Effects of Exchange Rates on Employment in Canada

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Abstract

Under a flexible exchange rate regime, the Canadian economy is constantly affected by fluctuations in exchange rates. This paper focuses on the effect of the exchange rate on employment in Canada. We find that appreciation of the Canadian dollar has significant effects on employment in manufacturing industries; such effects are mostly associated with the export-weighted exchange rate, but not the import-weighted exchange rate. Meanwhile, the exchange rate has little effect on jobs in nonmanufacturing industries. Because the manufacturing sector accounts for only about 10 percent of employment in Canada, the overall effect of the exchange rate on employment is small. In addition, we quantify the loss of manufacturing employment associated with a commodity market boom, during which the Canadian dollar tends to appreciate. Our estimates suggest that when commodity prices increase by 15.77 percent (one standard deviation of annual change in commodity prices between 1994 and 2010), manufacturing employment in Canada decreases by 0.8 percent, which is about 0.08 percent of the total employment.

JEL classification codes: F1, F3, J2

Keywords: exchange rate, employment in Canada

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1 Introduction

The current monetary policy regime in Canada is inflation-targeting. Under this regime, the Bank of Canada adjusts the nominal interest rate to target inflation, and the exchange rate is flexible, allowing the bank to pursue an independent monetary policy tailored to the needs of the Canadian economy. Because Canada actively participates in international markets as a small open economy, the Canadian dollar has experienced substantial fluctuations in its value relative to other currencies.

The October 2010 issue of the Monetary Policy Report of the Bank of Canada recognized the potential negative effects of a strong Canadian dollar: "A combination of disappointing productivity performance and persistent strength in the Canadian dollar could dampen the expected recovery of Canada's net exports. Heightened tensions in foreign exchange markets could inhibit necessary global adjustment and put additional pressure on freely floating currencies"(p.27). One concern is that a commodity boom typically leads to appreciation of the Canadian dollar, which reduces the competitiveness of Canadian manufacturing industries in the world market.

In this paper, we use data from 1982 to 2012 to assess the effects of the exchange rate on Canadian employment in both manufacturing and nonmanufacturing industries. We believe that these effects are important considerations for policy makers who want to assess the potential cost of the current monetary policy regime and determine whether Canada should restrict exchange rate movements.

Our main findings are as follows. First, exchange rate fluctuations affect employment in manufacturing industries. Our estimate suggests that for the average manufacturing industry, a 1 percent appreciation in the trade-weighted exchange rate reduces employment by 0.66 percent. When we distinguish between import-weighted and export-weighted exchange rates, we find that most of the effects on employment are associated with the export-weighted exchange rate, whereas the import-weighted exchange rate does not have significant partial effects on employment.

Second, appreciation of the Canadian dollar does not appear to have negative effects on employment in nonmanufacturing industries. Because manufacturing accounts for only about 10 percent of total employment in Canada, the overall effect of exchange rate fluctuations on Canadian employment is relatively small.

Third, because commodity prices tend to comove positively with the value of the Canadian dollar, we also estimate the loss of manufacturing employment associated with a commodity boom. The estimates suggest that if commodity prices experience a positive shock of one standard deviation (i.e., a 15.77 percent increase in the overall price of commodities produced in Canada), the manufacturing sector is predicted to lose 11,656 jobs. This amounts to a 0.8 percent decrease in manufacturing employment and a 0.08 percent decrease in total employment in Canada.

Overall, our empirical results suggest that the effects of exchange rate appreciations on employment are small in Canada. Therefore, in terms of employment, a flexible exchange rate regime does not appear to impose an undue burden on the Canadian economy. Of course, we recognize that a commodity boom can have different regional impacts because of differences in industrial composition. For instance, Ontario and Quebec accounted for 44.8 percent and 28.7 percent of Canada's manufacturing employment in 2010, while Alberta accounted for 54.4 percent of employment in mining, quarrying, and oil and gas extraction. However, monetary policy is ill suited to address regional issues. Policy discussion regarding potential regional imbalances associated with a commodity boom is beyond the scope of this paper.

Our paper contributes to the literature on Dutch disease, and the broader literature on the "resource curse". The literature on Dutch disease focuses on the exchange rate channel. That is, a commodity boom may cause a currency to appreciate, which could harm the manufacturing sector (more generally, the non-commodity tradable sector) in an open economy. The literature on the resource curse is much wider in the sense that it includes not only the exchange rate channel but also other mechanisms, such as rent-seeking, corruption, domestic conflict, and high volatility (i.e., topics that are typically discussed in the fields of development and economic growth). In particular, our paper adds to literature on the existence of Dutch disease in Canada.

In the literature on Dutch disease in Canada, our paper is most closely related to work by Shakeri, Gray, and Leonard (2012). They adopted a two-step approach to estimate the relationship between the real Canada–US exchange rate and commodity prices, and the effect of the exchange rate on manufacturing output. In the exchange rate equation, they established that both energy and non-energy commodities play important roles in explaining the exchange rate, especially after 2004. Regarding industrial output, they found that only 25 out of 80 manufacturing industries experienced Dutch disease (i.e., a drop in output associated with currency appreciation). In particular, labor-intensive industries such as textiles, apparel, and leather products were affected the most, followed by petroleum and coal, electronic equipment and appliances, furniture, food and beverages, and transportation equipment.

The empirical approach and regression specification of our paper differ from the work of Shakeri, Gray, and Leonard (2012) in a number of ways. (1) We focus on the impact of the exchange rate on employment rather than on output. (2) We not only study the manufacturing sector at a disaggregate level, but also expand the study scope by examining non-manufacturing industries. (3) In our analysis of manufacturing industries, we construct trade-weighted industry-specific exchange rates to exploit industry heterogeneity in exposure to exchange rate fluctuations, whereas Shakeri, Gray, and Leonard (2012) relied on the real bilateral exchange rate between Canada and the United States. (4) In estimating the employment effect, our models allow industry-specific trade and input–output characteristics — the imported input share, the import penetration ratio, the export orientation ratio, and the fraction of output sold to commodity industries — to influence the effects of the exchange rate on jobs. Moreover, we find evidence that although manufacturing industries suffer a mild case of Dutch disease, other industries are not affected negatively by appreciation of the Canadian dollar.

Beine, Bos, and Coulombe (2012) argued that an important driver of the bilateral Canadian–US dollar exchange rate is the weakness of the US dollar, which has little to do with the evolution of commodity prices. After accounting for changes in the strength of the US dollar, they still found that a stronger Canadian dollar was associated with a decrease in Canadian industrial employment. However, their list of industries prone to Dutch disease is somewhat different from that of Shakeri, Gray, and Leonard (2012). Specifically, according to Beine, Bos, and Coulombe (2012), the industries most affected by Dutch disease were textiles, machinery, and computer and electronics, followed by plastics and rubber, furniture, printing, paper, primary metals, and transportation equipment. Industries such as food, beverage and tobacco products, textile products, leather and allied products, petroleum and coal, non-metallic minerals, and electronic equipment were not affected by exchange rate fluctuations.

