The Macroeconomic Impact of NAFTA Termination

Joseph B. Steinberg*

July 17, 2018

Abstract

U.S. President Trump has threatened to leave the North American Free Trade Agreement. How much would each country and industry gain or lose if this threat is carried out? Would trade imbalances within the region diminish? Would the transition to new production and expenditure patterns be costly? To provide quantitative answers to these questions, I analyze the consequences of NAFTA termination in a dynamic general equilibrium model with a detailed input-output production structure and adjustment frictions in factor markets and international trade. Regional trade flows would fall dramatically, particularly in sectors like agriculture, where tariffs and trade elasticities are high, and production in the transportation sector, which relies heavily on intermediate input trade, would decline. The macroeconomic and welfare consequences of NAFTA termination are minor, however, and trade imbalances in the region would remain.

*University of Toronto. Email: joseph.steinberg@utoronto.ca

"We are in the NAFTA (worst trade deal ever made) renegotiation process with Mexico & Canda.Both being very difficult,may have to terminate?"

— U.S. President Donald Trump, Twitter, August 27, 2017

1 Introduction

The North American Free Trade Agreement is under threat. U.S. President Donald Trump has called the agreement "the worst trade deal in history " and blamed it for persistent U.S. trade deficits and declining manufacturing employment. More concerning yet, he has threatened to pull out of the agreement if it cannot be renegotiated to his adminstration's satisfaction. In this paper, I use a dynamic general equilibrium model to quantify the short- and long-run impact of terminating NAFTA on trade flows, welfare, sectoral reallocation, and trade imbalances.

Signed in 1992 and implemented in 1994, NAFTA created the largest free trade area the world had ever seen. Since the agreement's inception trade between its members has grown dramatically. Today, the three NAFTA economies are heavily intertwined. Canada and Mexico trade significantly more with the United States than they do with any other country, and the United States only trades more with China than it does with its neighbors. Extensive regional supply chains have blossomed as trade has grown. In the transportation equipment sector, for example, intermediate input trade with the United States accounts for 30 percent Canada's gross output and more than 50 percent of Mexico's.

Recently, however, trade relationships in the region have become strained. President Trump has pointed to U.S. trade deficits with Canada and Mexico as evidence of the deal's "unfairness" and his administration has forced talks to renegotiate the agreement, threatening to leave it entirely if a satisfactory deal is not reached. Canada's trade policies, in particular, have earned the President's ire. Soon after he took office, his Commerce Department imposed countervailing duties of a whopping 292 percent on imports of Bombardier aircraft[1] and promised to impose 24 percent duties on softwood lumber. More recently, the President has complained vociferously about Canada's dairy supply management system. Progress in renegotiation talks has been reported to be slow, and there is widespread concern that the Trump adminstration will make good on its threats to terminate the agreement. In this paper, I provide quantitative analysis about the macroeconomic consequences that would follow NAFTA's dissolution, providing answers to key questions

[1]These duties were levied in September, 2017. In January, 2018, the U.S. International Trade Comission rejected the duties, however, finding in favor of Bombardier in the dispute.

such as: how much would each country's welfare rise or fall? Which industries would gain and which would lose? Would trade imbalances within the region shrink? Would the transition to a post-NAFTA equilibrium be costly?

To answer these questions, I develop a dynamic general equilibrium model with a detailed input-output production structure and costs of adjusting each sector's factor allocations and trade flows over time. The model has four countries: the United States, Canada, Mexico, and the rest of the world. Households in each country work, consume, and borrow or lend by trading bonds. Each country has five production sectors: agriculture, resource extraction, transportation equipment, other manufacturing, and services. Firms in each sector make dynamic decisions about investment, employment, and imported intermediates because adjusting each of these inputs over time is costly. I calibrate the model's parameters so that it replicates an input-output matrix from the World Input Output Database (Timmer et al., 2015) that contains data on NAFTA countries' current production and trade relationships.

I use the calibrated model to quantify the impact of NAFTA termination by comparing two equilibria: the *benchmark* in which NAFTA remains in force forever; and the *termination* equilibrium in which NAFTA ends permanently in 2018. When NAFTA is terminated, NAFTA members levy the same most-favored-nation (MFN) import tariffs on each other's products that they levy on products from other World Trade Organization members. MFN tariffs are particularly high in the transportation sector and Mexico also levies high tariffs on agricultural products. In the long run, bilateral trade flows between NAFTA members are 6–14 percent lower in the termination equilibrium than in the benchmark. Trade falls most in agriculture and resources, which have high trade elasticities, and least in the transportation sector, which has a very low trade elasticity. Production and consumption in the transportation sector, however, fall substantially, illustrating the importance of intermediate input trade for this sector. The long-run welfare effects of NAFTA termination are small: consumption falls by 0.03 percent in the United States, 0.07 percent in Canada, and 0.03 percent in Mexico. The economy takes many years to transition to its post-NAFTA steady state but this adjustment process is not costly. Including these transition dynamics, the welfare losses from NAFTA termination are similar to the long-run declines in consumption. NAFTA termination will cause the U.S. trade deficit with Canada to shrink but cause its deficit with Mexico to grow.

This paper contributes to several strands of literature. First, it contributes to the growing literature on the consequences of protectionist trade policies. A number of recent studies have analyzed the potential implications of the United Kingdom's impending departure from the European Union (Dhingra et al., 2016b,c,a;

McGrattan and Waddle, 2017; Ebell et al., 2016; Baker et al., 2016; Steinberg, 2017). Barattieri et al. (2017); Ruhl (2014) study the macroeconomic consequences of temporary trade barriers like antidumping and countervailing duties. Conconi et al. (2017) show how rules of origin requirements in free trade agreements like NAFTA increase trade costs with the rest of the world. My paper is the first to quantify the macroeconomic consequences of NAFTA termination.

More generally, my paper contributes to the recent literature that quantitifies the effects of trade policy reforms using models with many countries, many sectors, and international input-output linkages (Caliendo and Parro, 2015; Costinot and Rodríguez-Clare, 2014; Giri et al., 2017). These studies highlight the importance of intersectoral and international heterogeneity in shaping the aggregate effects of changes in trade policy. Caliendo and Parro (2015) in particular quantify the welfare gains from forming NAFTA. My paper builds on this literature by embedding a rich, input-output production and demand structure into a dynamic model, which allows me to quantify the costs of short-term adjustments to NAFTA termination as well as the long-term consequences.

Finally, a number of other recent studies have analyzed the macroeconomic effects of trade policy reforms and other shocks in dynamic, open-economy models with adjustment frictions on investment (Bajona and Kehoe, 2010; Brooks and Pujolas, 2016; Ravikumar et al., 2017; Eaton et al., 2011), employment (Dix-Carneiro, 2014), and trade (Baldwin, 1992; Krugman, 1986; Engel and Wang, 2011; Alessandria and Choi, 2007; Ruhl, 2008; Alessandria and Choi, 2016; Alessandria et al., 2015). My model features all three, and is the first to integrate them into a model with a realistic input-output production structure.

2 What's at stake: key facts about tariffs, trade, and production

To set the stage for my analysis of the consequences of NAFTA termination, I first turn to the data to summarize what's at stake: how much tariffs on trade between NAFTA members could rise and how important this trade is for these countries.

2.1 Tariffs

How much could tariffs rise if NAFTA is terminated? The United States, Canada, and Mexico are all members of the World Trade Organization, and the WTO's most-favored-nation (MFN) rule stipulates that in the absence of a regional free trade agreement, WTO members should levy the same tariff on all other WTO members' products. The WTO reports each member country's MFN tariff schedule at the 6-digit HS industry level. I combine these schedules with COMTRADE data on bilateral trade between NAFTA members at the same 6-digit level to compute import-weighted bilateral tariff rates for five broad sectors: agriculture, resource extraction, transportation equipment, and other manufacturing. Table 1 lists the HS code ranges included in each sector and table 2 shows the results of the analysis.

The transportation equipment sector, whose international supply chain has featured prominently in media coverage of the NAFTA debate, would have relatively high post-NAFTA tariffs compared to other manufactured goods. The elasticity of subsitution between domestic and foreign products—also known as the trade elasticity—in this sector is very low (Caliendo and Parro, 2015), which indicates that a reduction in trade in this sector triggered by NAFTA termination could be particularly painful. The resource sector, which is particularly important for Canada and Mexico, would have low post-NAFTA tariffs. The trade elasticity in this sector is very high, however, which suggests that even a small increase in tariffs could lead to a large drop in trade. Finally, Mexico would levy very high post-NAFTA tariffs on agricultural products, and because the trade elasticity in agriculture is also relatively high this could lead to a large reduction in agricultural trade.

This analysis may understate the extent to which trade costs could rise as a result of NAFTA termination. The literature on trade costs has found that non-tariff barriers like transportation costs, differences in product regulations, and search costs are often larger than formal import tariffs (Anderson and van Wincoop, 2004; Allen, 2014; Lim, 2016). This is particularly true in the services sector, which I have excluded from the analysis above because formal tariffs do not exist. Data limitations make it difficult to conclusively determine the effects of NAFTA termination on bilateral non-tariff barriers in trade between NAFTA members, so I analyze the importance of non-tariff barriers in the context at hand by conducting sensitivity analyses using my quantitative model.

2.2 Trade flows and production

The macroeconomic consequences of NAFTA termination depend not only on potential increases in trade costs, but also on the importance of intra-NAFTA trade for member countries, particularly in sectors like agriculture and transportation equipment in which trade costs could rise substantially.

To depict NAFTA members' key production and demand relationships, I use the World Input Output Database (Timmer et al., 2015), henceforth WIOD. This dataset, which has been widely used in recent international trade studies, contains annual data on production, intermediate inputs, and final demand for 43 countries and 56 industries. Unlike national input-output tables reported by national statistical agencies like the U.S. BEA, the WIOD data break down each reporter country's imports by source country and use (intermediate input or final expenditure), and thus provide a complete picture of the world input-output structure. I aggregate all countries other than the United States, Canada, and Mexico into a single "rest of the world" country, and I aggregate the 56 industries into the same five sectors described in section 2.1. Table 3 summarizes the macroeconomic importance of these relationships, listing average trade and production figures over the most recent five-year period in the dataset as a fraction of each country's GDP, and figures 1–3 provide visual illustrations.

2.2.1 Aggregate trade openness

Figure 1 shows that NAFTA members differ substantially in their exposure to international trade. Overall, the United States is less open to trade than Canada and Mexico. International trade (measured as the sum of exports and imports) averaged 26 percent of U.S. GDP between 2010 and 2014, compared to 63 percent and 58 percent in Canada and Mexico, respectively. Further, trade with other NAFTA members is less important for the United States: trade with Canada and Mexico accounts for a quarter of total U.S. trade, while trade with other NAFTA countries—primarily the United States—accounts for more than 60 percent of total trade for Canada and Mexico. These facts suggest that Canada's and Mexico's stakes in the future of NAFTA are much higher than the United States'.

2.2.2 Sectoral production and trade

Figure 2 shows that NAFTA members also differ substantially in the sectoral composition of their trade and output. Panel (a), which shows overall regional trade flows relative to sectoral GDP, illustrates the importance of NAFTA trade for each sector. Panel (b), which shows regional intermediate input trade, illustrates the importance of regional supply chains. Panels (c) and (d), which show the sectoral composition of each country's GDP and regional trade flows, respectively, illustrate the macroeconomic significance of regional trade flows in each sector.

The agriculture sector is less open to regional trade than other sectors and accounts for a small fraction of GDP in all three NAFTA countries. Consequently, high post-NAFTA tariffs in this sector may have small aggregate consequences. In Canada and Mexico, however, trade with the United States accounts for 62 and 45 percent of agricultural value added, respectively, and so the sector-level stakes for these countries are high. This is particularly true in Mexico where agriculture tariffs stand to rise dramatically.

NAFTA countries all trade resources intensively—this sector accounts for a larger share of their trade than their value added—but resources trade within NAFTA is particularly important for Canada. Resources trade with the United states, in particular, is close to 100 percent of Canadian value added in this sector and almost 8 percent of Canadian GDP. Post-NAFTA tariffs in this sector are likely to be low, but because resources output is highly substitutable across countries (Caliendo and Parro, 2015), even these low tariffs could have a significant impact on Canada's resource sector and Canada's economy as a whole.

The transportation equipment sector is about the same size as the agriculture sector in all three NAFTA countries but is more exposed to international trade, particularly trade in intermediate inputs within the NAFTA region (see panel (b) of figure 2). In all three countries, the trade in transportation equipment is larger than value added in this sector due to extensive international input-output linkages. In Canada, the ratio of NAFTA trade to value added in transportation is more than 4, and imported intermediate inputs from the U.S. transportation sector alone are almost three-quarters of value added. Combined with high post-NAFTA tariffs on transportation equipment and a very low trade elasticity in this sector(Caliendo and Parro, 2015), these facts imply that NAFTA termination could cause significant disruption in this sector that could have aggregate consequences despite the sector's small size.

