Trade (Dis)integration:
The Sudden Death of NAFTA

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Abstract

This paper uses a PVAR model to study the macroeconomic effects of trade disintegration among NAFTA members. The results reveal substantial asymmetric responses, showing that the US is the most affected economy from a sudden negative trade integration shock. Moreover, Canada and the US are found to be relatively more interconnected with each other compared to the Mexican economy. Our findings question the US decision to push for the renegotiation of the NAFTA agreement.

Keywords: NAFTA, Trade Integration, PVAR Model

JEL Classification: F14, F15, C33

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I. INTRODUCTION

Regionalism has entered a new phase, with mega-regional trade negotiations suddenly collapsing and unexpected withdrawals from long-standing integration schemes. Deep divisions and turmoil over trade issues are epitomised in the uncertain future of the North American Free Trade Area (NAFTA), where President Trump recently called for a renegotiation of the deal. This environment has led to questions about the effects of a 'break-up' shock. There are a number of notable examples of the collapse of large-scale and/or long-standing integration schemes. Head *et al*. (2010) explore the trade dynamics of former colonies with their coloniser, within a gravity framework; while conceptually similar, Fidrmuc and Fidrmuc (2003) examine the trade effects of the collapse of the Soviet block. However, the literature is limited and not much is known about the effect of these negative shocks compared to trade integration.

Methodologically, the analysis of unexpected shocks or surprises is typically undertaken within a structural vector autoregression (SVAR) modelling framework. This type of analysis is frequently applied, and the advantages are well understood, in the context of business cycles and the monetary transmission mechanism (Fève *et al*., 2018). On the other hand, research using SVAR modelling to consider the impact of shocks in a trade setting is still in its infancy. For example, Çakir and Kabundi (2013) investigate an export/import shock, Nordmeier *et al*. (2016) a trade liberalization shock, Du *et al*. (2017) a political relations shock, and, most recently, Schmitt-Grohé and Uribe (2018) consider a terms of trade shock. Schmitt-Grohé and Uribe (2018) focus on a group of emerging and poor countries and find that terms of trade shocks have a more limited impact on key macroeconomic indicators, than one would expect from models with micro-foundations. The focus for Nordmeier *et al*. (2016) is somewhat different, where they explore the impact of a trade liberalisation shock on the German labour market; they find a positive effect broadly in line with the existing literature. Du *et al*. (2017) find that political shocks die out quickly, and therefore high-frequency data is required to identify the impact of such shocks on trade. The authors also find that gravity models use low frequency data, and in doing so fail to identify the impact of these shocks. Finally, Çakir and

Kabundi's (2013) global VAR (GVAR) analysis allows the authors to identify trade linkages between South Africa and the BRIC (Brazil, Russia, India and China) countries.

This paper provides a novel contribution to this emerging literature by exploring a trade disintegration shock within a PVAR framework; thereby allowing us to examine the effect of the shock on various macroeconomic indicators for the three members of NAFTA (Canada, Mexico and the US). The main advantage of PVARs over traditional SVAR models is the addition of the cross-sectional structure. Furthermore, PVARs can capture greater variety of potential interlinkages than GVARs (Pesaran *et al.*, 2004), which impose a particular structure on the interdependencies. These are significant properties that allows us to assess and test the potential linkages and spillovers among the examined economies. In conducting this analysis, we provide a timely contribution to the literature considering the potential impact of the sudden collapse of the NAFTA agreement. Furthermore, we illustrate the usefulness of PVAR modelling to explore the responses to a trade disintegration shock for the NAFTA participants.

Our empirical results show a significant degree of heterogeneity in terms of macroeconomic responses of the three NAFTA members, and reveal that the US economy is the most vulnerable to a negative trade integration shock. Furthermore, the US and Canadian economies are found to be more interlinked with each other as opposed to Mexico. These findings question the decision by the US administration for a renegotiation or full withdrawal from the NAFTA agreement.

The rest of the paper is organized as follows. **Section II** presents the empirical methodology and the data. **Section III** discusses the empirical results. Finally, **Section IV** concludes.

