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Canadian Economic Analysis Department
Bank of Canada
Ottawa, Ontario, Canada K1A 0G9
savl@bankofcanada.ca
mkhan@bankofcanada.ca

Abstract

In an open economy such as Canada's, exchange rate movements can have a material impact on consumer prices. This is particularly important in the current context, with the significant depreciation of the Canadian dollar vis-a-vis the U.S. dollar since late 2012. This paper provides a broad overview of the various mechanisms by which exchange rate movements pass through to consumer prices and discusses the implications of exchange rate pass-through (ERPT) for the conduct of monetary policy. It then describes some of the tools used at the Bank of Canada to help quantify ERPT. We conclude by taking a closer look at the current situation in Canada, presenting a range of evidence that suggests ERPT has played an important role in recent inflation dynamics.

Résumé

Dans une économie ouverte comme le Canada, les mouvements du taux de change peuvent avoir une incidence considérable sur les prix à la consommation. Ce constat revêt une importance particulière dans le contexte actuel où le dollar canadien s'est fortement déprécié depuis la fin de 2012 par rapport à la devise américaine. Dans cette étude, les auteurs brossent un portrait des divers mécanismes par lesquels les variations du taux de change se répercutent sur les prix à la consommation et analysent les conséquences de ce phénomène de transmission pour la conduite de la politique monétaire. Ils décrivent ensuite certains des outils qu'utilise la Banque du Canada pour mesurer le degré de transmission des mouvements de change. En conclusion, ils examinent de plus près la situation actuelle au Canada et présentent un éventail de faits qui donnent à penser que la transmission des variations du taux de change a grandement influé sur la dynamique récente de l'inflation.

1. Introduction

In an open economy such as Canada's, exchange rate movements can have a material impact on consumer prices. This is particularly important in the current context, with the depreciation of the Canadian dollar of about 26 per cent vis-a-vis the U.S. dollar since September 2012. This paper addresses several aspects of exchange rate pass-through (ERPT). We begin by providing a broad overview of the theory of how exchange rate movements pass through to consumer prices, as well as the implications of ERPT for the conduct of monetary policy. This is followed by a discussion of some of the tools used at the Bank of Canada to help quantify ERPT. We conclude by taking a closer look at the current situation in Canada, presenting a range of evidence that sheds light on the extent to which Canadian inflation has been boosted by ERPT.

2. Theory

Changes in the external value of the Canadian currency have both direct and indirect effects on consumer prices. Consider, for example, the effects associated with a depreciation of the Canadian dollar (**Figure 1**). The direct effects work through two main channels of transmission. First, prices of finished goods that are imported into Canada become more expensive as a result of the reduced purchasing power of the Canadian dollar. Second, prices of imported inputs that are used in the domestic production of goods also become more expensive. This increases the production costs of domestic producers who may subsequently pass on these higher costs (to varying degrees) to consumers via higher prices. However, the timing and magnitude of the overall direct effect of ERPT to consumer prices are uncertain and depend on several factors, including the rate of pass-through to import prices, the share of imports in the consumption basket, demand conditions, the cost of adjusting prices and perceptions of the duration of the depreciation. Note also that prices for services are typically relatively immune to direct ERPT since they are largely domestically oriented and therefore less subject to price pressures emanating from higher import costs.

ERPT can also have indirect effects on consumer prices through changes in the composition of demand and in the levels of aggregate demand and wages. Following a depreciation of the currency, demand for Canadian goods rises both at home and abroad. This is because higher prices for imported goods create an increase in demand for domestically produced substitutes, while cheaper prices for Canadian exports in turn raise foreign demand for such goods. Higher demand for Canadian goods puts additional pressures on domestic prices. Finally, the increase in demand for Canadian goods will, eventually, lead to a higher demand for labour and thus to rising wages, which, in turn, could also be reflected in higher prices.[1]

3. Exchange rate pass-through and monetary policy

It is important to keep in mind that although a depreciation of the dollar is likely to boost inflation, over the longer run, inflation ultimately depends on monetary policy. As long as monetary policy is successful

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[1] For more information on exchange rate movements and their effects on consumer prices, see Laflèche (1996–97).