Trade, and intermediate input trade in particular, is also important for the rest of the manufacturing sector. As in the transportation equipment sector, trade in other manufacturing exceeds value added for all three countries. The other manufacturing sector accounts for a larger share of each country's GDP than transportation but the consequences of NAFTA termination for this sector are lower: tariffs in other manufacturing will rise less than in transportation equipment and the trade elasticity is higher.

The services sector, the largest sector in each of the three countries, is unlikely to be significantly affected by NAFTA termination. Services are tradable—each country trades more services than agricultural products, for example—but the services sector is significantly less open to trade than other sectors. Further, terminating NAFTA should have little effect on services trade costs since tariffs on services are rare.

2.2.3 Trade imbalances

One of the key issues at play in the debate over NAFTA is trade imbalances. U.S. president Trump has stated repeatedly that U.S. trade deficits with Canada and Mexico suggest that NAFTA is "unfair" to the United States, and that shrinking, or even reversing, these deficits is his administration's primary goal in renegotiating or terminating NAFTA.

Recently, as figure 3 shows, the United States has indeed run trade deficits with both Canada and Mexico, but these deficits were small relative to the aggregate U.S. trade deficit. The U.S. trade deficit with the rest of the world was almost four times larger than the deficit with Mexico and almost six times larger than the deficit with Canada. Consequently, whatever the effects of NAFTA termination on bilateral U.S. deficits with Canada and Mexico, the effect on the aggregate U.S. trade deficit (not to mention aggregate U.S. production, employment, and welfare) is likely to be small.

These imbalances are more important when viewed from the Canadian and Mexican perspectives, however. The average trade surplus with the United States between 2010 and 2014 was 3.3 percent and 7.4 percent of GDP in Canada and Mexico, respectively. Thus, rebalancing trade within the NAFTA region could have significant macroeconomic consequences for these two countries.

It is not clear ex ante how NAFTA termination will affect these imbalances. Canada's trade surplus with the United States consists mostly of natural resources which will likely be taxed lightly when NAFTA is terminated but are highly substitutable across countries. Mexico's trade surplus consists mostly of transportation equipment and other manufacturing account. While post-NAFTA trade in transportation equipment will be taxed more heavily, the trade elasticity in this sector is low, and tariffs will not rise significantly on other manufacturing. Additionally, although Mexican agriculture trade with the United States is currently balanced Mexico will levy much higher post-NAFTA tariffs in this sector than the United States.

3 Model

The model I use to analyze the consequences of terminating NAFTA is a dynamic general equilibrium environment with four countries: the United States, Canada, Mexico, and the rest of the world. The length of a period in the model is one year and there is no uncertainty; model agents have perfect foresight.[2] Each

[2] Steinberg (2017) finds that trade policy uncertainty associated with Brexit has small macroeconomic and welfare consequences.

country has a representative household and five production sectors: agriculture, resource extraction, transportation equipment, other manufacturing, and services. Countries are indexed by $i, j \in I$ and sectors are indexed by $r, s \in S$. Households work, consume, and save. Competitive firms in each sector produce output using capital, labor, and intermediate inputs. International trade in each sector is facilitated by Armington aggregators (henceforth distributors) that pay import tariffs and iceberg transportation costs to import foreign products.

Trade costs are modeled as import tariffs that are rebated lump-sum to households. There are two forces in the model that make short-term adjustments to changes in trade policy different than long-term adjustments. First, distributors must pay convex costs to adjust the quantities they import from foreign suppliers, and as a result the elasticity of substitution between products from different countries varies endogenously over time. Second, producers in each sector must pay costs to adjust their capital stocks and employment levels, and this makes sectoral reallocations following trade policy changes costly.

3.1 *Gross output production*

Gross output in country i's sector s, $y^s_{i,t}$, is produced using capital, $k^s_{i,t}$, and labor, $\ell^s_{i,t}$, rented from households, and intermediate inputs, $m^{s,r}_{i,t}$, purchased from distributors in each sector $r \in S$. Adjusting sectoral employment over time reduces output, however, and large adjustments are particularly costly. The production technology is given by

$$y^s_{i,t} = \min\left\{\frac{(k^s_{i,t})^{\alpha^s_i}(\ell^s_{i,t})^{1-\alpha^s_i}}{\lambda^{s,v}_i}, \min_{r\in S}\left[\frac{m^{s,r}_{i,t}}{\lambda^{s,r}_i}\right]\right\} - \phi_\ell\left(\frac{\ell^s_{i,t}}{\ell^s_{i,t-1}} - 1\right)^2 \ell^s_{i,t-1}. \tag{1}$$

The Leontief specification is consistent with Atalay (2014), who estimates the elasticities of substitution between value added and intermediates from different sectors to be approximately zero, and Kehoe et al. (2017), who show that it accounts for the dynamics of U.S. sectoral intermediate expenditures. The direct requirement coefficients $\lambda^{s,v}_i$ and $\lambda^{s,r}_i$, govern the shares of value added and intermediates from each sector, respectively, in gross output. The parameter ϕ_ℓ governs the size of the labor adjustment costs, which are modeled in as in Sargent (1978). Adjusting sectoral capital stocks is also costly; large changes in capital require disproportionately large purchases of investment goods. The law of motion for sectoral capital is modeled as in Eaton et al. (2011) and Lucas and Prescott (1971):

$$k^s_{i,t+1} = (1-\delta)k^s_{i,t} + \delta^{1-\phi_k}(x^s_{i,t})^{\phi_k}(k^s_{i,t})^{1-\phi_k}. \tag{2}$$

$x^t_{i,t}$ represents sectoral investment and the parameter ϕ_k governs the size of capital adjustment costs.

Gross output producers are perfectly competitive, and choose labor, investment, and intermediate inputs to maximize the present value of their dividends,

$$\sum_{t=0}^{\infty} \Lambda_{i,t} d^s_{i,t}, \tag{3}$$

where dividends are given by

$$d^s_{i,t} = p^s_{i,t} y^s_{i,t} - w_{i,t}\ell^s_{i,t} - p^x_{i,t} x^s_{i,t} - \sum_{r\in S} p^{m,r}_{i,t} m^{s,r}_{i,t}. \tag{4}$$

$p^s_{i,t}$ is the price of gross output in country i's s sector, $w_{i,t}$ is the wage, $p^x_{i,t}$ is the price of investment, and $p^{m,r}_{i,t}$ are the prices of intermediate inputs purchased from distributors in each sector $r \in S$. $\Lambda_{i,t}$ is the price used to discount the firm's dividends.

3.2 *International trade*

International trade is conducted by distributors that combine domestic and foreign products into non-tradable composites as in Armington (1969). In each country i and each sector s, there is one distributor for intermediate goods and another for final expenditures. In what follows, I describe the production technology and optimization problem of an intermediate distributor; the techology and problem of a final distributor are analogous. Country i's sector-s intermediate composite, $q^{m,s}_{i,t}$, is produced using inputs, $z^{m,s}_{i,j,t}$, from the s-sector in each country j according to a CES technology. In order to adjust the quantities they purchase from foreign suppliers, however, distributors must pay convex costs as in Krugman (1986) and Engel and Wang (2011). The intermediate distributor's technology is given by

$$q^{m,s}_{i,t} = \left\{ \sum_{j\in I} \mu^{m,s}_{i,j} \left(z^{m,s}_{i,j,t}\right)^{\frac{\zeta^{m,s}_i - 1}{\zeta^{m,s}_i}} \right\}^{\frac{\zeta^{m,s}_i}{\zeta^{m,s}_i - 1}} - \sum_{j\in I\setminus\{i\}} \phi_m \left(\frac{z^{m,s}_{i,j,t}}{z^{m,s}_{i,j,t-1}} - 1 \right) z^{m,s}_{i,j,t-1}. \tag{5}$$

$z_{i,j,t}^{m,s}$ denotes the quantity of sector-s intermediates purchased from country j. The parameter $\mu_{i,j}^{m,s}$ governs the share of products that are sourced from country j. $\zeta_i^{m,s}$ is the long-run elasticity of substitution between products from different countries—the long-run trade elasticity—which is allowed to vary by country, sector, and use. The parameter ϕ_m governs the size of the adjustment costs. $q_{i,t}^{f,s}$ is the final composite, $z_{i,j,t}^{f,s}$ are the final distributor's inputs, and $\mu_{i,j}^{m,s}$, $\zeta_i^{f,s}$, and ϕ_f are the analogous parameters of the final distributor's technology.

Like gross output producers, distributors face a dynamic optimization problem in which they choose a sequence of inputs to maximize the present value of their dividends. An intermediate distributor's dividends are given by

$$d_{i,t}^{m,s} = p_{i,t}^{m,s} q_{i,t}^{m,s} - \sum_{j \in I} p_{j,t}^{s}(1 + \tau_{i,j,t}^{s}) z_{i,j,t}^{m,s}, \tag{6}$$

where $\tau_{i,j,t}^{s}$ is the import tariff on products from country j. A final expenditure distributor's dividends are defined similarly.

In this environment the short-run trade elasticity differs endogenously from the long-run trade elasticity $\zeta_i^{m,s}$. To see why, consider the following expression obtained by taking the distributor's first-order condition for inputs from a foreign country $j \neq i$:

$$p_{j,t}^{s}(1 + \tau_{i,j,t}^{s}) = p_{i,t}^{m,s} \mu_{i,j}^{m,s} \left(\frac{z_{i,j,t}^{m,s}}{q_{i,t}^{m,s}} \right)^{-\zeta_i^{m,s}} - p_{i,t}^{m,s} \phi_m \left(2 \frac{z_{i,j,t}^{m,s}}{z_{i,j,t-1}^{m,s}} - 2 \right) - \Lambda_{i,t} p_{i,t+1}^{m,s} \phi_m \left(1 - \left(\frac{z_{i,j,t+1}^{m,s}}{z_{i,j,t}^{m,s}} \right)^2 \right) \tag{7}$$

When there are no import adjustment costs, a *ceteris parabus* one-percent increase in the price of the imported product—or, in the case of NAFTA termination, the import tariff—always induces a $\zeta_i^{m,s}$-percent decrease in the share of imported inputs in the composite bundle. In other words, the short-run elasticity of substitution between inputs from different countries always equals the long-run elasticity $\zeta_i^{m,s}$. In the presence of adjustment costs, the change in the share of inputs imported from country j depends on both the long-run elasticity and the trajectory of imports themselves. The larger the adjustment cost parameter ϕ_m, the more important these dynamics are in determining the short-run elasticity of substitution. Thus, this setup provides a parsimonious way to capture aggregate trade adjustment dynamics without modeling firm-level trade dynamics as in Ruhl (2008), Alessandria and Choi (2016), and Alessandria et al. (2015).

3.3 Investment

Each country has a nontradable investment good, $q^x_{i,t}$, that is an aggregate of inputs, $z^{x,s}_{i,t}$, purchased from final distributors:

$$q^x_{i,t} = \prod_{s\in S}(z^{x,s}_{i,t})^{\mu^{x,s}_i}. \tag{8}$$

The Cobb-Douglas formulation follows Bems (2008) and Kehoe et al. (2017), who show that sectoral expenditure shares in investment are approximately constant over time. The ideal price index of investment is $p^x_{i,t}$.

3.4 Households

The representative household in each country i chooses consumption, $c^s_{i,t}$, of each product $s \in S$, labor supply, $\ell_{i,t}$, and bond holdings, $b_{i,t+1}$, to maximize its lifetime utility,

$$\sum_{t=0}^{\infty}\beta^t \frac{1}{\psi}\left[c^{\gamma}_{i,t}(\bar{\ell}_i - \ell_{i,t})^{1-\gamma}\right]^{\psi}, \tag{9}$$

subject to the budget constraints

$$\sum_{s\in S} p^{f,s}_{i,t} c^s_{i,t} + Q_t b_{i,t+1} = w_{i,t}\ell_{i,t} + b_{i,t} + \sum_{s\in S}(d^s_{i,t} + d^{f,s}_{i,t} + d^{m,s}_{i,t}) + T_{i,t}, \tag{10}$$

and initial conditions for bonds. The aggregate consumption bundle, $c_{i,t}$, is given by a standard CES aggregate,

$$c_{i,t} = \left[\sum_{s\in S}\varepsilon^s_i (c^s_{i,t})^{\frac{\rho-1}{\rho}}\right]^{\frac{\rho}{\rho-1}}. \tag{11}$$

$T_{i,t}$ denotes the lump-sum transfer of revenues raised by tariffs and other taxes from the government. The parameters γ and ψ govern the share of time devoted to leisure and the intertemporal elasticity of substitution, respectively, and ρ is the elasticity of substitution between different sectors in consumption. $\bar{\ell}_i$ are time endowments. The discount factor used to value producers' and distributors' dividends is given by

$$\Lambda_{i,t} = \beta \frac{p^{f,s}_{i,t}}{p^{f,s}_{i,t+1}} \frac{u'^s_{i,t+1}}{u'^s_{i,t}}, \tag{12}$$

for any $s \in S$, where $u'^{s}_{i,t}$ denotes the household's marginal utility with respect to consumption in sector s in period t.