II. EMPIRICAL METHODOLOGY AND DATA

Our model is built upon a panel vector autoregressive model (PVAR) framework, where the terminology that we use thereafter is based on Canova and Ciccarelli (2013). In general, PVAR models are increasingly becoming a popular tool for examining the interactions of several entities. The main advantage over traditional structural VARs is the addition of a cross-sectional structure. This is a significant property that allows us to assess and test the potential linkages and spillovers among the examined countries. Letting $y_{i,t}$ be a vector of G endogenous variables of country i (i=1,…,N) at time t (t=1,…,T) with l lags (l=1,…,L) and x_t a set of M exogenous variables, common to all units, the PVAR model is written as:

$$
\begin{aligned}
y_{i,t} = {} & A_{i1,t}^{1} y_{1,t-1} + \ldots + A_{i1,t}^{L} y_{1,t-L} \\
& + A_{i2,t}^{1} y_{2,t-1} + \ldots + A_{i2,t}^{L} y_{2,t-L} + \ldots \\
& + A_{iN,t}^{1} y_{N,t-1} + \ldots + A_{iN,t}^{L} y_{N,t-L} + C_{i,t} x_t + e_{i,t},
\end{aligned} \tag{1}
$$

where $A_{ij,t}^{l}$ are G*G matrices, $C_{i,t}$ is a G*M matrix and $e_{i,t}$ are the uncorrelated over-time errors distributed as $N(0, \Sigma_{ii,t})$ with $\Sigma_{ii,t}$ the variance-covariance matrix. The model can be re-written in analytical form as:

$$
\begin{aligned}
\begin{pmatrix} y_{1,t} \\ y_{2,t} \\ \vdots \\ y_{N,t} \end{pmatrix} = {} & \begin{pmatrix} A_{11,t}^{1} & A_{12,t}^{1} & \cdots & A_{1N,t}^{1} \\ A_{21,t}^{1} & A_{22,t}^{1} & \cdots & A_{2N,t}^{1} \\ \vdots & \vdots & \ddots & \vdots \\ A_{N1,t}^{1} & A_{N2,t}^{1} & \cdots & A_{NN,t}^{1} \end{pmatrix} \begin{pmatrix} y_{1,t-1} \\ y_{2,t-1} \\ \vdots \\ y_{N,t-1} \end{pmatrix} + \ldots \\
& + \begin{pmatrix} A_{11,t}^{L} & A_{12,t}^{L} & \cdots & A_{1N,t}^{L} \\ A_{21,t}^{L} & A_{22,t}^{L} & \cdots & A_{2N,t}^{L} \\ \vdots & \vdots & \ddots & \vdots \\ A_{N1,t}^{L} & A_{N2,t}^{L} & \cdots & A_{NN,t}^{L} \end{pmatrix} \begin{pmatrix} y_{1,t-L} \\ y_{2,t-L} \\ \vdots \\ y_{N,t-L} \end{pmatrix} + \begin{pmatrix} C_{1,t} \\ C_{2,t} \\ \vdots \\ C_{N,t} \end{pmatrix} x_t + \begin{pmatrix} e_{1,t} \\ e_{2,t} \\ \vdots \\ e_{N,t} \end{pmatrix},
\end{aligned} \tag{2}
$$

with $e_{i,t} \sim N(0, \Sigma_{ii,t})$ and $\Sigma_{ii,t} = \begin{pmatrix} \Sigma_{11,t} & \Sigma_{12,t} & \cdots & \Sigma_{1N,t} \\ \Sigma_{21,t} & \Sigma_{22,t} & \cdots & \Sigma_{2N,t} \\ \vdots & \vdots & \ddots & \vdots \\ \Sigma_{N1,t} & \Sigma_{N2,t} & \cdots & \Sigma_{NN,t} \end{pmatrix}$,

where $y_{i,t}$ is the vector of endogenous variables, x_t contains the exogenous variables and $e_{i,t}$ are the error terms.

