The Macroeconomic Impact of NAFTA Termination

Joseph B. Steinberg
University of Toronto

April 24, 2019

Motivation

Donald J. Trump
@realDonaldTrump

Follow

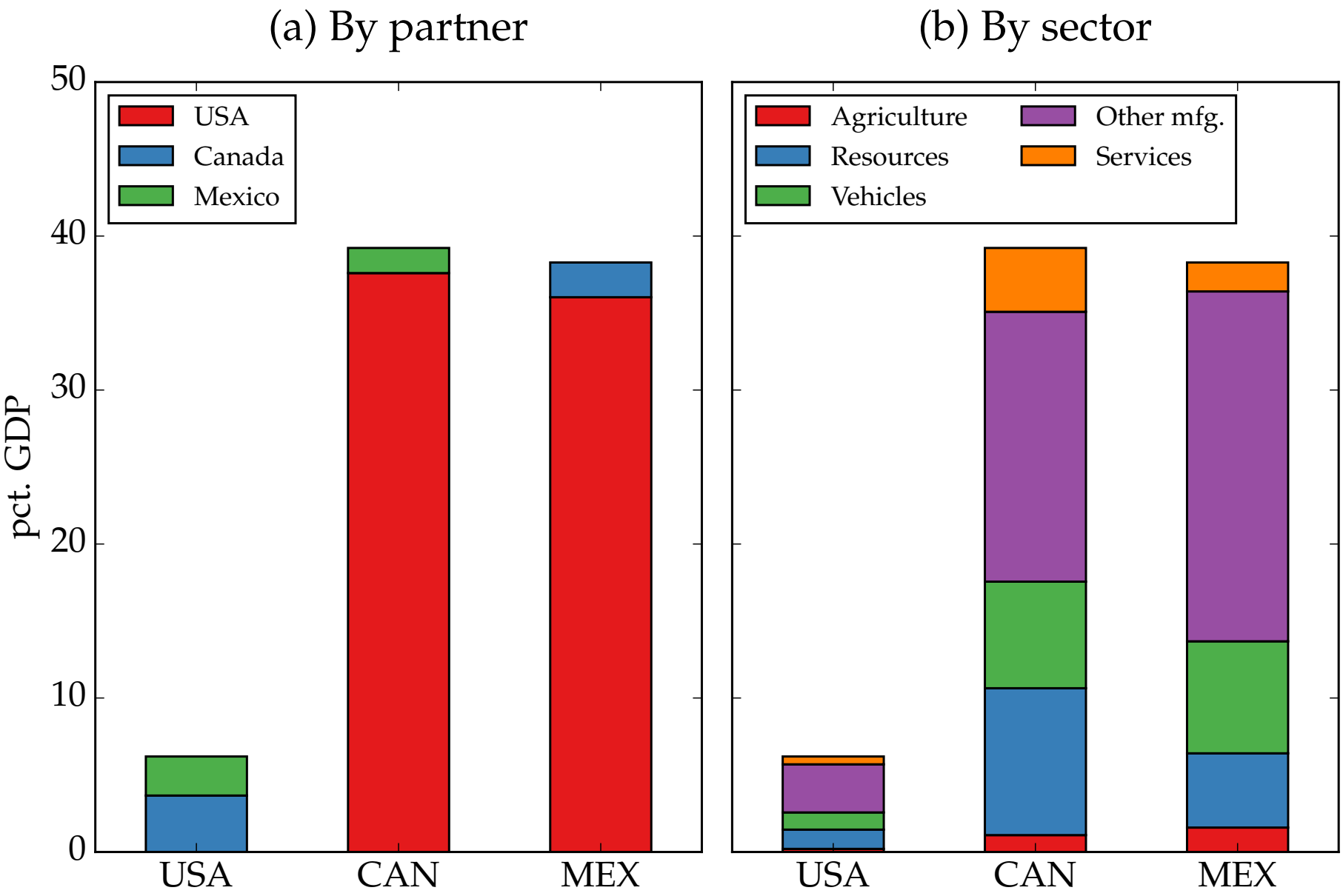
We are in the NAFTA (worst trade deal ever made) renegotiation process with Mexico & Canada.Both being very difficult,may have to terminate?