3.5 Market clearing

There are several markets that must clear in each period t. First, gross output must equal demand from all domestic and foreign distributors:

$$y^{s}_{i,t} = \sum_{j \in I} \left(z^{m,s}_{j,t} + z^{f,s}_{j,t} \right), \; \forall i \in I, \; \forall s \in S. \tag{13}$$

Second, firms' demand for intermediate inputs must equal output of intermediate distributors:

$$q^{m,s}_{i,t} = \sum_{r \in S} m^{r,s}_{i,t}, \; \forall i \in I, \; \forall s \in S. \tag{14}$$

Third, demand for investment inputs and consumption must equal final distributors' output:

$$q^{f,s}_{i,t} = c^{s}_{i,t} + z^{x,s}_{i,t}, \; \forall i \in I, \; \forall s \in S. \tag{15}$$

Fourth, firms' demand for investment must equal total output of the investment good:

$$q^{x}_{i,t} = \sum_{s \in S} x^{s}_{i,t}, \; \forall i \in I. \tag{16}$$

Fifth, labor markets must clear:

$$\ell_{i,t} = \sum_{s \in S} \ell^{s}_{i,t}. \tag{17}$$

Sixth, the international bond market must clear:

$$\sum_{i \in I} b_{i,t+1} = 0. \tag{18}$$

3.6 Equilibrium

An equilibrium, given a sequence of trade policy parameters, $\{(\tau^{s}_{i,j,t})_{i,j \in I, s \in S}\}_{t=0}^{\infty}$, is a sequence of quantities and prices that satisfies the optimality conditions of households, firms, and distributors, the marginal product pricing conditions for investment, and all of the market clearing conditions. In the long run, if trade costs are constant, an equilibrium will always converge to a steady state. As in Kehoe et al. (2017), though, there is not a unique steady state—there is a continuum of possible steady states indexed by the vector of long-run bondholdings $(b_{i,\infty})_{i \in I}$, and the steady state to which the economy converges depends on initial conditions as well as the other model parameters.

I construct two equilibria in my model. In the first, the *benchmark*, tariffs on intra-NAFTA trade are zero forever. In the second, the *termination* equilibrium, trade costs between NAFTA countries rise by the values shown in table 2 in period $t = 4$, which corresponds to 2018. I assume that this policy change is unanticipated: in periods $t = 0, 1, 2$, and 3 of the termination equilibrium, model agents believe that trade costs will not change from their benchmark values.[3] With these two equilibria in hand, we can measure the impact of NAFTA termination on each country's macroeconomic and trade dynamics by comparing the trajectories of model variables in the termination equilibrium to their benchmark counterparts.

4 Calibration

My calibration proceeds in three stages. First, I assign common parameters like discount factors and elasticities of substitution to standard values from the literature. Second, I set most of the remaining parameters so that the benchmark equilibrium—the one in which NAFTA is never terminated—matches input-output data that describe production and demand in NAFTA countries and the rest of the world in 2014, the most recent year available in the WIOD data. Third, I set ϕ_m and ϕ_f, the import adjustment cost parameters, so that short-run trade elasticities in the termination equilibrium are consistent with findings from the trade dynamics literature.

4.1 Assigned parameters

I set the discount factor, β, so that the steady-state real interest rate is 2 percent per year. ψ, which governs the intertemporal elasticity of substitution, is set to -1. The depreciation rate, δ, is set to 6 percent. The capital shares, α_i^s, are all set to the standard value of one-third. I follow Kehoe et al. (2017) and Atalay (2014) and set ρ, the elasticity of substitution between sectors in consumption, to 0.65. I set γ, the share of consumption in households' utility, so that households supply one-third of their labor endowments in a steady state. I

[3] This assumption is benign; welfare losses are the same if the policy change is anticipated.

set ϕ_ℓ, the labor adjustment cost parameter, to 6.5, the value used by Kehoe and Ruhl (2009) in their study of Mexico's 1995 sudden stop; this value is similar to that estimated by Sargent (1978). I set the capital adjustment cost parameter, ϕ_k, to 0.5, the value reported by Eaton et al. (2011). To set initial bondholdings, $b_{i,0}$, for the three NAFTA countries, I use data on their 2014 net foreign assets reported in the Lane and Milesi-Feretti (2007) dataset; the rest of the world's initial bondholdings are implied by market clearing. Table 4 lists these assigned parameter values.

To set the long-run trade elasticities, $\zeta_i^{m,s}$ and $\zeta_i^{f,s}$, I refer to the trade literature. For the four goods sectors—agriculture, resources, transportation equipment, and other manufacturing, I use Caliendo and Parro (2015)'s estimates of trade elasticities for 2-digit ISIC industries. The ISIC classification conveniently maps to the set of industries in the WIOD database. For each country i and sector s, I set the intermediate (final) elasticity, $\zeta_i^{m,s}$ ($\zeta_i^{f,s}$), to the average of the Caliendo and Parro (2015) estimates for the industries that comprise that sector, weighted by these industries shares' in country i's intermediate (final) imports of goods in that same sector. For the services sector, I follow Costinot and Rodríguez-Clare (2014) and set all elasticities to five, the average of the Caliendo and Parro (2015) estimates. Table 5 lists the assigned long-run elasticities, which range from 0.8 in transportation equipment to more than 40 in resources.

4.2 *Expenditure shares and other parameters calibrated to input-output data*

I calibrate the expenditure share parameters, $\lambda_i^{s,v}$, $\lambda_i^{s,r}$, $\mu_{i,j}^{m,s}$, $\mu_{i,j}^{f,s}$, $\mu_{s,i}^{x}$, ε_i^s, and the time endowments, $\bar{\ell}_i$, so that in the benchmark equilibrium, first-period expenditures on factors, intermediate inputs, consumption, and investment equal the values in the aggregated WIOD data for 2014 described in section 2.2. 2014 is the most recent year available in the dataset and serves as a good no-termination counterfactual because President Trump's election, and thus the possibility of NAFTA termination, was not foreseen at this time. This portion of the calibration procedure uses marginal product pricing equations and other equilibrium conditions to infer the expenditure share parameters that are consistent with the input-output data. Kehoe et al. (2017) describe this kind of procedure in more detail. As in Steinberg (2017), I set all import tariffs, $\tau_{i,j,t}^s$, to zero in the benchmark equilibrium, including on trade with the rest of the world. This implies that the Armington share parameters, $\mu_{i,j}^{m,s}$ and $\mu_{i,j}^{f,s}$, absorb all trade costs reflected in the 2014 input-output data as well as subjective home bias. This is without loss of generality since tariffs are rebated lump-sum to households. The parameters calibrated in this section contain many elements (for example, $\mu_{i,j}^{m,s}$ has $80 = 4 \times 5 \times 4$ elements) so I do not include them in the paper. They can be found in the supplemental materials available at http://www.economics.utoronto.ca/steinb44/files/nafta_supplement.zip.

4.3 *Import adjustment costs*

The last parameters that must be calibrated are ϕ_m and ϕ_f, the import adjustment cost parameters. There is no clear reference to assign for values for these parameters, so I calibrate them to to generate trade elasticity dynamics in the termination equilibrium that are consistent with the literature. I set them so that in the average aggregate one-year short-run trade elasticity in the period immediately following NAFTA termination is one, the standard value in the international macro literature (Heathcote and Perri, 2002). I measure short-run trade elasticities following Alessandria et al. (2015). For each country i, I measure the bilateral short-run trade elasticity in sector s with trade partner j as the percent change in country i's imports of sector-s products from country j divided by the percent change in import tariffs:

$$e^s_{i,j,t} = \log\left(\frac{p^s_{j,t}(z^{m,s}_{i,j,t} + z^{f,s}_{i,j,t})}{p^s_{j,0}(z^{m,s}_{i,j,0} + z^{f,s}_{i,j,0})}\right) \Big/ \log\left(\frac{1+\tau^s_{i,j,t}}{1+\tau^s_{i,j,0}}\right). \tag{19}$$

To measure each country's aggregate trade elasticity, I simply take the average of its sector-partner elasticities weighted by pre-termination imports. This average excludes elasticities in trade with the rest of the world; since trade costs with the rest of the world do not change the trade elasticity with the rest of the world measured in this way is undefined.

5 Quantitative results

Having laid out the model and calibrated its parameters, I turn now to the results of the quantitative analysis. Table 6 summarizes the long-run effects of NAFTA termination on trade, production, and consumption, and figures 4–5 illustrate the macroeconomic implications of these effects. Figure 6 illustrates the transition dynamics that follow NAFTA termination and table 7 lists welfare losses, which include the effects of these transition dynamics as well as long-run changes.

5.1 *Long-run trade and macroeconomic consequences*

In the long run, trade flows between NAFTA members fall by 6–14 percent. Mexican imports of NAFTA products fall most because Mexico levies the highest post-NAFTA tariffs, and Canadian imports fall least. At the sectoral level, trade in agriculture falls most because this sector has a high long-run trade elasticity and Mexico, in particular, levies high post-NAFTA tariffs; Mexican imports of agriultural products from the United States and Canada fall by 85 percent and 56 percent, respectively. Trade in the resource extraction sector also falls dramatically despite low post-NAFTA tariffs because this sector's trade elasticity is even higher. By contrast, despite high post-NAFTA tariffs in transportation equipment, trade in this sector falls only slightly because it has an extremely low long-run trade elasticity. Trade in other manufacturing falls modestly because this sector has an average long-run trade elasticity and low post-NAFTA tariffs.

All NAFTA members substitute towards trade with the rest of the world in reponse to NAFTA termination. Trade with the rest of the world in resource extraction, in particular, burgeons: Canadian and Mexican exports of resources to the rest of the world rise by 7.4 and 5.1 percent, respectively. Mexico significantly increases its imports from the rest of the world, especially in agriculture and other manufacturing. This substitution does not fully mitigate the decline in intra-NAFTA, however; NAFTA members' aggregate trade flows decline by 2–7 percent.

As panels (a), (c), and (e) of figure 4 show, the macroeconomic significance of these changes is larger for Canada and Mexico, whose economies rely heavily on NAFTA trade, and than for the United States, whose economy does not. The other manufacturing sector accounts for most of the decline in intra-NAFTA trade, even though trade in this sector does not fall as precipitously as trade in agriculture or resources, because of this sector's size (recall panel (d) in figure 2). For Canada, the decline in resources trade is also macroeconomically significant.

The top two rows of each panel in table 6 list the ultimate long-run macroeconomic consequences of NAFTA termination for each country. While production and consumption fall in the long run in all three countries, none of these effects are large; the long-run drop in consumption in each country is less than a tenth of a percent. For the United States and Canada, these losses are similar in magnitude to the gains from implementating NAFTA estimated by Caliendo and Parro (2015). For Mexico, the loss from termianting NAFTA is smaller because Mexico's MFN tariffs have fallen significantly since the 1990s.

5.2 Long-run trade balances

Although NAFTA termination has a significant impact on gross trade flows in the long run, it has only a small effect on long-run trade imbalances. As panels (b), (d), and (f) of figure 4 show, the U.S. trade deficit with Mexico grows larger due to the dramatic decline in Mexican imports of U.S. agricultural products, while the U.S. trade deficit with Canada shrinks due the decline in U.S. imports of Canadian resources. These changes, however, are small relative to the deficits' initial sizes. Relative to the size of the U.S. economy, the trade deficits with Canada and Mexico are small to begin with and so the changes that result from NAFTA termination are macroeconomically negligible.

From Canada's and Mexico's perspectives, the initial trade imbalances with the United States are large but the changes amount to no more than a few tenths of a percent of GDP. Further, these changes are also offset by increased trade imbalances with the rest of the world. Mexico, whose surplus with the United States grows, sees an increased trade deficit with the rest of the world driven by increased imports of agricultural products and other manufactured goods. Canada, whose surplus with the United States shrinks, sees an increased surplus with the rest of the world driven by natural resources and, to a lesser extent, services trade.

5.3 Long-run sectoral reallocation

The asymmetric responses of sectoral trade flows to NAFTA termination cause resources to reallocate across sectors. Panel (a) of figure 5 illustrates how production patterns change in each country. In the United States, the largest drop in sectoral production is seen in the agriculture sector due to the significant reduction in agriculture exports to Mexico. Production in the resources sector rises slightly, while production in other sectors declines. In Canada, production falls most in transportation, followed by resources and other manufacturing. In Mexico, which experiences the most production reallocation, transportation and other manufacturing production fall significantly, while agricultural production booms to offset Mexico's massive decline in imports in this sector.