The unrestricted PVAR specification suffers from over-parameterization; this is because even a small PVAR is characterised by high parameter-space dimensionality.[1] Overcoming this problem requires the imposition of structural restrictions. We focus on four groups of restrictions; i) cross-sectional heterogeneities, ii) dynamic interdependencies, iii) static interdependencies and iv) dynamic heterogeneities. In the present context, it would be unrealistic to assume the homogeneity of the examined economies. Therefore, we allow for cross-sectional heterogeneities, i.e., $A_{ik,t}^{l} \neq A_{jk,t}^{l}$ and $\Sigma_{ii,t} \neq \Sigma_{jj,t}$ when $i \neq j$. In addition, since we are interested in capturing all the potential cross-sectional linkages among the examined economies, we assume that our system is characterised by dynamic interdependencies. Thus, the endogenous variables of each country depend on the lags of the endogenous variables of every other country. Using the above notation, this is equivalent to $A_{ij,t}^{l} \neq 0$ when $i \neq j$. Furthermore, given the close economic ties among NAFTA members, we also allow for static interdependencies. Mathematically, $\Sigma_{ij,t} \neq 0$ when $i \neq j$. Therefore, we let a shock in one country be transmitted to another country. Finally, given the relative short time-span, it seems reasonable to assume dynamic homogeneity (homoscedasticity). These are the only type of restrictions that we impose in our model, i.e., $A_{ij,t}^{l} = A_{ij,s}^{l}$ and $\Sigma_{ij,t} = \Sigma_{ij,s}$, when $t \neq s$. The advantage of our PVAR specification is that allows for dynamic interactions among economies. In this way, our model differs from single VARs that are estimated using either data from one country or panel data (pooled estimates). Our model is estimated using the BEAR toolbox developed by Dieppe *et al*. (2016).

We use annual data for the period 1950 – 2011 for the three members of the NAFTA trade bloc (Canada, Mexico and the US).[2] The endogenous variables used in the analysis consist of: i) historical trade integration index (HTI), ii) real GDP (GDP), iii) consumption (CON) and iv) investment (INV).[3] As an exogenous variable we use the spot crude oil price (OIL) as a proxy for supply side effects. The selection of macroeconomic variables is based on Schmitt-

[1] In the unrestricted version of our relatively small PVAR, with $G = 4$, $N = 3$, $M = 1$ and $L = 1$, 225 model parameters and 120 error variances and covariances should be estimated.
[2] 2011 is the last available observation of the HTI index.
[3] Following the work of Schmitt-Grohe and Uribe (2018), we express all macroeconomic variables as log-deviations from the trend.

Grohe and Uribe (2018) and collected from the IMF-IFS database, while the oil price is from the FRED database. The HTI index is based on the work of Standaert *et al.* (2015). The main advantage is its bilateral nature, where HTI $_{i \to j}$ identifies country i as the exporter to country j, where HTI $_{i \to j} \neq$ HTI $_{j \to i}$. In this way, we have six different sub-indexes; HTI $_{CAN \to MEX}$, HTI $_{MEX \to CAN}$, HTI $_{US \to CAN}$, HTI $_{CAN \to US}$, HTI $_{US \to MEX}$ and HTI $_{MEX \to US}$. Each of these indexes proxies the level of trade integration between the two countries. **Figure 1** shows the evolution of the bilateral HTI indexes for the NAFTA members over the period 1950 – 2011. The figure shows evidence of considerable heterogeneity in the trade integration across the NAFTA participants.

III. EMPIRICAL RESULTS

We start the exposition of our results with reference to the GDP impulse responses presented in **Figure 2**. The left panel on the first row of **Figure 2** plots the Canadian GDP response to a negative shock in HTI $_{CAN \to US}$. The right panel on the first row presents the Canadian GDP response to a shock in HTI $_{CAN \to MEX}$. In a similar vein, the second row shows the Mexican GDP response to a shock in HTI $_{MEX \to CAN}$ (left panel) and a shock in HTI $_{MEX \to US}$ (right panel). Finally, the third row shows the US response from shocks in HTI $_{US \to CAN}$ and HTI $_{US \to MEX}$, respectively.