6:51 AM - 27 Aug 2017

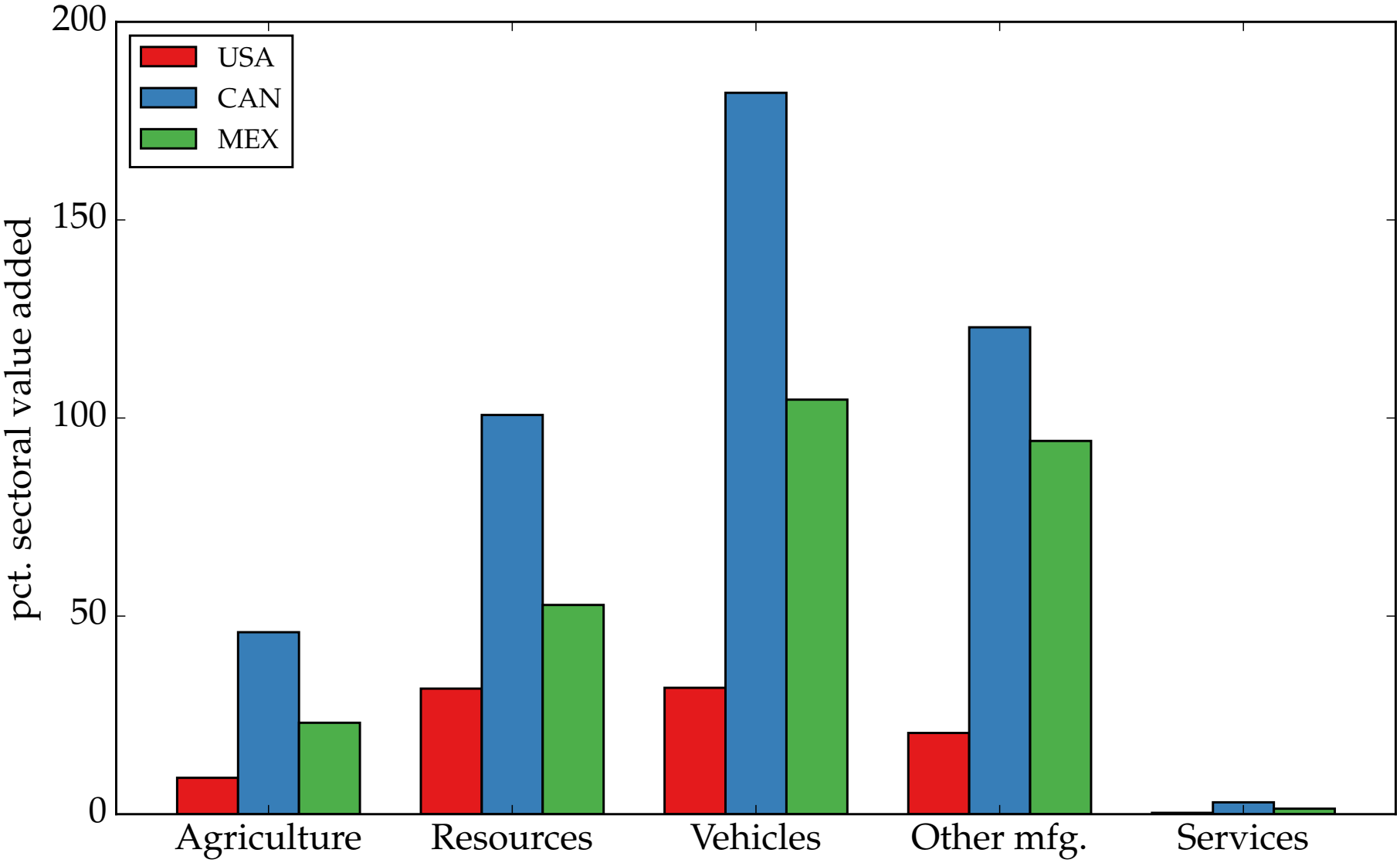
18,191 Retweets **79,337** Likes

26K 18K 79K

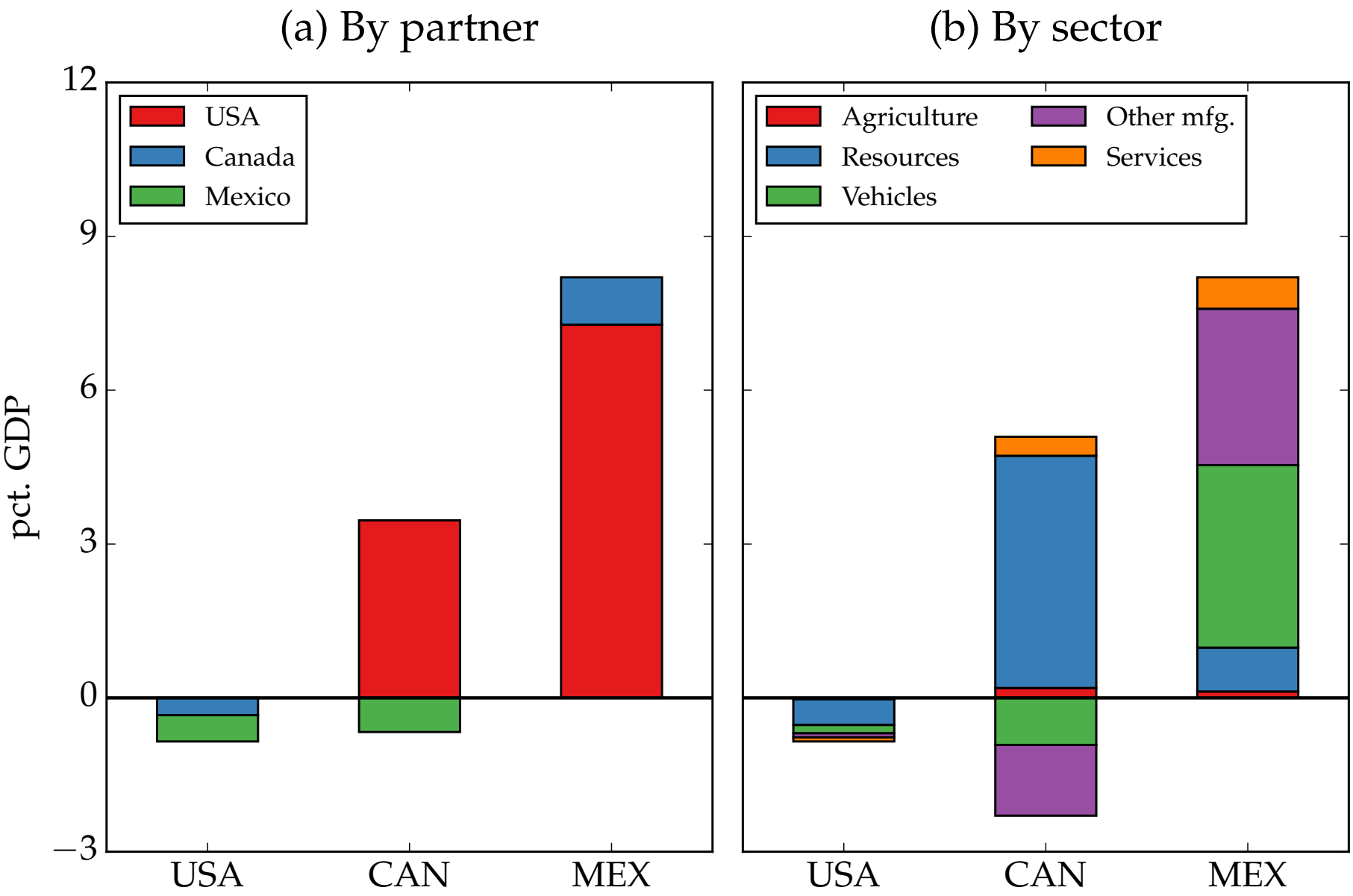
Gross NAFTA trade flows (WIOD, 2014)



NAFTA intermediate input trade (WIOD, 2014)



NAFTA trade imbalances (WIOD, 2014)



Introduction

Since NAFTA's inception, US, Canada, and Mexico's economies have become heavily intertwined

- Mexico and Canada trade significantly more with US than with any other country; US trades more only with China
- Extensive regional supply chains, particularly in transportation equipment sector
- But also trade imbalances: US trade deficits with Canada and Mexico

Trump administration forced renegotiation, threatened to terminate NAFTA if replacement not satisfactory

Future of negotiated replacement, USMCA, still uncertain

What would happen if NAFTA was terminated?

Toward a dynamic, quantitative analysis of trade reforms

Dynamic framework needed to evaluate whether NAFTA termination would reduce regional trade imbalances

Investment, int'l K flows, firm-level extensive margin dynamics affect both timing and extent of effects of trade reforms

- Ravikumar et al. (2018), Alessandria et al. (various)
- Speed of these adjustment margins also quantitatively important

IO linkages, sectoral heterogeneity crucial to quantify long-run impact of trade reforms

- Costinot and Rodríguez-Clare (2014), Caliendo and Parro (2015)
- Also significantly affect transition dynamics

This paper: quantitative evaluation with all of these elements

What I do

Build dynamic CGE model of NAFTA

- Multi-country, multi-sector, input-output structure
- Capital accumulation and endogenous trade imbalances
- Heterogeneous firms pay sunk costs to export
- Variety of other aggregate adjustment costs

Calibrate to match macro (input-output matrix) and micro (exporter dynamics) facts

Evaluate macroeconomic consequences of NAFTA termination

- What are short- and long-run effects for each country?
- What happens to regional trade imbalances?
- How do model ingredients affect extent and timing of losses?
- What would happen if NAFTA was replaced by something else?

What I find

All three countries' welfare falls

- US: -0.04%
- Canada: -0.12%
- Mexico: -0.22%

Regional trade imbalances remain

- US trade deficit with Canada shrinks
- US trade deficit with Mexico grows

Transition dynamics important: long-run losses > dynamic losses

Dynamic ingredients effect LR results, not just timing transition

IO linkages, other "static" ingredients effect transition, not just LR

Model

Model: overview

4 countries: US, Canada, Mexico, and rest of the world $(i \in I)$

- Representative households work, consume, invest, trade bonds
- Governments levy import tariffs and rebate proceeds to households

5 sectors: agriculture, resources, cars, other mfg., services $(s \in S)$

- Roundabout production structure
- Firms pay large fixed cost to start exporting, smaller cost to continue

Dynamic adjustment margins:

- Investment and endogenous trade imbalances
- Sunk-cost exporter dynamics
- Import and factor adjustment costs
- Shape LR effects of trade policy changes as well as SR effects!