Panel (b) illustrates how each country's consumption basket changes in response to these sectoral reallocations. Notably, consumption of transportation equipment falls significantly more than production in this sector. As I demonstrate in my sensityivity analyses below, this is due to the low trade elasticity and extensive international input-output linkages in this sector. Additionally, the Canadian and Mexican consumption baskets shift away from goods and towards services. Finally, despite the significant increase in Mexican agricultural production, Mexican consumption of agriculture still declines; domestic production and imports from the rest of the world do not fully make up for the decline in imports from the United States.

5.4 Trade and macroeconomic dynamics

The first two panels in figure 6 illustrate the transition dynamics of trade flows that follow NAFTA termination. Panel (a) shows that the short-run effects of NAFTA termination on trade are more muted than the long-run effects. It takes more than ten years for trade flows to adjust to their post-NAFTA steady states. This is due largely to the presence of import adjustment costs which, as discussed above, cause short-run trade elasticities to differ endogenously from the assigned long-run values. Panel (b) shows how each country's trade elasticity responds to NAFTA termination. By construction, each country's short-run trade elasticity is one in the period following termination, and it takes many years to reach their long-run values, which range from 7 to 10.

Panels (c)–(f) illustrates the effects of NAFTA termination on macroeconomic dynamics. Like trade flows, GDP and investment fall gradually in all three countries. In the United States and Canada, consumption adjusts more quickly. In Mexico, consumption actually rises in the short run because the trade balance rises slowly to its long-run post-NAFTA level. This gradual adjustment is due to the model's import adjustment costs; Mexico's agricultural imports take longer to adjust than its trade in other sectors because the long-run trade elasticity in agriculture is high.

5.5 Welfare

The long adjustment process to the post-NAFTA steady state shown in figure 6 suggests that the welfare losses associated with NAFTA termination could differ from the long-run changes in consumption. I measure welfare losses in the usual consumption-equivalent way, which asks households in each country what fraction of their annual consumption baskets they would give up to remain in the benchmark equilibrium in which NAFTA remains in force. Table 7 shows that welfare losses for all three countries are similar in magnitude to the long-run drops in consumption. For the United States and Canada, NAFTA termination reduces welfare by 0.03 and 0.07 percent, respectively. In Mexico, welfare actually rises by 0.01 percent as a result of the initial increase in consumption.

6 Sensitivity analyses and alternative scenarios

In this section I analyze the sensitivity of my results to key aspects of my calibration and explore several alternative scenarios for post-NAFTA trade policies. Table 7 compares welfare and trade effects in these exercises to the baseline analyses. Table 8 shows the effects on the transportation sector which helps highlight the economic forces at work in these exercises.

6.1 Sensitivity analyses

I conduct four sets of sensitivity analyses. In the first set, I analyze the roles of adjustment costs to capital, labor, and trade in shaping post-NAFTA transition dynamics and welfare losses. In the second, I study the role of input-output linkages in driving the results. In the third set of sensitivity analyses, I highlight the importance of the long-run trade elasticities. In the fourth, I illustrate the significance of modeling NAFTA termination as an increase in tariffs rather than iceberg trade costs.

6.1.1 Adjustment costs

Recent contributions to the international trade literature have highlighted the importance of adjustment frictions in factor markets and trade in shaping the transition dynamics that follow trade reforms (Brooks and Pujolas, 2016; Ravikumar et al., 2017; Dix-Carneiro, 2014; Alessandria et al., 2015). My baseline model features several such frictions: distributors must pay to adjust their import patterns and firms must pay to adjust their sector-specific factors. Figure 6 shows that as a result of these frictions, the U.S., Canadian, and Mexican economies take many years to transition to their new post-NAFTA steady states. Here, I ask: how costly are these adjustment frictions? To answer this question, I analyze three alternative versions of the model: one without import adjustment costs, a second without capital adjustment costs, and a third without labor adjustment costs.

Figure 7 shows trade and macroeconomic dynamics in the model without trade adjustment costs. In this version of the model trade flows fall almost immediately to their long-run levels. Consequently, trade elasticities ares approxmately constant over time. Investment also falls more quickly, because investment production relies on imported goods as well as domestic ones. The effects of trade adjustment costs on GDP and consumption dynamics are minor, however; these variables evolve similarly in this version of the model to the baseline.

Figures 8 and 9 show transition paths in the models without capital and labor adjustment costs, respectively. Investment is more volatile in the model without capital adjustment costs but the dynamics of trade, GDP, and consumption are similar to the baseline model's dynamics. In the model without labor adjustment costs, all variables evolve similarly to their baseline counterparts; consumption is less volatile but the differences are slight.

Table 7 shows that the welfare costs of all three frictions are small: the welfare losses from NAFTA termination in the three alternative models are similar to the losses in the baseline model. Thus, while trade adjustment frictions do slow the process of adjustment to the post-NAFTA equilibrium, these frictions are not costly.

6.1.2 Intermediate linkages

Giri et al. (2017), Caliendo and Parro (2015), and other recent quantitative trade studies have shown that intermediate input linkages are quantitatively important in shaping economic responses to trade policy reforms. Like these studies, my baseline model features a rich input-output structure in which firms in each sector use domestic and imported intermediates to produce their goods and services. As I have shown, all three NAFTA countries' transportation sectors rely particularly heavily on imported intermediate inputs. Here, I ask: what is the role of input-output linkages in determining the macroeconomic and sectoral consequences—particularly for the transportation sector—of NAFTA termination? To answer this question, I analyze a version of my model in which there are no intermediate inputs. In this alternative, I zero out all intermediate input cells in my input-output matrix before calibrating the model .[4] Thus, gross output equals value added in all sectors and international trade consists only of final expenditures.

Table 7 shows that for the United States and Canada, NAFTA trade falls by about the same amount in the no-intermediates alternative as in the baseline model and welfare losses are lower. For Mexico, trade falls less but welfare losses are larger. Table 8 shows that the effects of NAFTA termination are on the transportation

[4] I use the RAS procedure Bacharach (1965) to "balance" the alternative input-output matrix to ensure that all markets clear, ensuring that this matrix can represent an intratemporal equilibrium in my model.

equipment sector are significantly less pronounced in the no-intermediates alternative than in the baseline model. In all three NAFTA countries, transportation value added falls less than in the baseline; the difference is largest for Canada which imports the most intermediate inputs in this sector. Transportation consumption falls less in the no-intermediates alternative in the United States and Canada, which export intermediates and import final goods in this sector, and slightly more in Mexico, which imports intermediates and exports final goods Timmer et al. (2015).

The results of this analysis indicate that, as many analysts have predicted, regional production chains play a quantitatively important role in determining the consequences of NAFTA termination. In section 6.2.3 I expand upon this point by analyzing the importance of intermediate input trade with the rest of the world.

6.1.3 Trade elasticities

Trade elasticities—are key parameters in any trade reform analysis because they play a central role in determining how trade flows and welfare respond to changes in trade costs (Arkolakis et al., 2012). In multi-sector models, cross-sectoral differences in trade elasticities are particularly important (Caliendo and Parro, 2015; Costinot and Rodríguez-Clare, 2014). In my baseline analysis, I assigned sectoral trade elasticities based on Caliendo and Parro (2015)'s estimates. Agriculture and resources have high trade elasticities, while the transportation equipment sector has a low one. Here, I ask: how do cross-sectoral differences in trade elasticities shape the quantitative effects of NAFTA termination? To answer this question, I analyse two alternative versions of my model. In the first, all sectors have a long-run trade elasticity of 5, the average estimate reported by Caliendo and Parro (2015). In the second, I alter my assigned trade elasticities using recent insights by Kehoe and Ruhl (2013) and Kehoe et al. (2015), who show that sectors with many non-traded or "least traded" products respond more to trade reforms than the Caliendo and Parro (2015) elasticities imply.

In the symmetric-elasticity model, regional trade declines by about the same amount as in the baseline model but the welfare effects are different. U.S. welfare losses are smaller, while Canadian and Mexican welfare losses are larger. For Mexico, welfare losses are significantly higher in the symmetric-elasticity alternative because the decline in agricultural imports caused by its high tariffs in this sector is more painful. In the transportation sector, which has a low elasticity in the baseline model, imports fall more in the symmetric-elasticity alternative. This is less painful than in the baseline model, however, because it is easier to substitute domestic products for foreign ones.

In the least-traded-products version of the model (labeled "LTP trade elasticities" in tables 7–8), I use COMTRADE data on trade at the 6-digit HS level to calculate the share of least traded products in each sector, and then increase each sector's long-run trade elasticity by a factor of 3.65 times its least traded share following Kehoe et al. (2015). In the agriculture sector, which has the highest least traded share, the elasticity almost doubles. In the resources and transportation equipment sectors, on the other hand, which have the lowest least trades shares, the elasticity barely changes. In this version of the model, trade falls more than in the baseline and the welfare costs are larger, but the differences are minor. Caution should be taken when interpreting the differences in welfare effects, however, because the least-traded product effect might originate in firm-level export participation decisions rather than consumer preferences (Arkolakis, 2010). In this case, the welfare losses from the increased drop in trade in this exercise might be more costly.

6.1.4 Iceberg trade costs

I have modeled NAFTA termination as an increase in import tariffs that are rebated lump-sum to consumers. Raising tariffs is harmful because it raises consumer prices and reduces trade, but these effects are offset by the increased tariff revenue. Here, I ask: what would happen if NAFTA termination were modeled as an increase in non-tariff trade barriers, which entail real resource costs, instead? To answer this question, I repeat my quantitative exercise in a version of the model in which trade costs are not rebated to consumers.

In this version of the exercise, trade falls by approximately the same amounts as in the baseline exercise but the welfare costs of NAFTA termination are much larger. This analysis indicates that increased tariff revenue plays a significant role in mitigating the welfare losses from reduced regional trade flows. Consequently, if NAFTA termination causes increases in non-tariff barriers as well as formal import tariffs, it could cause significant harm to member countries' economies.

6.2 *Alternative scenarios*

In my baseline analysis I have assumed that NAFTA is terminated entirely, and when this happens its members will levy the same most-favored-nation tariffs on each others' imports that they levy on imports from other World Trade Organization members. Trade policies towards other countries are unaffected, and no renegotiated deal is reached between even a subset of NAFTA members. Here, I explore the effects of several alternative scenarios that could arise in place of, or in addition to, NAFTA termination.

6.2.1 Higher U.S. tariffs

The first alternative scenario is motivated by recent unilaterally protectionist U.S. policies to increase tariffs on steel, aluminum, and other imported products from around the world. In this version of the analysis I assume that when NAFTA is terminated the United States also doubles its most-favored-nation tariffs. Thus, U.S. tariffs on Canadian and Mexican products rise twice as much as in the baseline model, and U.S. tariffs on imports from the rest of the world rise as well. Canadian and Mexican import tariffs are the same in this scenario as in the baseline.

As expected, in this scenario U.S. imports from Canada and Mexico fall more than in the baseline analysis and its imports from the rest of the world fall as well. U.S. welfare actually rises, however, instead of falling; this result follows from an optimal tariff argument. Conversely, welfare losses in Canada and Mexico are larger than in the baseline analysis; it is Canada and Mexico, not the United States, that bear the burden of increased U.S. protectionism. As table 8 shows, the Canadian and Mexican transportation sectors shrink significantly more in terms of both production and consumption in this scenario, suggesting that input-output linkages may play a role in driving these results.

6.2.2 Bilateral free trade agreements

The second and third alternative scenarios explore the potential for Canada to mitigate its losses from NAFTA termination by signing bilateral free trade agreements. In the second alternative, NAFTA is terminated but the United States and Canada sign a bilateral free trade agreement. In the third, Canada forms a free trade agreement with Mexico, intead.

Table 7 shows that Canada's welfare losses are significantly smaller in the analysis in which NAFTA is replaced by a U.S.-Canada free trade agreement, but they are similar to the baseline losses in the analysis with a Canada-Mexico free trade agreement. Thus, Canada can mitigate most of its losses from NAFTA termination by signing a bilateral free trade agreement with the United States, but forming a free trade agreement with Mexico has little effect. These results follow from the fact that Canada's primary trade partner is the United States; it trades little with Mexico, so it has little to gain from a Canada-Mexico free trade agreement. The same logic holds true for Mexico; a bilateral free trade agreement with the United

States could mitigate Mexico's welfare losses from NAFTA termination , but an agreement with Canada could not.

6.2.3 Renegotiation with stronger domestic content requirements

One of the major sticking points in NAFTA renegotiation talks is domestic content requirements, especially in the transportation equipment sector. Also called rules of origin, these regulations restrict the amount of intermediate inputs that firms can purchase from non-NAFTA countries while remaining eligible for duty-free trade within NAFTA. Conconi et al. (2017) show that these requirements have already significantly reduced imports of intermediate inputs from the rest of the world. U.S. trade representatives, however, have demanded even stricter domestic content requirements, especially in the transportation sector, as a condition of remaining in NAFTA. Here, I analyze what would happen if NAFTA remains in force but domestic content requirements are increased. I model this by assuming that in the termination equilibrium, trade costs between NAFTA countries do not change but all NAFTA countries impose 10-percent iceberg trade costs on imported intermediate inputs from the rest of the world (trade costs on final goods from the rest of the world do not change). I model domestic content requirements as iceberg costs rather than tariffs because they generate no tax revenue for importing countries.

