CASE STUDY- TRANSPORTATION

Boardman, A. E., Laurin, C., Moore, M. A., & Vining, A. R. (2009). A cost-benefit analysis of the privatization of Canadian National Railway. *Canadian Public Policy*, *35*(1), 59-83.

EE465/EE463 Project Evaluation

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Introduction

- This article uses CBA to estimate the welfare gains from the privatization of **Canadian National Railway (CN)** in 1995.
- The welfare gains were estimated mainly based on cost savings due to privatization (relative to continued government ownership).
- The costs of **Canadian Pacific Railway** (another privately owned rail) were used to calculate the *counterfactual* costs.
- Also, the authors calculated the distribution of welfare gains among consumers, producers, and government, and between Canadians and non-Canadians.
- This study provides support for the argument that privatization leads to welfare gain in less competitive environment.

Canadian National Railway (CN)

- CN was formed as government-owned corporation during 1917-1923.
- By 1989, CN had become primarily a rail-freight company, and had a labor force of ~40,000.
- Its main competitor is Canadian Pacific Railway (CP), which is privately owned and also focuses on freight transportation.
- In early 1990s, both CN and CP faced strong competition from trucking and shipping.
- As a result of declines in real output prices relative to input prices, both companies' financial performance weakened in the 1990s.
- In November 1995, CN was privatized.

Canadian National Railway

Pixsource: binaryoptionevolution.com

Canadian Pacific Railway

Pixsource: tickrwatch.com

Data

- Most data are obtained from the annual reports of *Rail in Canada* 1981-2003:
  - Output – measured in terms of "revenue-tonne kilometres"
  - Revenues and costs are for freight and non-freight activities
- All revenue and cost data are converted into constant 1992 $ using GDP deflator and CPI.
- Timeframe of data used:
  - Pre-1992: government operation
  - 1992: transition year
  - 1993-2003: privatization period

Description of Data

Variable	*Measure*	*Source*
Output[a]	Revenue-tonne kilometres of freight	RIC[b] Table 9
Revenue[c]	Dollar amount	RIC Table 1-1
Variable costs		
Fuel[d]	Overall cost of diesel ($)	RIC Table 6
Direct labour	Labour used for transportation or equipment maintenance	RIC Table 11
Fixed costs		
Indirect labour	Road maintenance plus general administrative services	RIC Table 11
Benefits		RIC Table 1-1
Capital[e]	Total expenditures on "ways and structures" and "equipment" minus labour costs for "ways and structures" and maintenance of "equipment"	RIC Table 1-1
Miscellaneous	Total rail operating expenses minus the above costs	RIC Table 1-1
Other railroad data		
Employment	Number of employees in Canada	RIC Table 11
Annual compensation	Average annual pay	RIC Table 11
Hourly compensation	Average hourly pay	RIC Table 11
Other variables		
Privatization transactions cost	Cost per share x number of shares sold	
Cost per share	$1.0125 (the amount that the government agreed to pay to the underwriters for each share sold)	RBC Dominion Securities 1995
Number of shares sold at privatization	83.8 million	Bruce 1997, 149

Notes:
[a] Railways produce multiple outputs but the data do not allow us to disaggregate output by type of freight, its origin or destination.
[b] RIC = Rail in Canada (Statistics Canada 2003). The table numbers may differ in other years.
[c] Freight revenues are approximately 90 percent of total revenues.
[d] Freight fuel costs represent about 98 percent of total fuel costs.
[e] Does not include investment on new track, although it does include depreciation on new track.

Methodology

- Total welfare due to a privatization of a firm can be written as:

$$\Delta W = V_{sp} - V_{sg} + (\lambda_g - \lambda_p)\mathrm{Z}$$

Where

W = social welfare

V_{sp} = the value to society of the firm under privatization

V_{sg} = the value to society of the firm under government operation

Z = the sale price of the firm

λ_g and λ_p are shadow multipliers on government revenue and private funds (assume they are zeros for now.)