Model: households

Choose consumption, $C_{i,t}$, sectoral investment, $(X^s_{i,t})_{s\in S}$, bonds, $B_{i,t+1}$, to maximize lifetime utility,

$$\sum_{t=0} \beta^t \frac{C_{i,t}^{1-\gamma}}{1-\gamma}$$

subject to budget constraints,

$$P^c_{i,t} C_{i,t} + \sum_{s\in S} P^x X^s_{i,t} + Q_t B_{i,t+1} = W_{i,t}\bar{L}_{i,t} + \sum_{s\in S} R_{i,t} K^s_{i,t} + \Pi_{i,t} + T_{i,t},$$

law of motion for sectoral capital,

$$K^s_{i,t+1} = (1-\delta)K^s_{i,t} + X^s_{i,t},\ s \in S,$$

and initial conditions for bonds, $B_{i,0}$, and sectoral capital, $(K^s_{i,0})_{s\in S}$

Model: aggregation

Consumption, investment are aggregates of sectoral composites:

$$C_{i,t} = \left(\sum_{s \in S} \varepsilon_i^{c,s} \left(Z_{i,t}^{c,s} \right)^{\frac{\rho^c - 1}{\rho^c}} \right)^{\frac{\rho^c}{\rho^c - 1}}, \quad \sum_{s \in S} X_{i,t}^s = \left(\sum_{s \in S} \varepsilon_i^{x,s} \left(Z_{i,t}^{x,s} \right)^{\frac{\rho^x - 1}{\rho^x}} \right)^{\frac{\rho^x}{\rho^x - 1}}$$

Composites are bundles of domestic and imported varieties:

$$\Upsilon_{i,t}^{u,s} = \left[\sum_{j \in I} \mu_{i,j}^{u,s} \left(\int_{\Omega_{i,j,t}^s} y_{i,j,t}^{u,s}(\omega)^{\frac{\theta - 1}{\theta}} \right)^{\frac{\theta}{\theta - 1} \frac{\zeta_i^s - 1}{\zeta_i^s}} \right]^{\frac{\zeta_i^s}{\zeta_i^s - 1}}$$

- Separate composites for final ($u = f$) and intermediate ($u = m$)
- $\Omega_{i,j,t}^s$: set of j's varieties available in i
- Demand curve for varieties: $\tilde{y}_{i,j,t}^{u,s}(p) \propto (1 + \tau_{i,j,t}^{u,s})^{-\theta} p^{-\theta}$

Model: firms

Each (i, s) has unit measure of monopolistically competitive firms

- No firm creation margin (yet!)

Heterogeneous in

- Productivity $z \sim N(0, \sigma_i^s)$, iid across firms and time
- Exporter status $e_j \in \{0, 1\}$ for each $j \in I \setminus \{i\}$

Selling domestically is free

Cost of exporting to j, $\kappa_{i,j}^s(e_j)$, depends on current status

Production technology (Atalay, 2017; Kehoe et al., 2018)

$$f_i^s\left(z, k, \ell, (m^r)_{r \in S}\right) = \exp(z) \times \min\left\{\frac{k^\alpha \ell^{1-\alpha}}{\lambda_i^{s,va}}, \min_{r \in S}\left[\frac{m^r}{\lambda_i^{s,r}}\right]\right\}$$

Model: firms

Static problem: conditional on having access to market j ($e_j = 1$), choose prices and inputs to maximize profits in that market

$$\pi^s_{i,j,t}(z) = \max_{p^f, p^m, k, \ell, (m^r)_{r \in S}} \left\{ \sum_{u \in \{m,f\}} p^u \tilde{y}^{u,s}_{j,i,t}(p^u) - W^s_{i,t}\ell - R^s_{i,t}k - \sum_{r \in S} P^{m,r}_{i,t} m^r \right\}$$

$$s.t. \sum_{u \in \{m,f\}} y^{u,s}_{j,i,t}(1 + \xi^s_{j,i,t}) = f^s_i\left(z, k, \ell, (m^r)_{r \in S}\right)$$

Sell to both final and intermediate aggregators

CRS technology allows profit-maximization problem to be separated across destinations

Model: firms

Dynamic problem (also separable across destinations): given current export status e_j, choose new status e_j'

$$V^s_{i,j,t}(z, e_j) = \max_{e_j'} \left\{ e_j' \pi^s_{i,j,t}(z) - W_{i,t} \kappa^s_{i,j}(e_j) + \Lambda_{i,t} \int_{-} V^s_{i,j,t}(z', e_j') \, \mathrm{d}F^s_i(z') \right\}$$

Characterized by entry and exit cutoffs:

- $z > \underline{z}^s_{i,j,t}$: enter
- $z < \bar{z}^s_{i,j,t}$: exit

Bilateral export participation rate evolves according to

$$\Omega^s_{j,i,t} = \left(1 - F^s_i(\bar{z}^s_{i,j,t})\right) \Omega^s_{j,i,t-1} + \left(1 - F^s_i(\underline{z}^s_{i,j,t})\right) \left(1 - \Omega^s_{j,i,t-1}\right)$$

Model: adjustment costs

Reduced-form, quadratic adjustment costs in addition to micro-founded trade dynamics

- Sectoral capital, $K^s_{i,t}$, and labor, $L^s_{i,t}$
- Bundles of imported varieties: $\Upsilon^{u,s}_{i,j,t} \equiv \left(\int y^{u,s}_{i,j,t}(\omega)^{(\theta-1)/\theta} \right)^{\theta/(\theta-1)}$

All denominated in units of labor:

$$\bar{L}_i = \sum_{s \in S} \Bigg\{ L^s_{i,t} + \sum_{j \in I \setminus \{i\}} \left[\left(1 - F^s_i(\bar{z}^s_{i,j,t}) \right) \Omega^s_{j,i,t-1} \kappa^s_{i,j}(1) + \left(1 - F^s_i(\underline{z}^s_{i,j,t}) \right) \left(1 - \Omega^s_{j,i,t-1} \right) \kappa^s_i(0) \right] \Bigg)$$
$$+ \eta_L \left(\frac{L^s_{i,t}}{L^s_{i,t-1}} - 1 \right)^2 L^s_{i,t-1} + \eta_K \left(\frac{K^s_{i,t}}{K^s_{i,t-1}} - 1 \right)^2 K^s_{i,t-1} + \eta_M \sum_{\substack{j \in I \setminus \{i\} \\ u \in \{m,f\}}} \left(\frac{\Upsilon^{u,s}_{i,j,t}}{\Upsilon^{u,s}_{i,j,t-1}} - 1 \right)^2 \Upsilon^{u,s}_{i,j,t-1} \Bigg\}$$

Competitive intermediaries rent factors from households to firms; arbitrage condition pins down sector-specific factor prices

Armington aggregators also solve dynamic optimization problem

Model: equilibrium

Sequence of objects that satisfies optimality, market clearing

- Aggregates: macro and sector-level quantities and prices
- Firm-level: value functions, cutoffs, export participation rates

Construct two equilibria with different trade costs

- Benchmark: constant at NAFTA levels forever
- Termination: increase unexpectedly in 2019 (period 0 = 2014)

Given LR trade costs, infinite number of possible steady states

- Initial conditions, bond market access, adjustment costs, etc. determine steady state to which equilibrium converges
- Altering these assumptions/parameterizations affects long-run as well as short run!