Table 7 shows that strengthening domestic context requirements would actually be worse than terminating NAFTA entirely. In fact, welfare falls even more this exercise than in the iceberg-cost version of NAFTA termination. Trade with the rest of the world falls significantly and the transportation equipment sectors in Canada and the United States are impacted about as much as in the baseline exercise. This exercise indicates that policymakers should be particularly wary of acceding to the Trump administration's demands for stricter domestic content requirements.

7 Conclusion

In this paper I have used a dynamic general equilibrium model with an input-output production structure and adjustment frictions in factor markets and trade to assess the consequences of terminating the North American Free Trade Agreement for member countries' trade flows, macroeconomic dynamics, welfare, and sectoral performance. When NAFTA is terminated in 2018, NAFTA members charge the same import tariffs on each other's products that they charge on products from other World Trade Organization members.

Tariffs rise most in the transportation equipment sector and, in the case of Mexico, agriculture.

In the long run, NAFTA termination would reduce aggregate trade flows between NAFTA members by 6–14 percent and would cause output and consumption to fall in all three member countries. Terminating NAFTA would have little effect on regional trade imbalances, however. At the sectoral level, Mexican imports of U.S. agricultural products would fall most because Mexico charges high tariffs in this sector. Trade in natural resources, which is highly substitutable across countries, would also fall significantly. Despite high tariffs, trade in transportation equipment would fall the least because the trade elasticity in this sector is low. Precisely because of this low elasticity, however, the small drop in trade is costly; transportation value added and consumption fall significantly in all three countries. My results indicate that strong international input-output linkages in this sector also play an important role in how it is affected by NAFTA termination.

In the short run, trade would fall gradually after NAFTA is terminated because it is costly for importers to adjust the quantities they purchase from foreign suppliers, and sectoral investment also adjusts gradually. Taking into account these transition dynamics, welfare would fall by 0.03 percent in the United States and 0.07 percent in Canada after NAFTA is terminated, and it would rise by 0.01 percent in Mexico. These welfare effects are similar to the long-run changes in consumption, which implies that the process of adjustment to the new post-NAFTA steady state is not costly.

In addition to the baseline NAFTA termination scenario, I have analyzed a range of alternatives: one in which the United States raises all import tariffs unilaterally, others in which Canada forms bilateral free trade agreements with its former NAFTA partners, and yet another in which NAFTA is renegotiated to include stricter domestic content requirements. Canada and Mexico would bear the brunt of increased U.S. protectionism, and increasing domestic content requirements would be worse than terminating NAFTA entirely.

References

Alessandria, George and Horag Choi, "Do Sunk Costs of Exporting Matter for Net Export Dynamics?," *The Quarterly Journal of Economics*, 2007, *122* (1), 289–336.

_ **and** _ , "The Dynamics of the U.S. Trade Balance and Real Exchange Rate: The J Curve and Trade Costs?," Working Paper February 2016.

_ **,** _ **, and Kim J. Ruhl**, "Trade Adjustment and the Welfare Gains from Trade," Working paper 2015.

Allen, Treb, "Information Frictions in Trade," *Econometrica*, November 2014, *82*, 2041–2083.

Anderson, James E. and Eric van Wincoop, "Trade Costs," *Journal of Economic Literature*, September 2004, *42* (3), 691–751.

Arkolakis, Costas, "Market Penetration Costs and the New Consumers Margin in International Trade," *Journal of Political Economy*, 2010, *118* (6), 1151–1199.

_ , Arnaud Costinot, and Andrés Rodríguez-Clare, "New Trade Models, Same Old Gains?," *American Economic Review*, 2012, *102* (1), 94–130.

Armington, Paul S., "A Theory of Demand for Products Distinguished by Place of Production (Une thÃl'orie de la demande de produits diffÃl'renciÃl's d'aprÃÍs leur origine) (Una teorÃ■a de la demanda de productos distinguiÃl'ndolos segÃžn el lugar de producciÃşn)," *Staff Papers (International Monetary Fund)*, 1969, *16* (1), 159–178.

Atalay, Enghin, "How Important Are Sectoral Shocks?," Working Paper 2014.

Bacharach, Michael, "Estimating Nonnegative Matrices from Marginal Data," *International Economic Review*, September 1965, *6* (3), pp. 294–310.

Bajona, Claustre and Timothy Kehoe, "Trade, Growth, and Convergence in a Dynamic Heckscher-Ohlin Model," *Review of Economic Dynamics*, July 2010, *13* (3), 487–513.

Baker, Jessica, Oriol Carreras, Simon Kirby, Jack Meaning, and Rebecca Piggott, "Modelling events: The short-term economic impact of leaving the EU," *Economic Modelling*, 2016, *58* (C), 339–350.

Baldwin, Richard E, "Measurable Dynamic Gains from Trade," *Journal of Political Economy*, February 1992, *100* (1), 162–74.

Barattieri, Alessandro, Matteo Cacciatore, and Fabio Ghironi, "Protectionism and the Business Cycle," Working paper 2017.

Bems, Rudolfs, "Aggregate Investment Expenditures on Tradable and Nontradable Goods," *Review of Economic Dynamics*, 2008, *11* (4), 852–883.

Brooks, Wyatt J. and Pau S. Pujolas, "Capital Accumulation and the Welfare Gains from Trade," Working Paper 2016.

Caliendo, Lorenzo and Fernando Parro, "Estimates of the Trade and Welfare Effects of NAFTA," *Review of Economic Studies*, 2015, *82* (1), 1–44.

Conconi, Paola, Manuel García-Santana, Laura Puccio, and Roberto Venturini, "From Final Goods to Inputs: The Cascade Effect of Preferential Rules of Origin," CEPR Working Paper 11084 2017.

Costinot, Arnaud and Andrés Rodríguez-Clare, "Chapter 4 - Trade Theory with Numbers: Quantifying the Consequences of Globalization," in Elhanan Helpman Gita Gopinath and Kenneth Rogoff, eds., *Handbook of International Economics*, Vol. 4 of Handbook of International Economics, Elsevier, 2014, pp. 197 – 261.

Dhingra, Swati, , Gianmarco Ottaviano, Thomas Sampson, and John van Reenen, "The Impact of Brexit on Foreign Investment in the UK," CEP Brexit Analysis 3, Centre for Economic Performance 2016.

__ **, Gianmarco Ottaviano, Thomas Sampson, and John Van Reenen**, "The Consequences of Brexit for UK Trade and Living Standards," CEP Brexit Analysis 2, Centre for Economic Performance 2016.

__ **, Hanwei Huang, Gianmarco Ottaviano, João Paulo Pessoa, Thomas Sampson, and John Van Reenen**, "The Costs and Benefits of Leaving the EU: Trade Effects," CEP Brexit Analysis Technical Paper, Centre for Economic Performance May 2016.

Dix-Carneiro, Rafael, "Trade Liberalization and Labor Market Dynamics," *Econometrica*, 2014, *82* (3), 825–885.

Eaton, Jonathan, Samuel Kortum, Brent Neiman, and John Romalis, "Trade and the Global Recession," NBER Working Paper 16666,, National Bureau of Economic Research, Inc January 2011.

Ebell, Monique, Ian Hurst, and James Warren, "Modelling the long-run economic impact of leaving the European Union," *Economic Modelling*, 2016, *59*, 196 – 209.

Engel, Charles and Jian Wang, "International trade in durable goods: Understanding volatility, cyclicality, and elasticities," *Journal of International Economics*, January 2011, *83* (1), 37–52.

Giri, Rahul, Kei-Mu Yi, and Hakan Yilmazkuday, "Sectoral Heterogeneity and the Gains from Trade," Working paper 2017.

Heathcote, Jonathan and Fabrizio Perri, "Financial autarky and international business cycles," *Journal of Monetary Economics*, April 2002, *49* (3), 601–627.

Kehoe, Timothy J. and Kim J. Ruhl, "Sudden stops, sectoral reallocations, and the real exchange rate," *Journal of Development Economics*, July 2009, *89* (2), 235–249.

__ **and** __ , "How Important Is the New Goods Margin in International Trade?," *Journal of Political Economy*, 2013, *121* (2), 358–392.

__ **, Jack Rossbach, and Kim J. Ruhl**, "Using the new products margin to predict the industry-level impact of trade reform," *Journal of International Economics*, 2015, *96* (2), 289–297.

__ **, Kim J. Ruhl, and Joseph B. Steinberg**, "Global Imbalances and Structural Change in the United States," *Journal of Political Economy*, 2017, *Forthcoming.*

Krugman, Paul, "Pricing to Market when the Exchange Rate Changes," NBER Working Papers 1926, National Bureau of Economic Research, Inc May 1986.

Lane, P. R. and G. M. Milesi-Feretti, "The External Wealth of Nations Mark II: Revised and Extended Estimates of Foreign Assets and Liabilities, 1970–2004," *Journal of International Economics*, 2007, *73*, 223–250.

Lim, Kevin, "Firm-to-Firm Trade in Sticky Production Networks," Working paper 2016.

Lucas, Robert E. and Edward C. Prescott, "Investment Under Uncertainty," *Econometrica*, 1971, *39* (5), 659–681.

McGrattan, Ellen R. and Andrea L. Waddle, "The Impact of Brexit on Foreign Investment and Production," NBER Working Papers 23217 2017.

Ravikumar, B., Ana Maria Santacreu, and Michael Sposi, "Capital Accumulation and Dynamic Gains from Trade," Working paper 2017.

Ruhl, Kim J., "The International Elasticity Puzzle," Working paper 2008.

_ , "The Aggregate Impact of Antidumping Policies," Working paper 2014.

Sargent, Thomas J., "Estimation of Dynami Labor Demand Schedules under Rational Expectations," *Journal of Political Economy*, 1978, *86* (6), 1009–1044.

Sposi, Michael, "Demograhics and the Evolution of Global Imbalances," Working paper 2017.

Steinberg, Joseph B., "On the Source of U.S. Trade Deficits: Global Saving Glut or Domestic Saving Drought?," Working Paper, 2016.

_ , "Brexit and the Macroeconomic Impact of Trade Policy Uncertainty," Working paper 2017.

Timmer, Marcel P., Erik Dietzenbacher, Bart Los, Robert Stehrer, and Gaaitzen J. de Vries, "An Illustrated User Guide to the World Input-Output Database: the Case of Global Automotive Production," *Review of International Economics*, 2015, *23* (3), 575–605.

Table 1: WIOD sectoral aggregation scheme

Sector	HS codes	WIOD industries
Agriculture	1–14	Crop and animal production, hunting and related service activities; Forestry and logging; Fishing and aquaculture
Resources	25–27	Mining and quarrying; Manufacture of coke and refined petroleum products
Transportation	86–89	Manufacture of motor vehicles, trailers and semi-trailers; Manufacture of other transport equipment
Manufacturing	15–24; 28–85; 90–97	Manufacture of food products, beverages and tobacco products; Manufacture of textiles, wearing apparel and leather products; Manufacture of wood and of products of wood and cork, except furniture, manufacture of articles of straw and plaiting materials; Manufacture of paper and paper products; Printing and reproduction of recorded media; Manufacture of chemicals and chemical products; Manufacture of basic pharmaceutical products and pharmaceutical preparations; Manufacture of rubber and plastic products; Manufacture of other non-metallic mineral products; Manufacture of basic metals; Manufacture of fabricated metal products, except machinery and equipment; Manufacture of computer, electronic and optical products; Manufacture of electrical equipment; Manufacture of machinery and equipment n.e.c.; Manufacture of furniture, other manufacturing
Services	N/A	Repair and installation of machinery and equipment; Electricity, gas, steam and air conditioning supply; Water collection, treatment and supply; Sewerage, waste collection, treatment and disposal activities, materials recovery, remediation activities and other waste management services; Construction; Wholesale and retail trade and repair of motor vehicles and motorcycles; Wholesale trade, except of motor vehicles and motorcycles; Retail trade, except of motor vehicles and motorcycles; Land transport and transport via pipelines; Water transport; Air transport; Warehousing and support activities for transportation; Postal and courier activities; Accommodation and food service activities; Publishing activities; Motion picture, video and television programme production, sound recording and music publishing activities, programming and broadcasting activities; Telecommunications; Computer programming, consultancy and related activities, information service activities; Financial service activities, except insurance and pension funding; Insurance, reinsurance and pension funding, except compulsory social security; Activities auxiliary to financial services and insurance activities; Real estate activities; Legal and accounting activities, activities of head offices, management consultancy activities; Architectural and engineering activities, technical testing and analysis; Scientific research and development; Advertising and market research; Other professional, scientific and technical activities, veterinary activities; Administrative and support service activities; Public administration and defence, compulsory social security; Education; Human health and social work activities; Other service activities; Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use; Activities of extraterritorial organizations and bodies