Another branch of the literature on Dutch disease relies on analysis of national time-series data. Hutchison (1994) applied cointegration analysis and a vector correction model to data from the UK, Norway, and the Netherlands. No evidence of Dutch disease was found because there was little trade-off between development of the energy sector and development of the manufacturing sector in these countries, especially in the long run. Similarly, Bjϕrnland (1998) used a structural VAR model to study Dutch disease in Norway and the UK and found at best weak support for Dutch disease. In Norway, manufacturing output actually benefited from energy booms according to the analysis. There was some weak evidence of Dutch disease in the UK in the long run, although the economy responded positively in the short run.

Other papers extended the empirical study of Dutch disease to Saudi Arabia (Looney, 1990), Russia (Oomes and Kalcheva, 2007), and Kazakhstan (Egert and Leonard, 2008). The overall evidence is mixed. Many industries in Saudi Arabia, especially those producing mostly tradable goods, suffered from Dutch disease (Looney, 1990). In Russia, however, there was no clear evidence that a resource boom hurt the manufacturing output (Oomes and Kalcheva, 2007). In Kazakhstan, the economy has largely been spared Dutch disease because an exchange rate mechanism is absent. The real exchange rate of the non-oil open sector is simply not linked to real oil prices (Egert and Leonard, 2008).

Leung and Yuen (2007) used data on manufacturing industries coded according to the three-digit Standard Industrial Classification (SIC) system from 1981 to 1997 and examined exchange rate effects on employment and wages in Canada. They found that appreciation reduced manufacturing employment, but had little impact on wages. Coulombe (2008) used provincial data for a subset of manufacturing industries according to the three-digit North American Industry Classification System (NAICS) from 1987 to 2006 and studied exchange rate effects on employment in Canada. They found a significant negative effect of the exchange rate on manufacturing employment, especially in provinces with large manufacturing bases such as Ontario and Quebec.

A number of papers have examined the effects of the exchange rate on other aspects of the Canadian economy, such as firm performance and survival (Baggs, Beaulieu, and Fung, 2009; Tomlin, 2010) and labor productivity (Tang, 2010). There is also a well-established body of literature on the effects of the US dollar exchange rate on the labor market, particularly employment, in the United States. Papers based on data up to the 1990s (Campa and Goldberg, 2001; Klein, Schuh, and Triest, 2003) find that the exchange rate has a very small effect on employment in manufacturing industries, with the exchange rate elasticity for employment no greater than 0.1 in magnitude. Using city-level data in the 2000s, Huang and Tang (2013) found that the exchange rate has significant effects on both manufacturing and nonmanufacturing employment in US cities.

Our paper contributes in a number of ways to literature on the effects of the exchange rate on employment in Canada. First, we examine the effects of the exchange rate on the overall economy beyond manufacturing industries. Second, we exploit differences in trade partners across industries to construct industry-specific exchange rates. From this, we can utilize cross-sectional variation in exchange rates in addition to the time-series variation in exchange rates that is traditionally used in the literature. Third, our work suggests that the decrease in manufacturing employment is mostly associated with appreciation in the export-weighted exchange rate, not in the import-weighted exchange rate. Fourth, we provide an assessment of manufacturing employment losses associated with a commodity boom via the exchange rate channel.

The remainder of the paper is organized as follows. Section 2 describes general trends for the exchange rate and employment in Canada. Section 3 presents an empirical analysis of the effect of the exchange rate on employment in manufacturing industries and in the broader economy. Section 4 estimates the relationship between commodity prices and the exchange rate, and quantifies potential job losses following appreciation induced by a commodity boom. Conclusions follow.

2 Exchange Rate and Employment Trends in Canada

In this section, we discuss the general employment trends for the major industries in Canada and movements in the exchange rate between 1982 and 2012. During this period, total employment in Canada, including both full-time and part-time work, grew from 10.9 million in 1982 to 17.5 million in 2012.[1] Meanwhile, the Canadian population increased from 25.1 million to 34.8 million.[2] Because the growth in total employment (60 percent) is higher than the growth in population (38.4 percent), the overall employment picture for Canada seems healthy over the entire period, notwithstanding the 2008–2009 recession during the worldwide financial and economic crisis.

We next examine employment trends by major industry groups. The first two rows in Table 1 reveal that service industries employ far more workers than goods industries, and the proportional contribution of service industries to total employment has increased over time. In the following rows, we tabulate statistics for five main goods industries (two-digit NAICS codes in parentheses): agriculture, forestry, fishing, and hunting (11); mining, quarrying, and oil and gas extraction (21); utilities (22); construction (23); and manufacturing (31–33). Note that data for industries 11 and 21 are not available before 1987. Instead, we use data for the agriculture industry (111–112) and forestry, fishing, mining, quarrying, and oil and gas (113–114, 21) for 1982. Overall, the proportional contribution of goods industries to total employment has declined substantially. Even though the percentage of total employment in mining, quarrying, and oil and gas, and in construction has increased, the increases are not large enough to offset the declines in other goods industries, most of which occurred in manufacturing.

The decline in manufacturing employment is concentrated in Ontario and Quebec. Between 1982 and 2012, the share of employment in the manufacturing industries decreased by 6.9 percent across Canada. Ontario alone accounted for 57.4 percent of this loss, and Quebec accounted for another 27.0 percent. On average, Ontario and Quebec accounted for 47.7 percent and 28.3 percent, respectively, of Canadian manufacturing employment during the period 1982–2012. These data suggests that Ontario bore a disproportionately large loss in manufacturing employment.

[Insert Table 1 here]

[Insert Figure 1 here]

In the upper panel of Figure 1, we plot employment in goods industries and in service industries, and the real Canadian-dollar effective exchange rate index (CERI), a trade-weighted exchange rate index published by the Bank of Canada. The CERI is a direct rate, so an increase in the CERI represents effective appreciation of the Canadian dollar, whereas a decrease represents depreciation of the Canadian dollar. Construction of the real CERI is described in the Appendix of Huang, Pang, and Tang (2014). To facilitate comparison, we normalize all variables to 100 in 1987. The real exchange rate, which is mostly driven by movements in the nominal exchange rate, went through two complete cycles between 1982 and 2012. It depreciated moderately during the first half of the 1980s, and then appreciated back to the original level by the early 1990s. Starting from 1992, the exchange rate experienced decade-long depreciation (26.4 percent between 1992 and 2002) and then substantial appreciation between 2002 and 2012 (43.4 percent).

The lower panel of Figure 1 shows data for five goods industry groups. Again, manufacturing industry stands out because employment in this group appears to have an inverse relationship with the strength of the Canadian dollar. For instance, increases in manufacturing employment in the early 1980s and in the 1990s both correspond to episodes of depreciation of the Canadian dollar. A more noticeable example is the drop in manufacturing employment after 2000, which largely coincides with the strong run-up of the Canadian dollar. For other goods industries, construction employment has been steadily increasing since 1982, except during the 1981–1982, 1990–1992, and 2008–2009 recessions. The number of jobs in the agriculture, forestry, fishing, and hunting industry has been declining since the mid-1980s. Employment in the mining, quarrying, and oil and gas industry seems to track exchange rate movements quite closely, presumably because the world demand for these commodities drives both the strength of the Canadian dollar and employment in these Canadian industries. Interestingly, employment in the utilities industry also seems to follow the pattern of the exchange rate. One potential explanation for this is a common factor that affects employment in the utilities industry and the exchange rate in the same direction. For example, a recession leads to a lower demand for utilities, which then lowers employment in the utilities industry. At the same time, a weak economy tends to weaken the currency as well. In other words, Figure 1 presents only unconditional correlations. It does not exclude the possibility that certain observed relationships (e.g., the negative relationship between the exchange rate and manufacturing employment) are caused by other macroeconomic factors (e.g., when the Bank of Canada raises the interest rate, the Canadian dollar is likely to become stronger while employment is likely to decrease). In the next section, we extend our analysis beyond simple correlations in time series and exploit variations in trade exposure across industries. We also control for a number of macroeconomic factors in the regression analysis.