Calibration

Calibration: overview

1. Assign initial conditions, elasticities, other common parameters

2. Calibrate expenditure shares to match WIOD input-output matrix

3. Calibrate exporting costs, productivity distributions to match exporter dynamics facts from literature

4. Set termination equilibrium trade costs using MFN tariffs

Calibration: assigned parameters

Standard values for common parameters (β, ψ, α, δ, ρ^c, ρ^x, γ)

Initial conditions for bonds and capital taken directly from data

Factor adj. costs η_K, η_L set to 10 (Kehoe and Ruhl, 2008)

Import adj. cost η_M chosen so that 1-year trade elasticity is 1

Armington elasticities ζ_i^s based on Caliendo and Parro (2015):

Sector	Elasticity
Agriculture	8.11
Resources	31.82
Vehicles	0.88
Other mfg.	5.17
Services	5.00

Calibration: expenditure shares

Expenditure shares ($\lambda_i^{s,v}$, $\lambda_i^{s,r}$, $\mu_{i,j}^{u,s}$, $\varepsilon_i^{x,s}$, $\varepsilon_i^{c,s}$) chosen so that first period of benchmark equilibrium replicates input-output matrix

Source: World Input Output Database (WIOD)

- Widely used in quantitative trade studies
- Summarizes production, intermediate inputs, and final demand for 43 countries and 56 2-digit ISIC industries
- Data for 2014: latest available, but several years before Trump's election (and NAFTA termination) thought possible
- Aggregate non-NAFTA countries into single "rest of the world,", industries into 5 broad sectors

Trade costs set to zero in benchmark: $\mu_{i,j}^{u,s}$ absorb all trade costs with ROW, and iceberg costs between NAFTA countries

Calibration: exporting costs + productivity distributions

Jointly calibrate exporting costs $\kappa_{i,j}^s(0), \kappa_{i,j}^s(1)$ and productivity dispersions σ_i^s to match

- Export participation rate = 25% (Alessandria et al. 2014)
- Bilateral exporter exit rate = 45% (Steinberg, 2019)
- Top 5% share of bilateral exports = 58% (Steinberg, 2019)

Summary of results (200+ jointly calibrated parameters):

- $\sigma_i^s \approx 0.6$
- $\kappa_{i,j}^s(0) \approx 4 \times \kappa_{i,j}^s(1)$

Ongoing issues:

- Assume no export costs in oil sector (high Armington elasticity makes sunk-cost model numerically intractable)
- Same moments for all countries and sectors; (country, sector)-specific moments in progress

Calibration: termination equilibrium tariffs

Based on MFN tariff schedules for 6-digit HS industries

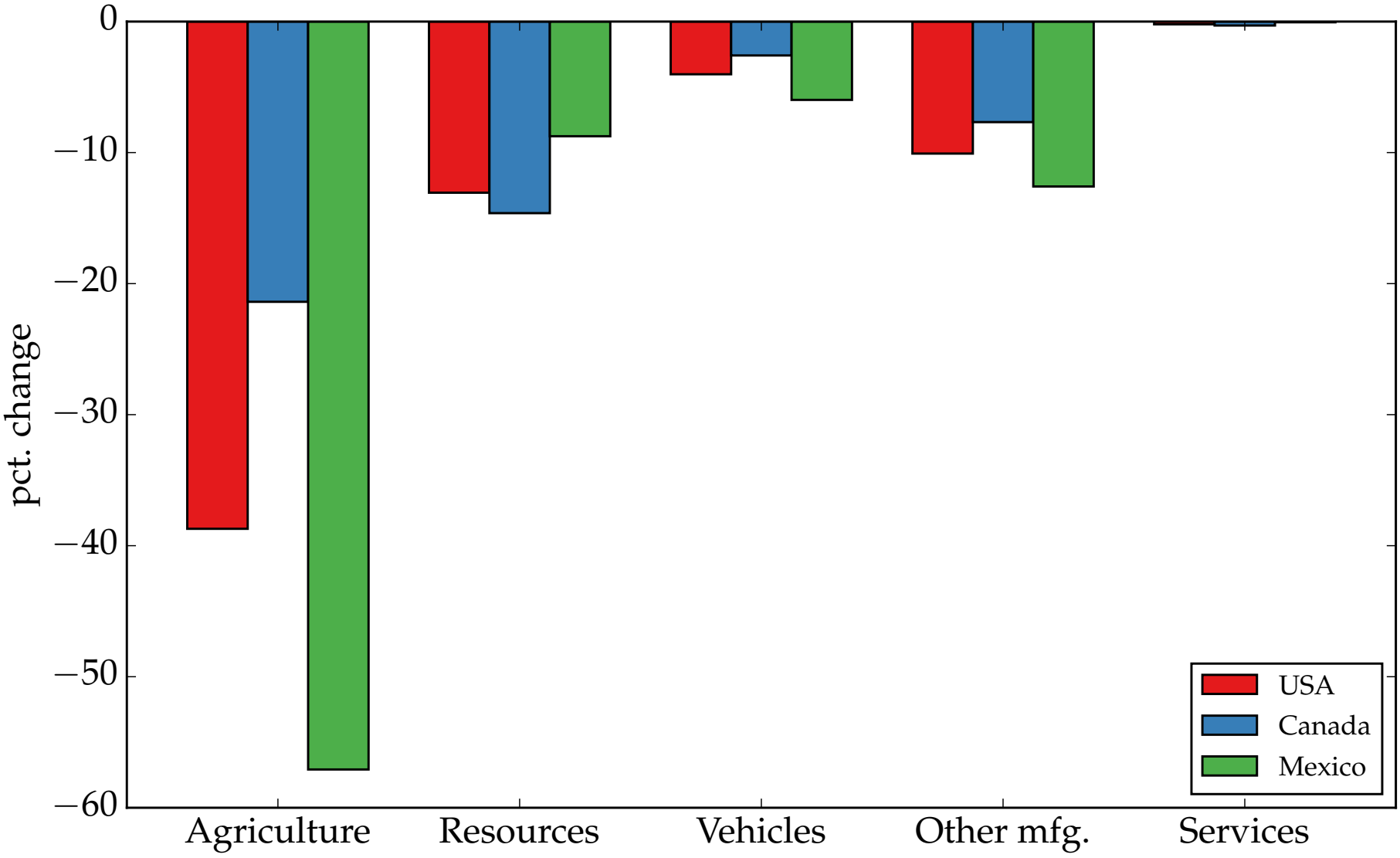
Aggregate to 5 sectors weighting by imports from COMTRADE

Changes in tariffs after NAFTA termination (p.p.):