Table 2: Change in import tariffs after NAFTA termination

Trade partner	Agriculture	Resource extraction	Trans. equip.	Other manuf.	Total
(a) United States					
Canada	1.74	0.74	2.30	1.79	1.51
Mexico	3.19	0.52	7.75	1.76	3.14
Rest of world	0.00	0.00	0.00	0.00	0.00
(b) Canada					
United States	3.28	0.61	4.55	1.55	2.14
Mexico	0.57	0.38	5.20	1.47	2.56
Rest of world	0.00	0.00	0.00	0.00	0.00
(c) Mexico					
United States	29.18	0.18	7.62	3.65	5.40
Canada	13.29	0.08	12.22	2.97	6.19
Rest of world	0.00	0.00	0.00	0.00	0.00

Table 3: Sectoral production and trade in NAFTA (2010–2014 averages, percent GDP)

Quantity	Agriculture	Resource extraction	Trans. equip.	Other manuf.	Services	Total
(a) United States						
Value added	1.22	3.63	1.51	9.81	83.83	100.00
Exports	0.33	0.91	1.22	4.04	4.48	10.99
to Canada	0.04	0.18	0.36	0.87	0.22	1.67
to Mexico	0.05	0.14	0.11	0.66	0.04	1.00
to rest of world	0.25	0.59	0.75	2.50	4.23	8.32
Imports	0.29	2.28	1.60	7.19	2.60	13.96
from Canada	0.05	0.64	0.28	0.78	0.25	2.01
from Mexico	0.05	0.25	0.30	0.84	0.08	1.52
from rest of world	0.19	1.39	1.01	5.57	2.27	10.42
Net exports	0.04	-1.38	-0.38	-3.15	1.89	-2.97
with Canada	-0.01	-0.47	0.07	0.09	-0.04	-0.34
with Mexico	-0.01	-0.11	-0.19	-0.18	-0.04	-0.52
with rest of world	0.06	-0.80	-0.26	-3.06	1.96	-2.10
(b) Canada						
Value added	1.59	8.85	1.52	9.56	78.48	100.00
Exports	1.26	7.50	3.47	11.09	8.40	31.71
to United States	0.49	6.16	2.73	7.50	2.43	19.31
to Mexico	0.07	0.01	0.04	0.32	0.08	0.52
to rest of world	0.71	1.33	0.70	3.27	5.88	11.89
Imports	0.56	3.39	5.24	16.64	5.36	31.19
from United States	0.40	1.68	3.43	8.40	2.08	15.99
from Mexico	0.02	0.10	0.29	0.69	0.05	1.15
from rest of world	0.14	1.60	1.51	7.56	3.23	14.05
Net exports	0.70	4.11	-1.77	-5.56	3.03	0.52
with United States	0.09	4.48	-0.71	-0.90	0.36	3.31
with Mexico	0.04	-0.09	-0.25	-0.36	0.03	-0.64
with rest of world	0.57	-0.27	-0.81	-4.29	2.65	-2.16
(c) Mexico						
Value added	3.28	8.80	3.06	14.70	70.16	100.00
Exports	0.91	5.23	5.42	16.49	1.63	29.68
to United States	0.72	3.55	4.24	11.92	1.07	21.49
to Canada	0.03	0.15	0.43	1.01	0.08	1.69
to rest of world	0.16	1.53	0.76	3.56	0.49	6.49
Imports	0.91	2.34	3.20	19.37	3.04	28.85
from United States	0.64	1.99	1.62	9.31	0.54	14.10
from Canada	0.10	0.01	0.06	0.47	0.12	0.76
from rest of world	0.17	0.34	1.52	9.58	2.38	13.99
Net exports	-0.00	2.89	2.23	-2.88	-1.41	0.82
with United States	0.08	1.56	2.62	2.60	0.53	7.39
with Canada	-0.06	0.14	0.37	0.53	-0.04	0.93
with rest of world	-0.02	1.19	-0.76	-6.02	-1.89	-7.50

Table 4: Assigned parameters except trade elasticities

Parameter	Meaning	Value	Source or target
β	Discount factor	0.98	2% Long-run interest rate
ψ	Intertemporal elasticity	-1	Standard
δ	Depreciation rate	0.06	Standard
α_i^s	Capital shares	0.33	Standard
ρ	Consumption elasticity	0.65	Kehoe et al. (2017); Atalay (2014)
γ	Consumption utility share	0.33	Standard
ϕ	Capital adjustment cost	0.8	Steinberg (2016); Sposi (2017)
φ_ℓ	Labor adjustment cost	6.5	Kehoe and Ruhl (2009); Sargent (1978)
φ_k	Capital adjustment cost	0.5	Eaton et al. (2011)
φ_m, φ_f	Import adjustment costs	2.9	Short-run trade elascicity = 1.0
$b_{i,0}$	Initial bondholdings	(-40.6 0.52 -2.85)	Lane and Milesi-Feretti (2007)

Table 5: Assigned long-run trade elasticities

Use	Agriculture	Resource extraction	Trans. equip.	Other manuf.	Services
(a) United States					
Intermediate	8.11	30.82	0.80	5.46	5.00
Final	8.11	37.23	0.88	4.78	5.00
(b) Canada					
Intermediate	8.11	29.80	0.87	5.48	5.00
Final	8.11	39.74	0.82	4.62	5.00
(c) Mexico					
Intermediate	8.11	35.01	0.97	5.64	5.00
Final	8.11	31.49	0.97	3.71	5.00
(d) Rest of world					
Intermediate	8.11	27.25	0.87	5.75	5.00
Final	8.11	45.72	0.84	4.61	5.00

Table 6: Long-run effects of NAFTA termination (percent changes)

Quantity	Agriculture	Resource extraction	Trans. equip.	Other manuf.	Services	Total
(a) United States						
Value added	-1.70	0.38	-0.43	-0.29	-0.03	-0.07
Consumption	-0.27	-0.03	-0.57	-0.12	-0.01	-0.03
Exports	-13.43	-3.10	-1.60	-3.37	0.15	-2.07
to Canada	-21.35	-16.93	-3.12	-6.05	-1.28	-7.29
to Mexico	-85.04	-7.86	-6.19	-12.91	-1.00	-14.02
to rest of world	0.15	0.46	0.05	0.01	0.18	0.16
Imports	-6.73	-7.37	-1.78	-1.91	-0.12	-2.26
from Canada	-12.08	-14.33	-1.79	-8.18	0.84	-8.30
from Mexico	-22.22	-10.12	-6.12	-10.17	0.38	-9.11
from rest of world	0.40	0.86	0.13	0.41	-0.26	0.25
Net exports/GDP (p.p.)	-0.03	0.03	0.01	-0.03	0.01	-0.01
with Canada	-0.00	0.03	-0.01	0.00	-0.00	0.02
with Mexico	-0.03	0.00	0.01	-0.01	-0.00	-0.02
with rest of world	-0.00	0.00	-0.00	-0.02	0.01	-0.01
(b) Canada						
Value added	-0.32	-1.17	-1.76	-1.15	0.00	-0.22
Consumption	-0.44	-0.06	-1.91	-0.41	0.06	-0.07
Exports	-6.18	-8.56	-2.46	-5.39	1.29	-4.21
to United States	-12.08	-14.33	-1.79	-8.18	0.84	-8.30
to Mexico	-56.08	1.58	-9.50	-9.62	-0.15	-14.13
to rest of world	0.84	7.37	0.15	0.32	1.10	1.76
Imports	-15.37	-14.54	-2.23	-2.80	-1.35	-4.16
from United States	-21.35	-16.93	-3.12	-6.05	-1.28	-7.29
from Mexico	-2.77	-6.63	-3.72	-7.59	-0.81	-6.03
from rest of world	2.06	0.32	0.66	1.75	-1.44	0.88
Net exports/GDP (p.p.)	0.00	-0.01	0.01	-0.01	0.01	-0.01
with United States	0.00	-0.03	0.01	-0.00	0.00	-0.02
with Mexico	-0.00	0.00	0.00	0.00	0.00	0.00
with rest of world	0.00	0.01	-0.00	-0.01	0.01	0.01
(c) Mexico						
Value added	9.48	0.68	-3.45	-2.27	-0.15	-0.25
Consumption	-0.92	0.11	-0.84	-0.47	0.15	-0.03
Exports	-17.73	-1.75	-6.16	-8.58	0.55	-6.63
to United States	-22.22	-10.12	-6.12	-10.17	0.38	-9.11
to Canada	-2.77	-6.63	-3.72	-7.59	-0.81	-6.03
to rest of world	-1.62	5.10	0.14	-2.06	0.64	0.94
Imports	-66.58	-7.57	-3.49	-4.84	-1.17	-6.49
from United States	-85.04	-7.86	-6.19	-12.91	-1.00	-14.02
from Canada	-56.08	1.58	-9.50	-9.62	-0.15	-14.13
from rest of world	18.33	-3.03	0.04	4.69	-1.27	3.09
Net exports/GDP (p.p.)	0.03	0.01	-0.01	-0.03	0.00	-0.00
with United States	0.03	-0.00	-0.01	0.01	0.00	0.02
with Canada	0.00	-0.00	-0.00	-0.00	-0.00	-0.00
with rest of world	-0.00	0.01	0.00	-0.04	0.00	-0.02

Table 7: Welfare and long-run trade effects in alternative models (percent changes)

	Welfare			NAFTA trade			ROW trade		
Model	USA	Canada	Mexico	USA	Canada	Mexico	USA	Canada	Mexico
Baseline	-0.03	-0.07	0.01	-9.35	-7.87	-11.35	0.21	1.33	2.27
Sensitivity analyses									
No import adj. costs	-0.03	-0.07	-0.01	-9.33	-7.85	-11.35	0.21	1.34	2.28
No capital adj. costs	-0.03	-0.07	0.01	-9.35	-7.87	-11.37	0.20	1.34	2.24
No labor adj. costs	-0.03	-0.07	0.01	-9.35	-7.87	-11.36	0.21	1.33	2.26
No intermediate inputs	0.00	-0.01	-0.04	-8.61	-8.87	-7.59	0.17	1.74	0.36
LTP trade elasticities	-0.03	-0.08	-0.02	-11.77	-9.68	-14.67	0.30	1.77	3.17
Sym. trade elasticities	-0.02	-0.09	-0.22	-9.15	-6.15	-13.46	0.31	1.32	1.35
Iceberg costs	-0.11	-0.54	-0.65	-9.19	-7.74	-11.17	0.23	1.41	2.48
Alternative scenarios									
Higher U.S. tariffs	0.05	-0.23	-0.16	-12.54	-10.80	-14.49	-5.44	0.89	1.70
US-Canada FTA	-0.02	-0.01	-0.00	-4.71	-0.29	-11.49	0.13	0.09	2.31
Canada-Mexico FTA	-0.02	-0.07	0.00	-9.38	-7.50	-10.74	0.20	1.27	2.20
Stricter DCR	-0.36	-0.56	-0.64	2.46	2.72	2.03	-14.49	-14.51	-17.11

Table 8: Long-run effects on transportation sector in alternative models (percent changes)

	Value added			Consumption		
Model	USA	Canada	Mexico	USA	Canada	Mexico
Baseline	-0.43	-1.76	-3.45	-0.57	-1.91	-0.84
Sensitivity analyses						
No import adj. costs	-0.43	-1.75	-3.46	-0.57	-1.91	-0.87
No capital adj. costs	-0.44	-1.76	-3.46	-0.58	-1.91	-0.82
No labor adj. costs	-0.43	-1.76	-3.45	-0.57	-1.91	-0.83
No intermediate inputs	-0.10	-0.12	-0.66	-0.03	-0.38	-0.94
LTP trade elasticities	-0.42	-1.82	-3.62	-0.57	-1.92	-0.88
Sym. trade elasticities	0.16	-5.73	-12.22	-0.49	-1.95	-1.17
Iceberg costs	0.19	-0.32	-0.03	-0.66	-2.40	-1.51
Alternative scenarios						
Higher U.S. tariffs	-0.70	-2.67	-5.78	-1.08	-2.37	-1.14
US-Canada FTA	-0.15	-0.09	-3.46	-0.42	-0.28	-0.84
Canada-Mexico FTA	-0.43	-1.64	-3.26	-0.57	-1.73	-0.79
Stricter DCR	-0.61	-1.00	-0.73	-0.67	-0.79	-1.08

Figure 1: NAFTA members' bilateral trade flows (2010–2014 averages)