Figure 1: Pass-through from a depreciation of the Canadian dollar to consumer prices

Source: Laflèche 1996–97
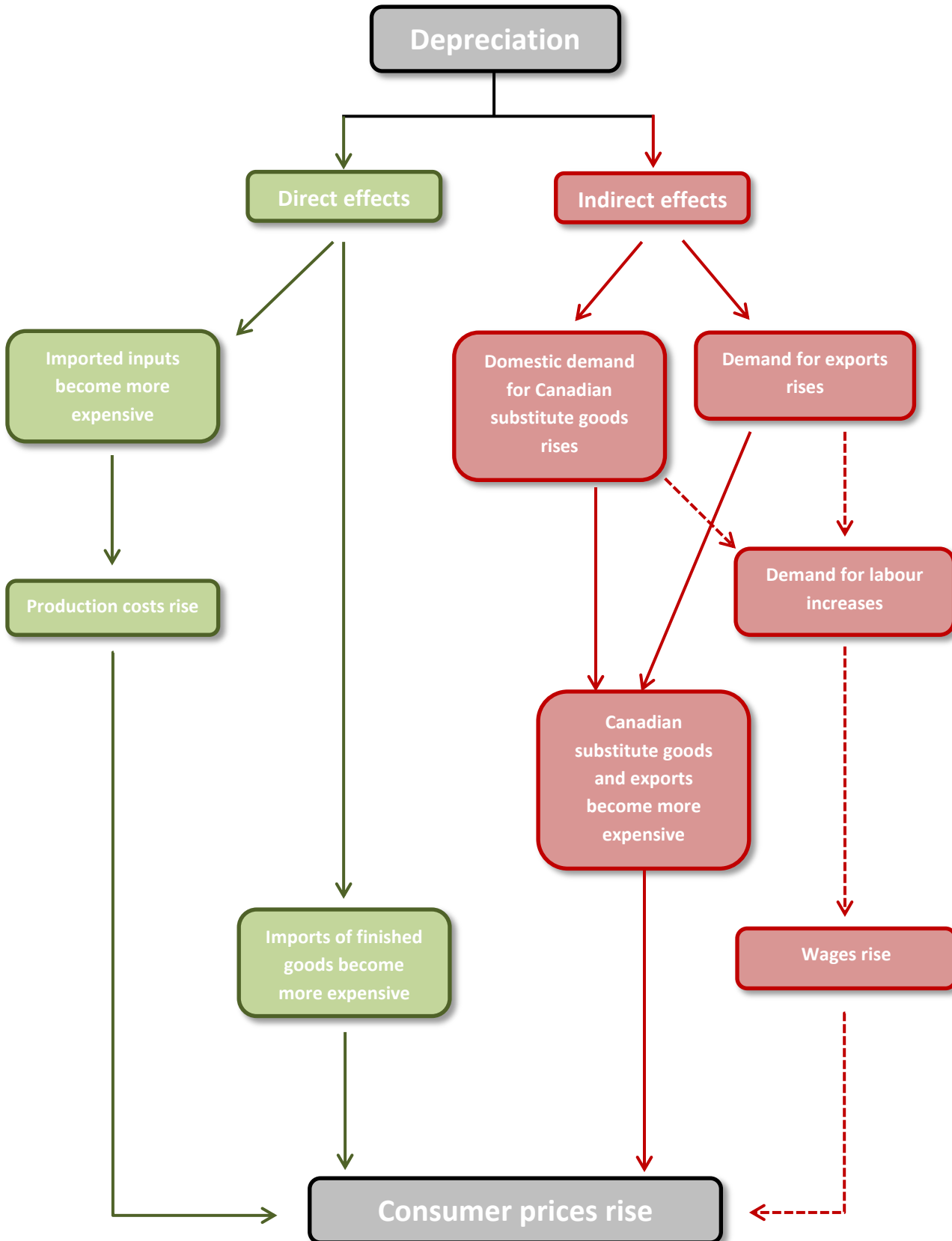
in keeping long-term inflation expectations anchored near the target level, ERPT will have only a transitory direct effect on the rate of inflation. As discussed by Yellen (2015), this allows the central bank to "look through" the direct effects of ERPT and focus instead on persistent inflation pressures emanating from the relative balance of demand and supply in the economy. This point is illustrated in **Figure 2**, which provides a stylized example of the direct impact on inflation of a one-time permanent 10 per cent depreciation of the Canadian dollar. As shown, this depreciation has a permanent effect on the *level* of consumer prices. However, as this effect stabilizes, the *rate of inflation* falls back to its previous trend. Since monetary policy actions take a considerable time to affect inflation, reacting to such shocks is unnecessary and, at worst, can be counterproductive.