3 Empirical Analysis

Because the evidence in Section 2 suggests that the exchange rate is likely to have affected manufacturing employment in Canada, we first estimate the effects of the exchange rate on a group of manufacturing industries according to the four-digit NAICS classification. The empirical strategy borrows heavily from the theoretical work and empirical specification of Campa and Goldberg (2001), who examined the effect of the exchange rate on employment from the perspective of firms. In this framework, a firm uses labor, domestically produced inputs, and imported inputs in its production, and sells products in both domestic and foreign markets.

The exchange rate affects a firm's demand for labor in a number of ways, not all of which work in the same direction. First, when the home currency appreciates, home products become more expensive compared to foreign products. As a result, domestic demand for a home firm's products decreases, so the home firm requires less labor. Second, when the home currency appreciates relative to currencies in export destination markets, demand for home products in those markets also decreases. This again depresses the home firm's demand for labor. Third, appreciation makes imported inputs cheaper. If labor and imported inputs are complements in production, on appreciation, home firms will use more imported inputs and hire more labor at the same time. However, if labor and imported inputs are substitutes in production, home firms will choose to substitute labor with cheaper imported inputs on appreciation. Demand for labor decreases in this case.

Because of the lack of data on international trade at the firm level, we follow the literature and test these theoretical implications using data at the industry level. The assumption is that the relationship between the exchange rate and employment in an industry resembles that for an average firm in the industry.

As pointed out by Huang and Tang (2013), the exchange rate in import trade and the exchange rate in export trade may have different effects. First, the countries from which an industry imports inputs and against which the industry competes in the domestic market can be different from the countries to which the industry exports its products. Second, while the theory clearly predicts that appreciations in the export exchange rate decrease demand for labor, the effect of the import exchange rate on employment is ambiguous. As stated earlier, appreciations in import exchange rates have two effects: they make imported products cheaper, and lower the cost of imported inputs. Depending on whether imported inputs and labor are complements or substitutes, the overall effect of appreciation of the import exchange rate on employment can be positive or negative.[3] Therefore, we compute the export-weighted real exchange rate and the import-weighted real exchange rate for each industry. We refer to these as the export exchange rate and the import exchange rate, respectively. Because these two exchange rates are highly correlated, with a correlation coefficient of 0.83, we use a third measure of the exchange rate that is equal to the average of the import exchange rate and the export exchange rate. We refer to this as the trade-weighted exchange rate. We construct the exchange rate variables such that an increase in the exchange rate implies currency appreciation. We use data for 86 manufacturing industries (four-digit NAICS codes) in five regions in Canada from 1990 to

2010. We document detailed information on construction of the variables in the Appendix of Huang, Pang, and Tang (2014). From Figure 2 we can see that because the industries differ in how much they trade with each country, there are considerable variations in the industry-specific export and import exchange rates.

[Insert Figure 2 here]

In the left panel of Figure 3, we plot the export exchange rate indices for the five manufacturing industries (four-digit NAICS code) with the highest employment: plastic products, motor vehicle parts, printing and related support activities, meat products, and cut and sew clothing. Between 1990 and 2010, these five industries accounted for 4.70 percent, 4.65 percent, 4.25 percent, 3.40 percent, and 3.37 percent, respectively, of Canadian manufacturing employment. In the right panel, the export and import exchange rates for motor vehicle parts track each other quite closely, although differences remain.

[Insert Figure 3 here]

Our baseline regression is

$$\begin{aligned}\Delta L_{ijt}(\%) =& \beta_0 + (\beta_1 + \beta_2 \cdot expori_{it-1} + \beta_3 \cdot impinp_{it-1} + \beta_4 \cdot imppene_{it-1} \cdot \Delta e_{it}(\%) \\ & + \beta_5 \cdot expori_{it-1} + \beta_6 \cdot impinp_{it-1} + \beta_7 \cdot imppene_{it-1} \\ & + \beta_8 \cdot ioshare_{it} \cdot \Delta P_t^{com}(\%) + \beta_9 \cdot ioshare_{it} + \beta_{10} \cdot \Delta P_t^{com} \\ & + \beta_{11} \cdot \Delta y_t(\%) + \beta_{12} \cdot \Delta y_{it}^*(\%) + \beta_{13} \cdot \Delta r_t^s + \beta_{14} \cdot \Delta r_t^l \\ & + \beta_{15} \cdot \Delta G_t(\%) + \beta_{16} \cdot \Delta P_t^e(\%) + \beta_{17} \cdot t + \beta_{18} \cdot \Delta L_{ijt-1}(\%) \\ & + \beta_{19} \cdot \Delta L_{ijt-2}(\%) + \beta_{20} \cdot \Delta L_{ijt-3}(\%) + f_{ij} + u_{ijt}, \end{aligned} \tag{1}$$

where $\Delta L_{ijt}(\%)$ is the growth rate for employment in manufacturing industry i in region j of Canada between period t and $t-1$. The five regions in our sample are Atlantic Canada, Quebec, Ontario, the Prairies, and British Columbia.[4] The variable $\Delta e_{it}(\%)$ is the percentage change in the trade-weighted exchange rate specific to industry i. The variable $expori_{it}$ is the export orientation ratio, defined as the fraction of output by industry

i exported in year t; $impinp_{it}$ is the imported input share, defined as the fraction of imported inputs for the total production cost for industry i in year t; and $imppene_{it}$ is the fraction of imports in total domestic sales by industry i in year t.

In theory, commodity prices can affect employment via two channels. First, in a country such as Canada, which is a net exporter of commodities and for which commodities account for a large proportion of total exports, commodity prices and exchange rates are often positively correlated; therefore, changes in commodity prices may affect the exchange rate, which further affects employment. Second, production of commodities requires goods from other industries. Following a commodity boom, employment tends to increase in industries that sell a large fraction of their products to the commodity sector. Thus, we include the fraction of output of manufacturing industry i sold to commodity industries ($ioshare_{it}$), the percentage change in the Bank of Canada commodity price index ($\Delta P_t^{com}(\%)$), and the interaction between these two variables in the regression. We define the commodity sector as the sum of agriculture, forestry, fishing, and hunting (industry 11 in the NAICS) and mining, quarrying, and oil and gas extraction (industry 21 in the NAICS).

We also include variables to control for various macroeconomic conditions. The variables $\Delta y_t(\%)$ and $\Delta y_{it}^*(\%)$ are real GDP growth for Canada and export-weighted real GDP growth in Canada's top trading partners; they are proxies for changes in the aggregate demand. The change in the real 3-month prime corporate paper rate (Δr_t^s) accounts for the change in the short-term real interest rate, and the change in the real yield of Canadian government bonds over 10 years (Δr_t^l) accounts for the change in the long-term real interest rate. Moreover, the percentage change in the government expenditure share in GDP ($\Delta G_t(\%)$) is included to represent the fiscal policy environment. To control for input costs, we include the percentage change in the real nonresidential electric power price ($\Delta P_t^e(\%)$). Because manufacturing employment in Canada has experienced an across-theboard secular decline, we include a linear time trend (t) on the right-hand side. The theory of dynamic labor demand suggests that, owing to hiring and firing costs, optimal labor adjustment takes more than one period to be realized (Nickell, 1986). We thus include a lag of the dependent variable to account for the dynamics in labor adjustment. Moreover, we include industry–region fixed effects (f_{ij}) to capture heterogeneity among industries and regions.

