Misallocation and Trade Policy

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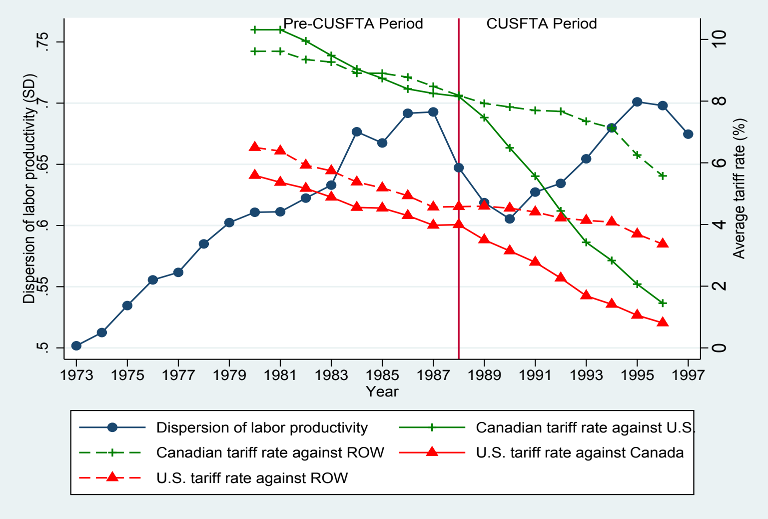
Figure 1: Dispersion of labor productivity and average tariff rates



Note: Used plant-level data from the ASM and tariff data from Trefler (2004). CUSFTA mandated annual reduction in tariffs and other trade barriers across industries over a ten-year period starting on January 1, 1989. The plot shows the average within-industry standard deviation of log labor productivity, measured as value added per worker, across plants. The weights are industry employment shares.

Why is resource misallocation important?

- Explains a large part of cross-country TFP differences (Restuccia & Rogerson, 2008; Hsieh & Klenow, 2009)
- Can lower aggregate TFP particularly during crises or recessions (Oberfield, 2013; Sandleris & Wright, 2014; Ziebarth, 2014)

Trade literature

- International trade agreements generate productivity gains from within-firm growth and between-firm reallocation (Pavcnik, 2002; Melitz, 2003; Trefler, 2004,; Lileeva and Trefler, 2010) and through reduction of secondary distortions (Khandelwal et al., 2013; McCaig & Pavcnik, 2014)
- International trade does reduce input market distortions (Tito and Wang, 2018)

What is missing in the literature?

- The relationship between the degree of resource misallocation (as measured by dispersion in revenue TFP) and a particular trade policy.

Research Question

- Did the Canada-U.S. Free Trade Agreement (CUSFTA) reduce resource misallocation in Canada?

Why examine CUSFTA?

- The implementation of CUSFTA can be viewed as a natural experiment.
  - Negotiations for the FTA began in September 1985.
  - There was a considerable uncertainty about whether there would be an agreement until after the November 1988 general election returned the Conservatives for a second term.
  - The agreement went into effect on January 1, 1989.
- In particular, CUSFTA was not accompanied by other macroeconomic reforms or implemented in response to a particular macroeconomic crisis unlike many trade liberalizations in some developing countries.
- This makes CUSFTA ideal for identifying the causal effect of trade policy on resource misallocation.

What is the importance of this study?

- This study sheds light on implications of the United States-Mexico-Canada Agreement (USMCA).

Method

- Use plant-level data from the Annual Surveys of Manufactures (ASM), tariff data from Trefler (2004), and a dynamic panel data model.

Main result

- The Canada-U.S. Free Trade Agreement (CUSFTA) did reduce resource misallocation in Canada:
  - Specifically, CUSFTA reduced misallocation by approximately 4% and consequently, increased TFP by around 4% in Canada.
  - This translates into a contribution of 23% to the overall TFP growth of Canada's manufacturing sector.

Method for Measuring Misallocation

- To infer the presence and size of misallocation, we can use the dispersion of TFPR across firms within-industry (Hsieh & Klenow, 2009).
- In this study, I measure TFPR for plant i in industry s:

$$TFPR_{si} \equiv \frac{P_{si}Y_{si}}{K_{si}^{\alpha}(w_{si}L_{si})^{1-\alpha}},$$

  where $P_{si}Y_{si}$ is value added in production activities.