Figure 2: Consequences on inflation of a 10 per cent depreciation of the Canadian dollar

Of course, if the currency continues to depreciate for an extended period, then inflation could deviate from target for somewhat longer than is suggested in this example. A sufficiently persistent depreciation could also have second-round effects through higher long-term inflation expectations. The intuition from Figure 2 would still apply to more persistent depreciations, though it would arguably be even more important to vigilantly monitor long-term inflation expectations for any evidence that they are being affected by ERPT.

Source: Authors' calculations

Conversely, the policy implications of the indirect effects of ERPT are quite different from those associated with the direct effects. In general, monetary policy should react to shocks that affect aggregate demand in the economy. These indirect effects of ERPT manifest themselves in the output gap, estimates of which are indeed a key input into monetary policy decisions.

Another important point to consider is that exchange rate movements in Canada are often caused, in part, by changes in commodity prices. The net impact on inflation will depend on the relative magnitudes of these two opposing forces. For example, a lower Canadian dollar will tend to boost inflation through the channels described in section 2, but if the depreciation is caused by lower commodity prices, then the latter will decrease inflation through its direct impact on commodity-intensive consumer prices (such as gasoline). In addition, lower commodity prices have negative indirect consequences for inflation through the resulting lower levels of aggregate demand.

Distinguishing transitory price movements, including those associated with direct ERPT, from persistent ones is crucial for the conduct of monetary policy. Measures of core inflation, which typically exclude or down-weight certain volatile prices, are widely used by central banks to help isolate persistent inflation pressures. However, no measure of core inflation is likely to be immune to the transitory direct effects of ERPT. This is because ERPT affects a wide range of consumer goods that, on average, do not display particularly volatile price movements and therefore tend not to be excluded from the measurement of core inflation. Examples of such goods include clothing, footwear, reading material, textiles, appliances

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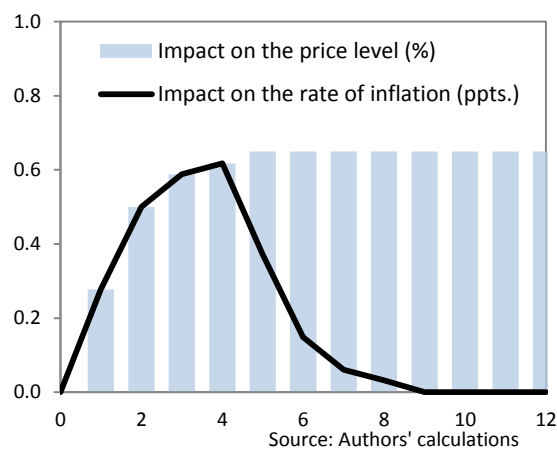
and furniture. This highlights the importance of consulting a wide range of information, including models and data-driven analysis, to assess underlying inflation pressures in the presence of large currency movements.