Cost Savings at CN due to Commercialization-Privatization

- Given zero multipliers, the welfare change is:

$$V_{sp} - V_{sg} = C_g^{CN} - C_p^{CN} + F - T$$

Where

$C_g^{CN} - C_p^{CN}$ = PV of cost savings (relative to counterfactual)

C_g^{CN} = the 1992 PV of CN's operating costs under unchanged government ownership

C_p^{CN} = the 1992 PV of CN's operating costs under "private ownership"

F = the 1992 PV of the projected future gain attributable to privatization from 2004 onward

T = the 1992 PV of transaction costs of privatization

Calculation of Costs (1)

- PV of CN's operating costs under "private ownership" during 1993-2003:

$$C_p^{CN} = \sum_t \frac{ATC_t^{CN}}{(1+s)^t} Q_t^{CN}$$

Where

t = 1 for 1993, … , t = 11 for 2003

s = social discount rate (3.5%)

ATC_t^{CN} = CN's actual average total cost ($1992/revenue-tonne kilometre) in year t

Q_t^{CN} = CN's actual Canadian freight rail output in revenue-tonne kilometres in year t

Calculation of Costs (2)

- Two approaches to estimate CN's counterfactual costs (costs that would have been under continued government ownership)

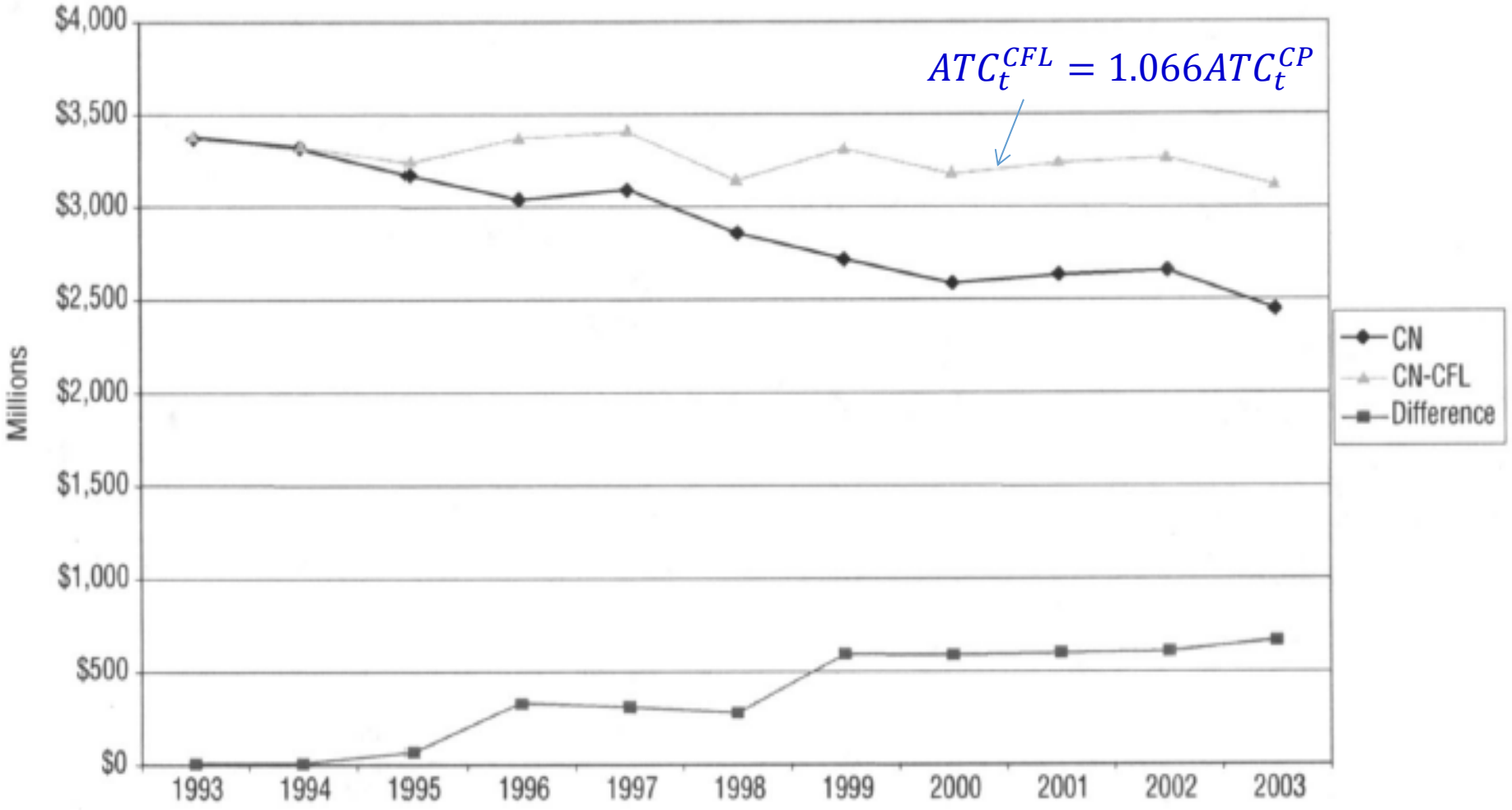
1. Base-case approach:

