

Asymmetric Adjustment Costs in Subnational Separation: Evidence from Fiscal Federalism and Commodity Trade

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Abstract

Standard trade theory predicts that smaller economies bear disproportionate adjustment costs when exiting larger unions. Brexit confirmed this pattern: the UK experienced GDP losses roughly ten times larger than the EU-27. This prediction breaks down when the departing region makes substantial net fiscal contributions and specializes in commodities with globally elastic demand. I examine the Alberta-Canada case through three frameworks: modified gravity models distinguishing commodity from manufactured goods trade, fiscal federalism models calibrated to Canadian transfers, and optimal currency area criteria. Drawing on the 1993 Czechoslovak dissolution and Brexit, I identify conditions under which standard asymmetries reverse. When fiscal transfers are large relative to trade costs, and the separating region exports globally fungible commodities while the federation imports goods with low substitution elasticity, the conventional small-country penalty fails. These findings inform debates about federal sustainability with heterogeneous regional economies.

1 Introduction

Economic separation typically harms smaller, departing regions most severely. The UK's exit from the EU confirms this: GDP fell 6-8% relative to counterfactual by 2025 (Bloom et al., 2025), while EU-27 losses averaged 0.5% (IMF, 2018; Bisciari, 2019). This 10:1 disparity follows from standard gravity models (Anderson and van Wincoop, 2003): new borders impose proportionally larger costs on smaller economies because more of their trade crosses the barrier.

This result rests on assumptions about the separating region's economic structure. When a region simultaneously (i) makes large net fiscal contributions, (ii) specializes in commodities with globally elastic demand, and (iii) experiences monetary policy misalignment, the welfare ranking can reverse. Alberta presents this configuration. It contributes 13.5% of federal revenues while representing 11.6% of population (Fraser Institute, 2025), generating cumulative net contributions of \$244.6 billion from 2007-2022. It produces 83.6% of Canada's crude oil (CER, 2025) while oil and gas extraction constitutes 25% of provincial GDP versus under 2% in Ontario and Quebec (Statistics Canada, 2024c). Research identifies Alberta as the only Canadian province where common monetary policy imposes significant welfare costs (Chaban and Voss, 2016).

I develop three frameworks to analyze separation under these conditions. First, I extend Anderson-van Wincoop (2003) to distinguish commodities with globally elastic demand from manufactures with regionally differentiated varieties. Second, I model fiscal federalism following Broadberry (2006), calibrating to Canadian transfers. Third, I apply optimal currency area criteria (Mundell, 1961; Bayoumi and Eichengreen, 1997) to assess monetary misalignment.

Section 2 develops the modified gravity framework and derives reversal conditions. Section 3 models fiscal transfer cessation. Section 4 examines debt allocation using international precedents. Section 5 applies OCA theory. Section 6 calibrates to Canadian data. Section 7 discusses Brexit and Czechoslovak evidence. Section 8 concludes.

2 Trade Disruption: When Does Commodity Specialization Mitigate the Small-Country Penalty?

2.1 Standard Gravity Model Predictions

The Anderson-van Wincoop (2003) structural gravity equation provides the canonical framework for analyzing border effects. Bilateral nominal trade between regions i and j is:

$$X_{ij} = \frac{Y_i Y_j}{Y^W} \left(\frac{t_{ij}}{\Pi_i P_j} \right)^{1-\sigma} \quad (1)$$

where Y_i , Y_j are regional outputs, Y^W is world output, t_{ij} is the bilateral trade cost factor, $\sigma > 1$ is the elasticity of substitution, and Π_i and P_j are multilateral resistance terms defined by:

$$\Pi_i^{1-\sigma} = \sum_j P_j^{\sigma-1} \theta_j t_{ij}^{1-\sigma} \quad (2)$$

$$P_j^{1-\sigma} = \sum_i \Pi_i^{\sigma-1} \theta_i t_{ij}^{1-\sigma} \quad (3)$$

where $\theta_i = Y_i/Y^W$ denotes income shares.