  1. Use the Wooldridge (2009) method to estimate labor and capital elasticities to calculate TFPR
  2. Use labor share and capital share from Statistics Canada's KLEMS database to calculate TFPR

- Use the dispersion of the log of labor productivity

  3. Calculate labor productivity as value added in production activities per hour worked by production workers

▸ Hsieh & Klenow (2009) Model ▸ Wooldridge (2009) Method

Dynamic Panel Data Model

$$
\begin{aligned}
Y_{st} &= \beta_0 + \theta Y_{st-1} + \delta\tau_{st} + X_{st}^T\beta + \lambda_t + u_{st}, \quad |\theta| < 1 \\
u_{st} &= \alpha_s + v_{st} \\
v_{st} &= \epsilon_{st} + \gamma\epsilon_{st-1}, \quad 0 < \gamma < 1
\end{aligned}
$$

- Y_{st} - Misallocation for industry s in year t
- Y_{st-1} - Misallocation for industry s in year $t-1$ (could capture resource misallocation across firms evolving over time)
- τ_{st} - Tariff rates (Canadian tariff rates on US exports, US tariff rates on Canadian exports) for industry s in year t
- X_{st}^T - Vector of covariates to account for firm and industry characteristics.
  - Industry-specific exchange rate
  - Share of value-added by foreign-controlled plants
  - Mean age of plants
  - Herfindahl index (controls for market concentration and could be a proxy for markups)
  - U.S. control using NBER-CES productivity database (could pick up demand and supply shocks that are common to both countries)
- λ_t - Year fixed effects
- α_s - Unobserved time-invariant industry-specific effects
- $\epsilon_{st} + \gamma\epsilon_{st-1}$ - MA(1) error term (could capture possible adjustment costs due to TFPR shocks)

System GMM

- Key identifying assumption for the causal inference:

$$E[Y_{0st}|\alpha_s, Y_{st-1}, X'_{st}, \tau_{st}] = E[Y_{0st}|\alpha_s, Y_{st-1}, X'_{st}]$$

- As Y_{st-1} is correlated with α_s because Y_{st-1} is a function of α_s, OLS estimators are biased and inconsistent.
- To remove unobserved time-invariant industry-specific effects (α_s), we could take first difference:

$$\Delta Y_{st} = \theta \Delta Y_{st-1} + \delta \Delta \tau_{st} + \Delta X'_{st} \beta + \Delta \lambda_t + \Delta \epsilon_{st} + \gamma \Delta \epsilon_{st-1}$$

  where $\Delta \epsilon_{st}$ is correlated with the lagged dependent variable, ΔY_{st-1}, because both are a function of ϵ_{st-1}.
- To correct this endogeneity problem, I use the system GMM method proposed by Arellano and Bover (1995) and Blundell and Bond (1998).
- Because the composite error, $\epsilon_{st} + \gamma \epsilon_{st-1}$ is MA(1), only lags two or higher are valid instruments for the level equation.
- Because ϵ_{st-2} is the farthest lag of ϵ_{st} that appears in the difference equation, lags three or higher are valid instruments for the difference equation.

Plant-level data from the ASM

- The ASM has been conducted since 1917 and covers entire the manufacturing sector in Canada.
- Use the cross-sectional 1973-1999 file
  - Plants in the ASM are classified into 232 industries (after dropping four printing and publishing industries due to false deaths) at the four-digit 1980 SIC level.

Tariff Data from Trefler (2004)

- Use 209 four-digit industries after 16 industries were aggregated into eight in Trefler's database for the period of 1980-1996.

▸ Data sources ▸ Dropped observations ▸ Large plants ▸ Foreign controlled plants

Major Drawbacks of the ASM

1. The ASM does not record capital stock or investment data.
2. Energy costs were not reported by smaller plants in the pre-1982 period.

Methods to Impute Capital Stock

1. Scale plant-level energy costs using the industry-level capital-energy ratio, calculated from Statistics Canada's KLEMS database (Tomlin, 2014)
2. Allocate industry-level capital stock from Statistics Canada's Investment and Capital Stock Division using plant-level capital cost (nominal value added less payroll) (Baldwin & Gu, 2003)