## 4. Quantifying exchange rate pass-through

A variety of models are used at the Bank of Canada to help quantify ERPT. These include structural models of the Canadian economy, such as ToTEM (Terms-of-Trade Economic Model) and LENS (Large Empirical and Semi-structural model), which account for the linkages between inflation, monetary policy and the exchange rate.[2] Estimates from these models are supplemented with those from reduced-form equations, which are particularly useful for quantifying the *direct* impact of ERPT and providing richer insight into how different categories of the consumer price index (CPI) are being affected.

For example, a bottom-up approach estimates ERPT to individual components of the CPI, based on historical experience, and then aggregates them to form overall estimates for both CPIX and total CPI inflation.[3] More specifically, the following equation is estimated using quarterly data from 1995 to 2013:

$$\Delta p_t^i = \alpha + \sum_{j=0}^{4} \beta_j \Delta e_{t-j} + \sum_{j=0}^{4} \gamma_j \Delta ppi_{t-j}^i + \theta y_t + \varepsilon_t,$$

where Δp_t^i is the log difference of the domestic price level for component *i*, Δppi_t^i is the log difference of the external price level[4] for component *i*, Δe_t is the log difference of the nominal U.S./Canada exchange rate, and y_t is the conventional measure of the output gap. Controlling for changes in foreign prices is important, since import costs are a function of the exchange rate as well as producer prices in the local currency of the country of origin. Including the output gap as an additional control variable ensures that the estimated coefficients on the exchange rate are capturing the direct effects of ERPT instead of the indirect effects that operate through changes in aggregate demand.

The estimate of short-run pass-through is given by β_0, whereas the long-run estimate is simply the sum of the coefficients on the exchange rate, $\sum_{j=0}^{4} \beta_j$.[5]

Figure 3: Estimated exchange rate pass-through

Source: Authors' calculations
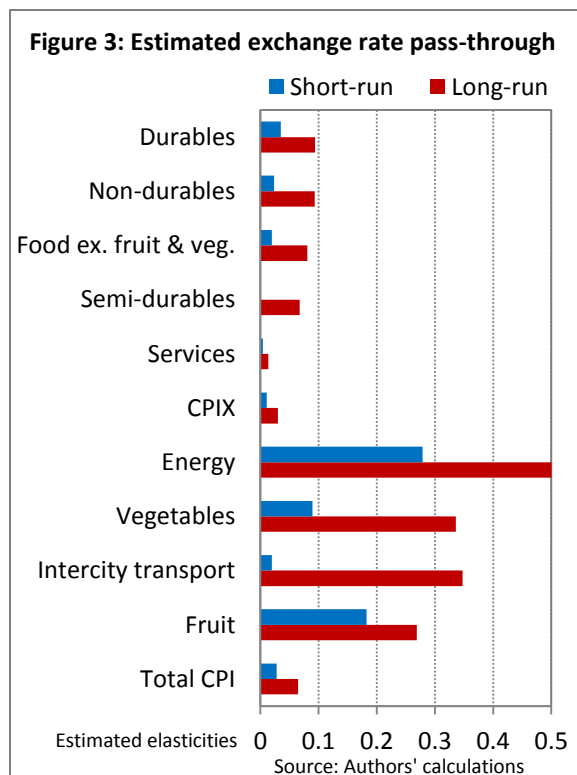
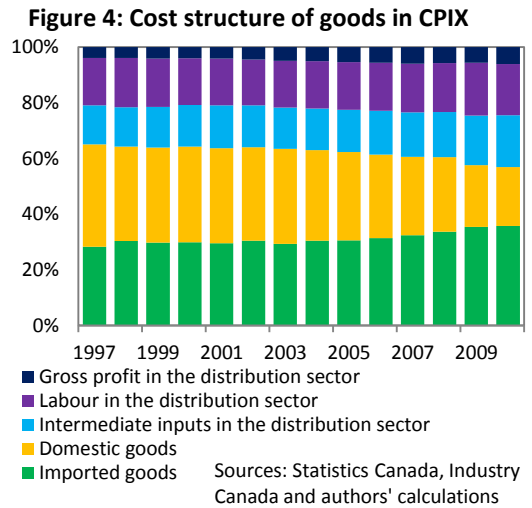[2] See Dorich et al. (2013) and Gervais and Gosselin (2014) for details on these models.
[3] CPIX excludes eight of the most volatile components of the CPI and the effect of changes in indirect taxes on the remaining components.
[4] Depending on the equation, this is either a trade-weighted foreign producer price or the relevant global commodity price.
[5] We find no evidence of pass-through at longer lags, so adding more lags does not alter the results.