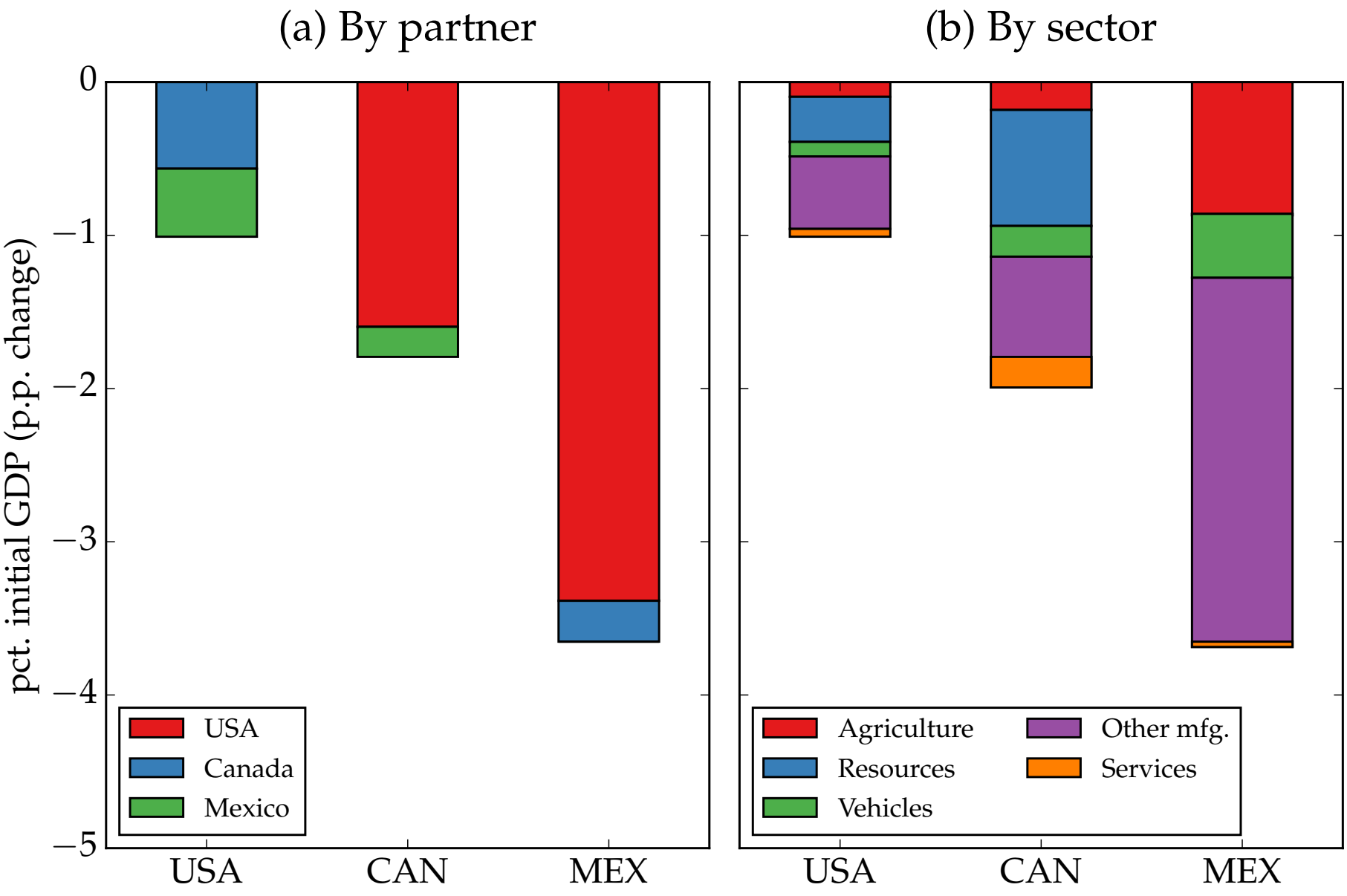
Partner	Agriculture	Resources	Cars	Other mfg.	Total
(a) United States					
Canada	1.74	0.74	2.30	1.79	1.51
Mexico	3.19	0.52	7.75	1.76	3.14
(b) Canada					
United States	3.28	0.61	4.55	1.55	2.14
Mexico	0.57	0.38	5.20	1.47	2.56
(c) Mexico					
United States	29.18	0.18	7.62	3.65	5.40
Canada	13.29	0.08	12.22	2.97	6.19

Results

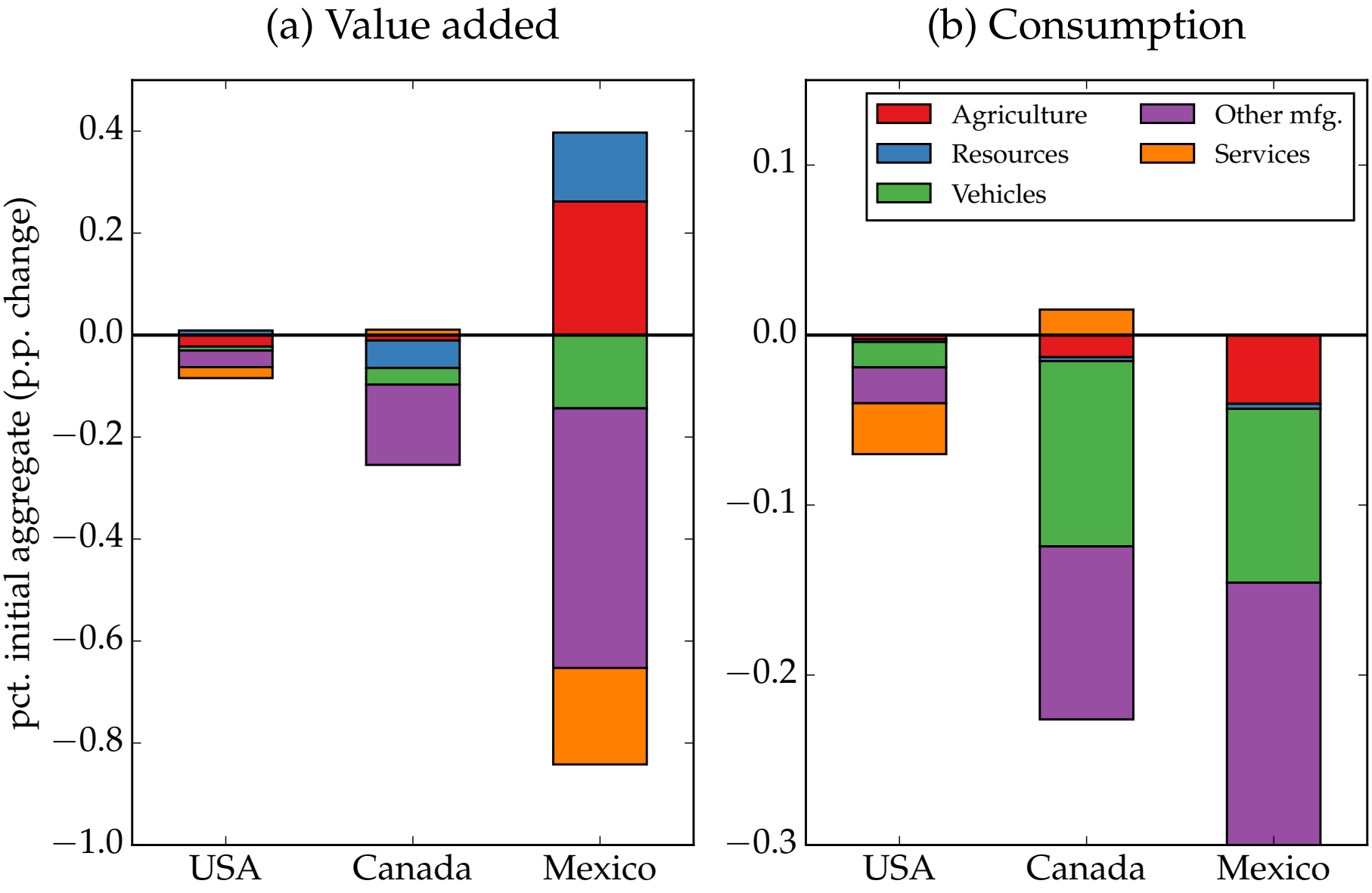
Long-run results: gross NAFTA trade volumes