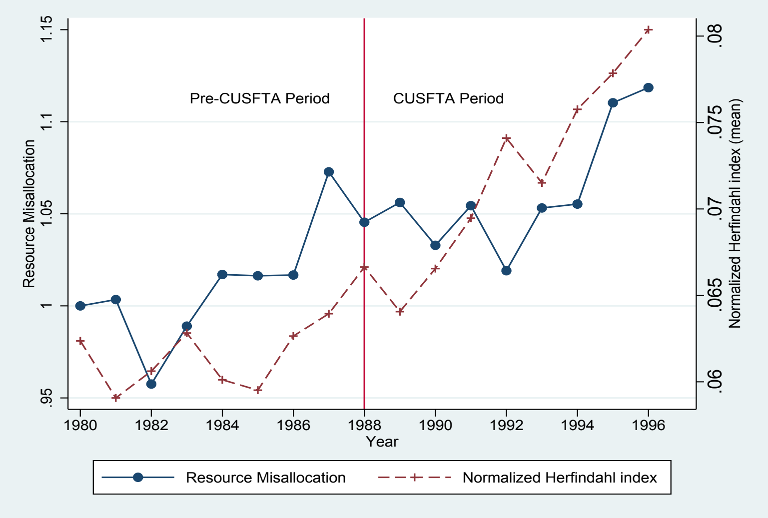
MissingCapital

Table 1: Labor and capital coefficients

SIC	Fuel & Power (Tomlin, 2014) Hours	Capital	Wage	Capital	Capital Service (Baldwin & Gu, 2003) Hours	Capital	Wage	Capital	KLEMS Lab	Capital
10	0.64	0.05	0.71	0.02	0.46	0.38	0.52	0.38	0.53	0.47
11	0.26	0.34	0.22	0.35	0.32	0.46	0.31	0.46	0.48	0.52
12	0.61	-0.05	0.87	0.07	0.07	0.54	0.21	0.52	0.35	0.65
15	0.47	0.08	0.51	0.06	0.40	0.32	0.41	0.32	0.78	0.22
16	0.57	0.06	0.62	0.04	0.38	0.33	0.43	0.33	0.63	0.37
17	0.71	0.05	0.75	0.02	0.59	0.30	0.63	0.29	0.76	0.24
18	0.55	0.13	0.64	0.09	0.46	0.34	0.46	0.33	0.63	0.37
19	0.65	0.00	0.71	-0.01	0.54	0.29	0.57	0.29	0.71	0.29
24	0.56	0.07	0.62	0.06	0.44	0.31	0.49	0.30	0.73	0.27
25	0.65	0.06	0.67	0.04	0.58	0.26	0.57	0.25	0.75	0.25
26	0.55	0.12	0.60	0.10	0.51	0.28	0.55	0.27	0.74	0.26
27	0.53	0.11	0.55	0.09	0.47	0.34	0.48	0.34	0.67	0.33
28	0.79	-0.03	0.80	-0.03	0.72	0.25	0.73	0.26	0.68	0.32
29	0.62	0.11	0.65	0.08	0.45	0.33	0.47	0.33	0.72	0.28
30	0.70	0.05	0.69	0.07	0.59	0.29	0.58	0.29	0.71	0.29
31	0.54	0.12	0.59	0.10	0.51	0.33	0.52	0.32	0.67	0.33
32	0.69	0.13	0.72	0.08	0.60	0.30	0.59	0.29	0.70	0.30
33	0.39	0.17	0.49	0.12	0.36	0.33	0.42	0.32	0.66	0.34
35	0.68	-0.01	0.73	-0.04	0.52	0.34	0.53	0.33	0.62	0.38
36	0.40	0.06	0.47	0.06	0.29	0.47	0.36	0.46	0.63	0.37
37	0.34	0.12	0.44	0.10	0.52	0.42	0.52	0.41	0.48	0.52
39	0.72	0.03	0.70	0.03	0.59	0.29	0.57	0.29	0.67	0.33
Mean	0.57	0.08	0.62	0.07	0.47	0.34	0.50	0.34	0.65	0.35

Note: To estimate coefficients, I use the method developed in Wooldridge (2009).

Figure 2: Resource misallocation and Herfindahl index



Note: To measure resource misallocation, I use the dispersion of TFPR that is calculated based on estimated labor and capital elasticities applying the method developed by Wooldridge (2009). I use the normalized Herfindahl index as, $H^* = \frac{H - \frac{1}{N}}{1 - \frac{1}{N}}$, where $H = \sum_{i=1}^{N} S_i^2$, N is the number of plants, and S_i is the market share (measured by value added) of plant i.

Table 2: The effects of tariffs on resource misallocation

Dependent Variable: Resource misallocation (standard deviation of TFPR or labor productivity)

Independent Variables	**Wooldridge (2009)** (1)	**Wooldridge (2009)** (2)	**Solow Residual** (1)	**Solow Residual** (2)	**Labor Productivity** (1)	**Labor Productivity** (2)
AR(1) Coefficient	0.49***	0.49***	0.26***	0.26***	0.71***	0.71***
	(0.08)	(0.08)	(0.08)	(0.08)	(0.10)	(0.10)
Canada tariffs against U.S.	0.19***		0.12***		0.08**	
	(0.03)		(0.03)		(0.04)	
U.S. tariffs against Canada		0.20***		0.20***		0.15**
		(0.04)		(0.04)		(0.06)
Exchange rate (industry specific)	0.05***	0.05***	0.05***	0.05***	0.03*	0.02
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Share of foreign-controlled plants	0.06***	0.06***	0.03***	0.03***	0.06***	0.06***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)
Mean age of plants	-0.06***	-0.06***	-0.09***	-0.09***	-0.03**	-0.03**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
Standardized Herfindahl index	0.06***	0.06***	-0.06***	-0.06***	0.06**	0.06**
	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)
U.S. control	0.21***	0.21***	0.13***	0.14***	0.06	0.07
	(0.03)	(0.03)	(0.04)	(0.04)	(0.05)	(0.05)
N	3344	3344	3344	3344	3344	3344
m2	0.74	0.74	0.04	0.05	2.29	2.26
Sargan test (df=27)	32.40	32.33	30.98	30.95	23.65	23.60
P value of Sargan test	0.22	0.22	0.27	0.27	0.65	0.65

Method used to calculate TFPR or productivity: Wooldridge (2009), Solow Residual, Labor Productivity.