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Figure 3 shows short- and long-run estimates of ERPT to the various components, as well as to CPIX and total CPI. Long-run ERPT to CPIX and total CPI is estimated at 3 and 6 per cent, respectively. In other words, a 10 per cent depreciation in the Canadian dollar is estimated to boost CPIX inflation by 0.3 percentage points and total CPI inflation by 0.6 percentage points. In the short-run, ERPT to CPIX inflation is close to zero, although there is still a material impact on total inflation. This divergence reflects the relatively fast and more pronounced impact of currency movements on commodity-intensive components that are excluded from CPIX. Since energy prices are determined in global markets and in U.S.-dollar terms, currency movements affect the energy-intensive CPI components fairly quickly. Many types of fruits and vegetables are imported and most are consumed fresh, so ERPT occurs relatively quickly for these components as well.
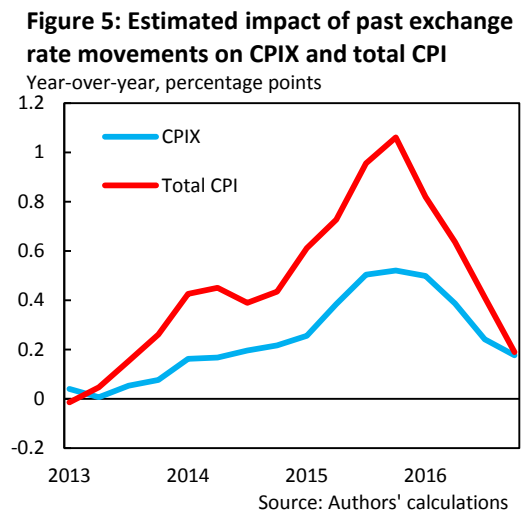
Although our estimates suggest that movements in the Canadian dollar can have a sizable direct impact on inflation, they also indicate that only a small portion of exchange rate movements tend to be reflected in consumer prices. One likely reason for this result is that import costs are only a small portion of the various costs incurred through the supply chain in bringing goods to consumers. As shown in **Figure 4**, a large share of the cost structure of Canadian goods comprises domestic costs, including labour costs incurred by domestic distributors.[6]

Figure 4: Cost structure of goods in CPIX

■ Gross profit in the distribution sector
■ Labour in the distribution sector
■ Intermediate inputs in the distribution sector
■ Domestic goods
■ Imported goods

Sources: Statistics Canada, Industry Canada and authors' calculations

5.   Current situation in Canada

Since September 2012, the Canadian dollar has depreciated by about 26 per cent against the U.S. dollar, and this has had a meaningful impact on the prices of many consumer goods in Canada. However, because there is much uncertainty regarding the precise extent to which ERPT is currently contributing to Canadian inflation, a variety of sources are utilized to arrive at an overall assessment.

Figure 5 shows the estimated impact of past exchange rate movements on both CPI and CPIX inflation, using the model described in section 4. This method suggests that, as of the third quarter of 2015, the past depreciation of the Canadian dollar is boosting CPIX and total CPI inflation by about 0.5 and 1.0 percentage points, respectively. ERPT is expected to peak in the second half of the year before fading gradually toward the end of 2016.

Figure 5: Estimated impact of past exchange rate movements on CPIX and total CPI

Year-over-year, percentage points

CPIX
Total CPI

Source: Authors' calculations

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[6] These computations use data from Statistics Canada's Input-Output (IO) tables.

