Is There a J-Curve Effect in the Services Trade in Canada? A Panel Data Analysis

Trofimov, Ivan D.

Kolej Yayasan Saad (KYS) Business School

15 October 2020

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Ivan D. Trofimov*

Abstract

The effects of the real exchange rate changes on the sectoral trade balance (as opposed to the balance of aggregate trade) have received limited consideration in the empirical studies. In this paper we focus on services trade and examine the dynamics of Canada's bilateral trade balance in services with its 53 major trading partners during 1990-2018. To account for slope heterogeneity and cross-sectional dependence we apply mean group (MG), pooled mean group (PMG), common correlated effects mean group (CCEMG), augmented mean group (AMG) estimators to the trade balance equation, alongside the dynamic fixed effects (DFE) estimator. The results provide strong evidence of a short-run deterioration and a long-term improvement of the services trade balance following depreciation in an aggregate panel as well as sub-panels, hence supporting the J-curve effect hypothesis and satisfying Marshall-Lerner condition. At the level of individual cross-sections, the evidence was mixed: a number of economies experienced long-term improvement of the trade balance, albeit without short-term deterioration.

Keywords: J-curve; panel data; trade balance; exchange rate; services

JEL Code: F14, F32, C23

Introduction

The J-curve effect, that is the temporal variation of the trade balance following the depreciation (devaluation) of the currency, has been subject to extensive empirical and theoretical research in recent decades. The focus, however, tended to be on the consideration of the effect in trade in primary and manufactured goods, specifically in the aggregate trade of the country with the rest of the world, or bilateral trade between the countries. Few studies stand as exception (Wijeweera and Dollery 2013, for Australia; and Prakash and Maiti 2016, for Fiji); as far as developed economies, where services sector is prominent in the economy, are concerned, the empirical research of the J-curve effect has been limited. The purpose of this paper is to address this research gap and consider the effect in Canada, as one of the developed economies with substantial international trade in services. The above tendency in the research has been pronounced notwithstanding the salience of services sector in the international trade and governance, as well as the new role of services in the changing economy that allows testing of the hypotheses that were previously limited to the tradeables.

Firstly, the rapid rise of the service economy in the developed world starting from the second half of the twentieth century has been well documented in the literature (Fourastié 1952; Kuznets 1971) and explored laterally (growth of services and declining productivity; services and the change in economy-wide profitability; services and innovation pace, among other aspects, Baumol 1967; Barras 1990; Paitaridis and Tsoulfidis 2012). The indisputable point is that services in the developed world are no longer an insignificant or backward sector that is subsidiary to other types of activities, as was the case historically in agricultural or industrial economy. Specifically, in Canada (that is frequently represented as economy with strong primary and agricultural sector), the services in the 2010s accounted for over three quarters of GDP and four fifth of the total employment, while the exports and imports of services stood at 5.0% and 6.2% of GDP, up from 3.0% in the early 1980s (Miroudot 2017: 2). Importantly, the Canadian services sector has been well diversified, including a range of services types, the most salient being business services (financial, engineering and IT) followed by travel and transportation services (Van Der Marel 2017: 2).

* Kolej Yayasan Saad (KYS) Business School, Malaysia. E-mail: ivan.trofimov1@gmail.com

Secondly, the growth of the services sector has policy implications. The direct implications arise in the GATT/WTO system and regional trade agreements, where trade barriers on services trade persist to a much larger extend than in the case of trade in manufactured goods, and where removal of the barriers could deliver significant effect on the broader economy. Indirectly, the growth of services trade is potentially a way to correct external deficits. Canada is one of many developed economies that has experienced deficit of the current account in the recent years (caused, among other factors, by the intensified competition in manufacturing on the part of newly industrialized and developing economies). The period when current account went into surplus in the late 1990s and early 2000s was short-lived. The explanations as to the underlying reasons of trade and current account deficits included the overvaluation of domestic currency that makes exports dear and imports cheaper (Krugman and Baldwin 1987), imbalance between country's savings and investment (Chrystal and Wood 1988), or growth of the budget deficit (Feldstein 1986; Niskanen 1988). If the former explanation is correct (and J-curve effect holds), the exchange rate adjustments and associated export expansion in services would assist in reduction of the trade deficit.

Thirdly, in contemporary economy, the consideration of services as nontradeable appears outdated (with the exception of certain categories of services, such as personal services), given the globalisation and technological progress that make service activities intertwined with production and trade in goods, specifically when services become part and parcel of global value chains, or when manufacturing export competitiveness hinges on seamless imports of services. In this regard the consideration of the J-curve effect (as well as other trade effects and hypotheses) in the context of the services trade may not be unjustified (Miroudot 2017: 1; Nordas and Rouzet 2015; Jones and Kierzkowski 2001).

This paper examines the trade in services of Canada with its 53 major trading partners during the 1990-2018 period. Given the data structure, the use of time series methods (e.g. linear of asymmetric ARDL) is precluded and instead the panel data econometric methods are applied. The services trade of Canada is imbalanced, in that the largest trading partner in services is United States (56% of total trade in the mid-2010s), followed by the UK (with only 5.6% of total services trade), and the trade with the developed economies well exceeds the trade with the developing economies. The countries in question are diverse and include those that maintain positive trade balance with Canada across the study period, have consistent trade deficit or switch between surplus and deficit. These aspects of the data are taken into account and accordingly additional estimates are performed for the sub-groups of trading partners.

The rest of the paper is organised as follows. Section 2 overviews the services trade of Canada and provides a brief literature review of the Marshall-Lerner condition and J-curve effect. Section 3 explains the model, the data and the empirical methodology. Section 4 reports the empirical findings. Section 5 provides concluding remarks and discusses the findings.

Literature review

The Marshall-Lerner (ML) condition, a derivative of the trade balance with respect to the real exchange rate, states the positive effects of the depreciation (devaluation) on the trade balance in the long-run (provided the absence of trade surplus or deficit prior to depreciation and the infinite price elasticities of the supply of exports in the trading economies). In contrast, the premise of the J-curve effect is a non-linear relationship between the two variables in the short-run and a more complex series of adjustments in the trade balance. The adjustment process is conditional on the currency used on the export and import contracts and on the size of domestic and foreign elasticities of the supply of exports and demand for imports. Immediately after the depreciation (currency-contract stage), there is no adjustment in prices and volumes of export and imports and no substitution between domestically produced or imported products in either trading partner country. At the pass-through stage that follows, the adjustment on the part of prices (without changes in volumes) initiates the substitution process that takes momentum and reaches apex at the quantity-adjustment stage (where both prices and quantities adjust). The particular J-curve shape of the trade balance, however, is not guaranteed with alternative I-, L-, M-, N-, V- and W-curves possible (Magee 1973: 317). The J-curve is present, if at the currency-contract stage the domestic export contracts are denominated in domestic currency while domestic import contracts are denominated in foreign currency, and if at the pass-through stage the supply for the country's exports and imports is price inelastic.

