the CPI to test for ERPT. But, as already noted, the pass-through effects onto the CPI are likely to be quite muted.

Although evidence could be found of near-complete pass-through of exchange rate changes into the prices of homogeneous and widely traded goods such as oil and other primary commodities, evidence for highly differentiated manufactured goods and speciality products was hard to find.

Another result common to many macro studies was a noticeable declining trend in ERPT over time. The increasing adoption of inflation-targeting frameworks by both advanced and emerging-market economies may explain this phenomenon,

along with the growing importance of differentiated manufacturing goods relative to raw materials in global trade.

Several other explanations have also been put forward for weak and declining estimates of ERPT, but unfortunately there isn't time to discuss them here. The bottom line, in any event, is that, although the estimated macroeconomic effects might not appear to be very large, exchange rate pass-through does exist and is operating in a predictable, helpful, way.

More Convincing Microeconomic Evidence of ERPT

Happily, much stronger and more convincing results have recently become available by taking a micro approach. Researchers using rich micro databases have been able to analyze detailed information on individual commercial transactions and can now test for ERPT at the level of individual firms and products.

This micro approach means researchers can overcome the problems associated with endogeneity and heterogeneity in the earlier macro studies. Bringing it down to the level of the firm and specific transactions provides a clearer picture and allows a more sensible pattern to emerge.

Several such studies have recently been completed by my colleagues at the Bank, and others are in progress. What I would like to do in this, the concluding section of my talk, is give you a quick overview of some key results from two of these studies.

The first study uses data from the Canadian Border Services Agency on every single shipment of apparel imported into Canada between July 2002 and August 2008—more than 6.5 million transactions.⁴ Early results from this study show that the degree of pass-through depends importantly on two things: the currency in which the imports are invoiced, and whether the goods are shipped directly from the country that produced them or through a third country that served as an intermediary.

In this regard, it is important to note that the pass-through literature distinguishes between what is called “producer-currency pricing” and “local-currency pricing.” The difference between the two is this: with producer-currency pricing, producers/exporters choose to invoice goods in their own country's currency. Think of a Chinese exporter that decides to invoice clothing to be shipped to Canada in Chinese renminbi. Local-currency pricing, in contrast, refers to a situation in which this same exporter chooses to invoice in Canadian dollars (i.e., the local currency of the importing country).

Some interesting results emerge from this study. First, short-run ERPT was much higher for transactions priced in the producer's currency; second, pass-through was much higher for goods shipped directly from the producer's country (regardless of which currency they were invoiced in), as opposed to through a third country.

One reason why imports invoiced in local currency exhibit much less pass-through could be that exporters who price in local currency tend to be more concerned about preserving market share in the foreign country. They are

prepared to absorb some of the higher costs associated with adverse currency moves to avoid passing them along to their customers.

A similar logic might explain the lower pass-through numbers observed on imports that come to Canada through a third country, such as the United States, as opposed to directly from the exporter's country. Foreign exporters who are less familiar with the Canadian market, or who feel that they have less leverage with local customers, may want to rely on the distribution networks of other, more experienced firms and be more flexible in the prices they charge. However, in almost every case—whether they involved producer- or local-currency pricing—the estimated pass-through coefficients were higher than those reported in previous macro studies, indicating that the endogeneity/heterogeneity problems discussed earlier were significant. ERPT, in other words, is more important than previously believed.

The second study that I'd like to describe asks whether gaps between domestic and foreign prices that are larger than normal can be used as predictors of future exchange rate moves.⁵ The authors collect goods-level data for Japan, the United Kingdom and the United States, calculate deviations from the LOP and test to see if the size of the deviations has what they termed "superior predictive ability" with regard to future movements in the exchange rate. The results for the United States and Japan were particularly encouraging. They showed that the price deviations had significant predictive power, which was positively correlated with the degree of price misalignment and which improved with the length of the forecast horizon (i.e., the performance got better the further out you went). In other words, exchange rates seemed to be moving in the right direction, helping to reduce the deviations from the LOP.

Conclusion

What can we conclude from all of this? Looks can be deceiving. Casual observation and evidence gleaned from simple charts would seem to raise serious questions about the functioning of domestic and foreign markets, and about the international trading system more generally. Recent studies, however, paint a far more positive picture of the role of exchange rates in influencing relative prices and facilitating the international adjustment. Despite the large and persistent price gaps that are frequently observed between Canadian and foreign prices at the aggregate level, more detailed work suggests that deviations from the law of one price and purchasing-power parity are not as large or as persistent as many believe.

While significant price discrepancies exist, the reasons for them can largely be explained and are not evidence of serious market failure. Market forces are at work and are generally pushing prices and the exchange rate in the right direction.

However, they do not operate in a vacuum. Their movements are affected by other fundamental forces, and what we pay in Sackville compared with what we pay in Bangor is the end result of many competing pressures. This is not to say that markets are perfect or that there is no room for improvement. Significant trade restrictions and barriers to competition exist, and anything that can be done to reduce them—free trade agreements, for example—is all to the good. Nor am I

suggesting that exchange rates are always at their equilibrium or at fundamentally justified levels. As with any asset price, bouts of temporary overshooting and excess volatility are common. However, the broad trends and behaviour of these markets are more positive than many believe and earlier evidence might indicate.

Thank you.

¹ The price gap—or the shaded blue area—in Chart 1 is defined as the ratio of Canadian to U.S. CPI (the U.S. CPI converted to Canadian dollars) benchmarked to 2007 using the Bank’s Internet survey.

² Although individual surveys compare prices for identical products in Canada and the United States, a shortcoming of this approach is that it is not possible to track the exact same products over time. Therefore, the size and composition of the sample tends to vary across surveys.

³ I. Ramzi, R. Lafrance and J. Murray, “The Turning Black Tide: Energy Prices and the Canadian Dollar,” *Canadian Journal of Economics* 41, 3 (2008): 737–59.

⁴ M. Devereux, W. Dong and B. Tomlin, “Exchange Rate Pass-Through, Currency Invoicing and Trade Partners,” *mimeo*, Bank of Canada, 2013.

⁵ W. Dong and D. Nam, “Exchange Rates and Individual Good’s Price Misalignment: Evidence of Long-Horizon Predictability,” *Journal of International Money and Finance* 32 (2013): 611–36.