Note: An observation is a year and an industry. Standard errors are in parentheses. ***, **, and * indicate statistically significant coefficients at 1%, 5%, and 10% percent levels, respectively.

Autocorrelation Test

Robustness Checks

My primary results are consistent across several robustness checks:

1. Imputing missing tariff rates ▸ Imputing
   - As robustness checks, I impute tariff rates by calculating mean tariff rates at three-digit or two-digit level and use those tariff rates for missing industries.
2. Endogenous tariff rates ▸ Predetermined
   - To justify this robustness check, I regress tariff rates on lagged misllocation. ▸ Reverse causality
3. Incorpoting export characteristics of plants ▸ Exporting characteristics
   - Due to data limitation (only four years data available), I use OLS instead of dynamic panel data model.

Misallocation and Productivity Gains

Calculate the long-run effect of tariffs on misallocation, the change in misallocation due to CUSFTA, and the change in TFP due to change in misallocation as follows:

$$\eta^j = \frac{\delta^j}{1-\theta^j}, \; j = CA, US \quad (1)$$

$$\Delta Y_s^j = \eta^j \left[(\tau_{s1}^j - \tau_{s1}^{j,ROW}) - (\tau_{s0}^j - \tau_{s0}^{j,ROW}) \right] \quad (2)$$

$$\Delta logTFP_s^j = -\frac{\sigma}{2} \Delta Y_s^j, \; \sigma = 5 \quad (3)$$

where δ is the tariff coefficient, θ is the AR(1) coefficient, τ is the tariff rates, and σ is the elasticity of substitution between plant value added.

Table 3: The effect of CUSFTA on misallocation and productivity (%)

Method	**Misallocation**	**Productivity Gains**	**Contribution to Growth**
Wooldridge (2009)	-4.15	4.07	23.11
Solow residual	-3.08	2.12	12.07
Labor productivity	-2.85	4.44	14.87

Note: Method means here the method is used to calculate TFPR or productivity. During the period from 1988 to 1996 for the manufacturing sector, I find, using the ASM database, that the TFP growth rate is 17.6 percent and the labor productivity growth rate is 29.83 percent.

Method

- Use plant-level data from the Annual Surveys of Manufactures (ASM), tariff data from Trefler (2004), and a dynamic panel data model.

The Takeaway Message

- The Canada-U.S. Free Trade Agreement (CUSFTA) did reduce resource misallocation in Canada:
  - Specifically, CUSFTA reduced misallocation by approximately 4% and consequently, increased TFP by around 4% in Canada.
  - This translates into a contribution of 23% to the overall TFP growth of Canada's manufacturing sector.

Future work

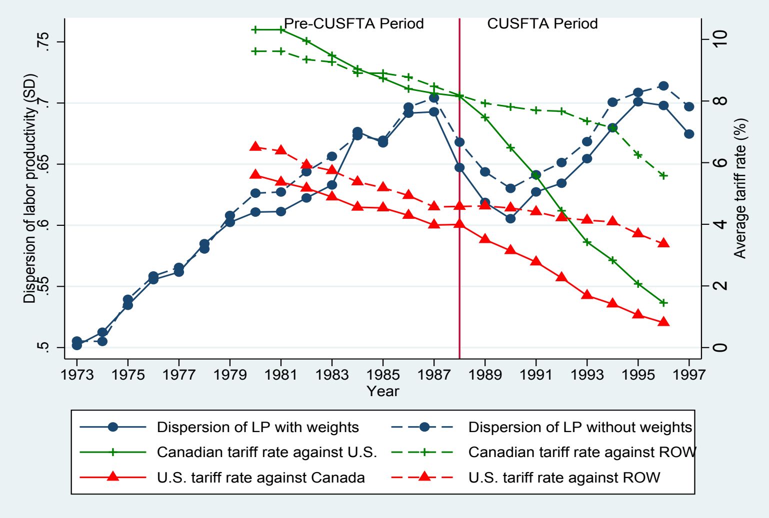
- Develop a model to explain the mechanism by which a trade agreement reduces resource misallocation

Implications of USMCA

Thank You

Appendix

Figure 3: Dispersion of labor productivity and average tariff rates



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◂ Motivation

Provisions of USMCA

Dairy

1. Giving the US tariff-free access to 3.6% (up from 3.25% under Trans-Pecific Partnership) of the $15.2 billion (as of 2016) Canadian dairy market.
2. Canada agreed to eliminate Class 7 pricing provisions on certain dairy products, while Canada's domestic supply management system remains in place.

Automobiles

1. Cars or trucks with at least 75% (the current requirement is 62.5%) of their components made in the United States, Mexico, or Canada can be sold with zero tariffs.
2. 30% of the work done on these cars must be done by workers who earn US$16 per hour starting in 2020 and the percentage will increase to 40% by 2023.
3. Tariffs on steel and aluminum also affect the automobile sector.
   - The United States imposed 25% tariff on steel and 10% tariff on aluminum imports.