Figure 2 here

Findings from the left panel in **Figure 2** suggest that Canadian and US activity is negatively affected, with the US experiencing the highest and the longest impact. Interestingly, our evidence suggests that both economies respond negatively on impact. This reflects the strong interconnection between the two economies. On the contrary, a shock in HTI $_{CAN \to MEX}$ and HTI $_{US \to MEX}$ does not impact economic activity in Canada and the US in a statistically significant way. As far as Mexican economic activity is concerned (second row of **Figure 2**), our evidence reveals that Mexico is robust to a trade disintegration shock; both GDP responses are statistically insignificant. One possible explanation is that Mexican exports could still be traded with US/Canada outside the NAFTA agreement, particularly those that support supply chains, or to alternative markets without significant increases in economic costs.[4]

Figures 3-5, show the impulse responses of the remaining macroeconomic variables (CON and INV) for the three NAFTA members. The left panel of **Figure 3** plots the responses of Canadian consumption and investment to a negative shock in HTI $_{CAN \rightarrow US}$. The effects in both variables are negative and statistically significant. Investment initially decreases by 0.02%, while consumption is reduced by slightly less. Even though the reduction is not large, the variables return to their pre-shock levels only after 4 years. The right panel of **Figure 3** shows the effect for the Canadian economy of a negative shock to HTI $_{CAN \rightarrow MEX}$. Our evidence suggests that the Canadian economy responds negatively on impact. However, the effects are both economically and statistically insignificant. This asymmetric reaction of Canada reflects the primary role of the US economy.

Figures 3-5

Looking into the Mexican economy, the reaction to HTI shocks presents quite an interesting outcome. For the former case (the integration between Mexico and Canada), the left panel of **Figure 4** shows that Mexican consumption and investment increase as result of a negative shock. However, this increase is statistically insignificant as the broad error bands depict. For the case of a HTI $_{MEX \rightarrow US}$ shock (right panel of **Figure 4**), the reaction is roughly zero.

Turning to the US economy, our evidence reveals further asymmetries. A sudden negative shock to HTI $_{US \rightarrow CAN}$ has a significant economic cost for the US, as it is depicted in the left panel of **Figure 5**. A 1% decrease in HTI causes a roughly 0.5% reduction in both consumption and investment. On the other hand, the US seems to be unaffected by a negative

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[4] Recent evidence suggests that the benefits to Mexico from the NAFTA deal are limited (Ramírez Sánchez *et al.*, 2018).

shock in HTI $_{US \rightarrow MEX}$. The responses presented in the right panel of **Figure 5** show negative albeit insignificant reactions.

Finally, we supplement our empirical results with a battery of tests, using alternative specifications, orderings and transformations of the variables in the PVAR model, to check the robustness of our main findings. As a first exercise, we estimate the implulse responses based on the PVAR model without the inclusion of the exogenous variable (OIL) in our specification. Our results and main conclusions remain almost identical. Additionally, we employ the PVAR model using alternative orderings of the endogenous variables and we find that the results remain robust. Lastly, we replicate the PVAR analysis using the logs of the endogenous variables (without using the series transformed in log-deviations from the trend) and our main results remain unaltered.[5]

Overall, our PVAR model reveals strong evidence of asymmetries among the three NAFTA members. The economy more susceptible to trade disintegration is found to be the US and, then, Canada. On the contrary, Mexico proves to be quite robust to a sudden trade shock. Moreover, the US and Canadian economies are found to be relatively more interconnected with each other rather than with the Mexican economy. Our results reaffirm the recent evidence of Weisbrot *et al.* (2014) and Ramírez Sánchez *et al.* (2018), while we call into question the earlier findings on the effects of NAFTA by Krueger (1999) and Burfisher *et al.* (2001).

IV. CONCLUSIONS

The present paper is the first study that explores trade disintegration shocks within a PVAR framework. The current interest in the NAFTA integration scheme, and its potential disintegration in particular, provides an ideal setting to illustrate the usefulness of this methodology. The PVAR framework allows us to assess and test the potential linkages and spillovers among the NAFTA economies when faced with an unexpected shock. Moreover, the

[5] These results can be provided upon request.

recent trend of sudden trade disintegration shocks, provides a number of other settings where this methodology could be applied in future.

By taking into account cross-country heterogeneity, we are able to identify asymmetric macroeconomic responses to trade disintegration among the three NAFTA participants. The US is found to have the highest losses, while Mexico the least. Canada has already started to diversify its export markets by signing new trade deals (for example, the Comprehensive Economic and Trade Agreement (CETA) with the European Union and the Trans-Pacific Partnership (TPP) with the Pacific Rim countries), which are likely to further mitigate the negative effects of a potential collapse of NAFTA. In terms of Mexico, they would experience non-tariff barrier reductions (for example, by avoiding the NAFTA Rules of Origin) by trading under World Trade Organisation rules, which would go some way to mitigate the associated tariff increases. On the other hand, US consumers would experience higher prices due to increases in trade costs, where there is also the potential for additional US welfare loss due to any retaliation from Mexico and Canada. Overall, our findings suggest that a sudden unexpected negative shock on the integration of the NAFTA block damages the US.