The recent decades witnessed extensive empirical research of the J-curve effect and Marshall-Lerner condition. The brief survey that follows rests on the existing literature reviews in the area (Bahmani-Oskooee and Ratha 2004a) and provides only a cursory look of the empirical work on these topics. In terms of scope, the studies examined a majority of developed, developing and transition economies on individual basis or as country groups. In terms of model specification, the research tended to rely on the trade balance equation that includes domestic and foreign income, real exchange rate and, in a number of cases, monetary and fiscal variables; or alternatively on the separate estimation of the exports and imports equations. While the earlier studies (due to the data constraints) examined the aggregate trade of the country with the rest of the world (e.g. Guptar-Kapoor and Ramakrishnan, 1999), later research started considering bilateral trade and disaggregated commodity data (Bahmani-Oskooee and Brooks 1999; Bahmani-Oskooee and Wang 2007). The econometric methods included (but were not limited to) OLS and linear regression models (Rose and Yellen 1989), models with polynomial distributed lags (Marwah and Klein 1996), vector autoregressions (Demirden and Pastine 1995), linear or non-linear autoregressive distributed lag (ARDL) models (Bahmani-Oskooee and Fariditavana 2019), among others.

The findings of the empirical research were mixed. A number of studies demonstrated the presence of the J-curve: Arize (1987) in the study of eight African nations, Moffett (1989) in the study of US trade, Reis Gomes and Senne Paz (2005) in the study of aggregate trade in Brazil, Jamilov (2013) in Azerbaijan, Petrovic and Gligoric (2010) in Serbia trade, no name a few. On the other hand, no J-curve was identified by Rose and Yellen (1989) and Rose (1991) in the OECD setting, and Bahmani-Oskooee and Ratha (2004b) in the US. Alternative patterns were also indicated (e.g. positive linear relationship in short- and long-term, Akbostanci, 2004; or the absence of long-run relationship, Bahmani-Oskooee and Alse 1994), as were the period- and context-specific results (J-curve effect conditional on trade liberalisation, or foreign exchange management regime, Brada et al. 1997; Lal and Lowinger 2002).

The studies that concern J-curve effect in the services sector or the J-curve effect in Canada are as follows.

Junz and Rhomberg (1973) examined the effects of exchange rates and relative prices of exports on the total manufactured exports and the respective market shares in 14 developed economies, including Canada, using the annual data for the 1953-1969 period and applying ordinary least squares (OLS) and time series methods. The lags, associated with J-curve and initially hypothesized by Magee (1973), were confirmed and the presence of J-curve was established. The results were confirmed by other earlier studies (Gylfason and Schmid 1983; Gylfason and Risager 1984; Marquez 1990).

Bahmani-Oskooee and Alse (1994) considered a sample of 19 developed and 22 developing economies (including Canada), and applied Engle-Granger cointegration test for the bivariate setting. In the case of Canada, no cointegration was detected, suggesting the absence of positive or negative relationship between real exchange rate and the trade balance in the long-run.

Marwah and Klein (1996) estimated the US and Canada's trade balance equations with real exchange rate and income variables using the quarterly data for the 1977-1992 period. The results were obtained by the combination of the instrumental variable method and polynomial distributed lag structure. The J-curve effect was significant in both economies, albeit the inflection point (marking the start of the trade balance improvement) was reached sooner in the case of Canada and the initial negative effects on the trade balance were more pronounced. Certain deterioration of the trade balance was observed over a longer period, but the authors refrained from giving alternative names to this pattern.

On the other hand, the study by Lee and Chinn (2006) of the interaction between current account and real exchange rate in the G-7 economies revealed no J-curve effect in Canada. The authors used the quarterly data for the 1979-2000 period and considered the bivariate structural VAR model, thus imposing minimal assumptions for identification order. In the equation for the current account, the statistically significant coefficient of the real exchange rate was identified only in the case of UK and Germany. In a related vein, the analysis of the impulse response functions indicated deterioration of Canada's current account following exchange rate shock.

The more recent studies of the J-curve effect in Canada used both aggregate and disaggregated trade data. Bahmani-Oskooee and Bolhasani (2008) examined trade in 152 commodities between Canada and the US, its major trading partner, over the 1962-2004 period. Based on the results from ARDL model, the favourable long-term effects on the trade balance following the balance initial deterioration were observed only in approximately 50% of commodities. A similar result was demonstrated by Bahmani-Oskooee et al (2008) in a study of Canada's bilateral trade with its 20 trading partners: the J-curve was identified only in 11 out of 20 partner economies. Lastly, the results from the asymmetric ARDL model estimated by Bahmani-Oskooee and Fariditavana (2019) show limited support for the J-curve hypothesis in Canada-US bilateral trade: out of 161 commodities, the J-curve effect was present in 72 cases in a linear and 85 cases in non-linear (asymmetric) specification.

Regarding the J-curve effect in the services trade, Wijeweera and Dollery (2013) considered the foreign exchange rate effects on goods and services trade of Australia, using the quarterly data for the 1988-2011 period and applying the linear ARDL model. The sectoral effects were opposite: the J-curve was observed in the services trade, but the inverse pattern (positive response of the trade balance to devaluation in the short-run, and negative in the long-run) was present in the goods trade.

The similar variation in the effects was demonstrated by Prakash and Maiti (2016) in the study of the J-curve in the external trade of Fiji during the 1975-2012 period. The cointegration tests revealed the significant and positive relationship between exchange rate and trade balance in the goods trade, but significant and negative relationship in the case of service trade, suggesting appreciation as a driving force of trade deficit in the goods (but not services) trade. Regarding the short-run effects, the VECM model results indicated, in the case of goods trade, the worsening of the trade balance in the short- and medium term followed by the balance improvements, i.e. the presence of the J-curve. However, no such pattern was observed for the services trade, where the coefficients of the real exchange rate were positive all the way through.

The most recent study of the issue was conducted by Cheng (2020). Focusing on the US economy, applying the ARDL model and using the quarterly data for the 1999-2015 period, the author estimated exchange rate elasticities for the aggregate services trade of the US, as well as for the nine major services categories. Similarly to previous studies, the findings were mixed: in the long-run, the depreciation tended to improve the services trade balance, however, this regularity did not hold for all services categories (no significant short- or long-run effects of exchange rate changes were observed for insurance services or charges for the use of intellectual property).

The analysis that follows attempts to contribute to the existing literature, by focusing on the aggregate services trade of Canada. In light of the above studies, we expect the like mixed results for different services categories and do not presume a priori the presence of the J-curve.

Methodology

Model

The model of the trade balance as a function of real effective exchange rate, domestic and foreign GDP is given as (Bahmani-Oskooee and Harvey 2017; Kaya 2021, to name a few):

$$\ln TB_{it} = \alpha_{1i} + \beta_{1i} \ln CGDP_t + \beta_{2i} \ln GDP_{it} + \beta_{3i} \ln RER_{it} + \mu_{it} \quad (1)$$

,where $\ln TB_{it}$ is the trade balance of Canada with its respective trading partner (trade balance defined as the ratio of exports to imports), $\ln CGDP_t$ is GDP of Canada in period t, $\ln GDP_{it}$ is the

GDP of the respective trading partner), $\ln RER_{it}$ is the bilateral real exchange rate between Canada and trading partner i. All variables undergo logarithmic transformation. Bilateral RER are given as:

$$RER_{it} = \frac{E_{it} P_d}{P_f} \tag{2}$$

,where E_{it} is a bilateral nominal exchange rate between Canada and its respective trading partner (with units of foreign currency quoted against one unit of domestic currency, Canadian dollar), P_d is the price level in Canada and P_f is the price level in the trading partner country. The level of prices is measured by means of consumer price index (CPI). The appreciation (depreciation) of Canadian dollar is indicated by the increase (decrease) in the nominal and real exchange rate.