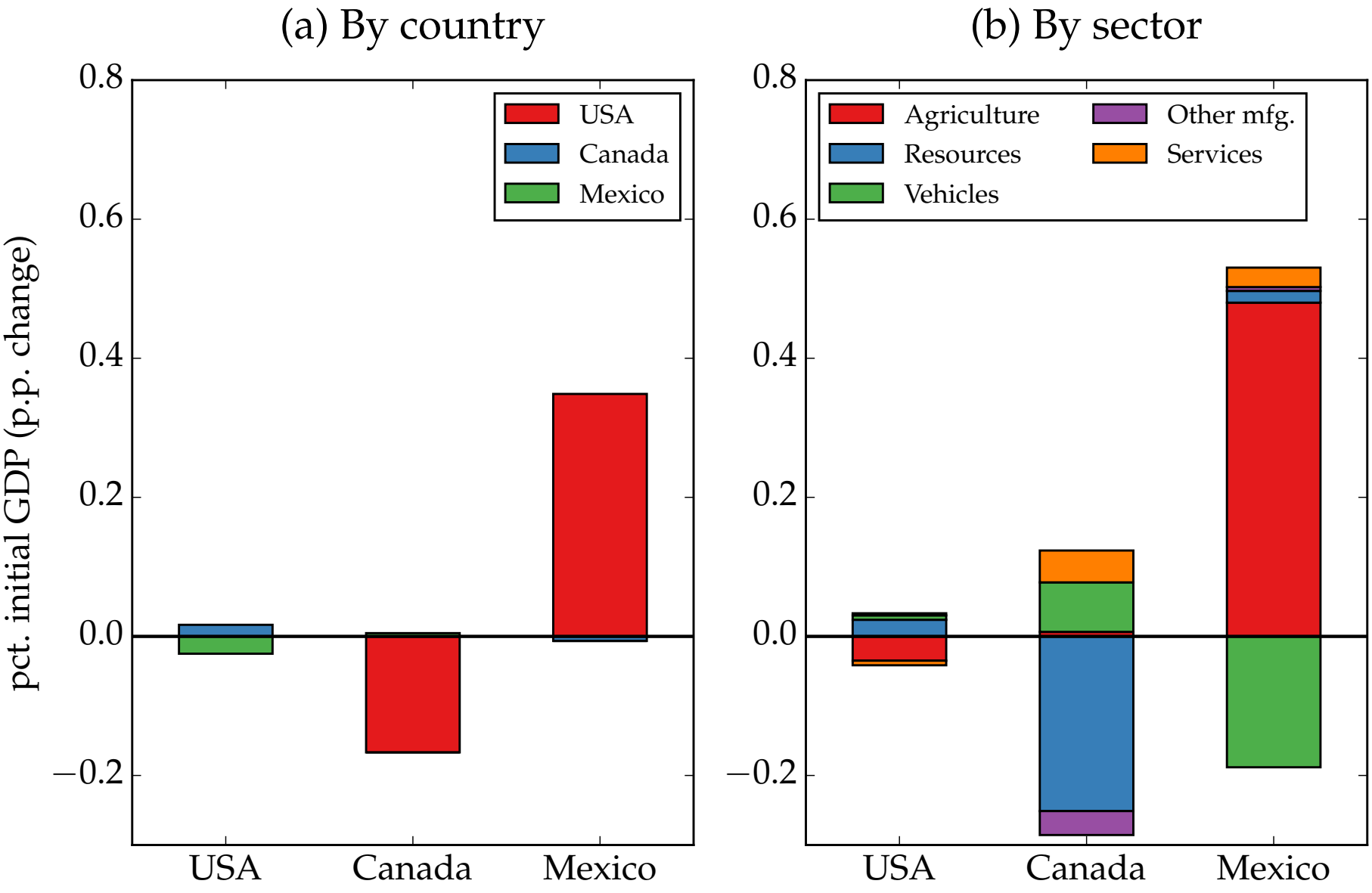
Long-run results: NAFTA trade



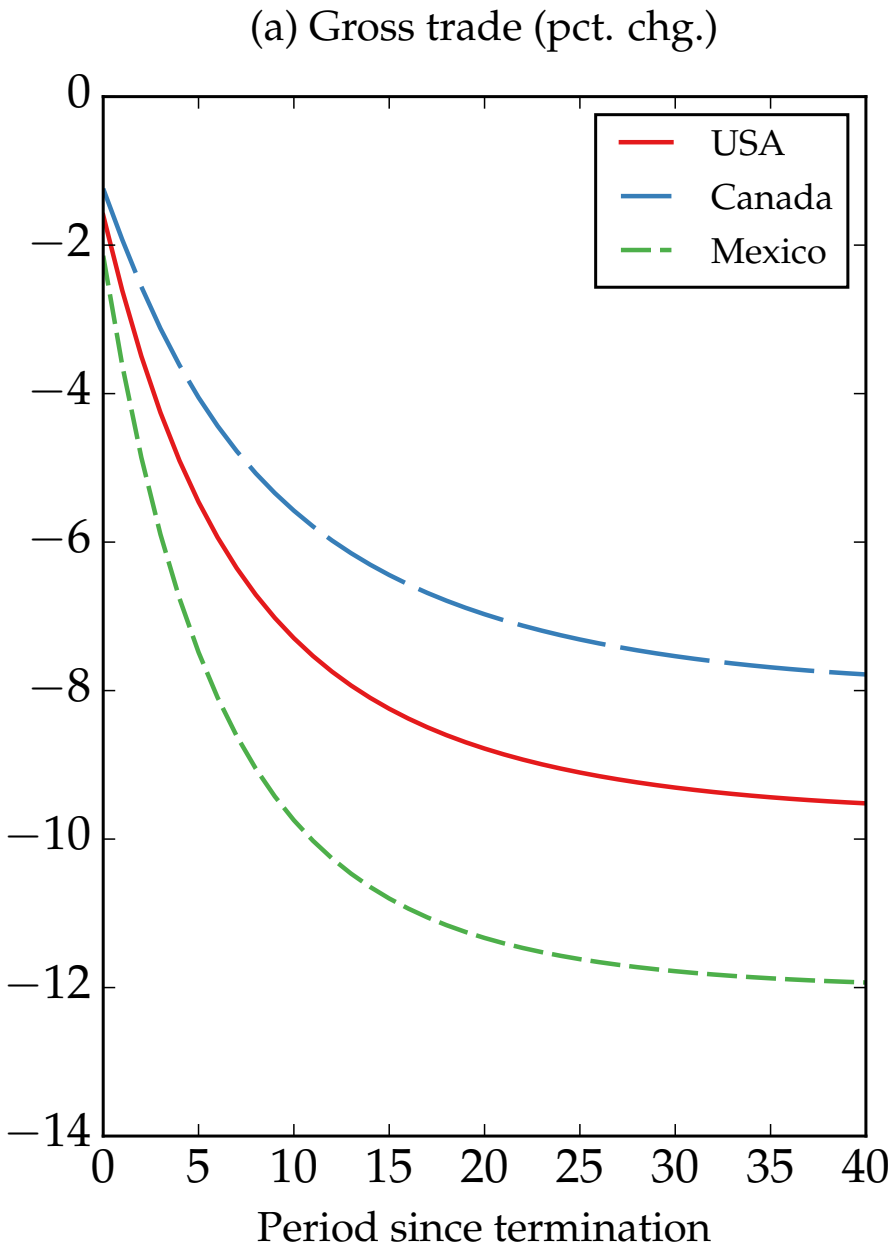
Long-run results: output and consumption