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FIGURES

Figure 1: Bilateral trade integration index (HTI) for the three NAFTA members (1950 – 2011).

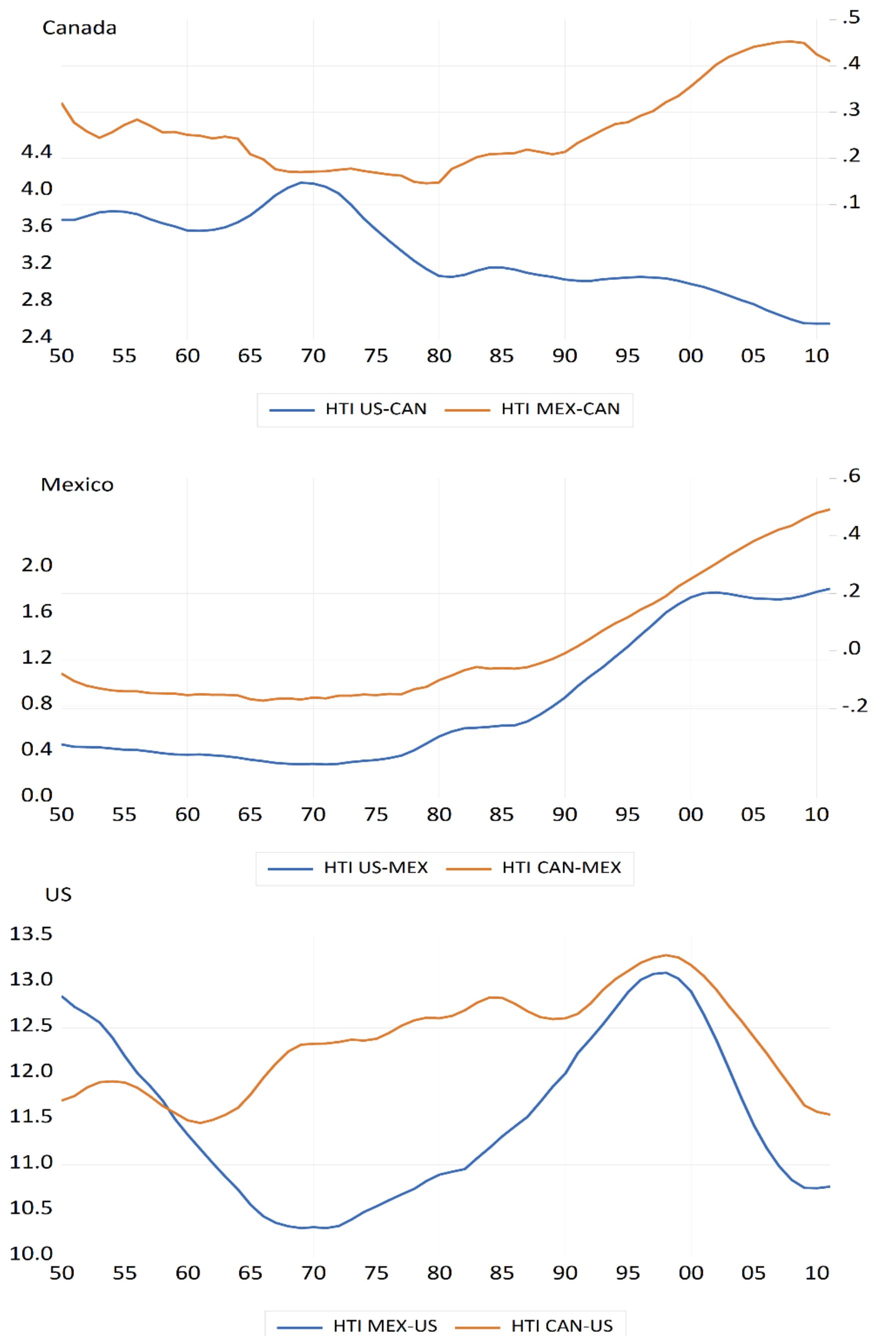

Figure 2: Impulse responses of the Canadian, Mexican and US real GDP (GDP) to a negative shock to the bilateral trade integration index (HTI).