The expected signs of the coefficients are as follows: negative for β_{1i} representing the growth of imports driven by domestic GDP growth; positive for β_{2i} indicating the GDP growth of Canada's trading partners and hence the growth of exports from Canada; negative for β_{3i} in the long run. We note the possibility of positive β_{1i} in the case of import-substitution process in Canada and faster growth in the domestic production of importable goods vis-a-vis domestic consumption of importables. In addition, while negative β_{3i} coefficient is hypothesized in the long-run, the J-curve is present when β_{3i} in the short-run is positive.

Data

We consider Canada's annual data on trade in services with its 53 trading partners, as reported in the OECD International Trade in Services Statistics (ITSS) data set.[1] (Appendix contains the complete list of Canada's trading partners used in this study). We note that in the case of services, the USA remained the major trading partner throughout the study period (1990-2018), followed by large developed economies (UK, Germany, France, Japan), some of the smaller developed economies (Ireland, Hong Kong,[2] Netherlands, Singapore and Switzerland), as well as Mexico and China. The bilateral trade data has been reported in the millions of current US dollars and the trade balance was defined as the ratio of the nominal value of exports to the nominal value of imports without performing conversion of nominal to real values of trade.

For the purpose of the real exchange rate (RER) calculation, we use the nominal bilateral exchange rate data contained in the International Monetary Fund/IMF *International Financial Statistics* data set.[3] The data set adopts direct quotation (units of foreign currency per US dollar) and uses the average values for the period. By calculating the cross currency exchange rates, we then express the nominal bilateral exchange rate of the respective economy currency per Canadian dollar. We take the consumer price index (CPI) data for individual economies (with base year set at 2010) from the United States Department of Agriculture Economic Research Service (USDA ERS) *International Macroeconomic Data Set* and find the price level ratios for each economy, defined as CPI in Canada divided by the foreign country's CPI.[4] As a last step we multiply these price level ratios by the bilateral nominal exchange rates of foreign currency per Canadian dollar to obtain the bilateral real exchange rates.

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[1] The data is available at https://stats.oecd.org/Index.aspx?DataSetCode=TISP_EBOPS2010. The data has been accesses on 25 July 2020.

[2] Special Administrative Region of the People's Republic of China.

[3] The data is available at https://data.imf.org/regular.aspx?key=61545862. The data has been accessed on 25 July 2020.

[4] The data is available at https://www.ers.usda.gov/data-products/international-macroeconomic-data-set/. The relevant spreadsheet is 'Consumer Price Indexes (2010 Base) Historical'. The data has been accessed on 25 July 2020.

$\hat{\varepsilon}_{it}$

The real GDP data at 2010 constant prices is contained in the USDA ERS *International Macroeconomic Data Set*. For each economy, we define the 'rest of the world GDP' as the world GDP minus the GDP of that individual economy.

Econometric method

We examine the statistical and unit root properties of the series as well as the possible presence of cross-sectional correlation. We employ the first generation panel unit root tests: Im-Pesaran-Shin/IPS, Levin-Lin-Chu/LLC, Breitung, ADF-Fisher χ^2 and PP-Fisher χ^2 (Maddala and Wu 1999; Breitung 2000; Choi 2001; Levin et al. 2002; Im et al. 2003). Each of the tests assumes the existence of common unit root under the null hypothesis, and (trend) stationarity in some in some of the panels under the alternative hypothesis. In LLC test, the alternative hypothesis assumes (trend) stationarity for all panel members. The GDP of Canada is placed as regressor in every cross-section, hence, to ascertain the unit properties of this variable, the single series' unit root tests are used (ADF, ERS and KPSS).[5]

Given the ongoing globalisation and economic integration of the countries in general and the structure of the services trade of Canada in particular (with the bulk of the trade conducted within a group of developed economies), it become necessary to account for the possibility of the common unobserved factors reflected in the cross-sectional dependence in the error term (De Hoyos and Sarafidis 2006: 482-3). Cross sectional dependence violates OLS assumptions of independent and identically distributed error term, can potentially lead to endogeneity and create bias in the estimates. The Breusch-Pagan test for cross-sectional dependence that has been used conventionally is applicable for the particular form of data structures, where $T > N$ (i.e. time dimension is greater that cross-sectional dimension), whereas the data set used in this paper has 29 annual observations and 53 cross-sections. In this case the statistical properties may be distorted and therefore we apply the Pesaran tests of weak and strong cross-sectional dependence (Pesaran 2004, and Pesaran 2015) that are sufficiently flexible in respect to the study's panel data structure, where time dimension of the data is smaller than the cross-sectional dimension. In the former test, the null hypothesis of a strong cross-sectional independence is contrasted with an alternative hypothesis of a strong cross-sectional dependence. In the latter test, the less restrictive null hypothesis is of weak dependence, while an alternative hypothesis is of strong dependence. With cross-sectional dependence measured by the correlation between the units, the weak form of it implies convergence of correlation to zero as N goes to infinity, while the strong form envisages convergence of correlation to the constant.

Provided there is cross-sectional dependence in either weak or strong form, the cross-sectionally augmented IPS test (CIPS) by Pesaran (2007) that accounts for common factor structure in the panel is conducted. Similarly to the above tests, the null of common unit root is contrasted with (trend) stationarity in some panels.

As a next step, if the dependent variable is not stationary in level (not integrated of order zero) and none of the variables are integrated of order two, the Pedroni, Kao and Westerlund tests of cointegration for panel data are conducted (Pedroni 2004; Kao 1999; Westerlund 2007).

Pedroni cointegration test is an extension of the Engle-Granger cointegration test for the panel data setting. The test obtains residuals from the hypothetical cointegration regression that corresponds to the trade balance model in Equation (1) as follows:

$$y_{it} = \theta_i' d_t + \beta_i z_{it} + \varepsilon_{it} \tag{3}$$

and

$$\hat{\varepsilon}_{it} = \hat{\gamma}_i \hat{\varepsilon}_{it-1} + \hat{\mu}_{it} \tag{4}$$

[5] The Augmented Dickey-Fuller (ADF) and Elliott-Rothenberg-Stock Dickey-Fuller GLS (ERS DF-GLS) tests assume unit root under the null hypothesis, while Kwiatkowski-Phillips-Schmidt-Shin (KPSS) stationarity test has I(0) of the series under the null.