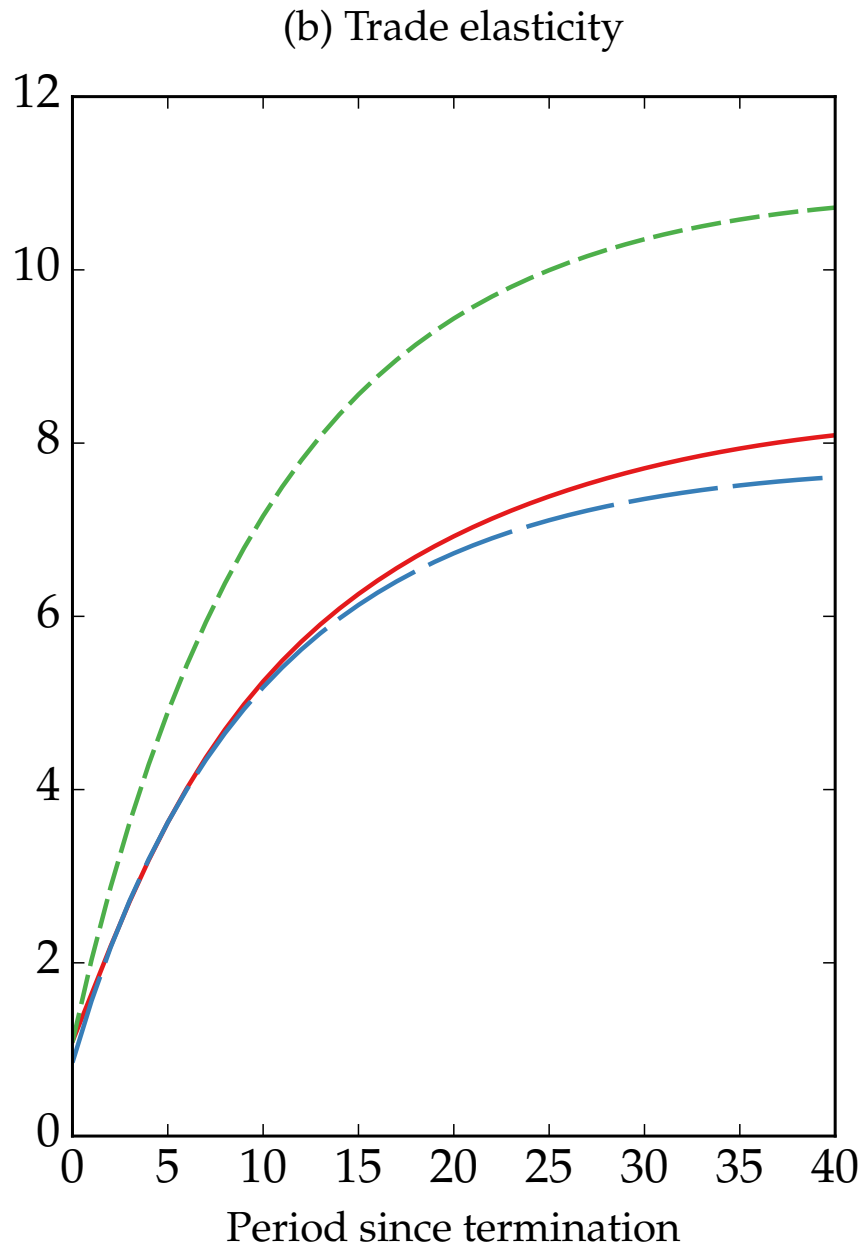


Long-run results: NAFTA trade balances

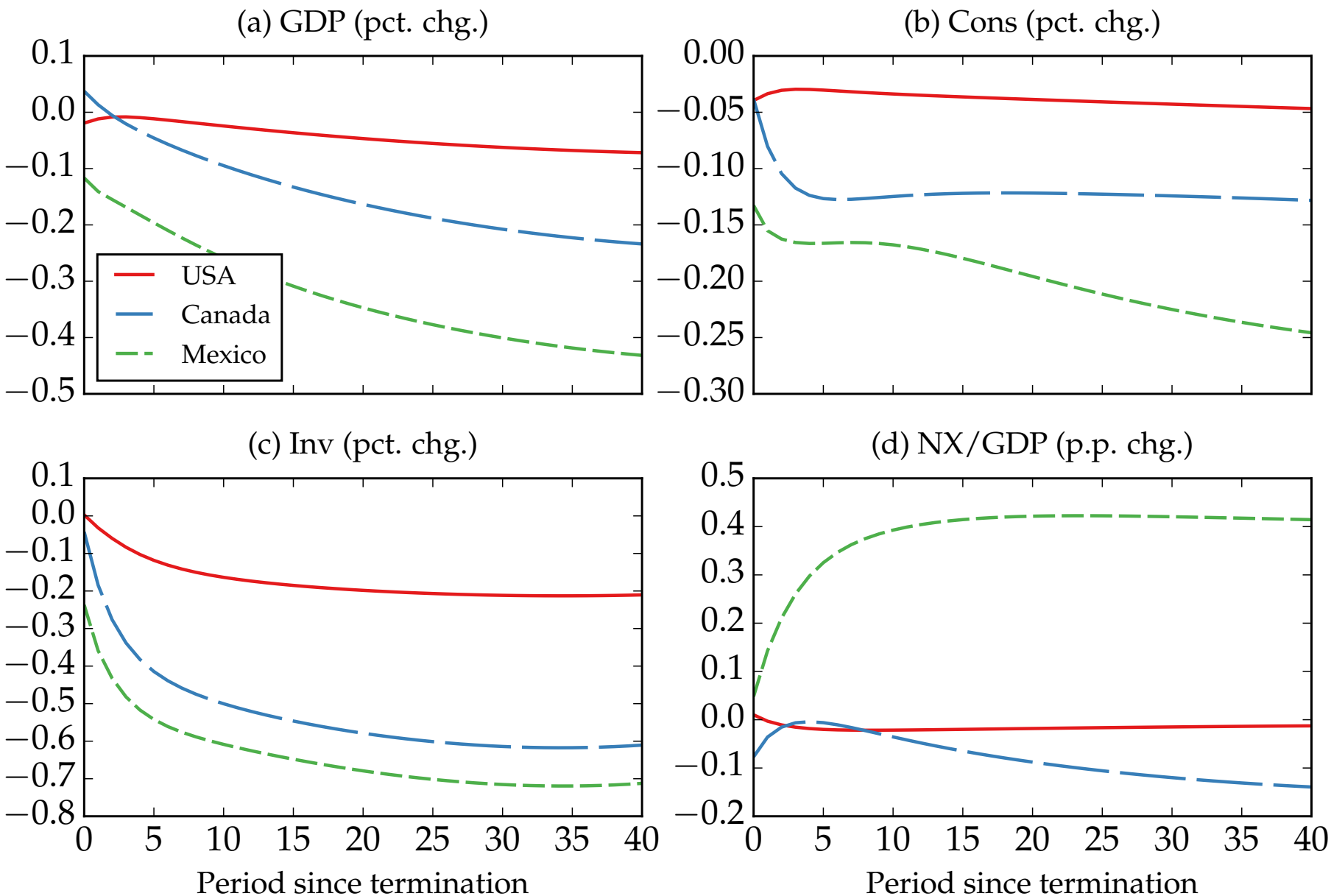


Dynamic results: NAFTA trade





Dynamic results: macro aggregates



Results: welfare

Country	LR Cons. (% chg.)	Welfare (% chg.)	Ratio
USA	-0.050	-0.043	0.866
CAN	-0.131	-0.124	0.949
MEX	-0.254	-0.222	0.863

NAFTA termination hurts all 3 countries, but Mexico loses most

Transition dynamics reduce welfare losses by 5-16%

Q: What drives differences between SR and LR welfare?

Q: What would happen if NAFTA was replaced by something else?

Q: How (and why) do results differ from previous estimates of welfare effects of NAFTA implementation?

What drives transition dynamics?