- Based on the data over the 4-year period immediately prior to the privatization of CN (1988-1991), CN's ATC is ~6.66% higher than CP's ATC.
- Assume that the gap between CN's ATC and CP's ATC remains the same after privatization.
- PV of CN's counterfactual 1993-2003 total costs:

$$C_g^{CN} = \sum_t \frac{1.066 ATC_t^{CP}}{(1+s)^t} Q_t^{CN}$$

FIGURE 1a

CN Total Costs Smoothed: Actual, Non-Privatization Base-Case Counterfactual, and Difference (in millions of 1992 dollars), 1993–2003



Calculation of Costs (3)

2. Conservative counterfactual:

- Assume that CN's ATC continues to decline at a *faster rate* than CP's ATC after the privatization.
- During 1981-1991, CN's ATC declined by 1.062% faster than CP's ATC.
- CN's counterfactual ATC in year t:

$$ATC_t^{CFL} = ATC_{t-1}^{CN} \times \left(\frac{ATC_t^{CP}}{ATC_{t-1}^{CP}} - 1.062 \right)$$

- For example, CN's ATC in 1993 is:

$$ATC_{1993}^{CFL} = ATC_{1992}^{CN} \times \left(\frac{ATC_{1993}^{CP}}{ATC_{1992}^{CP}} - 1.062 \right)$$

Conservative Counterfactual

FIGURE 2a

CN and CP Smoothed Average Total Costs (ATC, 1992 dollars per revenue tonne-kilometre of output), 1981–2003