,where d_t represents one of the deterministic components. The test does not allow cross-sectional dependence, however, parameters $\theta_i^{'}$ and β_i account for individual fixed effects, and heterogeneity in trend and slope coefficients. The tests examines residuals from Equation (4) and tests their stationarity. The null hypothesis of no cointegration implies that residuals are I(1) and the autoregressive (AR) coefficient of the residual equals unity for all i , i.e. $H_0 : \gamma_i = 1$. The two alternative hypotheses imply that residuals are I(0), in particular, the homogeneous alternative assumes common AR coefficient for all i , $H_1 : \gamma_i = \gamma < 1$, while the less restrictive heterogeneous alternative allows variation in the value of the AR coefficient, $H_1^g : \gamma_i < 1$. For the former alternative, the within-dimension statistics are constructed, while for the latter alternative the between-dimension statistics (allowing individual AR coefficients) are used.

Kao (Engle-Granger based) test adopts a similar approach to Pedroni test, allows for cross-section specific intercepts, but sets common slopes across i . The residuals are obtained from the least-squares dummy variable (LSDV) of the model in Equation (1). The conventional Dickey-Fuller tests are then applied to the residuals. The null hypothesis is of absence of cointegration and I(1) order of residual series ($H_0 : \gamma_i = 1$), while an alternative is of residuals' stationarity ($H_1 : \gamma_i < 1$).

Westerlund test, based on error-correction representation (as opposed to integration order and unit root properties of the residuals in Pedroni and Kao tests), allows for cross-section dependence in the panel and does not impose a common factor restriction. The error-correction model written as:

$$\Delta y_{it} = \theta_i^{'} d_t + \alpha_i (y_{i,t-1} - \beta^{'} z_{i,t-1}) + \sum_{j=1}^{p_i} \alpha_{ij} \Delta y_{i,t-1} + \sum_{j=-q_i}^{p_i} \gamma_{ij} \Delta z_{i,t-j} + e_{it} \quad (5)$$

,where d_t represented deterministic component and α_i measures the speed of adjustment to the long-run equilibrium. The null hypothesis is of no error correction and no cointegration, $H_0 : \alpha_i = 0$ for all i . The alternative hypotheses are the presence of error correction and cointegration for at least one i , i.e. $H_1^g : \alpha_i < 0$ (group-mean tests), or the presence of cointegration for all i so that α_i is equal for all i , i.e. $H_1^p : \alpha_i = \alpha < 0$ (panel tests).

In the case when cross-sectional dependence is present and the variables are cointegrated, we proceed with estimating the trade balance model using the mean group (MG) estimator (Pesaran and Smith, 1995), the dynamic fixed effects and pooled mean group estimators, DFE and PMG (Pesaran et al. 1999), as well as estimators that account for cross-sectional dependence, such as the common correlated effects mean group (CCEMG) estimator (Pesaran 2006; Chudik and Pesaran 2013), and the augmented mean group (AMG) estimator (Eberhardt and Teal 2010).

We use the former three estimators in complementary fashion, given that no a priori assumptions are made regarding the country-specific heterogeneity in the short- and long-run. The PMG estimator assumes homogeneity in the long-run, but heterogeneity in the short-run relationship, the MG estimator allows for heterogeneity in both, while DFE estimator is the most restrictive in that coefficients and speed of adjustment are set homogeneous in both short- and long-run (based on the comparison of methods in Asteriou et al. 2020: 7-8). All three estimators require a sufficient number of cross-sections and hence are suitable for the empirical setting in the present paper (with $N = 53$). The CCEMG and AMG estimators do not include short-run effects, but control for the unobservable common factors via the weighted cross-sectional averages of independent variables and regressand; in the former case, the averages are introduced merely to help remove the bias due to the unobservables, and hence are not amenable for empirical interpretation (Eberhardt 2012: 64).

Notation-wise, the MG, PMG and DFE estimations are performed on the panel ARDL with the error-correction component:[6]

$$\Delta \ln TB_{it} = \sum_{j=1}^{p-1} \psi_j^i \Delta \ln TB_{it-j} + \sum_{j=0}^{q-1} \phi_j^i \Delta X_{it-j} + \delta^i \left[\ln TB_{it-1} - \left\{ \beta_0^i + \beta_j^i X_{it-1} \right\} \right] + \varepsilon_{it} \tag{6}$$

,where $\ln TB$ is the logarithm of trade balance, X is a $k \times 1$ vector of regressors from the Equation (1), p and q are the lags of the log of trade balance and the regressors, ψ and ϕ are the short-run coefficients of the log of trade balance and the regressors, β is the long-run elasticity, δ is the error-correction term, that indicates the speed of adjustment to the long run equilibrium, i and t are country and time indicators. The MG estimation does not impose any restrictions, while the PMG and DFE estimations set respectively $(N-1)/k$ and $(N-1)/(2k+2)$ restrictions on Equation (6).

The general exposition of the CCEMG and AMG panel estimators (adopted from Eberhardt 2012: 62) is as follows. For cross-section $i = 1, \ldots, N$ and time period $t = 1, \ldots, T$ the model is estimated:

$$y_{it} = \beta_i z_{it} + u_{it} \tag{7}$$

$$u_{it} = \alpha_{1i} + \lambda_i f_t + \varepsilon_{it} \tag{8}$$

$$z_{it} = \beta_{2i} + \lambda_i f_t + \gamma_i g_t + e_{it} \tag{9}$$

,where y_{it} , z_{it} and β_i are observable dependent variable, regressor(s), and the respective coefficients; α_{1i} is time-invariant group heterogeneity parameter, representing group fixed effects; f_t is unobserved common factor that accounts for the above-mentioned cross-country heterogeneity and cross-sectional dependence; and u_{it} is the sum of unobservable common factors and an idiosyncratic error terms ε_{it}. With CCEMG estimator, the Equation (1) thus transforms into:

$$\ln TB_{it} = \alpha_{1i} + \beta_{1i} \ln CGDP_t + \beta_{2i} \ln GDP_{it} + \beta_{3i} \ln RER_{it} + b_{i0} \overline{\ln TB}_t + b_{i1} \overline{\ln CGDP}_t + $$

$$+ b_{i2} \overline{\ln GDP}_t + b_{i3} \overline{\ln RER}_t + \mu_{it} \tag{10}$$

,where $\overline{\ln TB}_t = 1/N \sum_{i=1}^{N} \ln TB_{it}$, $\overline{\ln CGDP}_t = 1/N \sum_{i=1}^{N} \ln CGDP_{it}$, $\overline{\ln GDP}_t = 1/N \sum_{i=1}^{N} \ln GDP_{it}$ and $\overline{\ln RER}_t = 1/N \sum_{i=1}^{N} \ln RER_{it}$.

Kapetanios et al (2011) note that common correlated effects estimators are consistent irrespective of the integration order of the unobserved common factor, and notwithstanding the absence of cointegration between observed, unobserved factors and trade balance, real exchange rate and income of the trading partners, as long as error term u_{it} is I(0). The stationarity of the u_{it} term from the CCEMG model is tested using the above-mentioned panel unit root tests. The application of CCEMG estimator is supposed to reduce (eliminate) the cross-sectional dependence, as evidence by a smaller value of Pesaran CD statistic post-estimation.