Transitions: dynamic adjustment margins

	LR cons. loss (%)			Welfare loss (% LR loss)		
Model	USA	CAN	MEX	USA	CAN	MEX
Baseline	-0.050	-0.132	-0.256	0.859	0.944	0.857
No capital adj. costs	-0.062	-0.140	-0.253	0.808	0.941	0.910
No import adj. costs	-0.054	-0.137	-0.294	0.849	0.939	0.815
Fixed trade balances	-0.062	-0.175	-0.293	0.683	0.640	0.714
Const. trade balances	-0.072	-0.200	-0.309	1.430	0.630	0.741
Static exporting	-0.050	-0.124	-0.248	0.833	0.937	0.850
No export costs	-0.050	-0.122	-0.239	0.831	0.934	0.844

K accumulation, bond trading alter extent and timing of welfare effects (Brooks and Pujolas, 2018; Ravikumar et al., 2018)

Speed of adjustments also matter

Extensive-margin dynamics affect LR more than SR

Transitions: dynamic effects of other ingredients

	LR cons. loss (%)			Welfare loss (% LR loss)		
Model	USA	CAN	MEX	USA	CAN	MEX
Baseline	-0.050	-0.132	-0.256	0.859	0.944	0.857
No IO linkages	0.002	-0.012	-0.041	0.129	0.919	0.996
Cobb-Douglas prod.	-0.085	-0.284	-0.481	0.888	0.971	0.943
Cobb-Douglas cons.	-0.030	-0.110	-0.255	1.195	1.224	0.898

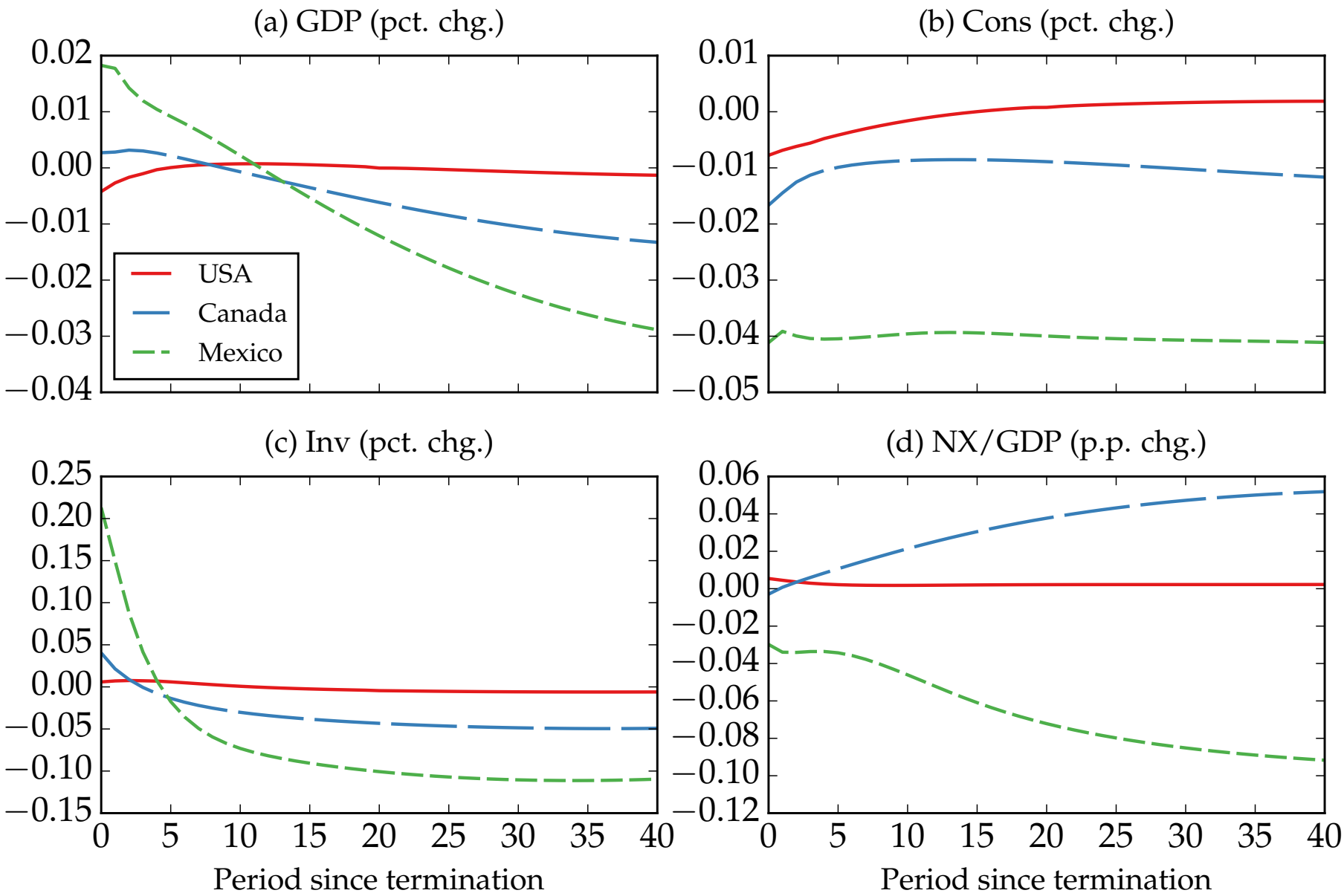
IO linkages important drivers of LR welfare effects (Caliendo and Parro, 2015; Giri et al. 2018)

IO structure also affects welfare timing

Complementarities, too, affect LR and SR welfare

Mechanism: alter households' ability to use investment, trade imbalances to smooth consumption

Transitions: macro dynamics without IO linkages



Other post-NAFTA scenarios

Other scenarios: welfare results

	LR cons. loss (%)			Welfare loss (% LR loss)		
Model	USA	CAN	MEX	USA	CAN	MEX
Baseline	-0.050	-0.132	-0.256	0.859	0.944	0.857
Higher U.S. tariffs	0.059	-0.350	-0.521	1.200	0.925	0.869
US-Canada FTA	-0.035	-0.023	-0.262	0.875	0.766	0.871
Canada-Mexico FTA	-0.049	-0.119	-0.235	0.862	0.942	0.856
NAFTA + stricter DCR	-0.038	-0.064	-0.066	0.810	0.858	0.871

NAFTA termination worse for Canada, Mexico if, in addition, US becomes unilaterally more protectionist

FTA with US would mitigate most harm for Canada or Mexico, but Canada-Mexico FTA would have little effect

Keeping NAFTA but strengthening domestic content requirements makes all members worse off

Comparison to other studies

Comparison to other studies

	LR cons. loss (%)			Welfare loss (% LR loss)		
Model	USA	CAN	MEX	USA	CAN	MEX
Baseline	-0.050	-0.132	-0.256	0.859	0.944	0.857
Cobb-Douglas prod.	-0.085	-0.284	-0.481	0.888	0.971	0.943
Const. trade balances	-0.072	-0.200	-0.309	1.430	0.630	0.741
Pre-NAFTA tariffs	-0.126	0.058	-0.334	0.933	1.139	0.879
All three	-0.267	-0.139	-1.075	1.987	0.176	0.795

Results differ from Caliendo and Parro (2015) estimates

- Canada: 0.12% vs. -0.08%
- Mexico: 0.22% vs. 1.31%

Differences driven by: (i) production complementarities (ii) bond-market access; (iii) pre-NAFTA tariffs vs. current MFN tariffs

Changes in production structure, K accumulation also matter

Summary

Used dynamic GE model to quantify macroeconomic effects of NAFTA termination

- Multi-sector, input-output production structure
- Investment, int'l K flows, extensive-margin dynamics, adj. costs

Main findings:

- Termination hurts all NAFTA members
- Does not rebalance regional trade

Broader lessons for dynamic trade analysis:

- Dynamic ingredients have long-run effects
- IO linkages, other static ingredients have dynamic effects