A new border raises multilateral resistance proportionally more for the smaller economy. For Alberta (region A , income share $\theta_A \approx 0.15$ of Canadian GDP) and rest-of-Canada (region C , share $\theta_C \approx 0.85$), introducing a border with cost factor $b > 1$ yields:

$$\frac{\Delta \Pi_A}{\Pi_A} \approx \frac{\theta_C (b^{1-\sigma} - 1)}{\theta_C + \theta_{ROW} \tilde{t}_{A,ROW}^{1-\sigma}} \quad (4)$$

Since $\theta_A < \theta_C$, Alberta faces proportionally larger increases in multilateral resistance.

2.2 Commodity Disaggregation and Welfare Effects

Trade volume and welfare effects diverge when we distinguish commodity types. Partition exports into energy E and other goods M . Welfare cost for region i is:

$$\Delta W_i = - \sum_k \frac{X_{ij}^k}{Y_i} \cdot \frac{(b_k^{1-\sigma_k} - 1)}{\sigma_k - 1} \quad (5)$$

For commodities with high world demand elasticity σ_E , the term $(b_E^{1-\sigma_E} - 1)/(\sigma_E - 1)$ approaches $-\ln b_E$. Alberta's interprovincial energy exports constitute a modest share of total exports. In 2023, interprovincial exports totaled \$102.1 billion while international exports reached \$171.6 billion (Statistics Canada, 2023). Energy commodities redirect to global markets with minimal price discount.

For remaining Canada, import elasticities differ. Canada receives 4.3 million barrels per day from Alberta, representing 83.6% of national crude supply (CER, 2025). Research shows substitution between crude types (heavy sour versus light sweet) is harder than standard models assume (Öhlinger et al., 2024), with short-run elasticities around $\sigma_E^{import} \approx 2-3$ for specific grades.

Proposition 1 (Conditions for welfare cost reversal). *Let the separating region specialize in producing a commodity E with world demand elasticity σ_E substantially larger than the substitution elasticity σ_M for other goods. Even when the separating region is small ($\theta_A < \theta_C$), the welfare cost ratio $\Delta W_C/\Delta W_A$ may exceed unity if:*

$$\frac{X_{CA}^E}{Y_C} \cdot \frac{1}{\sigma_E^{import} - 1} > \frac{X_{AC}^M}{Y_A} \cdot \frac{1}{\sigma_M - 1} \quad (6)$$

This condition states that the remaining federation's dependence on the separating region's commodity exports, weighted by import substitution difficulty, exceeds the separating region's dependence on the federation's other goods, weighted by standard substitution elasticity.

2.3 Calibration to Alberta-Canada Data

Alberta's interprovincial exports total \$102.1 billion (2023), of which energy constitutes a substantial but uncertain share.¹ Rest-of-Canada GDP is \$2.64 trillion. With $\sigma_M \approx 5$ (standard Armington estimate) and $\sigma_E^{import} \approx 2.5$, and applying a border cost factor $b = 1.15$ consistent with Anderson-van Wincoop estimates, the proposition's condition appears plausibly satisfied, though precise welfare calculations remain challenging given data limitations.

3 Fiscal Transfer Mechanisms and Permanent Revenue Shocks

3.1 The Canadian Equalization System

Model the Canadian fiscal federation with n provinces indexed by p having fiscal capacities FC_p (per capita revenue-generating ability at national-average tax rates). The equalization entitlement for province p is:

$$E_p = \max(\bar{FC} - FC_p, 0) \times Pop_p \quad (7)$$

where $\bar{FC} = \sum_p FC_p \cdot Pop_p / \sum_p Pop_p$ is the population-weighted national standard. Seven provinces currently receive \$26.2 billion in equalization (2025–26), with Quebec receiving 52% (\$13.6 billion) (Finance Canada, 2025).

Lemma 1 (Impact of removing high-capacity province). *Removing Alberta reduces the national standard \bar{FC} by:*

$$\Delta \bar{FC} = \frac{Pop_A}{\sum_{p \neq A} Pop_p} (FC_A - \bar{FC}) > 0 \quad (8)$$

mechanically reducing recipient provinces' entitlements.

¹Energy export data by destination is not comprehensively published. Estimates suggest \$35–45 billion in interprovincial energy flows.