With AMG estimator, the unobserved common factors are treated in three steps. Firstly, the pooled regression with year dummies is estimated via first difference OLS and the relevant dummies are

[6] The description of panel ARDL model is adopted from Elveren and Hsu (2016: 564).

collected. Secondly, the OLS for each panel member is estimated with dummies' coefficients replacing unobserved common factors. Thirdly, the average of estimated coefficients of individual panel members is taken, in a similar fashion to MG and CCEMG estimators. Notation-wise (Kaya 2021: 13; Eberhardt 2012: 64):

$$\Delta \ln TB_{it} = \alpha_{1i} + \beta_i \Delta z_{it} + \sum_{t=2}^{T} c_t \Delta D_t + \varepsilon_{it} \tag{11}$$

,where z_{it} is a vector of regressors and D_t are year dummies.

$$\ln TB_{it} = \alpha_i d_t + \beta_i z_{it} + \lambda_i \hat{c}_t + \varepsilon_{it} \tag{12}$$

,where the coefficient of year dummy $\hat{c}_t$ replaces f_t. The panel coefficient β_{AMG} is then estimated as average of the estimates of coefficients in previous equation, $\hat{\beta}_{AMG} = 1/N \sum_{i}^{N} \beta_i$.

Empirical results

Table 1 demonstrates the descriptive statistics of the variables in logarithms. All variables in question had positive means and medians. The minimum values of the logarithm of the trade balance and real exchange rate were negative (explained by the substantial imbalances in the trade of Canada with some of the partners in selected years, and devaluation of Canadian dollar against certain developed economies' currencies).[7] The Jarque-Bera test indicates that data is not normally distributed. The test's null hypothesis is of zero skewness and zero excess kurtosis (or kurtosis equal to three), however all variables had non-zero skewness (with GDP variables skewed to the left, and trade balance and real exchange rate to the left). Kurtosis that is close to three was observed for the logarithm of real exchange rate and GDP of Canada's trading partners, while the distributions of the logarithm of trade balance and of Canada's GDP were respectively leptokurtic and platykurtic.

Table 1. Descriptive statistics

Variable	lnTB	lnCGDP	lnGDP	lnRER
Mean	0.089	7.252	5.664	2.090
Median	0.003	7.298	5.750	1.627
Maximum	3.256	7.560	9.789	9.617
Minimum	-2.144	6.900	1.546	-0.914
Std. Dev.	0.758	0.208	1.673	2.434
Skewness	0.571	-0.325	-0.294	0.927
Kurtosis	3.820	1.787	2.931	3.074
Jarque-Bera	126.605	121.371	22.471	220.259
Probability	(0.000)	(0.000)	(0.000)	(0.000)

Note. The p-values are indicated in the parentheses.

Table 2 present the results of the panel and univariate unit root tests. The tests were conducted with the two alternative deterministic components: constant or constant plus trend. The first-generation panel unit root tests (LLC, IPS, Breitung, ADF- and PP-Fisher) indicate that the logarithm of the trade balance was stationary in levels and the first differences with either deterministic component in the test, i.e. was integrated of order one. The similar integration property was observed for the logarithm of the real exchange rate (stationarity or trend-stationarity in the levels or differences). The logarithm of GDP of the Canada's respective trade partner contained unit root in each of the tests, when implemented with constant, and in three of the tests (LLC, ADF- and PP-Fisher) when implemented with constant and trend. The variable was (trend-)stationary in the first differences. The logarithm of Canada's GDP appears in every cross-section; hence the univariate tests were applied to this variable.

[7] The case of trade with Greece in 1993 and 2004 and Costa Rica in 1994, as well as weak Canadian dollar against UK pound, Swiss franc and US dollar in the 1990s.

According to ADF and ERS tests, the series contained unit root in either specification (the tests' statistics in absolute terms are smaller than any conventionally used critical values and therefore the unit root null hypothesis is not rejected). The KPSS stationarity test with I(0) integration order under the null hypothesis likewise indicates the unit root in Canada's GDP series in either specification of deterministic component (the test statistic is greater than the 95% quantile, i.e. significant at the 5% level). Overall, the mixed order of integration is observed: stationarity of the trade balance and real exchange rate and the unit root in GDP variables.

Both of Pesaran's tests indicate common unobserved factors in the panel (Table 3): the null hypothesis of weak dependence was rejected in favour of strong form of cross-sectional dependence for all variables, while the null hypothesis of cross-sectional independence was rejected in favour of strong form of dependence in the case of all variables, except the logarithm of the trade balance. The Pesaran CIPS test that was used to account for this property suggested unit root behaviour of the logarithm of the trade balance (at lag four in the specification with constant, and at lags two to four in the specification with constant plus trend), the logarithm of the real exchange rate (at all lags except lag two in the specification with constant), and the logarithm of the GDP of Canada's trading partners (only in the specification with constant and trend).

Table 2. Panel and univariate unit root tests' results

A. Specification with constant						
Test	lnTB	lnGDP	lnRER	d(lnTB)	d(lnGDP)	d(lnRER)
LLC	-6.096	-5.394	-5.205	-22.084	-11.852	-16.014
IPS	-6.918	**3.733**	-6.763	-25.390	-13.993	-18.100
ADF-Fisher	226.029	**73.523**	224.119	753.628	402.351	524.202
PP-Fisher	275.371	171.575	194.716	1288.770	574.322	813.927
B. Specification with constant plus trend						
Test	lnTB	lnGDP	lnRER	d(lnTB)	d(lnGDP)	d(lnRER)
LLC	-5.096	0.013	-4.684	-17.702	-10.757	-11.973
Breitung	-5.370	**0.849**	-5.938	-20.248	-10.098	-12.276
IPS	-5.613	**0.170**	-6.290	-21.756	-11.592	-13.741
ADF-Fisher	192.599	**0.135**	212.186	595.786	330.809	383.776
PP-Fisher	317.371	**0.713**	145.706	3367.640	760.611	1190.900
C. Univariate tests						
Test	lnCGDP	d(lnCGDP)				
ADF (c)	**-0.623**	-4.469				
ADF (c + t)	**-1.101**	-4.668				
ERS DF-GLS (c)	**-0.536**	-2.905				
ERS DF-GLS (c + t)	**-1.219**	-3.819				
KPSS (c)	*0.676*	0.148				
KPSS (c + t)	*0.156*	0.138				

Note. Statistics in bold indicates the rejection of (trend) stationarity hypothesis at all conventional significance levels. The statistics in italics indicates the rejection of (trend) stationarity at the 5% significance level.

Given that more robust panel unit root tests indicate the possibility of unit roots in the variables (importantly in the dependent variable and at higher lags) and the conflicting results of the tests (that are typical in the unit root tests), we consider cointegration among the variables. If cointegration is present, the estimators that are flexible with respect to cross-sectional dependence and the mixed order of integration are applied.