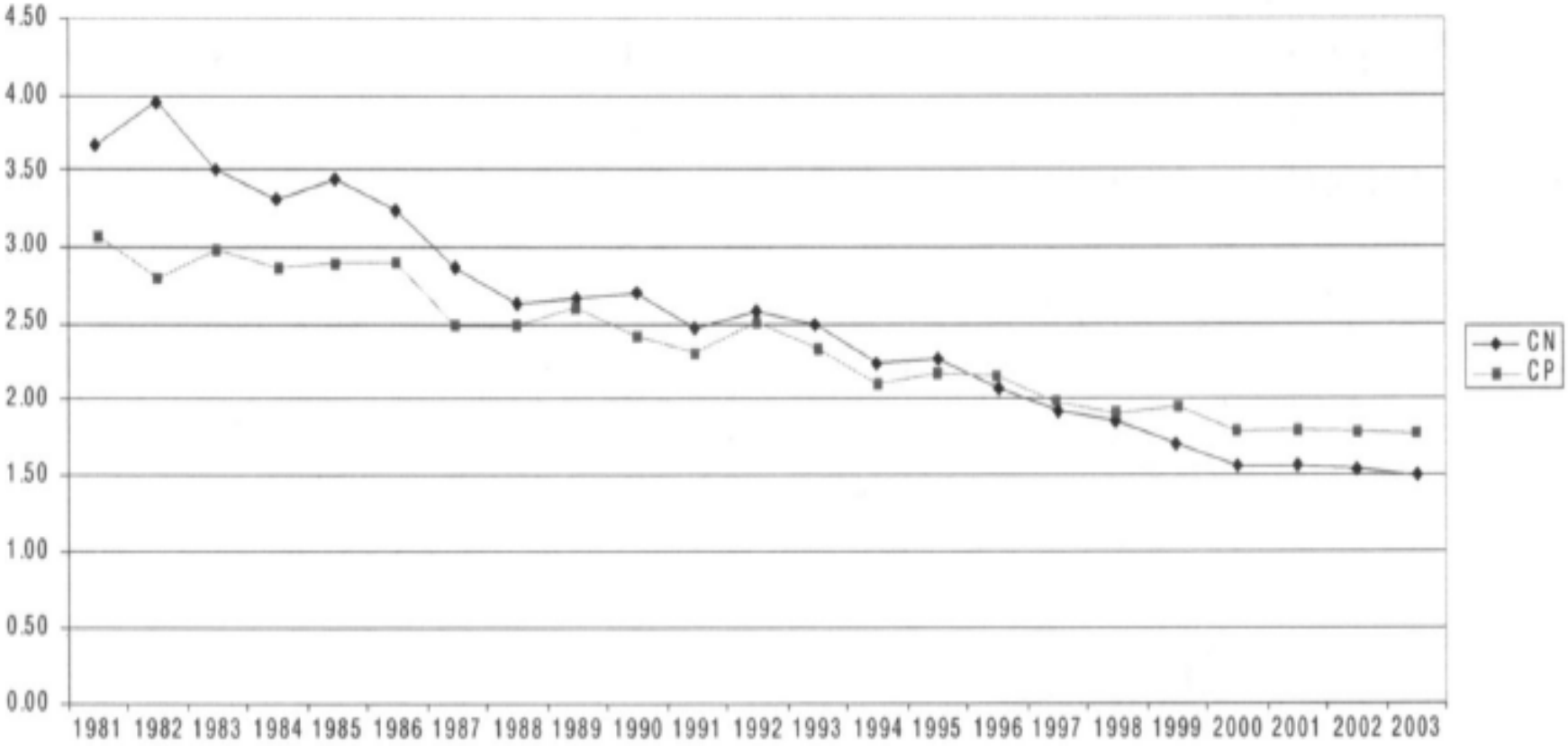
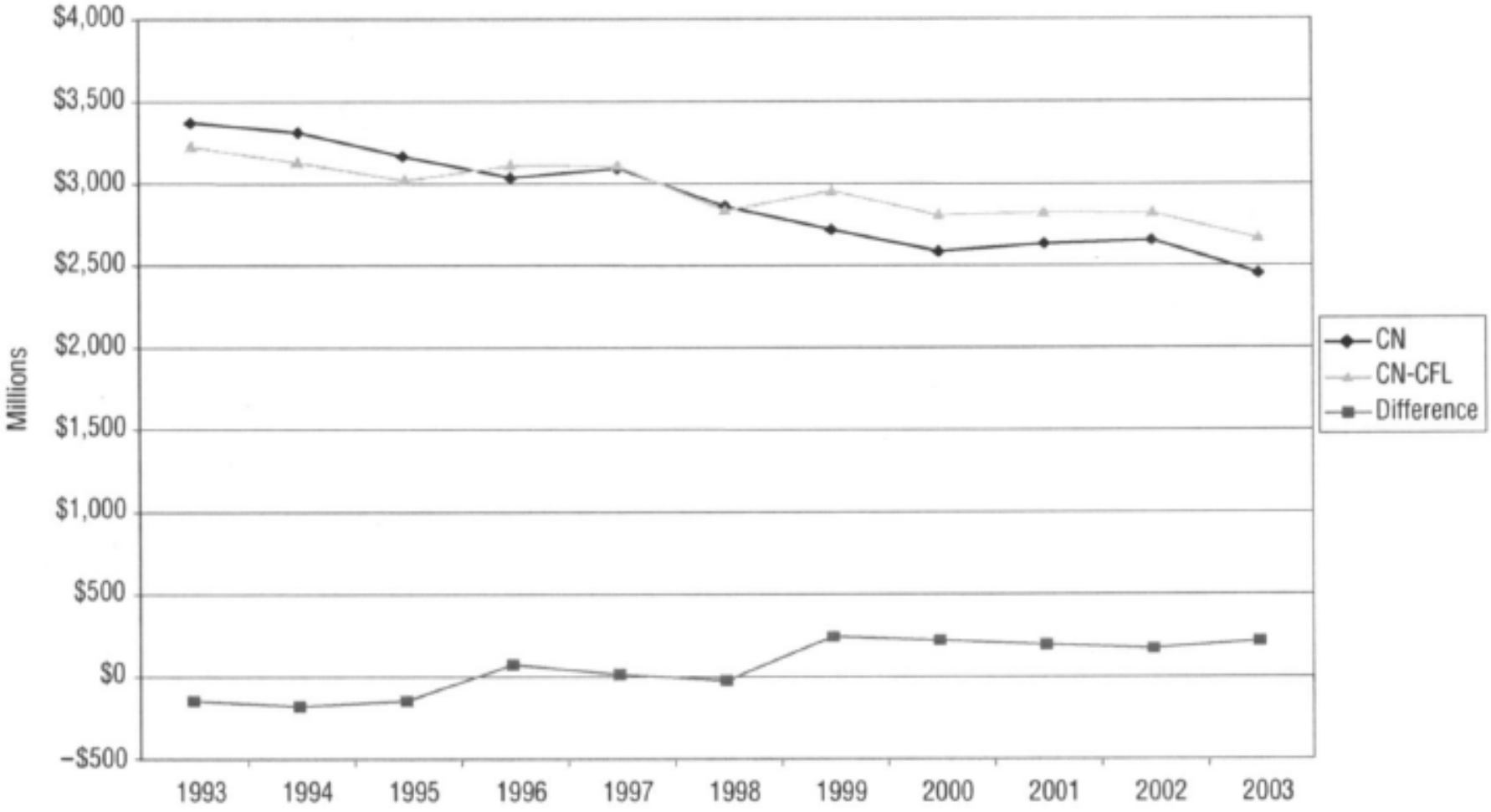