3.2 Net Fiscal Contribution Dynamics

The dominant effect operates through direct fiscal contributions. Alberta contributed 13.5% of federal revenues in 2022 while receiving approximately 11% of federal spending (Fraser Institute, 2025). This pattern reflects federal employment concentration in Ottawa: Alberta employs 4.9% of federal workers despite 11.6% population share (TBS, 2024).

Define Alberta's net contribution as $N_A = R_A - (G_A + T_A)$, where R_A is revenue contributed, G_A is program spending received, and T_A is transfers received. For 2022, $N_A = \$14.2$ billion (Fraser Institute, 2025). Cumulative contributions from 2007-2022 totaled \$244.6 billion, exceeding British Columbia (\$46.9 billion) and Ontario (\$41.9 billion) fivefold.

Post-separation, remaining Canada faces:

$$\Delta R_{-A}^{net} = -N_A - \Delta R_{-A}^{GE} \quad (9)$$

where ΔR_{-A}^{GE} captures general equilibrium revenue effects. The combined shock of \$14.2 billion represents approximately 0.5% of remaining-Canada GDP (\$2.64 trillion) and 5–7% of federal revenues.

Theorem 1 (Fiscal transfer asymmetry). *For a net fiscal contributor ($N_A > 0$), post-separation welfare changes satisfy:*

$$\frac{\Delta W_C^{fiscal}}{\Delta W_A^{fiscal}} = \frac{N_A/Y_C + \lambda_C \cdot \Delta D_C/Y_C}{-N_A/Y_A + \lambda_A \cdot \Delta D_A/Y_A} \quad (10)$$

where λ represents the shadow cost of public debt and ΔD is allocated debt. When $N_A > 0$, the numerator is positive (welfare loss for C) while the denominator is negative (welfare gain for A), implying opposite-signed welfare changes.

3.3 Comparison with Brexit

The UK's net EU contribution was £8-10 billion against GDP of roughly £2.0 trillion (0.4-0.5% of GDP) (HM Treasury, 2016). Alberta's \$14.2 billion against remaining-Canada GDP of \$2.64 trillion (0.54%) is proportionally similar. Relative to Alberta's

economy (\$474 billion), the contribution represents 3.0%.

4 Debt Allocation and Sustainability Dynamics

4.1 International Precedents

Canada's federal net debt stands at \$1.27-1.48 trillion (Finance Canada, 2025). The Czechoslovak dissolution provides the primary precedent: assets and liabilities were divided 2:1 by population via Constitution Act 541/1992 (Glatzova & Co., 2016). The 1983 Vienna Convention on Succession of States provides that debt should pass "in equitable proportions," but this convention never entered force (Vienna Convention, 1983).

Under population-proportional allocation, Alberta (11.6% of Canadian population) would assume \$145-175 billion. Against Alberta GDP of \$474 billion, this yields debt-to-GDP of 30.5-37%. Alberta's current provincial debt-to-GDP is projected at 8.7% for 2025-26 (TD Economics, 2025), with a Heritage Fund of \$30 billion (Alberta, 2025).

4.2 Debt Sustainability Framework

Define the debt evolution equation:

$$\frac{d}{dt} \left(\frac{D}{Y} \right) = (r - g) \cdot \frac{D}{Y} - pb \quad (11)$$

where r is the interest rate, g is GDP growth, and pb is the primary balance ratio. For remaining Canada, separation worsens all three components. The debt-to-GDP ratio rises from approximately 40% to 42-50% as debt divides but GDP shrinks. Alberta grew 3.0% in 2024 versus the national average of 2.0% (Statistics Canada, 2024a), so removing the fastest-growing province reduces g . Loss of \$14.2 billion net contribution reduces pb .

Alberta's GDP per capita (\$96,544) exceeds the national average (\$75,336) by 28% (Statistics Canada, 2024b). Removing Alberta reduces remaining-Canada per-capita

GDP to approximately \$72,600, a 3.6% decline in per-capita tax base.