Table 3. Cross-sectional dependence and Pesaran CIPS tests' results

Variable	lnTB	lnCGDP	lnGDP	lnRER		
Pesaran CD (strong)	4.905	199.905	186.349	49.439		
	(0.000)	(0.000)	(0.000)	(0.000)		
Pesaran CD (weak)	0.526	199.905	199.640	41.771		
	(0.599)	(0.000)	(0.000)	(0.000)		
Pesaran CIPS	Constant			Constant + trend		
	lnTB	lnGDP	lnRER	lnTB	lnGDP	lnRER
Lag 0	-2.819	-1.982	-1.854	-3.150	-2.023	-2.264
	(0.000)	(0.000)	(0.218)	(0.000)	(0.988)	(0.640)
Lag 1	-2.426	-2.219	-1.850	-2.710	-2.359	-2.384
	(0.000)	(0.000)	(0.227)	(0.001)	(0.350)	(0.280)
Lag 2	-2.180	-2.037	-1.967	-2.457	-2.191	-2.461
	(0.001)	(0.016)	(0.052)	(0.126)	(0.824)	(0.118)
Lag 3	-2.196	-2.124	-1.796	-2.368	-2.104	-2.410
	(0.000)	(0.003)	(0.364)	(0.326)	(0.947)	(0.218)
Lag 4	-1.896	-1.953	-1.674	-1.965	-1.976	-2.176
	(0.136)	(0.064)	(0.715)	(0.997)	(0.996)	(0.852)

Note. The p-values are indicated in the parentheses.

Pedroni cointegration test included eight within-dimension (panel) and three between-dimension (group) statistics (Table 4). In the test specification with constant, the null hypothesis of no cointegration was rejected at the 1% significance level for the six panel statistic out of eight and at the same significance level for the two group statistic out of three (in the specification with constant and trend, four panel and two group statistics were significant at the 1% level, and the null of the absent cointegration was rejected as well). We note, based on Pedroni (1999) that panel non-parametric and parametric statistics (Panel PP- and Panel-ADF statistics) are more reliable in the specification with constant and trend. In this paper, both of these statistics (weighted or unweighted) were significant and therefore there is a strong evidence of cointegration between trade balance, real exchange rate, and Canada's domestic and trading partners' GDPs. Kao tests confirms the findings, with the null hypothesis of no cointegration rejected in the only specification with constant. Westerlund cointegration test (Table 5) that is robust in the cross-sectional dependence setting was implemented with up to two lags. In the specification with constant, the null hypothesis of no cointegration was rejected by both panel tests and one group test, when the lags were set to zero, by one panel and one group test, when lag order was one, and by only one group test, when the lag order was two. In the specification with constant plus trend, the null hypothesis was rejected by one panel and one group tests for lower lag orders, while no rejection was observed when the lag order was two. Overall, the evidence is that at least some of the cross-sectional units are cointegrated.

The models with MPG, MG and DFE estimators that were applied next did not account for the cross-sectional dependence, but included the long- and short-run coefficients, thus making them particularly suitable for the analysis of the J-curve adjustments. In all three models, the error correction term (ECT) was negative and statistically significant and fell in $(0,-1)$ range. The convergence to the long-run equilibrium after the shock was relatively fast (convergence by 41.8%, 70.7%, and 36.4% per period respectively) and there was no over-correction. Following Kremers et al. (1992), the negative and significant ECT was a confirmation of the long-run relationship (cointegration) between the variables. The Hausman test was conducted to select between the estimators, and the outcome was that DFE estimator was preferable (nonetheless, we reported in Table 5 the results for all three models).

Table 4. Pedroni and Kao panel cointegration tests' results

Tests	Constant		Constant + trend	
	Statistic	Prob.	Statistic	Prob.
A. Pedroni test				
Panel unweighted				
Panel v-Statistic	2.215	(0.013)	-1.430	(0.924)
Panel rho-Statistic	-2.500	(0.006)	-0.061	(0.476)
Panel PP-Statistic	-8.554	(0.000)	-9.791	(0.000)
Panel ADF-Statistic	-7.058	(0.000)	-7.715	(0.000)
Panel weighted				
Panel v-Statistic	-1.586	(0.944)	-5.268	(1.000)
Panel rho-Statistic	-1.669	(0.048)	1.008	(0.843)
Panel PP-Statistic	-9.474	(0.000)	-11.649	(0.000)
Panel ADF-Statistic	-7.275	(0.000)	-9.025	(0.000)
Group				
Group rho-Statistic	-0.313	(0.377)	2.015	(0.978)
Group PP-Statistic	-13.863	(0.000)	-17.588	(0.000)
Group ADF-Statistic	-7.711	(0.000)	-9.200	(0.000)
B. Kao test				
ADF t-statistic	-4.502	(0.000)		

Note. The p-values are indicated in the parentheses.

Table 5. Westerlund panel cointegration tests' results

Specification	Constant		Constant + trend	
	Statistic	Prob.	Statistic	Prob.
Lags (0 0)				
Gt	-3.533	(0.000)	-3.793	(0.000)
Ga	-12.245	(0.093)	-12.754	(0.994)
Pt	-23.622	(0.000)	-25.385	(0.000)
Pa	-11.440	(0.000)	-12.375	(0.421)
Lags (1 1)				
Gt	-3.095	(0.000)	-3.322	(0.000)
Ga	-9.309	(0.957)	-10.282	(1.000)
Pt	-20.390	(0.000)	-21.630	(0.000)
Pa	-8.454	(0.135)	-8.878	(0.999)
Lags (2 2)				
Gt	-2.442	(0.053)	-2.534	(0.923)
Ga	-5.042	(1.000)	-5.258	(1.000)
Pt	-14.185	(0.424)	-16.212	(0.966)
Pa	-4.510	(1.000)	-5.095	(1.000)

Note. The p-values are indicated in the parentheses. Gt and Ga are group mean and Pt and Pa are panel mean tests.

In all three models, the coefficient of the logarithm of the real exchange rate was significant and negative. In the preferred DFE model, the long-run elasticity of the trade balance with respect to real exchange rate ranged stood at -0.184, i.e. the 1% depreciation of the Canadian dollar against the respective trading partner's currency improves Canadian trade balance by approximately 0.18%. The share of imported intermediate inputs in Canada's services exports has been lower than in manufacturing or the total exports, hence depreciation and the resulting rise in the cost of importables did not translate in the worsening services trade balance via 'imported input cost channel' (Prakash and Maiti 2016: 383; OECD 2018). The long-run trade balance elasticity with respect to Canada's GDP was negative in all three models, but significant at the 10% level only in the DFE model. The result is expected, given that Canada is an open economy with substantial share of imports in GDP (25.01% and 34.03% of GDP in 1990 and 2018 respectively, as reported by the World Bank).[8] The increase of domestic GDP results in greater imports of intermediate and capital goods,

[8] Indicator NE.IMP.GNFS.ZS, available at https://data.worldbank.org/indicator/NE.IMP.GNFS.ZS?locations=CA

and thus to deterioration of the trade balance. The effect of the trading partners' GDP on the Canada's trade balance was positive in two models (PMG and DFE), but insignificant in all three models. The latter result points to a number of factors that may prevent the improvement of Canada's services trade balance despite trading partners' economic growth. These are the trade protectionism in services (as evidenced by the gap between the GATS commitments and the actual trade restrictiveness levels), particularly in services categories where Canada has comparative advantage; the absence during most of the study period of the trade agreements that regulated services trade (NAFTA, CETA, TPP) or the delays in the implementation of such agreements; competition on the part of service supplies in the trading partner economies; the problems of (the lack of) complementarity between Canada's services exports and the trading partners' services imports; the dependence of services trade on the 'enabling factors (human capital, institutional environment) in the destination economies; among others (Van Der Marel 2017: 3-11; Saez et al. 2015).