Under the assumption that u_{ijt} is an independent and identically distributed (i.i.d.) error term, the model can be estimated with the Arellano–Bond general method of moments (GMM) estimator (Arellano and Bond, 1991), which can accommodate lag-dependent variables in panel regressions. Specification tests indicate that when we include at least three lags of the dependent variable, we cannot reject the null hypothesis that u_{ijt} is i.i.d. Therefore, we include three lags of the dependent variables in the regression for manufacturing industries. Because of the presence of interaction terms, the effects of the exchange rate depend on the values of the variables with which the exchange rate is interacted. To facilitate interpretation, we remove the sample mean from all the explanatory variables that are interacted.

Table 2 reports the regression results. In column 1 of the table, we estimate the baseline model (Equation 1). The coefficient for the trade-weighted exchange rate is -0.66 (significant at the 1 percent level), meaning that 1 percent appreciation in the average exchange rate is associated with a 0.66 percent reduction in manufacturing employment.[5] In column (2), we include both the export exchange rate and the import exchange rate. We also interact the export exchange rate with a one-period lag of the export orientation ratio, and the import exchange rate with one-period lags of the imported input share and the import penetration ratio. Conditional on the import exchange rate, the export exchange rate elasticity estimated for employment is -0.77 and is significant at the 5 percent level. The import exchange rate, however, does not have significant partial effects on employment; the coefficient is 0.13 and is not statistically different from zero.[6]

In Columns (1) and (2), we include variables derived from the input–output (IO) tables (i.e., the fraction of output sold to commodity industries, the imported input share, and the export orientation ratio). Because the IO tables are available only from 1997 to 2009 and we use one-year lags of the variables derived from the IO tables in the regression, our sample period is effectively from 1998 to 2010. In Column (3), we exclude variables that are constructed from the IO tables so that we can include the extra information from 1990 to 1997 in the regression.[7] While this regression does not account for industry-level heterogeneity other than the industry–region fixed effects, the magnitude of the coefficient for the trade-weighted exchange rate (−0.5) is only slightly smaller than that in the baseline model (−0.66). Overall, the results confirm the descriptive analysis in Section 2 that manufacturing employment responds negatively to exchange rate movements.

[Insert Table 2 here]

According to Equation (1), the effects of the exchange rate on jobs differ across industries because of its interaction with other variables. Table 3 lists the effects of the exchange rate for 21 manufacturing industries (three-digit NAICS codes).[8] More precisely, the effect of the exchange rate on employment in industry i is computed as

$$\hat{\beta}_1 + \hat{\beta}_2 \cdot \overline{expori}_i + \hat{\beta}_3 \cdot \overline{impinp}_i + \hat{\beta}_4 \cdot \overline{imppene}_i,$$

where $\overline{expori}_i$, $\overline{impinp}_i$, and $\overline{imppene}_i$ are the average export orientation ratio, the average imported input share, and the average import penetration ratio of industry i between 1997 and 2009, respectively.

Table 3 ranks all manufacturing industries (three-digit NAICS codes) according to the total effect of the exchange rate on employment. It also reports the individual components of the total exchange rate effect that are attributable to the exchange rate itself or interactions between the exchange rate and industry-specific characteristics such as the imported input share, the import penetration ratio, and the export orientation ratio. It is clear that there are substantial variations in the effects of the exchange rate across manufacturing industries, ranging from −0.42 for wood products (industry 321 in the NAICS code) to −1.65 for beverage and tobacco products (industry 312).

The estimates show that manufacturing industries such as beverage and tobacco products (312), petroleum and coal products (324), computer and electronic products (334), transportation equipment (336), textiles (313), textile products (314), and plastics and rubber products (326) are most affected by exchange rate movements. By contrast, manufacturing industries such as fabricated metal products (332), paper (322), furniture and related products (337), printing and related support activities (323), food (311), nonmetallic mineral products (327), and wood products (321) are least affected.

Most of the cross-industry differences are driven by differences in the imported input share. The estimated coefficient for the interaction between the exchange rate and the imported input share is negative, which is consistent with the theoretical scenario in which imported inputs and labor are substitutes. In other words, when the Canadian dollar appreciates, imported inputs become relatively cheaper, and firms/industries will choose to use more imported inputs but less labor. The size of this substitution effect depends on the degree to which imported inputs are used in each industry. In particular, industries that use more imported inputs (relative to the mean across all four-digit NAICS manufacturing industries) tend to experience a larger negative effect on employment when the Canadian dollar appreciates. On the contrary, industries that use less imported inputs (relative to the mean) tend to experience a much smaller negative effect on employment when the Canadian dollar appreciates. Our results are also compatible with the findings of Shakeri, Gray, and Leonard (2012) and Beine, Bos, and Coulombe (2012), even though the exact rankings vary because of the different approaches and data used. The industries for which we find the greatest Dutch disease effect, such as computers and electronics, transportation equipment, and textiles, tend to be labor-intensive. Intuitively, domestic labor used in these industries can be easily replaced by intermediate goods from abroad when the Canadian dollar appreciates. By contrast, for industries that use mostly domestic inputs such as wood, nonmetallic minerals, food, printing, and paper, this substitution effect is much smaller, and hence these industries are much less affected by Dutch disease.

We also find that export orientation plays little role in determining the exchange rate effect on employment. The estimated coefficient for the interaction between the exchange rate and the import penetration ratio has the wrong sign, but this coefficient is not significant by itself and has a small absolute value. Overall, most of the cross-industry differences are driven by differences in the imported input share. We recognize that the interaction between the imported input share and the exchange rate is not statistically significant by itself (although the joint effect of the exchange rate on employment is significant); therefore, evidence of heterogeneity in this dimension is weak.

[Insert Table 3 here]

In addition to manufacturing industries according to four-digit NAICS codes, we extend our analysis to include non-manufacturing industries. We examine 17 major industries according to two-digit NAICS codes in 10 provinces of Canada for a broader analysis of the effect of the exchange rate on jobs[9]. Using data from 1982 to 2012, we run regressions that are comparable to Equation (1), and find that employment in most industries is not affected by exchange rate movements at any conventional level of statistical significance. Details on these regressions can be found in Huang, Pang, and Tang (2014).

The above results suggest that exchange rate fluctuations only affect employment in manufacturing industries. Moreover, it is important to perform the analysis at a disaggregate (four-digit NAICS codes) level and account for industry heterogeneity in exposure to trade.