These estimates of ERPT are then checked against recent developments in the actual CPI. We focus on components of CPIX to abstract from the recent sizable declines in consumer energy prices. Since ERPT is likely to affect goods prices but have little impact on services, examining the relative progression of goods and services inflation is particularly informative in the current context. As shown in **Figure 6**, CPIX inflation has gained about one percentage point since the beginning of 2013, and the entire increase can be attributed to the run-up in core goods inflation. Excluding the impact of known factors not related to ERPT, such as a commodity-price-induced rise in meat prices,[7] this suggests that about 0.6 percentage points of the increase in CPIX inflation could be explained by ERPT.[8] All major categories of goods appear to have contributed (**Figure 7**), consistent with the insights gleaned from Figure 3. More specific examples within these categories include clothing, appliances and furniture.

Comparing the inflation rates of goods in Canada with high import content with those of their U.S. counterparts offers an alternative approach to gauging ERPT. This is because, despite a growing share of imports from low-cost countries such as China, the vast majority of Canadian imports still come from the United States (**Figure 8**).[9]

We find that the prices of many goods have started to grow at a much faster pace in Canada than the prices for comparable goods in the United States. This is particularly true for highly imported durable and semi-durable goods, which include furniture, appliances and apparel (**Figure 9** and **Figure 10**).

Scaling the Canada-U.S. inflation gaps for individual goods by their relative weights in the CPIX basket and then aggregating them provides an alternative reading of ERPT. This method yields an estimated ERPT of 0.7 percentage points as of August 2015. However, it is important to note

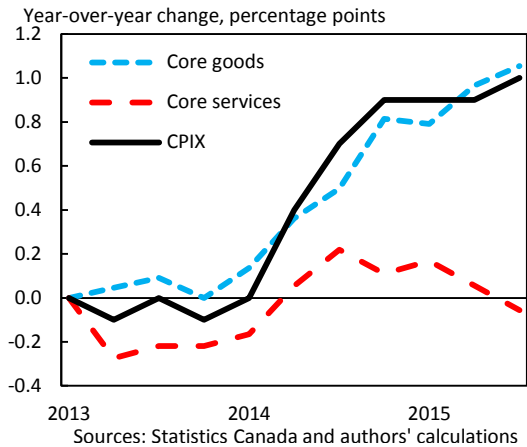**Figure 6: Contributions to the increase in CPIX inflation since 2013Q1**

Year-over-year change, percentage points

Sources: Statistics Canada and authors' calculations

Figure 7: Cumulative changes in inflation since 2013Q1

Year-over-year, percentage points

*excluding meat, fruit and vegetables

Sources: Statistics Canada and authors' calculations

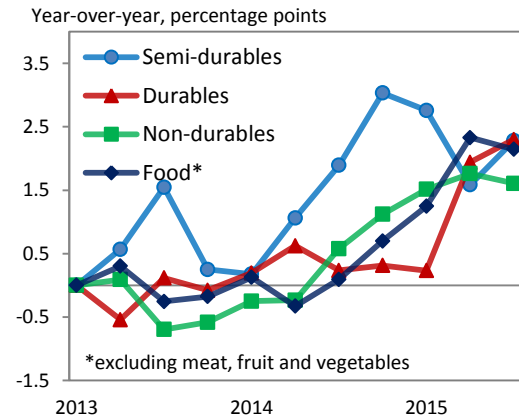**Figure 8: Direct import content of the CPI basket (%)**