FIGURE 1b

CN Total Costs Smoothed: Actual, Non-Privatization Conservative Counterfactual, and Difference (in millions of 1992 dollars), 1993–2003



Source: Authors' compilation.

Estimations of *F* (base-case)

- The PV of expected future gains from privatization (F) is calculated from a *continuation benefit (CB)*.
- CB is measured as the average annual savings due to privatization from 1999 to 2003:

$$CB = \frac{\sum_{99-03}(1.066ATC_t^{CP} - ATC_t^{CN})Q_t^{CN}}{5}$$

➢Expected future gain is the PV of the perpetuity of CV:

$$F = \frac{1}{(1+s)^{11}}\frac{CB}{s}$$

- Let s = 3.5%, and CB = $614 million.

➔ F = $12,015

Total Welfare Change

Base-Case Counterfactual:

- PV of cost savings:

$$C_g^{CN} - C_p^{CN} = \sum_t \frac{\left(1.066ATC_t^{CP} - ATC_t^{CN}\right)}{(1+s)^t} Q_t^{CN}$$
$$= \$3{,}114 \text{ billion}$$

- The PV of future gain = $12,015 million
- The PV of transaction costs is estimated to be $73 million.

➢ Total welfare gain = $C_g^{CN} - C_p^{CN} + F - T$ = $15,016 million.

Conservative Counterfactual:

➢ Total welfare gain = $4,346 million.