4 Commodity Booms and Job Losses in Manufacturing Industries

As shown in Figure 4, the real effective exchange rate index for the Canadian dollar tends to move in the same direction as the commodity price index published by the Bank of Canada, an index that tracks the prices of commodities produced in Canada. This positive relationship explains why the Canadian dollar is often referred to as one of the major commodity currencies in the world.[10] Section 3 reveals that the effects of the Canadian dollar exchange rate on employment are concentrated in manufacturing industries. Although neither the observed nor the estimated positive correlation proves that there is a causal effect of commodity prices on the value of the Canadian dollar, it is useful to quantify the expected loss of manufacturing jobs during commodity sector booms. In this section, we first estimate the exchange rate responses to an increase in commodity prices. Then we calculate the loss of manufacturing jobs associated with a commodity boom by combining the estimates in this section with the exchange rate elasticity for employment estimated in Section 3.

[Insert Figure 4 here]

The relationship between commodity prices and the Canadian dollar is well researched. The pioneers of this literature were Amano and van Norden (1995). They estimated a single error-correction model equation for the bilateral Canada–US real exchange rate that linked the real exchange rate to real energy and non-energy commodity prices, and the real interest rate differential between the two countries. They found that all the estimated coefficients were significant and displayed intuitive signs, except the estimated coefficient for energy prices was negative. This negative relationship between energy prices and the Canadian dollar was left as a puzzle that a number of researchers have tried to solve.[11]

Issa, Lafrance, and Murray (2008) first noted that the effect of energy prices on the

Canadian dollar had changed over time. They found a structural break in the long-run relationship between energy prices and the Canadian dollar, which turned from negative to positive in the early 1990s and was consistent with changes in energy prices and Canadian energy and trade policies at the time.

Bailliu et al. (2014) further expanded the exchange rate equation of Issa, Lafrance, and Murray (2008), developed a regime-switching model with a time-varying transition matrix, and examined the role of multilateral adjustment to US external imbalances in driving bilateral US–Canada real exchange rate movements. They found that during periods of large US imbalances, allowing for multilateral adjustment effects was crucial for a successful exchange rate model. The main message of Bailliu et al. (2014) was similar to that of Beine, Bos, and Coulombe (2012). Essentially, real depreciation of the US dollar because of an unsustainable level of external balances may account for a significant fraction of the exchange rate movements in Canada and other countries. Because these so-called US factors are completely exogenous to the domestic economy, standard bilateral exchange rate equations that only emphasize country-specific macroeconomic fundamentals would be insufficient in terms of explanatory and forecasting power.

Bayoumi and Mühleisen (2006) extended the original exchange rate equation of Amano and van Norden (1995) and argued that commodity exports affect the exchange rate through changes not only in trade but also in the volume of commodity trade. In other words, the impact of commodity prices depends on the size of the commodity sector. They found that, conditional on the magnitude of commodity production and exports, both energy and non-energy commodity prices had significant positive effects on the Canadian dollar.

Helliwell et al. (2004) estimated a nominal bilateral exchange rate equation and found that their model can successfully account for Canadian dollar movements since 1975. The key difference between theirs and previous models is that they included labor productivity differentials between Canada and the United States. Moreover, they considered a set of financial market variables, such as stock market prices, international risk premiums, the US current account deficit, and the fiscal deficit differential between Canada and the United States. However, they concluded that these financial variables add little to fitting of their exchange rate equation.

Using the literature, we estimate the following equation that links the industry-specific trade-weighted exchange rate to commodity prices:

$$\begin{aligned}\Delta e_{it} =& \alpha_0 + \alpha_1 \cdot (i_t^{Canada} - i_t^{US}) + \alpha_2 \cdot (laborprod_t^{US} - laborprod_t^{Canada}) + \alpha_3 \cdot CA_t^{US} \\ &+ \sum_i \gamma_i \cdot \Delta P_t^{com} \cdot D_i + v_{it}, \qquad (2)\end{aligned}$$

where P_t^{com} is the real commodity price index. The variables i_t^{Canada} and i_t^{US} are interest rates for 10-year government bonds in Canada and the United States, respectively. The variables $laborprod_t^{Canada}$ and $laborprod_t^{US}$ measure labor productivity in the two countries. The variable CA_t^{US} is the ratio of the current account balance to GDP in the United States. The parameters γ_i denote the commodity price elasticity for the trade-weighted exchange rate for industry i. We present the regression results with respect to the first three variables in Table 4, and summarize the estimates of γ_i for 86 manufacturing industries (four-digit NAICS codes) in the first row of Table 5. On average, a 1 percent increase in commodity prices leads to 0.08 percent appreciation in the industry-specific trade-weighted exchange rate. All estimates of γ_i are statistically significant at the 0.1 percent level.

[Insert Table 4 here]

[Insert Table 5 here]

Holding other factors constant, we can compute the effect of commodity prices on employment by multiplying the exchange rate elasticity for employment by the commodity price elasticity for the exchange rate. Specifically, for each industry i, the effect of a positive shock of one standard deviation in commodity prices (15.77 percent between 1994 and 2010) on employment is

$$\Delta L_i(\%) = 15.77\% \cdot \hat{\gamma_i} \cdot (\hat{\beta}_1 + \hat{\beta}_2 \cdot \overline{expori}_i + \hat{\beta}_3 \cdot \overline{impinp}_i + \hat{\beta}_4 \cdot \overline{imppene}_i),$$

where the expression in brackets is the marginal effect of the exchange rate on employment in industry i.

The second and third rows in Table 5 summarize the predicted growth rate for employment and the change in the number of jobs based on the employment level in 2010. The change in the number of jobs for industry i is calculated as $\Delta L_i = \Delta L_i(\%) \cdot L_{i,2010}$. After a 15.77 percent increase in commodity prices, employment in a manufacturing industry is predicted to decrease by 0.8 percent on average. The predicted total loss of manufacturing jobs is 11,656, equivalent to about 0.08 percent of total employment in Canada in 2010.

Lastly, we aggregate the predicted job losses for manufacturing industries according to three-digit NAICS codes and tabulate the predicted effects of a 15.77 percent increase in commodity prices on employment in Table 6. Among all industries, beverage and tobacco products, petroleum and coal products, and transportation equipment stand out because they account for 1.78 percent, 0.89 percent, and 10.76 percent of total manufacturing employment, but are predicted to account for 4.78 percent, 1.47 percent, and 14.95 percent, respectively, of total manufacturing job losses. Wood products and food industries also stand out because they account for 6.04 percent and 15.72 percent of total manufacturing employment, but are predicted to account for only 3.52 percent and 9.88 percent, respectively, of total manufacturing job losses. For the other industries, the proportion of predicted job losses is mostly in line with their proportion of total manufacturing employment.

[Insert Table 6 here]

5 Discussion and Conclusion

In this paper, we examine the effects of exchange rate movements on jobs in Canada. We find that real appreciation of the Canadian dollar has negative effects on employment in manufacturing industries, but not in other industries. Because the manufacturing sector accounts for only about 10 percent of employment in Canada, our estimates suggest that exchange rate movements have little impact on Canadian jobs as a whole.

In the regression analysis for manufacturing industries, we find that a 1 percent appreciation in the trade-weighted exchange rate is associated with a 0.66 percent decrease in employment on average. When we distinguish between import- and export-weighted exchange rates, we find that the export-weighted exchange rate has a significant effect on employment, whereas the partial effect of a change in the import-weighted exchange rate is statistically insignificant.