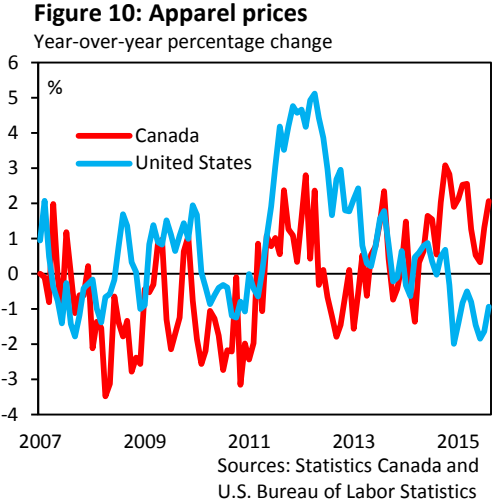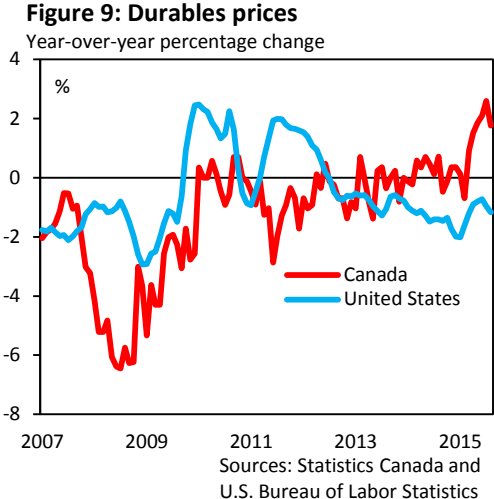Sources: Statistics Canada, Industry Canada and authors' calculations

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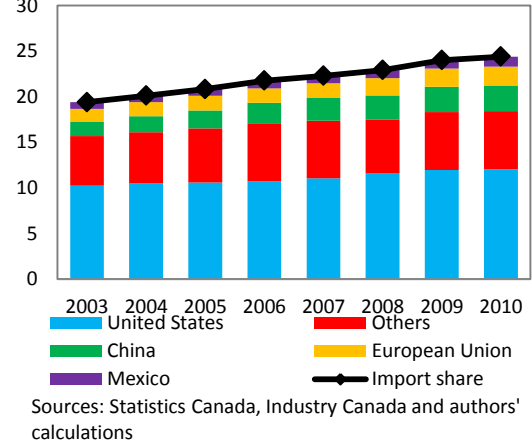
[7] Meat prices grew at a striking pace in 2014 as a result of supply shortages in North America.
[8] As discussed in Box 1 of the July 2015 *Monetary Policy Report*, the Bank judges that about 0.3 percentage points of this run-up in CPIX inflation can be attributed to the dissipation of the previous drag on inflation from heightened retail competition.
[9] The overall import share is calculated using data from Statistics Canada's Input-Output (IO) tables and is decomposed by country of origin using data from Industry Canada's Trade Data Online.

that this comparison will likely overstate ERPT, given that goods prices in the United States have also been held down by the recent broad-based appreciation of the U.S. dollar, as well as by slightly more excess supply in the United States than in Canada.

Based on this multi-pronged analysis, we assess that ERPT is currently boosting CPIX inflation by 0.5 to 0.7 percentage points and total inflation by 0.9 to 1.1 percentage points.

Figure 9: Durables prices
Year-over-year percentage change

Figure 10: Apparel prices
Year-over-year percentage change

Sources: Statistics Canada and
U.S. Bureau of Labor Statistics

Sources: Statistics Canada and
U.S. Bureau of Labor Statistics

6. Conclusion

Exchange rate movements can have a material impact on the prices of consumer goods in Canada. Our analysis suggests that the recent depreciation of the Canadian dollar is providing a sizable boost to Canadian inflation. Fortunately, with long-run inflation expectations anchored near the Bank of Canada's inflation target, ERPT can be expected to exert only a transitory influence over the rate of inflation. It will be important to continue to monitor this issue closely, since distinguishing transitory from persistent movements in inflation is crucial for monetary policy. Although measures of core inflation are typically used to help isolate persistent inflation pressures, such measures are not immune to the impact of ERPT. This highlights the importance of consulting a wide range of information, including models and data-driven analysis, to arrive at a sound judgment of the impact of ERPT.

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