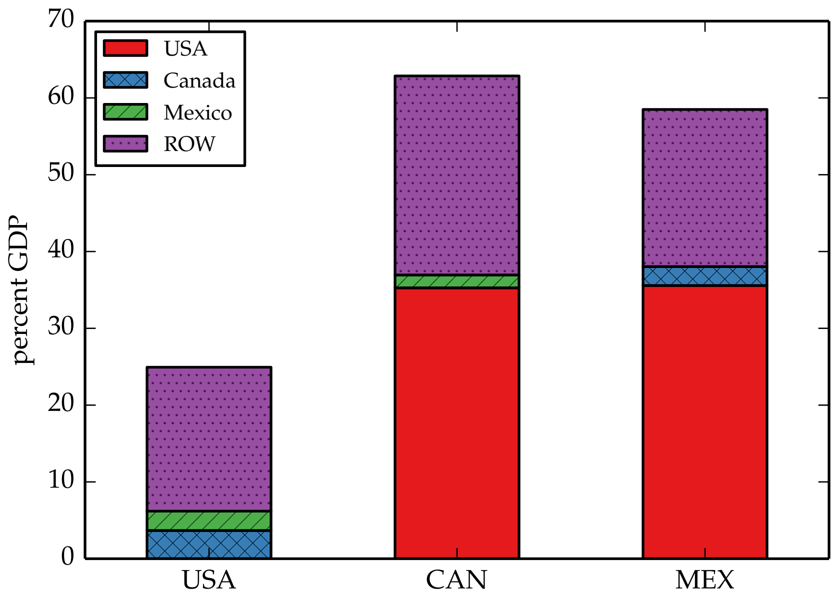

Figure 2: NAFTA members' sectoral trade flows (2010–2014 averages)

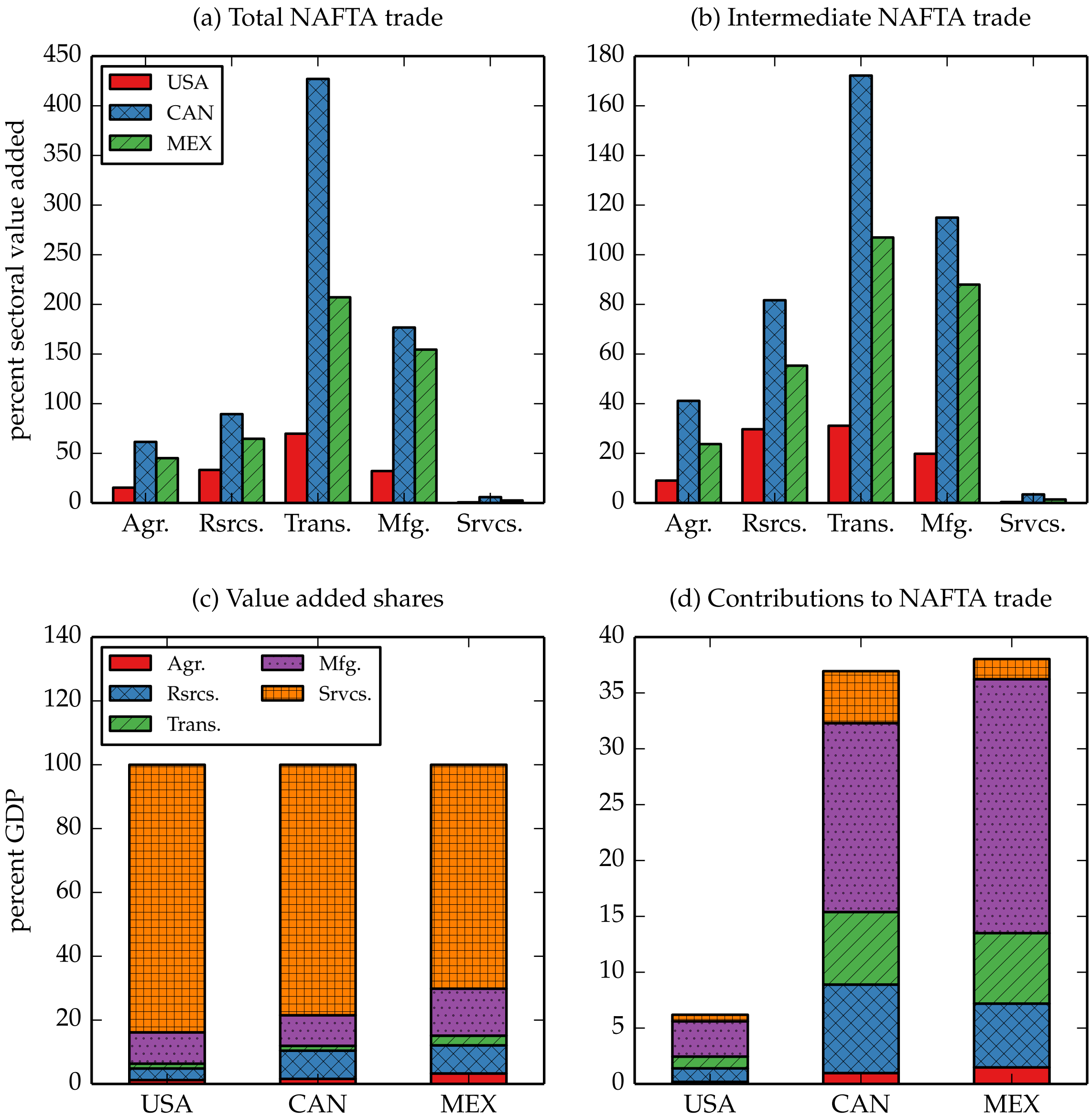

Figure 3: NAFTA trade imbalances (2010–2014 averages)