◂ Conclusion

A Brief Overview of the Hsieh & Klenow (2009) Model

- Each industry contains a continuum of monopolistic competitive firms (indexed by i) that differ in their physical productivity levels, A_i.
- Firms in an industry face a Dixit-Stiglitz-type constant elasticity demand system and choose a quantity (equivalently, price) to maximize the profit function:

$$\pi_i = (1-\tau_{Y_i})P_iQ_i - wL_i - (1+\tau_{K_i})RK_i \quad (4)$$

subject to the firm's inverse residual demand curve, $P_i = Q_i^{-\frac{1}{\sigma}}$, and the production function, $Q_i = A_iK_i^{\alpha}L_i^{1-\alpha}$.

- Where τ_{Y_i} is a firm-specific distortion (effectively a tax or subsidy on the firm's output) and τ_{K_i} is a firm-specific factor price distortion (high for firms that do not have access to credit, but low for firms with access to cheap credit).
- The factor prices–assumed constant across firms–are w for labor and R for capital.
- Given the isoelastic residual demand curve, firm i's profit-maximizing price and marginal cost:

$$P_i = \frac{\sigma}{\sigma-1}MC_i \quad (5)$$

$$MC_i = \left(\frac{R}{\alpha}\right)^{\alpha}\left(\frac{w}{1-\alpha}\right)^{1-\alpha}\frac{(1+\tau_{K_i})^{\alpha}}{A_i(1-\tau_{Y_i})} \quad (6)$$

Both distortions (τ_{Y_i} and τ_{K_i}) affect the firm's marginal cost and price, and firms with higher A_i have lower marginal costs and prices.

- At the optimal price and quantity, the firm's marginal revenue product of labor ($MRPL_i$) and capital ($MRPK_i$):

$$\begin{aligned} MRPL_i &\propto w\frac{1}{1-\tau_{Y_i}} \quad (7) \\ MRPK_i &\propto R\frac{1+\tau_{K_i}}{1-\tau_{Y_i}} \quad (8) \end{aligned}$$

  In the absence of distortions, marginal revenue products of both factors are equalized across firms.

- Using (7) and (8), firm TFPR is proportional to a weighted geometric average of the marginal products of labor and capital:

$$TFPR_i \propto (MRPK_i)^{\alpha}(MRPL_i)^{1-\alpha} \propto \frac{(1+\tau_{K_i})^{\alpha}}{1-\tau_{Y_i}} \quad (9)$$

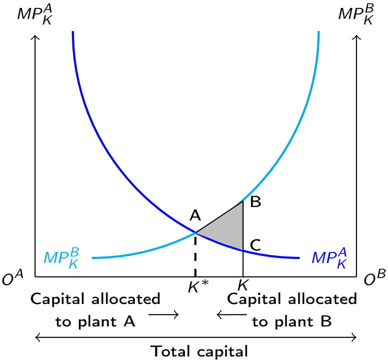
$$TFPR_i \equiv P_iA_i = \frac{\sigma}{\sigma-1}\left(\frac{R}{\alpha}\right)^{\alpha}\left(\frac{w}{1-\alpha}\right)^{1-\alpha}\frac{(1+\tau_{K_i})^{\alpha}}{(1-\tau_{Y_i})} \quad (10)$$

  TFPR does not vary across firms within an industry unless firms face capital and/or output distortions.

- To infer the presence and size of misallocation, we can measure the differences in TFPR across firms within-industry.

◂ Measuring Misallocation

Figure 4: Specific factor model



- Dispersion of input returns: An indirect measure of input misallocation
- Resource misallocation: The allocation of resources to plants with lower rather than higher returns

Production Function Estimation

- Calcuate TFPR as the residual of the plant-level production function separately for each two-digit industry, s, as follows:

$$logv_{it} = \beta_l^s logl_{it} + \beta_k^s logk_{it} + log\omega_{it} + \epsilon_{it}$$

  - v_{it} - log of real value added
  - l_{it} - log of labor input measued by real wage bill
  - k_{it} - Capital input
  - All variables are deflated using industry prices from KLEMS.

- Given the estimated elasticities β_l^s and β_k^s, I then calculate plant (log) TFPR as:

$$log\omega_{it} = logv_{it} - \hat{\beta}_l^s logl_{it} + \hat{\beta}_k^s logk_{it}$$

◂ Measuring Misallocation

Table 4: The sources of data

Data	Data Source	Data Level
Primary database	ASM cross-sectional file 1973-1999	Plant-level
Capital stock	Statistics Canada's Investment and Capital stock Division	Three-digit SIC 1980
Capital index	Statistics Canada's KLEMS database	Four-digit SIC 1980
Energy index	Statistics Canada's KLEMS database	Four-digit SIC 1980
Tariff rates	Trefler (AER, 2004)	Four-digit SIC 1980
Nominal exchange rate	Penn World Table 9.0	Country-level
Canada industry-specific prices	Statistics Canada's KLEMS database	Four-digit SIC 1980
U.S. Shipment deflator	NBER-CES	U.S. four-digit SIC 1987
U.S. TFP	NBER-CES	U.S. four-digit SIC 1987