In the short-run, the real exchange rate elasticity of the trade balance was positive in all three models (indicating the initial deterioration of the trade balance following depreciation), but significant only in PMG and MG models. The insignificance of the coefficient in the DFE specification is not unusual, given that transportation and travel services (that are the most sensitive to the changes in the exchange rates) are not the major components of Canada's total services trade. The short-run elasticity of the trade balance to Canada's GDP was negative and significant in all cases, while the elasticity with respect to trading partners' GDP was positive and insignificant (similarly to the long-run case). The real exchange rate elasticity of the trade balance was less than unity in absolute terms, attesting to the structure of Canada's services export, dominated by business services (accounting, financial, engineering and telecommunication services) that are relatively insensitive to exchange rate fluctuations.

Table 6. PMG, MG, DFE, CCE and AMG estimates

Specification	PMG		MG		DFE		CCE		AMG	
	Coeff.	Prob	Coeff.	Prob	Coeff.	Prob	Coeff.	Prob	Coeff.	Prob
Long-run										
lnGDP	0.200	(0.102)	-0.104	(0.829)	0.053	(0.720)	0.538	(0.155)	0.390	(0.226)
lnCGDP	-0.142	(0.296)	-0.163	(0.767)	-0.395	(0.067)	-0.178	(0.753)	-0.264	(0.485)
lnRER	-0.586	(0.000)	-0.592	(0.001)	-0.184	(0.045)	-0.313	(0.013)	-0.168	(0.086)
Short-run										
EC	-0.418	(0.000)	-0.707	(0.000)	-0.364	(0.000)				
d(lnGDP)	0.211	(0.618)	0.680	(0.149)	0.210	(0.448)				
d(lnCGDP)	-1.001	(0.031)	-1.349	(0.012)	-0.942	(0.039)				
d(lnRER)	0.263	(0.003)	0.313	(0.011)	0.048	(0.470)				
Constant	0.470	(0.001)	1.959	(0.225)	1.118	(0.001)	1.767	(0.376)	0.513	(0.766)
$\overline{\text{lnTB}}$							1.011	(0.000)		
$\overline{\text{lnGDP}}$							-0.557	(0.291)		
$\overline{\text{lnCGDP}}$							0.060	(0.763)		
$\overline{\text{lnRER}}$							0.317	(0.198)		
c									0.942	(0.000)
Hausman										
MG vs. PMG	1.020	(0.797)								
MG vs. DFE			0.070	(0.995)						
PMG vs. DFE					1.100	(0.777)				
Pesaran CD							-0.873	(0.383)	-1.627	(0.104)
Pesaran CIPS										
Lag 0							-4.809	(0.000)	-4.05	(0.000)
Lag 1							-4.136	(0.000)	-3.437	(0.000)
Lag 2							-3.404	(0.000)	-2.683	(0.000)
Lag 3							-2.888	(0.000)	-2.419	(0.000)
Lag 4							-2.357	(0.000)	-2.386	(0.000)

Note. The p-values are indicated in the parentheses. c represents the common dynamic process.

The CCE and AMG models that are robust for cross-sectionally dependent data and the mixed order of integration of variables confirm the above findings. In both models, the coefficient of the logarithm of the real exchange rate is negative and significant, indicating the improvement of the trade balance in the long-run following domestic currency depreciation. The coefficients of the trading partners' and Canadian GDP were respectively positive and negative, but insignificant in both models. The application of the CCE and AMG models has been warranted: post-estimation, the cross-sectional dependence has been corrected (the null hypothesis of cross-sectional independence was not rejected), as indicated by Pesaran CD statistics. The use of CCE mean group estimator was likewise appropriate, given that the residuals from the CCE model are stationary at a range of lags (as confirmed by the Pesaran CIPS test). The AMG model was initially estimated with common dynamic process and the group-specific linear trend; however, the latter term was insignificant and the model was re-estimated without it. The residuals of the AMG model were likewise stationary, hence attesting to the appropriateness of the model.

Overall, for the panel as a whole, the Marshall-Lerner condition appears satisfied: the long-run coefficient of the logarithm of the real exchange rate is negative (ranging from as low as -0.168 in the AMG model and as high as -0.592 in the MG model) and significant. The presence of J-curve could only be verified in the models that contain the short-run estimates (i.e. PMG, MG and DFE); in all three models the currency depreciation deteriorates the trade balance in the short-run (positive coefficient of the logarithm of the real exchange rate).

To perform robustness checks, we obtained the estimates for each cross-section in the PMG, CCE and AMG models, as well as for three smaller panels. The first panel excluded the US as Canada's largest trading partner in services; the second panel included all trading partners that were the developed economies; the third panel included only the developing economies (Appendix explains the grouping of the economies).

For the sake of brevity, Table 7 includes only the statistically significant elasticities. In the PMG model, six positive and two negative coefficients of the logarithm of the real exchange rate were identified in the short-run, suggesting the temporary deterioration of the trade balance after the depreciation in only six economies (Austria, Ireland, Netherlands, Spain, India and Pakistan) and temporary improvement in two economies (the US and Poland). With respect to coefficients of the trading partners' and Canadian GDP the findings were mixed: in the short-run, the positive effect of trading partners' economic growth on Canada's trade balance was observed in four cases, and negative in two cases, while the negative effect of Canada's economic growth on Canada's trade balance was identified in the trade with four economies (and the positive effects in the trade with another four economies). Overall, the PMG model did not indicate a large number of significant elasticities. In contrast, the findings of the CCE and AMG models were more in line with theoretical predictions. In the CCE model, the long-run real exchange rate elasticity of the trade balance was negative in eight economies (Singapore, Chinese Taipei, Mexico, Poland, Honduras, PR China, Russia and Saudi Arabia), thus pointing to the satisfaction of Marshall-Lerner condition. The positive coefficients of the trading partners' GDP and negative coefficients of the Canada's GDP were identified respectively in eight and ten economies. The AMG model yielded the largest number of significant elasticities: the Marshall-Lerner condition held in the trade with twelve economies (the US, the UK, Hong Kong, Chinese Taipei, Germany, Mexico, Poland, Brazil, Honduras, PR China, Nigeria and Thailand), while the positive coefficients of the trading partners' GDP and negative coefficients of Canada's GDP were observed in eleven and thirteen economies respectively. To summarize, in all three models, the number of significant coefficients was limited (particularly in the PMG model, and less so in the AMG model). In contrast to the panel results, at the level of individual cross-sections the J-curve effect (positive real exchange rate coefficient in the short-run and positive in the long-run, i.e. temporary deterioration of the trade balance followed by its improvement in the long-run) was not identified in any of the cases.