5 Monetary Policy Misalignment: Optimal Currency Area Analysis

5.1 OCA Criteria Applied to Alberta

Mundell's (1961) optimal currency area criteria (labor mobility, wage flexibility, fiscal transfers, and business cycle synchronization) provide a framework for assessing monetary separation costs. The Bayoumi-Eichengreen (1997) OCA index operationalizes:

$$SD(e_{ij}) = \alpha + \beta_1 SD(\Delta Y_i - \Delta Y_j) + \beta_2 DISSIM_{ij} + \beta_3 TRADE_{ij} + \varepsilon_{ij} \quad (12)$$

where $SD(e_{ij})$ measures predicted exchange rate variability.

Alberta exhibits substantial business cycle asymmetry. Mining and oil/gas extraction constitutes 25% of Alberta GDP versus under 2% for Ontario and Quebec (Statistics Canada, 2024c). Chaban and Voss (2016) found that "for all Canadian provinces except Alberta, there are no significant costs from operating under a common monetary policy." Bank of Canada research (Chamie et al., 1994) documented heterogeneous regional shocks, with Prairie provinces experiencing distinct supply shocks compared to central Canada.

5.2 Petrocurrency Effects

The Canadian dollar functions partly as a "petrocurrency." Bank of Canada research (Issa et al., 2008) identified a structural break in the 1990s where the CAD-oil price relationship reversed from negative to positive, reflecting Canada's transformation into a net oil exporter. Estimates of oil price explanatory power for CAD movements vary by methodology (Antweiler, 2015).

For an independent Alberta, dollarization offers advantages: energy exports are

USD-denominated and Alberta's trade is heavily US-focused. For remaining Canada, losing Alberta's \$171.6 billion in international exports (32.2% of Canada's total) would alter CAD equilibrium dynamics and reduce commodity-price sensitivity.

6 Empirical Calibration and Quantitative Assessment

6.1 Parameter Values

Table 1 summarizes calibrated parameters for the welfare decomposition.

Table 1: Calibrated Model Parameters

Parameter	Value	Source
Alberta GDP (Y_A)	\$474B	Statistics Canada (2024)
Rest-of-Canada GDP (Y_C)	\$2.64T	Statistics Canada (2024)
Alberta net fiscal contribution (N_A)	\$14.2B/year	Fraser Institute (2025)
Alberta interprovincial exports	\$102.1B	Statistics Canada (2023)
Alberta international exports	\$171.6B	Statistics Canada (2023)
Federal equalization total	\$26.2B	Finance Canada (2025)
Quebec equalization share	52%	Finance Canada (2025)
Federal debt (net)	\$1.27–1.48T	Finance Canada (2025)
Alberta GDP per capita	\$96,544	Statistics Canada (2024)
Canada GDP per capita	\$75,336	Statistics Canada (2024)
Alberta oil production	4.3 MMb/d	CER (2025)
Alberta share of national oil	83.6%	CER (2025)

6.2 Welfare Decomposition

Total welfare effects decompose as:

$$\Delta W_i = \Delta W_i^{trade} + \Delta W_i^{fiscal} + \Delta W_i^{monetary} + \Delta W_i^{debt} + \Delta W_i^{transition} \quad (13)$$

For Alberta: trade losses of 2-4% of GDP (gravity model predictions, mitigated by commodity fungibility) offset by fiscal gains of approximately 3.0% (\$14.2B / \$474B).

Monetary policy alignment or dollarization could yield further gains. Debt allocation is manageable. Transition costs are negative but one-time.

For remaining Canada: trade losses of 1-2% of GDP, with energy import adjustment costs potentially exceeding standard predictions. Fiscal losses approximate 0.5% ($\$14.2B / \$2.64T$) plus general equilibrium effects. Petrocurrency loss and deteriorating debt sustainability impose additional costs. Transition includes equalization reorganization and institutional relocation.

Conservative estimates suggest net effects near zero for Alberta and negative 1.5-2.5% of GDP for remaining Canada, with substantial uncertainty around point estimates.

7 Empirical Evidence from Historical Separations

7.1 Brexit: Confirming the Standard Asymmetry

Brexit confirms standard gravity predictions when fiscal transfers are modest. The UK experienced GDP losses of 6-8% relative to counterfactual (Bloom et al., 2025), while EU-27 losses averaged 0.5% (IMF, 2018; Bisciari, 2019). The UK's net EU contribution (£8-10 billion against £2.0 trillion GDP, or 0.4-0.5%) was smaller in relative terms than Alberta's Canadian contribution.