◂ Data

Table 5: Dropped obervations

year	# of plants	totalemp	prdwrk	hrwork	payroll	wage	tmatcost	vpm	vam	
		Percentage of Missing								
1980	3907	33.89	89.10	59.07	3.17	58.38	54.08	54.11	54.08	5
1981	3947	32.43	89.79	63.62	5.90	63.24	55.92	55.97	55.94	5
1982	4013	32.05	87.47	62.55	6.95	62.37	54.07	54.82	54.12	5
1983	3820	31.73	89.58	64.69	6.70	64.55	56.47	56.57	56.49	5
1984	3843	32.42	87.67	64.40	8.80	64.04	53.92	53.99	53.97	5
1985	3018	20.01	84.59	73.72	8.61	73.23	63.88	63.92	63.95	6
1986	3204	19.66	80.40	68.20	7.18	67.92	59.52	59.52	59.52	5
1987	2981	21.10	84.30	68.94	5.77	68.94	62.83	62.86	62.83	6
1988	2782	21.35	91.88	78.04	7.51	78.04	69.30	69.30	69.27	6
1989	2440	13.77	94.06	81.56	0.57	80.86	76.02	76.11	76.07	7
1990	2382	11.17	94.12	86.06	2.90	85.85	75.99	76.07	76.11	7
1991	2790	15.81	87.46	83.41	5.66	77.28	63.80	63.80	63.69	6
1992	2900	15.10	90.76	81.45	5.38	81.03	65.41	65.62	65.45	6
1993	2766	15.15	90.49	81.67	5.46	81.06	64.68	64.71	64.68	6
1994	2567	14.18	90.61	81.57	4.67	81.07	64.90	65.06	64.86	6
1995	2510	13.82	89.16	80.48	4.90	80.20	61.39	61.43	61.35	6
1996	2464	17.78	87.58	73.38	3.21	72.85	57.83	58.44	57.83	5
Mean	3078	21.26	88.77	73.69	5.49	72.99	62.35	62.49	62.37	6

Note: *totalemp* is the sum of production workers and salaried employees, *prdwrk* is the production workers, *hrwork* is the production hours worked, *payroll* is the sum of wages and salaries, *wage* is the production workers wages, *tmatcost* is the total material costs, *vpm* is the manufacturing production, *vam* is the manufacturing value added, and *vat* is the total value added.

◂ Data

Table 6: Coverage in large relative to small plants

year	# of plants		Percentage of Aggregate				Ratio of mean	
	Large	Small	Value added	Labour	Capital	Fuel & Power	Age	Productivity
1980	13434	13063	96.67	92.76	98.74	100.00	1.35	1.29
1981	13333	13098	96.81	93.08	98.67	100.00	1.36	1.29
1982	13580	11988	96.94	93.32	98.72	98.08	1.40	1.33
1983	13601	13422	96.85	92.84	98.86	97.89	1.53	1.36
1984	13551	15204	96.30	92.40	98.25	97.62	1.52	1.36
1985	10724	19060	92.86	86.55	96.80	95.91	1.41	1.33
1986	10142	20403	91.69	84.16	96.42	95.53	1.62	1.29
1987	9545	19805	90.65	81.02	96.26	94.48	1.55	1.32
1988	10288	21612	92.47	82.16	97.48	94.08	1.87	1.26
1989	11141	20110	92.85	82.10	97.59	93.89	2.09	1.23
1990	15493	16213	94.13	85.45	98.14	95.53	1.93	1.23
1991	11769	14974	92.94	82.93	97.63	94.36	1.54	1.21
1992	13149	12264	93.54	85.00	97.80	93.05	1.44	1.23
1993	12801	11759	94.42	85.40	98.15	93.66	1.36	1.22
1994	12889	11555	94.96	86.54	98.20	94.26	1.34	1.23
1995	12859	12070	94.88	86.60	98.19	93.97	1.47	1.23
1996	12793	14767	94.21	83.92	98.11	92.89	1.56	1.21

Note: For this table, I use the form-type variable that indicates whether a plant filled the short-form questionnaire (which is considered as a small plant) or the long-form questionnaire (which is considered as a large plant). I use capital stock based on Baldwin and Wulong (2003) measure.