Following a boom in the global commodity market, the value of the Canadian dollar tends to rise and employment in manufacturing industries typically drops. In our analysis, we quantify the loss of manufacturing jobs associated with a one standard deviation increase in commodity prices on manufacturing jobs. We find that the predicted loss of manufacturing jobs is about 0.8 percent of total manufacturing employment, or about 0.08 percent of total employment in Canada. We note that even though the predicted job loss is moderate in terms of the aggregate Canadian economy, the effects are concentrated in Ontario and Quebec because they account for 44.8 percent and 28.7 percent, respectively, of Canadian manufacturing employment in 2010. However, monetary and exchange rate policies are not suitable for addressing such regional imbalances.

Notes

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Council of Canada for financial support. All errors are ours.

[1]The employment data are from CANSIM Table 282-0008.

[2]The population data are from CANSIM Table 051-0001.

[3]Because it is not possible to distinguish systematically between imported intermediate inputs and final consumption goods, we are not able to compute an import exchange rate for imported inputs and an import exchange rate for final goods separately.

[4]At the province level, many industries report missing values for employment because of confidentiality reasons. Therefore, we use regions to include information on more industries in the regression.

[5]This estimate is much larger than the coefficient of −0.38 from a comparable regression for US manufacturing industries by Huang and Tang (2013).

[6]Huang and Tang (2013), using US data, reported similar findings for the difference between export and import exchange-rate effects on employment.

[7]The results are similar if we exclude the period affected by the most recent recession, using only data before 2009.

[8]The effects for the 86 manufacturing industries according to four-digit codes are available on request.

[9]The 17 industries, with their two-digit NAICS codes in parentheses, are agriculture, forestry, fishing, and hunting (11); mining, quarrying, and oil and gas extraction (21); utilities (22); construction (23); manufacturing (31–33); wholesale trade (41); retail trade (44–45); transportation and warehousing (48–49); information, culture, arts, entertainment, and recreation (51, 71); finance, insurance, real estate, and rental and leasing (52, 53); professional, scientific, and technical services (54), Business, building, and other support services (55-56), Educational services (61); health care and social assistance (62); accommodation and food services (72); other services (81); and public administration (91).

[10]Besides Canada, Australia and New Zealand also have primary commodities constituting a major proportion of their exports, and movements in commodity prices have been considered a significant driver for their currencies.

[11]For a brief survey, see Bailliu and King (2005).

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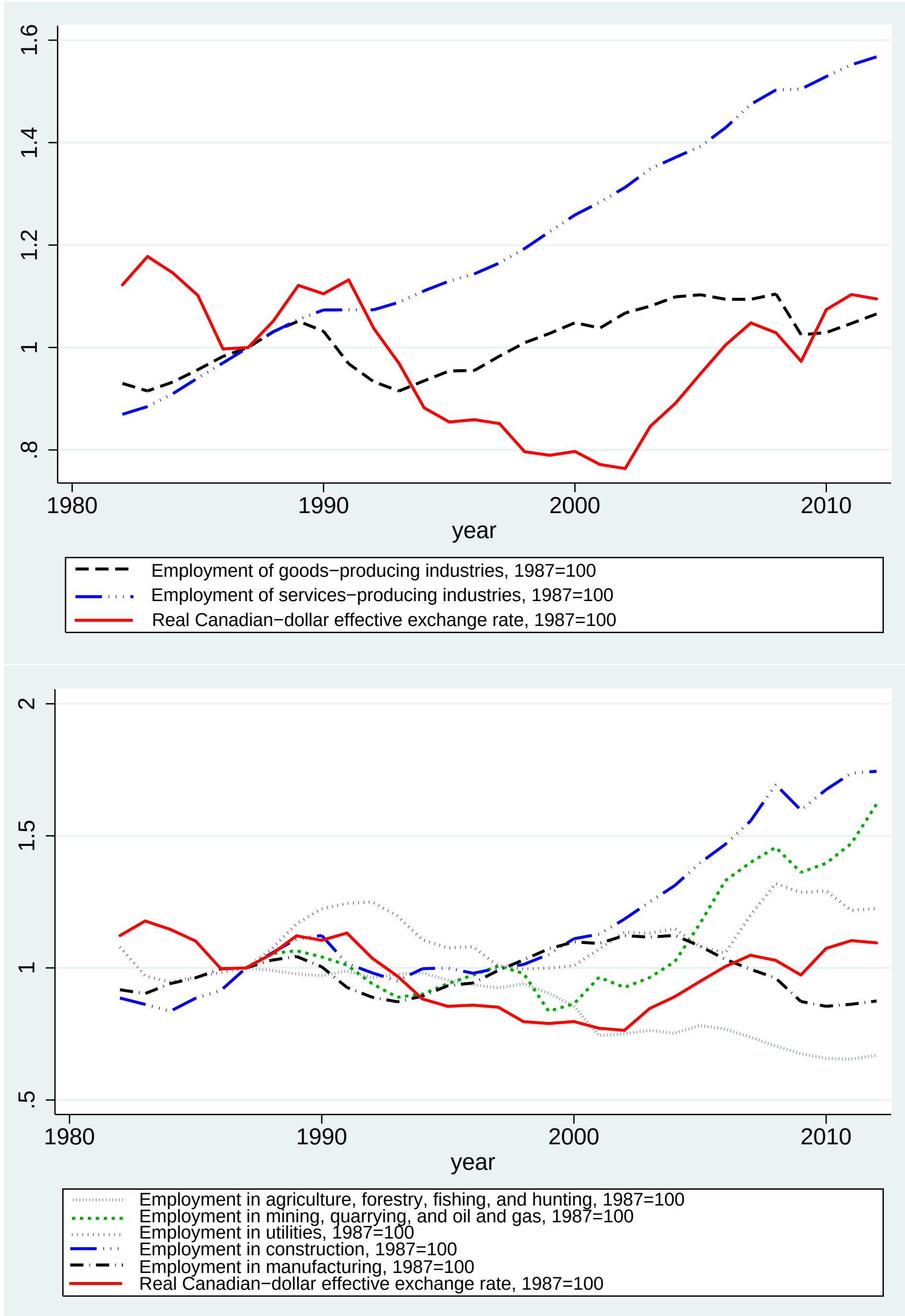

Figure 1: Real Canadian-dollar Effective Exchange Rate and Employment by Major Industries in Canada

Source: Authors' calculations.

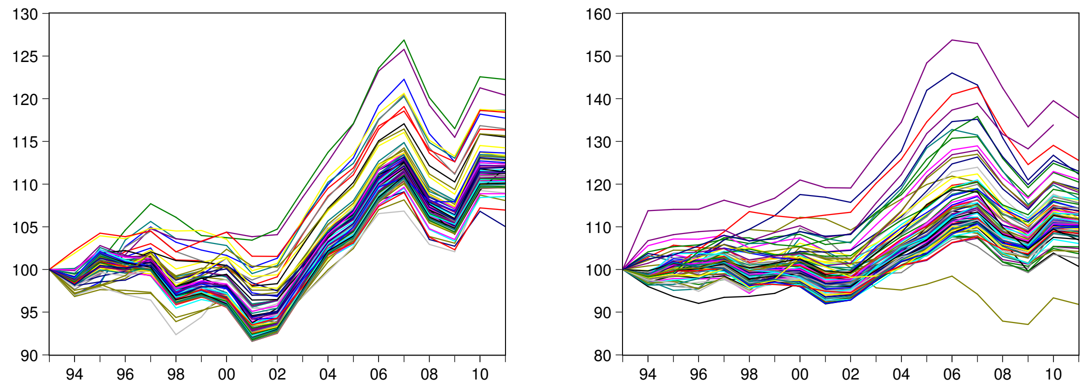

Figure 2: Industry-specific Export and Import Exchange Rate Indices, All Industries
Note: Each line in the left (right) panel is the export (import) exchange rate index for a manufacturing industry (four-digit NAICS code).
Source: Authors' calculations.