7.2 Czechoslovak Dissolution: When Structural Advantages Matter

The 1993 Czechoslovak dissolution offers more relevant insights. The Czech Republic (two-thirds of GDP and population) substantially outperformed Slovakia: budget surplus of +1.3% versus deficit of negative 9% in H1 1993 (Šujan, 1994), unemployment of 3-4% versus 11-15% (Gitter and Scheuer, 1998), FDI approximately 10 times higher (D'Apice, 2014), and currency depreciation of approximately 10% within months (Raiffeisen, 2023).

The structural difference: Slovakia depended on declining heavy industries and

implicit fiscal transfers, while the Czech Republic possessed adaptable manufacturing and stronger fiscal position. In the Alberta-Canada context, roles reverse: Alberta occupies the structurally stronger position. Canada’s remaining economy is far more developed than 1990s Slovakia. The parallel demonstrates that the economically stronger, fiscally sound region can outperform post-separation, not quantitatively similar outcomes.

7.3 Trade Destruction Even Under Cooperation

Even cooperative separations produce substantial trade destruction. Czech-Slovak bilateral trade fell significantly in early years despite maintaining customs union and initially shared currency (Fidrmuc and Fidrmuc, 2003). The gravity model predicts this: any border raises multilateral resistance. For Alberta, international exports (\$171.6B) already exceed interprovincial exports (\$102.1B) by 1.7:1, suggesting capacity to absorb reorientation.

8 Discussion and Limitations

8.1 Methodological Constraints

Standard causal inference approaches—difference-in-differences, synthetic controls, regression discontinuity—all require either cross-sectional variation or repeated treatment observations. Analyzing Alberta separation offers neither. The approach taken here—formal modeling calibrated to observed data and informed by historical precedents—represents the feasible methodology given these constraints.

8.2 Key Uncertainties

Several factors introduce uncertainty. Political economy: the analysis assumes rational negotiation; acrimonious separation could worsen outcomes. Indigenous rights: Treaties 6, 7, and 8 are held with the federal Crown, introducing complex legal dimensions. Trade agreements: Alberta would not automatically inherit CUSMA, CPTPP,

or CETA membership. Infrastructure: pipeline routes through US territory create third-party dependencies. General equilibrium: behavioral responses, investment flows, and migration patterns could alter outcomes substantially.

8.3 Normative Implications

This analysis makes no normative claim about whether separation should occur. The Alesina-Spoloore (1997) framework demonstrates that optimally designed federations dominate separation. The positive question examined here (conditional on separation, how would costs distribute?) differs from the normative question of optimal federal design.

The findings suggest federal systems with heterogeneous regional economies face sustainability challenges when fiscal transfers are large, economic structures diverge, and monetary policy systematically favors the majority at the expense of resource-producing regions. Addressing these tensions through federal design may be preferable to managing separation consequences.

9 Conclusion

Standard trade theory correctly predicts smaller economies face larger proportional costs when exiting unions. Brexit confirmed this: the UK bore costs roughly twelve times larger than the EU-27. This result depends on assumptions about the separating region's economic role.

When a region simultaneously (i) makes large net fiscal contributions, (ii) specializes in globally fungible commodities, and (iii) faces systematic monetary policy misalignment, the standard welfare ranking may not hold. Fiscal transfer cessation can dominate trade disruption costs, particularly when the federation depends on commodity imports with low short-run substitution elasticity while the separating region redirects exports to global markets.

Alberta exhibits these characteristics. It contributes \$14.2 billion annually net to federal finances (five times larger than any other province) while producing 83.6% of Canada's oil through infrastructure that cannot easily be replaced short-run. Re-

search identifies Alberta as the sole Canadian province poorly served by common monetary policy. Czechoslovak precedents demonstrate the economically stronger, fiscally sound region can outperform in separation scenarios.

These findings do not constitute an argument for separation, which would impose enormous transition costs and political disruption on both parties. They suggest conventional small-country penalty predictions may not apply where fiscal federalism asymmetries are pronounced and commodity specialization enables global market access. Understanding these conditions contributes to debates about federal sustainability and optimal federal design.

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