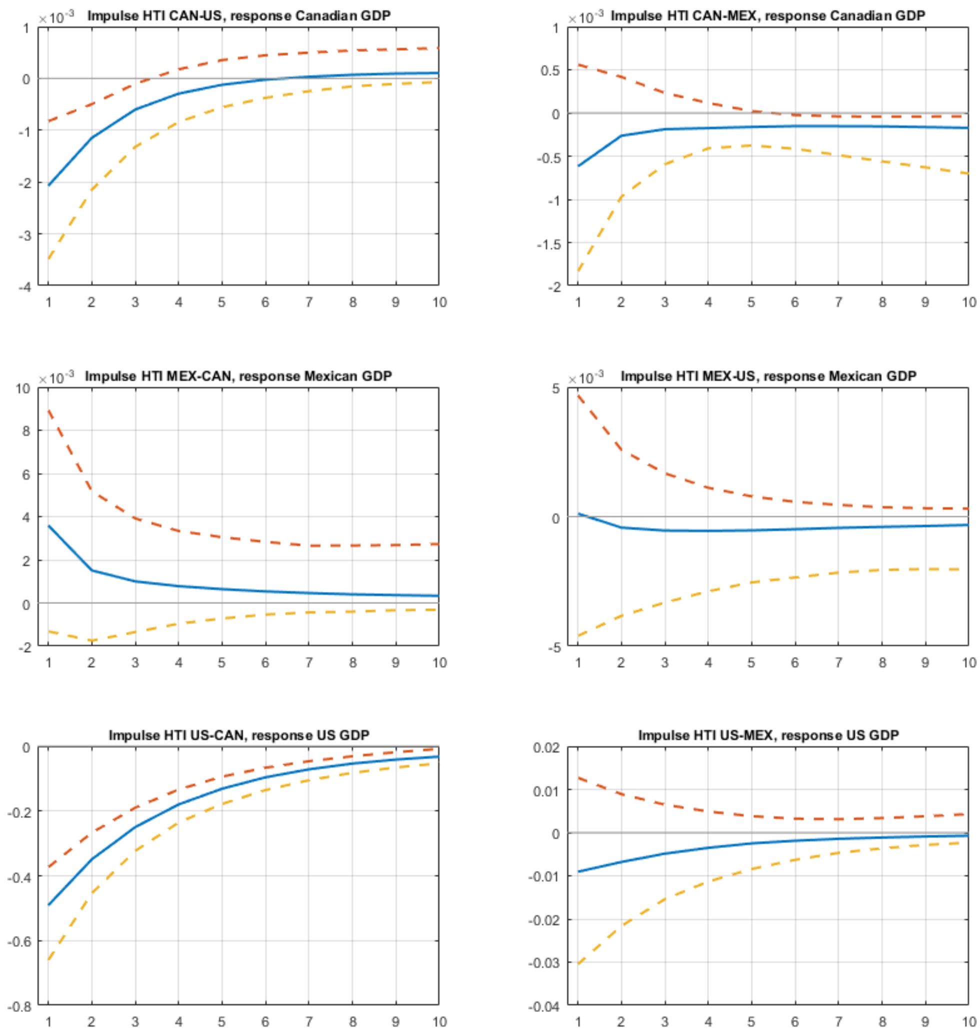

Figure 3: Impulse responses of the Canadian consumption (CON) and investment (INV) to a negative shock to the bilateral trade integration index (HTI) between Canada-US and Canada-Mexico.