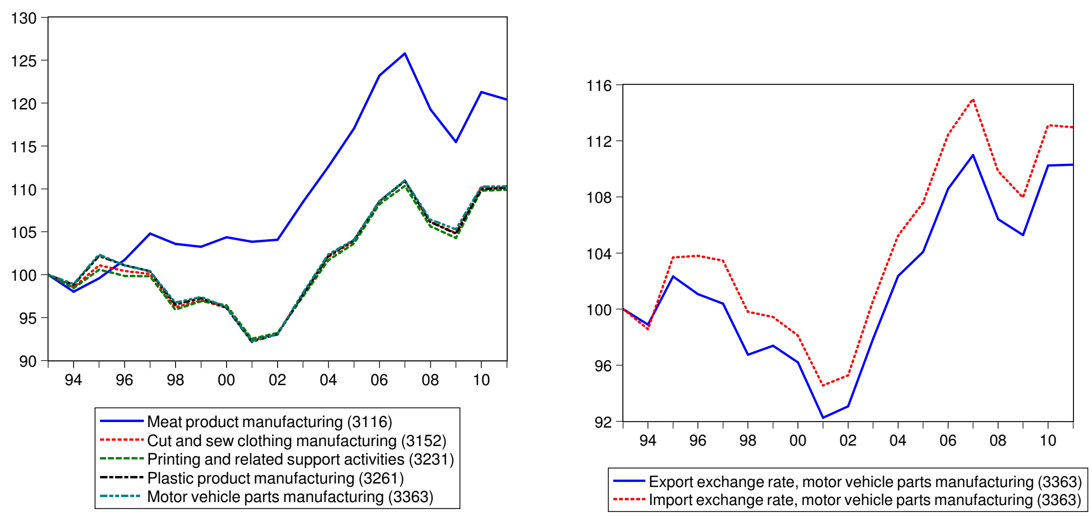

Figure 3: Industry-specific Export and Import Exchange Rate Indices, Selected Industries
Note: Each line in the left panel is the export exchange rate index for a selected manufacturing industry.
Source: Authors' calculations.

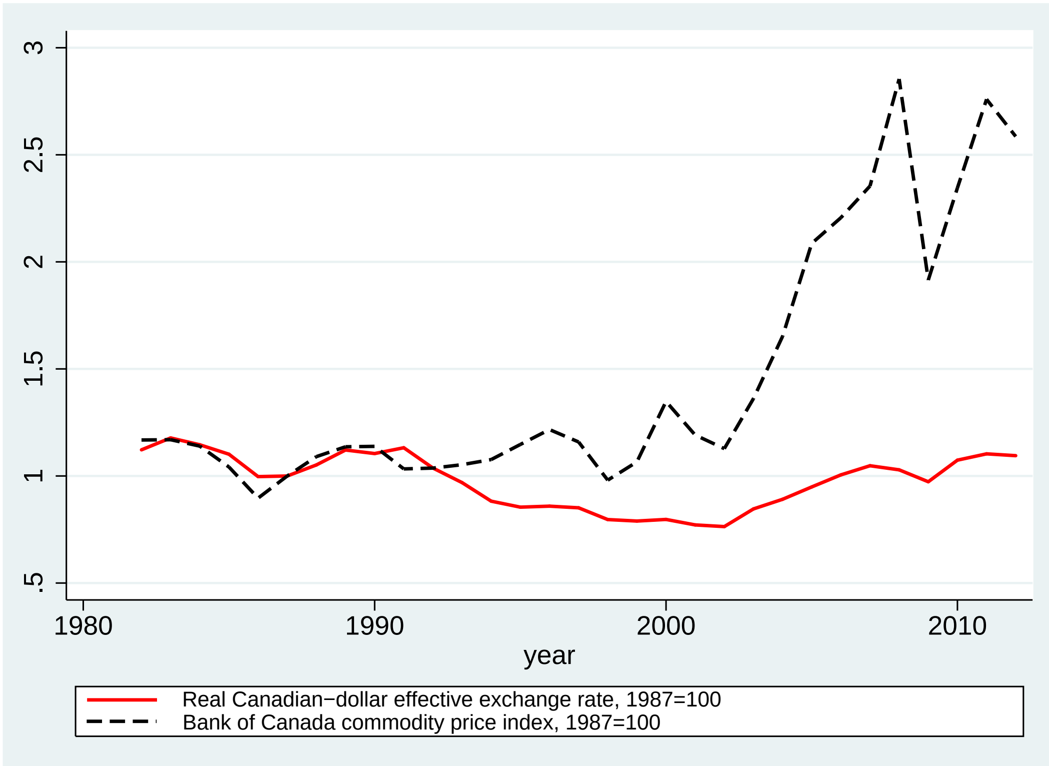

Figure 4: Commodity Price Index and Real Canadian-dollar Effective Exchange Rate

Source: Authors' calculations.

Table 1: Share of Major Industries in Total Employment

Industry (NAICS code)	1982	1987	2012
Services (41–91)	69.1%	70.5%	77.9%
Goods (11–33)	30.9%	29.5%	22.1%
Agriculture (111–112)	4.0%	3.8%	1.8%
Forestry, Fishing, Mining, Quarrying, Oil, and Gas (113–114, 21)	2.7%	2.3%	2.1%
Agriculture, Forestry, Fishing, and Hunting (11)		4.6%	2.2%
Mining, Quarrying, Oil, and Gas (21)		1.5%	1.7%
Utilities (22)	1.1%	0.9%	0.8%
Construction (23)	5.9%	5.9%	7.2%
Manufacturing (31–33)	17.1%	16.5%	10.2%

Note: NAICS stands for North American Industry Classification System.
Source: Authors' calculations.

Table 2: Regression Analysis for Manufacturing Industries According to Four-digit NAICS Codes