Table 7. PMG, CCE and AMG estimates for individual cross-sections

Country	PMG		Country	CCE		Country	AMG	
	Coeff.	Prob.		Coeff.	Prob.		Coeff.	Prob.
Austria	0.695	(0.096)	Singapore	-1.953	(0.000)	US	-0.468	(0.000)
Ireland	1.458	(0.038)	Chinese Taipei	-1.716	(0.002)	UK	-0.477	(0.061)
Netherlands	0.652	(0.072)	Mexico	-1.143	(0.013)	Hong Kong	-0.319	(0.010)
Spain	0.889	(0.057)	Poland	-0.848	(0.044)	Chinese Taipei	-1.259	(0.000)
India	1.800	(0.000)	Honduras	-2.509	(0.014)	Germany	-1.536	(0.000)
Pakistan	1.639	(0.014)	PR China	-2.518	(0.000)	Mexico	-1.001	(0.000)
US	-0.366	(0.000)	Russia	-0.197	(0.054)	Poland	-0.622	(0.014)
Poland	-1.212	(0.017)	Saudi Arabia	-0.861	(0.031)	Brazil	-0.544	(0.018)
			Trinidad & Tobago	1.955	(0.005)	Honduras	-1.569	(0.050)
			Argentina	0.389	(0.095)	PR China	-1.224	(0.006)
						Nigeria	-0.417	(0.014)
						Thailand	-0.774	(0.041)
						Denmark	1.242	(0.063)
						Trinidad & Tobago	1.747	(0.007)
						Philippines	0.828	(0.004)

Note. The individual cross-section estimates pertain to the long-term (PMG model) and the short-term (CCE and AMG models). The p-values are indicated in the parentheses. The countries are listed according to the sign of the effects.

The estimates of the real exchange rate elasticity of the trade balance in the sub-panels were generally similar to the ones in the aggregate panel. Table 8 illustrates that in the sub-panel that excludes the US, the long-run coefficient of the logarithm of the real exchange rate was negative (albeit not always significant) in all five models, thus confirming Marshall-Lerner condition. Additionally, in the PMG model, the short-run coefficient was positive, suggesting the presence of the J-curve effect. The similar regularity was observed in the sub-panel with developed economies (in this case, the DFE was the preferred model, and the coefficient in the AMG model was insignificant). In the smaller panel with developing economies, the preferred DFE model estimated positive real exchange rate coefficient in both short- and long-run (i.e. deterioration of the trade balance all the way through). Nonetheless, the more robust CCE and AMG models unequivocally indicated the satisfaction of the Marshall-Lerner condition in all three sub-panels.

Table 8. PMG, MG, DFE, CCE and AMG estimates for the sub-panels

Panel	PMG		MG		DFE		CCE		AMG	
	Coeff.	Prob	Coeff.	Prob	Coeff.	Prob	Coeff.	Prob	Coeff.	Prob
A. All excl. the US										
lnRER (long-run)	-0.474	(0.000)	-0.378	(0.119)	0.092	(0.316)	-0.336	(0.023)	-0.220	(0.055)
lnRER (short-run)	0.205	(0.044)	0.171	(0.319)	0.110	(0.316)				
B. Developed economies										
lnRER (long-run)	-0.620	(0.000)	-0.464	(0.050)	-0.969	(0.000)	-0.529	(0.050)	-0.179	(0.148)
lnRER (short-run)	0.291	(0.014)	0.251	(0.142)	0.287	(0.030)				
C. Developing economies										
lnRER (long-run)	-0.080	(0.279)	-0.311	(0.440)	0.149	(0.179)	-0.354	(0.135)	-0.330	(0.057)
lnRER (short-run)	0.151	(0.398)	0.084	(0.767)	0.122	(0.427)				

Note. The p-values are indicated in the parentheses.

Conclusion

The objective of this paper was to examine the effects of currency depreciation on the services bilateral trade balance of Canada with its 53 trading partners (both developed and developing economies). We considered the Marshall-Lerner condition (that presumes the improvement of the trade balance in the long run following depreciation), and the J-curve effect (that hypothesizes temporary deterioration of the trade balance in the short-run, followed by its eventual improvement). A sequential methodology was used, that as a first step ascertained the integration properties of the series, then checked for the cointegration between the variables, and lastly estimated the relationships using a variety of panel data models (pooled mean group/PMG, mean group/MG, dynamic fixed effects/DFE, common correlated effects/CCE, and augmented mean group/AMG). As part of robustness checks, the estimates were obtained for the individual cross sections (bilateral relations of Canada with a respective trading partner), as well as for smaller panels.

In the panel encompassing Canada's all trading partners, the Marshall-Lerner condition was identified by all five models and the improvement in the services trade balance took place in the long-run following Canadian dollar depreciation. The condition likewise held in the three smaller panels (for all trading partners excluding the US, as well as for the developed and developing economies). The only exception was the DFE model, where the relevant coefficient (that was statistically insignificant) pointed to the long-run deterioration in the trade balance. For the individual cross-sections, the condition held in a far smaller number of cases: in the common correlated effects (CCE) and augmented mean group (AMG) models, the balance' long-term improvement was observed in eight and twelve economies respectively. Regarding the J-curve effect, the PMG, MG and DFE models in a larger panel indicated short-term deterioration followed by a long-term improvement in the services trade balance. The similar effect was indicated in the sub-panels (with the exception of DFE model in the developing economies panel that pointed to the deterioration in both short- and long-run). However, at the individual cross-section level, the J-curve effect was hardly present: the cross-sections that experience long-term improvement in the balance and the economies that experienced the short-term deterioration (six economies in total, as indicated by the PMG model) were not the same. Overall, there is a strong evidence supporting the Marshall-Lerner condition, but limited evidence of the J-curve effect.

As was mentioned by Bahmani-Oskooee and Ratha (2004a: 1385) the absence of the J-curve may be attributed to a high level of aggregation of the data used in the empirical research, and thus the J-curve effect may be discovered if a more disaggregated data (e.g. trade in particular service categories) is used. The future research may likewise incorporate additional variables in the trade balance equation (monetary, policy), experiment with alternative functional forms or econometric techniques, or estimate import and export equations separately (given the likely differential reactions and adjustments in imports and exports to exchange rate shocks).

Appendix

The sample includes 53 trading partners of Canada. The developed and developing economies (defined as per World Bank classification) are denoted with # or no superscripts respectively.

The countries are as follows: Argentina, Australia[#], Austria[#], Belgium[#], Brazil, Chile, China (People's Republic of), Chinese Taipei[#], Colombia, Costa Rica, Cote d'Ivoire, Denmark[#], Egypt, El Salvador, Finland[#], France[#], Germany[#], Greece[#], Guatemala, Honduras, Hong Kong (China)[#], Jamaica, Japan[#], India, Indonesia, Ireland[#], Israel[#], Italy[#], Malaysia, Mexico, Netherlands[#], New Zealand[#], Nicaragua, Nigeria, Norway[#], Pakistan, Philippines, Poland, Portugal[#], Russia, Saudi Arabia, Senegal, Singapore[#], South Africa, South Korea[#], Spain[#], Sweden[#], Switzerland[#], Thailand, Trinidad and Tobago, Turkey, the UK[#], and the US[#].

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