◂ Data

Table 7: Coverage in foreign- relative to domestic-controlled plants

year	# of plants		Percentage of Aggregate				Ratio of mean	
	Large	Small	Value added	Labour	Capital	Fuel & Power	Age	Productivity
1980	3375	23122	46.20	38.03	49.49	47.81	1.17	1.03
1981	3295	23136	46.53	37.24	46.47	44.13	1.17	1.02
1982	3233	22335	45.40	36.67	45.95	44.20	1.20	1.02
1983	3179	23844	45.15	35.89	46.84	42.56	1.23	1.02
1984	3161	25594	44.96	35.87	46.84	42.45	1.25	1.02
1985	3055	26729	44.38	34.72	44.61	42.76	1.30	1.01
1986	3042	27503	43.35	33.86	45.88	44.18	1.37	1.02
1987	3072	26278	44.20	33.78	47.77	45.87	1.38	1.02
1988	3143	28757	44.28	32.99	48.82	46.64	1.45	1.03
1989	3199	28052	46.89	33.86	51.28	48.92	1.48	1.03
1990	3174	28532	47.65	35.04	52.92	49.67	1.48	1.02
1991	3013	23730	48.27	36.17	55.24	50.74	1.39	1.01
1992	2982	22431	47.57	36.41	53.71	49.84	1.37	1.01
1993	2903	21657	48.98	36.05	53.42	50.61	1.34	1.02
1994	2895	21549	47.87	35.42	52.73	49.05	1.34	1.02
1995	2802	22127	47.93	34.29	52.24	48.88	1.37	1.03
1996	2825	24735	47.21	32.94	50.54	47.71	1.50	1.02

Note: For this table, I use the classification of foreign-controlled plants variable from the ASM.

Data

Table 8: Coverage in positive relative to missing capital cost

year	# of plants Capital cost	Missing	Percentage of Aggregate Value added	Labor	Capital	Fuel & Power	Ratio of mean Age	Productivity
1980	26522	2846	98.34	94.82	100.00	96.20	1.13	1.22
1981	26454	2993	98.38	94.50	100.00	95.70	1.16	1.24
1982	25593	3647	97.41	92.02	100.00	92.31	1.06	1.18
1983	27032	3395	97.88	93.57	100.00	92.25	1.10	1.18
1984	28776	2635	98.60	95.31	100.00	95.26	1.14	1.25
1985	29810	2618	98.38	94.88	100.00	95.27	1.11	1.24
1986	30559	3131	98.40	94.42	100.00	95.12	1.09	1.23
1987	29358	3062	98.48	94.74	100.00	95.87	1.18	1.21
1988	31913	3805	97.72	93.15	100.00	95.79	1.29	1.20
1989	31271	3748	97.93	92.92	100.00	94.22	1.22	1.15
1990	31717	3820	97.69	92.99	100.00	93.62	1.16	1.14
1991	26867	5095	96.68	90.74	100.00	91.20	1.12	1.13
1992	25415	4711	97.43	91.83	100.00	90.63	1.09	1.12
1993	24572	4168	97.82	92.81	100.00	92.58	1.10	1.16
1994	24468	3480	98.46	94.15	100.00	96.47	1.06	1.19
1995	24936	3686	98.57	93.58	100.00	95.92	1.15	1.16
1996	27573	4259	98.33	93.61	100.00	94.40	1.18	1.18

Note:

Impute capital stock

Table 9: Arellano-Bond test for zero autocorrelation in first-differenced errors

Order	Method used to calculate TFPR or productivity											
	Wooldridge (2009)				Solow Residual				Labor Productivity			
	Canada		US		Canada		US		Canada		US	
	z	p	z	p	z	p	z	p	z	p	z	p
1	-4.14	0.00	-4.16	0.00	-3.31	0.00	-3.30	0.00	-4.80	0.00	-4.75	0.00
2	0.74	0.46	0.74	0.46	0.04	0.97	0.05	0.96	2.29	0.02	2.26	0.02
3	0.04	0.97	0.04	0.97	1.16	0.24	1.19	0.24	-0.98	0.33	-0.97	0.33
4	-1.25	0.21	-1.17	0.24	-0.85	0.40	-0.84	0.40	0.91	0.36	0.90	0.37

Note:

◂ Regression Results

Table 10: Imputing missing tariff rates

Dependent Variable: Resource misallocation (standard deviation of TFPR or labor productivity)

Independent Variables	**Wooldridge (2009)** (1)	(2)	**Solow Residual** (1)	(2)	**Labor Productivity** (1)	(2)
	Method used to calculate TFPR or productivity					
AR(1) Coefficient	0.50***	0.51***	0.33***	0.33***	0.66***	0.66***
	(0.09)	(0.09)	(0.09)	(0.09)	(0.08)	(0.08)
Canada tariffs against U.S.	0.08***		0.09***		0.08**	
	(0.02)		(0.03)		(0.04)	
U.S. tariffs against Canada		0.05*		0.14***		0.14**
		(0.03)		(0.04)		(0.05)
Exchange rate (industry specific)	0.04***	0.04***	0.05***	0.05***	0.02*	0.02*
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Share of foreign-controlled plants	0.06***	0.06***	0.03***	0.03***	0.07***	0.07***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)
Mean age of plants	-0.07***	-0.07***	-0.08***	-0.08***	-0.03**	-0.03**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Standardized Herfindahl index	0.05***	0.05***	-0.06***	-0.06***	0.00	0.00
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
U.S. control	0.20***	0.19***	0.15***	0.15***	0.15***	0.15***
	(0.03)	(0.03)	(0.04)	(0.04)	(0.05)	(0.05)
N	3706	3706	3706	3706	3706	3706
m2	0.98	0.99	0.60	0.60	2.26	2.25
Sargan test (df=27)	22.75	22.51	25.67	25.56	23.37	23.25
P value of Sargan test	0.70	0.71	0.54	0.54	0.66	0.67

Note: An observation is a year and an industry. Standard errors are in parentheses. ***, **, and * indicate statistically significant coefficients at 1%, 5%, and 10% percent levels, respectively.