Variables	1998–2010 (1)	1998–2010 (2)	1990–2010 (3)
Δ avg ER (%)	−0.66 (0.25)***		−0.50 (0.14)***
Δ avg ER (%) · lag export orientation	−0.0002 (0.004)		
Δ avg ER (%) · lag share of imported input	−0.02 (0.02)		
Δ avg ER (%) · lag import penetration	0.003 (0.007)		
Δ exp ER (%)		−0.77 (0.37)**	
Δ exp ER (%) · lag export orientation		−0.0003 (0.004)	
Δ imp ER (%)		0.13 (0.39)	
Δ imp ER (%) · lag share of imported input		−0.01 (0.01)	
Δ imp ER (%) · lag import penetration		0.005 (0.007)	
lag export orientation	0.05 (0.03)	0.06 (0.03)*	
lag share of imported inputs	0.11 (0.33)	0.11 (0.33)	
lag import penetration	0.6 (0.23)**	0.57 (0.23)**	
Δ real commodity price (%) *cdot* lag IO share	0.006 (0.006)	0.006 (0.006)	
lag IO share	−0.27 (1.05)	−0.27 (1.03)	
Δ real commodity price (%)	−0.08 (0.07)	−0.10 (0.07)	
Δ real GDP of Canada (%)	3.94 (1.65)**	3.84 (1.67)**	0.03 (0.47)
Δ real foreign GDP (%)	−2.23 (1.68)	−2.10 (1.67)	1.94 (0.49)***
Δ real interest rate, 3-month prime corporate paper	2.03 (0.58)***	2.03 (0.57)***	0.11 (0.31)
Δ real interest rate, 10-year+ government bond	−3.24 (1.65)**	−3.32 (1.66)**	−0.81 (0.27)***
Δ government expenditure share (%)	0.34 (1.57)	0.25 (1.58)	0.43 (0.38)
Δ real nonresidential electric power price (%)	0.08 (0.26)	0.09 (0.25)	0.17 (0.09)*
time	1.06 (0.71)	1.23 (0.7)*	−0.33 (0.17)**
Observations	1187	1187	2726
$Wald\ \chi^2\ statistic^a$	104.40	104.16	143.13
$p-value\ for\ AR(2)\ test^b$	0.39	0.40	0.65

Notes: All equations are estimated with the Arellano–Bond GMM estimator for dynamic panel regressions (Arellano and Bond, 1991).

Δ *avg ER* (%), Δ *exp ER* (%), and Δ *imp ER* (%) are the percentage changes in the real exchange rate weighted by trade, export, and import, respectively. *Lag IO share* is the fraction of output sold to commodity industries. *GDP* is gross domestic output.

[a]The Wald χ^2 statistics (with degrees of freedom equal to 20, 21, and 11) measure the overall significance of the models.

[b]The p-value for testing H0 that the errors are not autocorrelated, a condition under which the Arellano–Bond GMM estimator is consistent.

*$p < 0.1$, **$p < 0.05$, and ***$p < 0.01$.

Source: Authors' calculations.

Table 3: Industry-Specific Exchange Rate Effect on Employment at the Three-digit NAICS Level

Industry	Total marginal effect of ER on employment	ER × import input sh	ER × import penetration	ER × export orientation
Beverage and Tobacco Products (312)	−1.65 (0.89)*	−0.92	−0.08	0.01
Petroleum and Coal Products (324)	−1.01 (0.46)**	−0.24	−0.12	0.01
Computer and Electronic Products (334)	−0.92 (0.36)**	−0.33	0.06	0.00
Transportation Equipment (336)	−0.88 (0.32)***	−0.22	0.00	−0.00
Textiles (313)	−0.79 (0.3)***	−0.17	0.03	0.00
Textile Products (314)	−0.77 (0.3)***	−0.16	0.05	0.00
Plastics and Rubber Products (326)	−0.71 (0.31)**	−0.10	0.06	−0.01
Miscellaneous (339)	−0.69 (0.3)**	−0.09	0.05	0.00
Electrical Equipment, Appliances, and Components (335)	−0.69 (0.29)**	−0.08	0.05	0.00
Primary Metals (331)	−0.69 (0.26)***	0.00	−0.03	0.00
Chemicals (325)	−0.66 (0.28)**	−0.04	0.03	0.00
Leather and Allied Products (316)	−0.65 (0.35)*	−0.08	0.10	−0.01
Machinery (333)	−0.63 (0.3)**	−0.03	0.06	−0.01
Apparel (315)	−0.62 (0.27)**	0.02	0.01	0.00
Fabricated Metal Products (332)	−0.56 (0.26)**	0.14	−0.04	−0.00
Paper (322)	−0.55 (0.29)*	0.18	−0.08	−0.00
Furniture and Related Products (337)	−0.55 (0.27)**	0.18	−0.08	0.00
Printing and Related Support Activities (323)	−0.51 (0.28)*	0.20	−0.06	0.01
Food (311)	−0.48 (0.29)*	0.25	−0.08	0.01
Nonmetallic Mineral Products (327)	−0.47 (0.28)*	0.25	−0.07	0.00
Wood Products (321)	−0.42 (0.34)	0.35	−0.11	−0.00

Notes: *ER* is the trade-weighted real exchange rate. *Import input sh* is the imported input share.
$^*p < 0.1$, $^{**}p < 0.05$, and $^{***}p < 0.01$.
Source: Authors' calculations.

Table 4: Exchange Rate Regression

Variables	1994-2010 (1)
Canada–US long-run interest rate differential	0.22 (0.08)***
Canada–US labor productivity differential	−0.10 (0.02)***
US current account deficit	−0.31 (0.03)***
Δ commodity prices × industry dummies	included
Observations	1538
R^2	0.24

Note: $*p < 0.1$, $**p < 0.05$, and $***p < 0.01$.
Source: Authors' calculations.

Table 5: Effects of Commodity Price on Employment in Manufacturing Industries at the Four-digit NAICS Level

	Mean	Minimum	Maximum	Standard deviation	Total
γ_i: commodity price elasticity of trade-weighted exchange rate for industry i	0.08	0.05	0.11	0.01	not applicable
$\Delta L_i(\%)$: predicted employment growth after a 15.77% increase in commodity price	−0.8	−1.73	−0.30	0.27	not applicable
ΔL_i: predicted change in employment after a 15.77% increase in commodity price	−136	−740	−1	137	−11,656

Source: Authors' calculations.

Table 6: Job Losses at the Three-digit NAICS Level

Industry	Employment in 2010	% total manufacturing employment	Predicted change in employment (%)	Predicted change in employment	% total predicted change in employment
Food (311)	232,710	15.72	−0.49	−1,151	9.88
Beverage and Tobacco Products (312)	26,362	1.78	−2.11	−557	4.78
Textiles (313)	8,026	0.54	−0.86	−69	0.59
Textile Products (314)	9,762	0.66	−0.99	−97	0.83
Apparel (315)	25,670	1.73	−0.92	−236	2.03
Leather and Allied Products (316)	3,957	0.27	−0.95	−38	0.32
Wood Products (321)	89,381	6.04	−0.46	−410	3.52
Paper (322)	57,501	3.89	−0.67	−383	3.29
Printing and Related Support Activities (323)	56,325	3.81	−0.71	−397	3.41
Petroleum and Coal Products (324)	13,152	0.89	−1.31	−172	1.47
Chemical (325)	81,314	5.49	−0.84	−681	5.85
Plastics and Rubber Products (326)	95,069	6.42	−0.86	−819	7.03
Nonmetallic Mineral Products (327)	47,375	3.20	−0.63	−301	2.58
Primary Metals (331)	59,038	3.99	−0.74	−436	3.74
Fabricated Metal Products (332)	151,788	10.26	−0.69	−1,047	8.99
Machinery (333)	124,056	8.38	−0.75	−929	7.97
Computer and Electronic Products (334)	71,927	4.86	−1.05	−752	6.45
Electrical Equipment, Appliances, and Components (335)	36,740	2.48	−0.90	−332	2.84
Transportation Equipment (336)	159,301	10.76	−1.09	-1,742	14.95
Furniture and Related Products (337)	73,783	4.99	−0.76	−561	4.81
Miscellaneous (339)	56,773	3.84	−0.96	−545	4.67
Total	1,480,010	100%	NA	11,656	100%

Source: Authors' calculations.