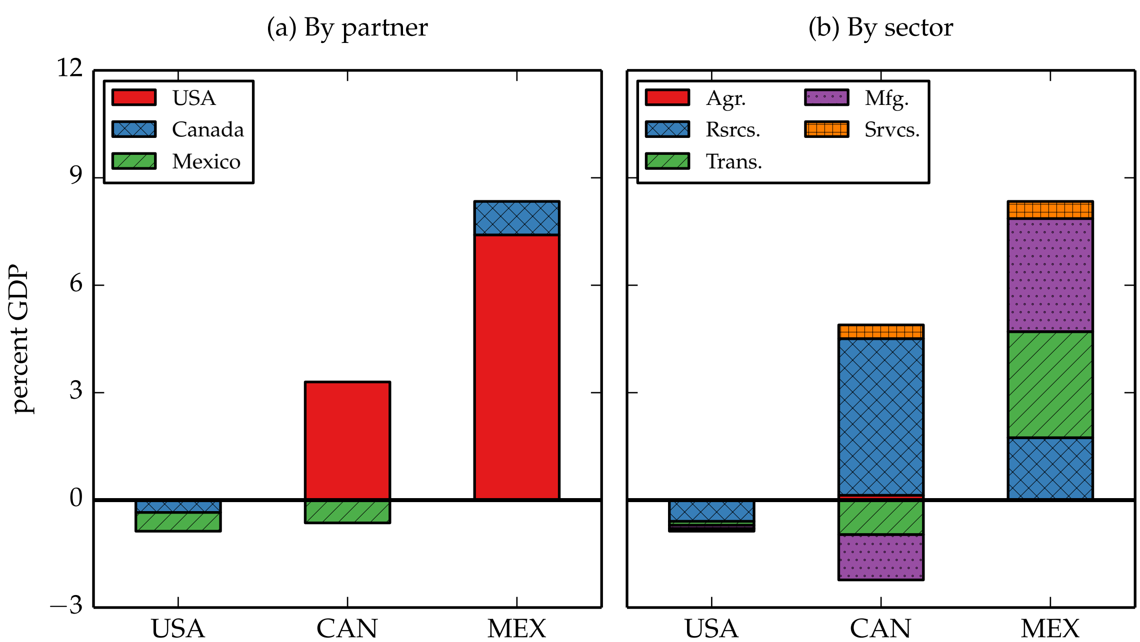

Figure 4: Long-run effects of NAFTA termination on trade

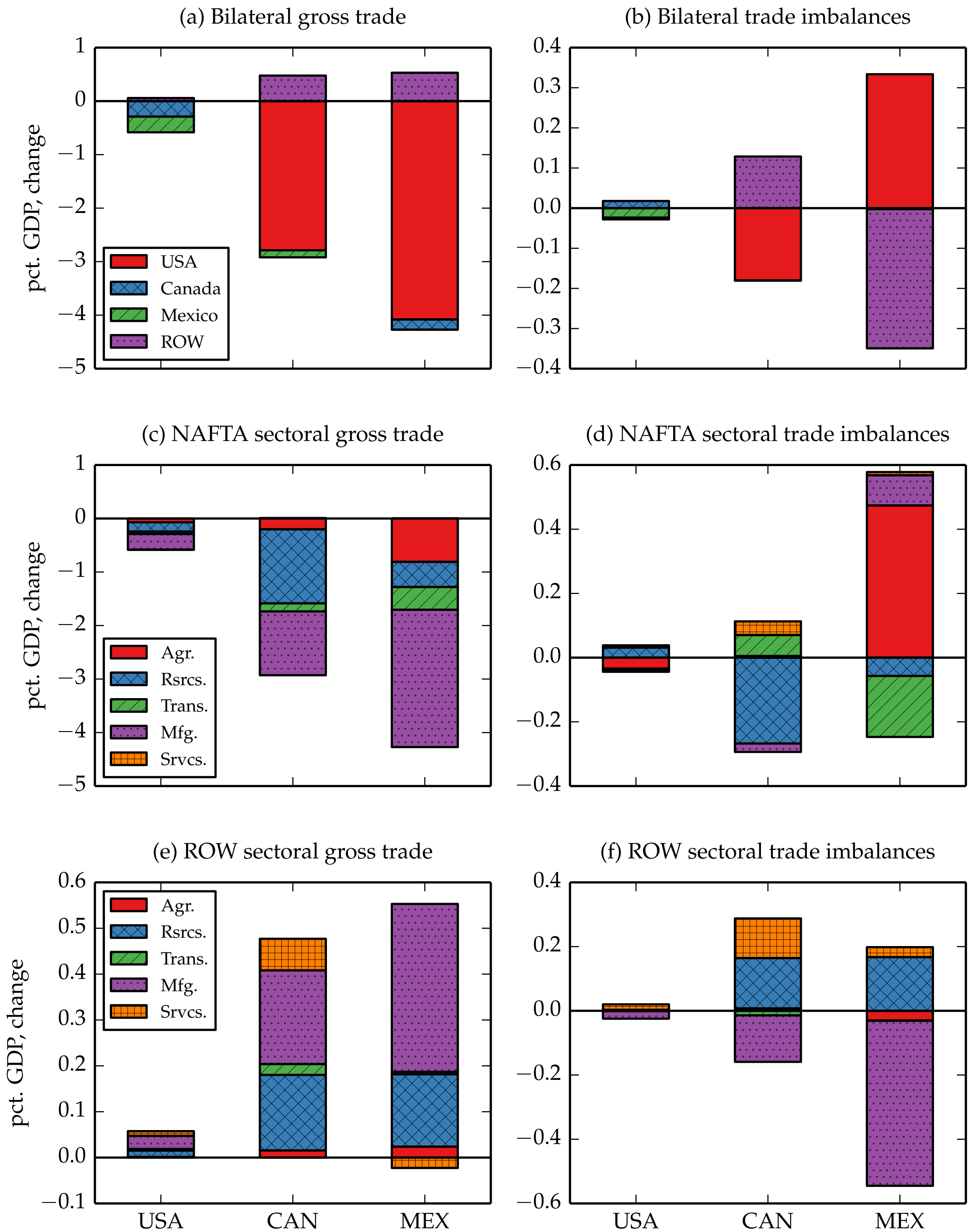

Figure 5: Long-run effects of NAFTA termination on sectoral reallocation

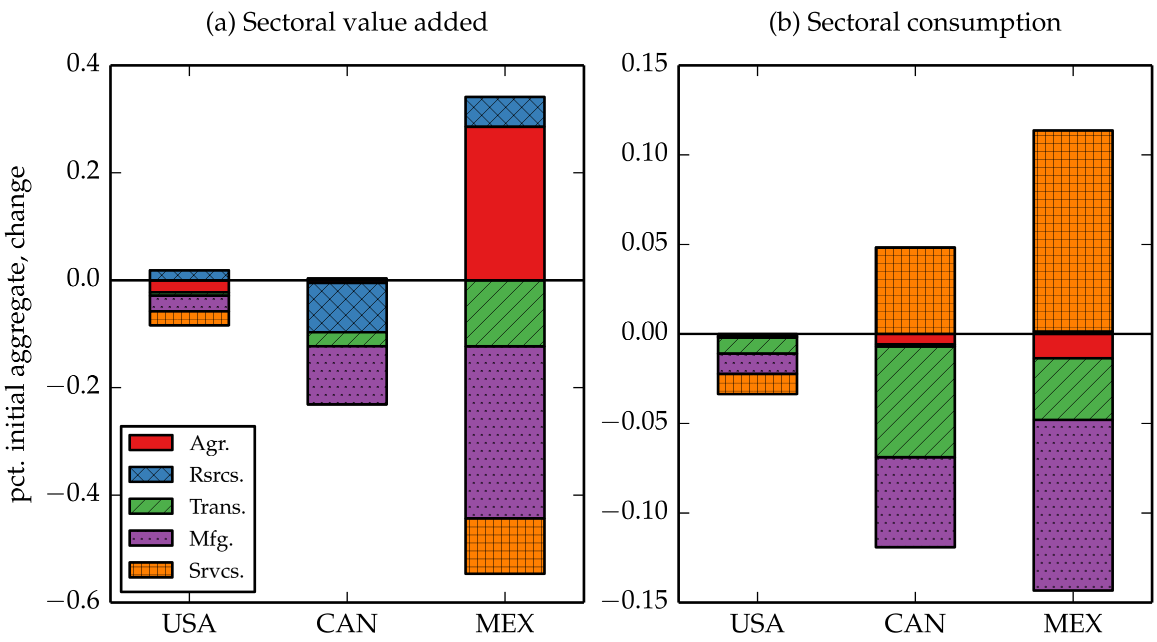

Figure 6: Dynamic effects of NAFTA termination

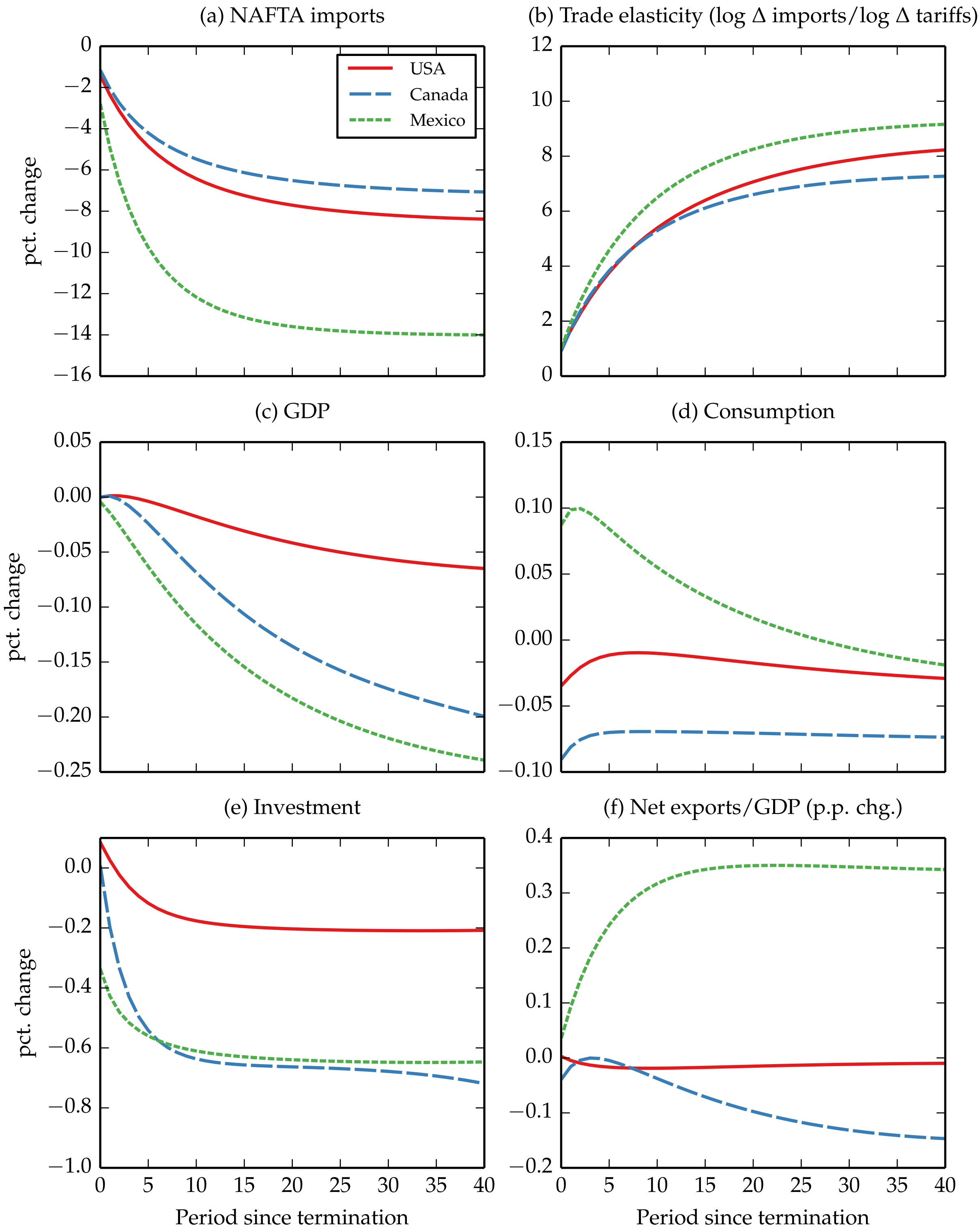

Figure 7: Dynamic effects of NAFTA termination (no trade adj. costs)

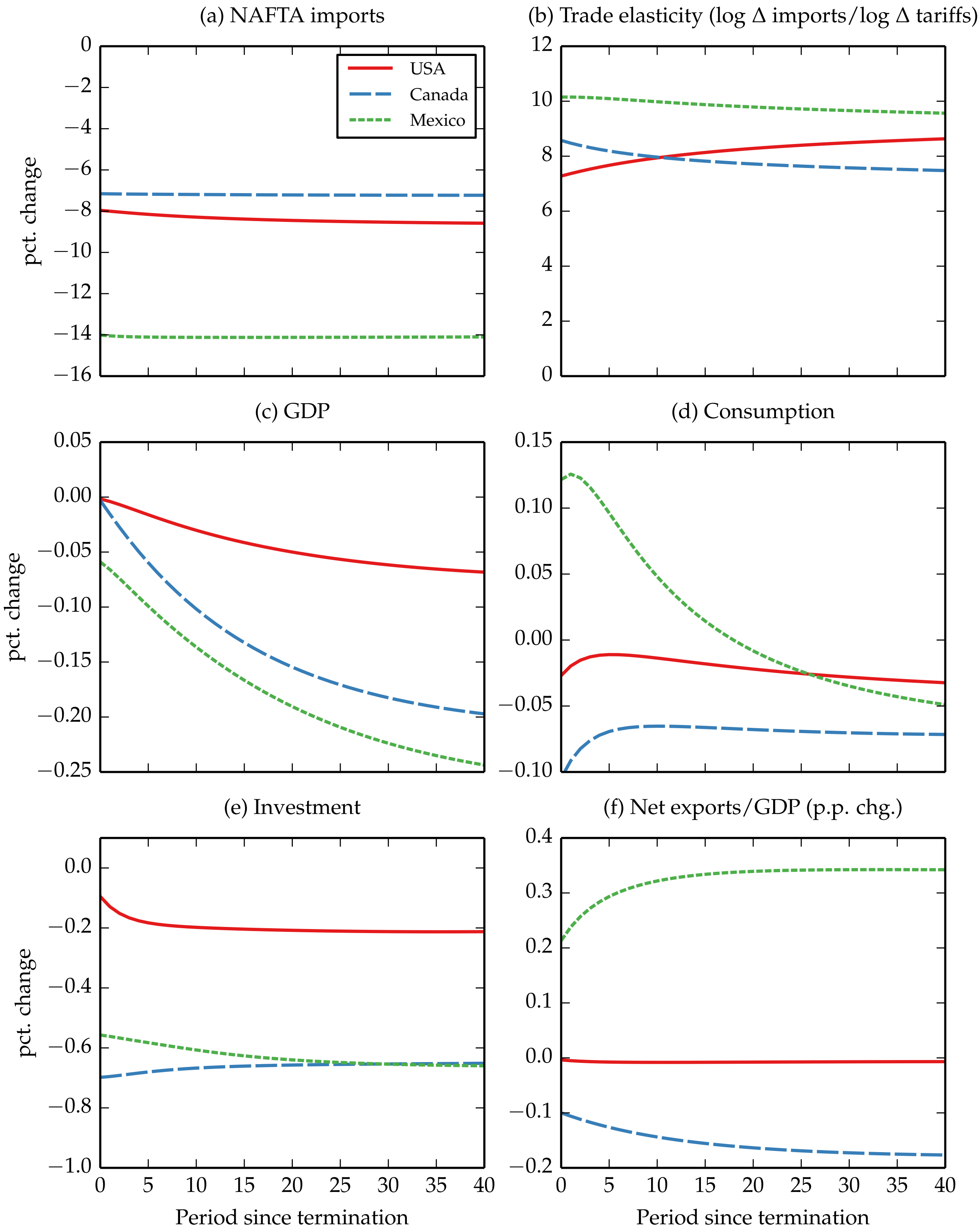

Figure 8: Dynamic effects of NAFTA termination (no capital adj. costs)

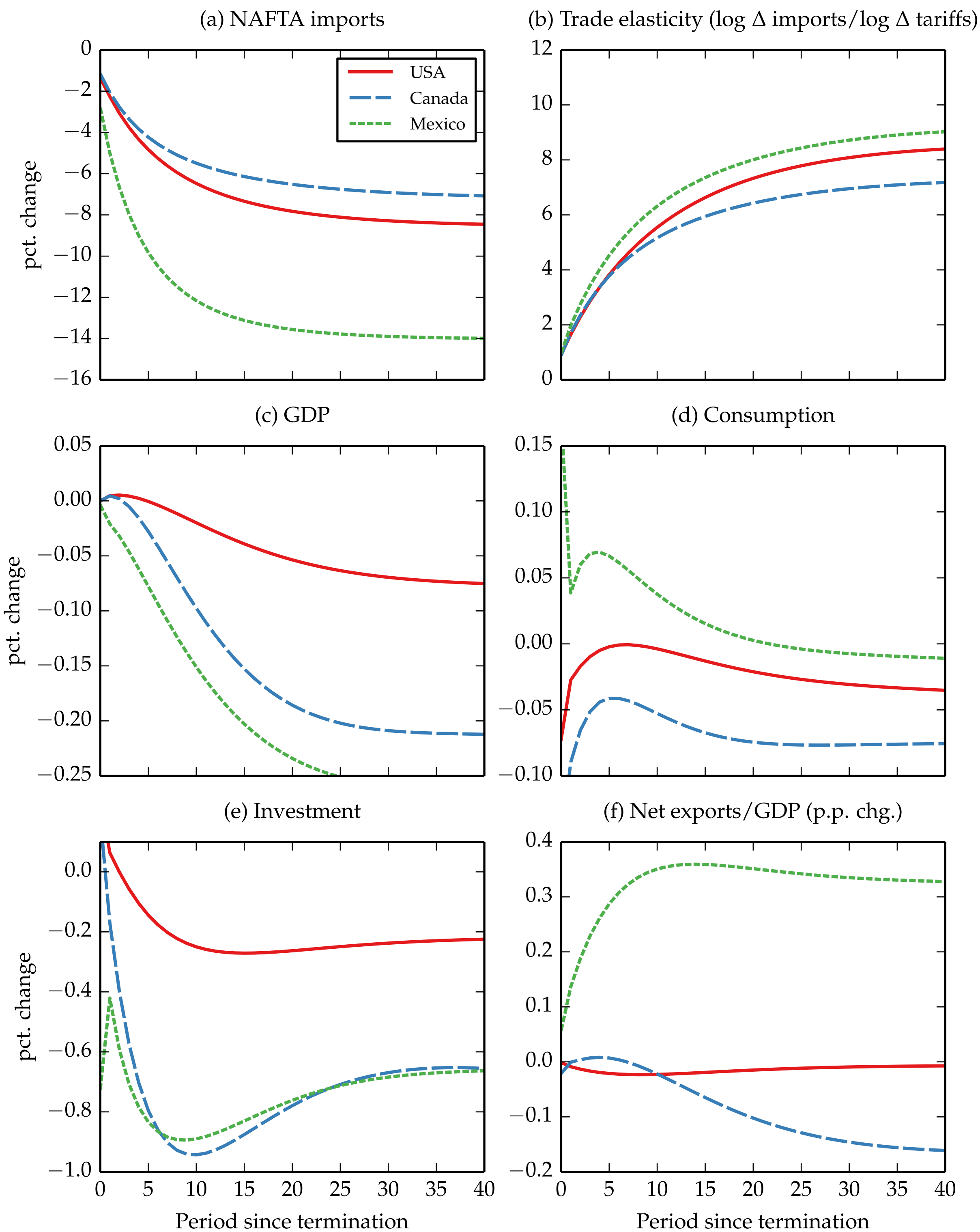

Figure 9: Dynamic effects of NAFTA termination (no labor adj. costs)