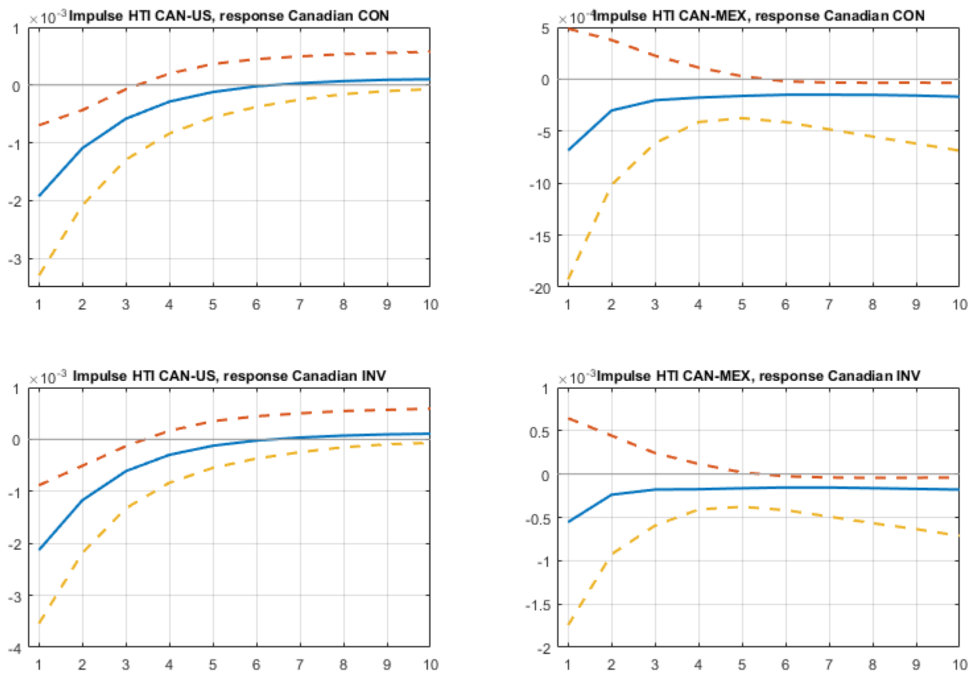

Figure 4: Impulse responses of the Mexican consumption (CON) and investment (INV) to a negative shock to the bilateral trade integration index (HTI) between Mexico-Canada and Mexico-US.

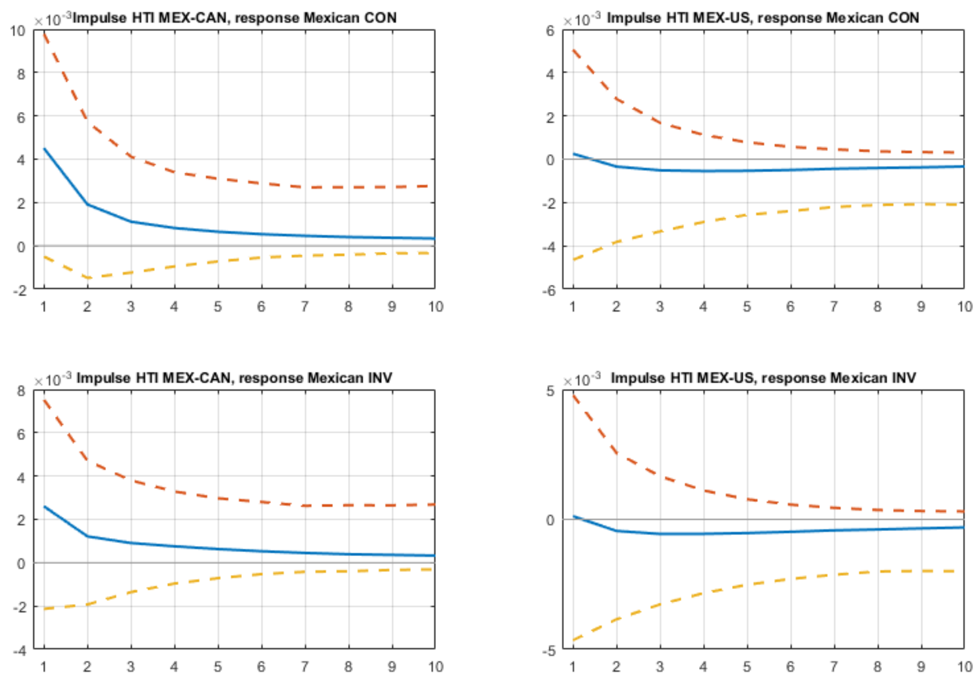

Figure 5: Impulse responses of the US consumption (CON) and investment (INV) to a negative shock to the bilateral trade integration index (HTI) between US-Canada and US-Mexico.