Robustness Checks

Table 11: Endogenous tariff rates

Dependent Variable: Resource misallocation (standard deviation of TFPR or labor productivity)

Independent Variables	Method used to calculate TFPR or productivity					
	Wooldridge (2009)		Solow Residual		Labor Productivity	
	(1)	(2)	(1)	(2)	(1)	(2)
AR(1) Coefficient	0.45***	0.52***	0.28***	0.23***	0.66***	0.66***
	(0.07)	(0.07)	(0.07)	(0.07)	(0.08)	(0.08)
Canada tariffs against U.S.	0.19***		0.11***		0.07**	
	(0.03)		(0.03)		(0.03)	
U.S. tariffs against Canada		0.18***		0.20***		0.16***
		(0.04)		(0.04)		(0.06)
Exchange rate (industry specific)	0.06***	0.05***	0.05***	0.05***	0.03**	0.03**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Share of foreign-controlled plants	0.07***	0.06***	0.03***	0.03***	0.07***	0.07***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)
Mean age of plants	-0.07***	-0.06***	-0.09***	-0.10***	-0.04***	-0.04***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
U.S. control	0.22***	0.21***	0.14***	0.14***	0.06	0.06
	(0.03)	(0.03)	(0.04)	(0.04)	(0.05)	(0.05)
Standardized Herfindahl index	0.07***	0.05**	-0.06***	-0.06***	0.05**	0.05**
	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)
N	3344	3344	3344	3344	3344	3344
m2	0.65	0.80	0.11	-0.03	2.35	2.31
Sargan test (df=54)	64.96	83.31	61.67	61.95	72.16	72.26
P value of Sargan test	0.15	0.01	0.22	0.24	0.05	0.06

Note: An observation is a year and an industry. Standard errors are in parentheses. ***, **, and * indicate statistically significant coefficients at 1%, 5%, and 10% percent levels, respectively.

Robustness Checks

Table 12: The effect of lagged misallocation on tariff rates

Dependent Variable: Tariff rates						
	Method used to calculate TFPR or productivity					
Independent Variables	Wooldridge (2009)		Solow Residual		Labor Productivity	
	(1)	(2)	(1)	(2)	(1)	(2)
Lagged Misallocation	0.01	0.01**	-0.01	0.02**	-0.05***	-0.01***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)
Constant	0.06***	0.03***	0.07***	0.03***	0.10***	0.04***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
N	3344	3344	3344	3344	3344	3344
R^2	0.00	0.00	0.00	0.00	0.02	0.00

Note: An observation is a year and an industry. Column titled 1 is for Canadian tariff rates on U.S. exports and column titled 2 is for U.S. tariff rates on Canadian exports. Standard errors are in parentheses. ***, **, and * indicate statistically significant coefficients at 1%, 5%, and 10% percent levels, respectively.

Robustness Checks

Table 13: Including exporting characteristics of plants

Dependent Variable: Resource misallocation (standard deviation of TFPR)						
Independent Variables	First Specification		Second Specification		Third Specification	
	(1)	(2)	(1)	(2)	(1)	(2)
Canada tariffs against U.S.	0.42***		0.35***		0.37***	
	(0.07)		(0.07)		(0.08)	
U.S. tariffs against Canada		0.52***		0.44***		0.44***
		(0.11)		(0.11)		(0.11)
Exchange rate (industry specific)	0.13***	0.12***	0.13***	0.12***	0.13***	0.13***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Share of foreign-controlled plants	0.11***	0.11***	0.12***	0.11***	0.11***	0.11***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Mean age of plants	-0.11***	-0.11***	-0.07***	-0.07***	-0.11***	-0.11***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
U.S. control	0.31***	0.32***	0.33***	0.33***	0.33***	0.34***
	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)
Standardized Herfindahl index	0.22***	0.21***	0.23***	0.23***	0.23***	0.22***
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Percentage of exporters			-0.07***	-0.08***		
			(0.02)	(0.02)		
Percentage of exports					-0.03	-0.04**
					(0.02)	(0.02)
N	836	836	836	836	836	836
R^2	0.26	0.25	0.27	0.27	0.26	0.26

Note: Column titled 1 is for Canadian tariff rates on U.S. exports and column titled 2 is for U.S. tariff rates on Canadian exports.