Distribution of the Welfare Gains

- Total welfare change:

$$\Delta W = \Delta CS + \Delta PS + \Delta GS$$

- Change in *consumer surplus*:

$$\Delta CS = \sum_t \frac{\left(P_t^{g,CN} - P_t^{p,CN}\right)}{(1+s)^t} Q_t^{CN} + F^{CS}$$

However, $P_t^{g,CN} = P_t^{p,CN}$. So, $\Delta CS = 0$.

- Change in *government surplus*:

$$\Delta GS = \Delta\Pi_p^{93-95} + Z + (0.6x0.75t^c + 0.4t^w)U + \tau\Pi_p - \Pi_g - T$$

Change in profit due to commercialization

PV of Sale price at privat'zn

Taxes on the profits to shareholders from underpricing the share offering

PV of corporate taxes on future profits under private ownership

PV of counterfactual profits

TABLE 2

Summary of the Welfare Gains Due to Privatization of CN and Their Distribution
(in millions of 1992 dollars)

	ΔW	ΔGS	ΔPS	$\Delta PS^{Canadian}$	$\Delta PS^{Foreign}$	$\Delta W^{Canadian}$
Base-case counterfactual[a]	15,056	6,901	8,155	3,692	4,463	10,593
Conservative counterfactual[b]	4,346	2,296	2,051	945	1,106	3,241

Notes:

[a] CN's unit costs = 1.066*CP unit costs.

[b] CN's unit costs fall 1.062 percent/year faster than CP's unit costs

Source: Authors' compilation.

Sensitivity Analysis

- Sensitivity to the discount rate
  - Baseline SDR = 3.5
  - SDR = real marginal rate of return in private sector = 5.5%
  - SDR = real average rate of return to a stock market index = 7.5%
- Sensitivity to the projected growth of CN output
  - Baseline – assume no future growth rate of CN output from 2004 onward
  - Sensitivity analyses – use 1% and 2% growth rates

TABLE 3
Sensitivity to the SDR and the Future Growth Rate of CN Output

SDR	ΔW	ΔGS	ΔPS	$\Delta PS^{Canadian}$	$\Delta PS^{Foreign}$	$\Delta W^{Canadian}$
	Base-Case Counterfactual (in millions of 1992 dollars)					
Future output growth rate = 0%						
3.5	15,056	6,901	8,155	3,692	4,463	10,593
5.5	8,810	4,463	4,347	1,977	2,370	6,441
7.5	5,955	3,327	2,628	1,203	1,426	4,530
Future output growth rate = 1%						
3.5	19,862	8,745	11,117	5,025	6,092	13,770
5.5	10,187	4,991	5,196	2,359	2,836	7,350
7.5	6,524	3,545	2,979	1,360	1,618	4,906
Future output growth rate = 2%						
3.5	31,076	13,048	18,029	8,135	9,893	21,183
5.5	12,350	5,821	6,529	2,959	3,570	8,780
7.5	7,299	3,843	3,456	1,575	1,881	5,418

Table 3 (Cont'd)

Conservative Counterfactual
(in millions of 1992 dollars)

SDR	ΔW	ΔGS	ΔPS	$\Delta PS^{Canadian}$	$\Delta PS^{Foreign}$	$\Delta W^{Canadian}$
Future output growth rate = 0%						
3.5	4,346	2,296	2,051	945	1,106	3,241
5.5	2,285	1,467	818	389	429	1,856
7.5	1,361	1,077	284	148	136	1,225
Future output growth rate = 1%						
3.5	5,965	2,917	3,049	1,394	1,654	4,311
5.5	2,748	1,645	1,104	518	586	2,163
7.5	1,552	1,151	402	201	201	1,352
Future output growth rate = 2%						
3.5	9,743	4,366	5,377	2,442	2,935	6,808
5.5	3,477	1,924	1,553	720	833	2,644
7.5	1,814	1,251	563	273	289	1,524

Source: Authors' compilation.

Conclusion

- This study uses CBA to estimate the welfare gains from the privatization of CN.
- One data advantage is the use of CP data to construct a more plausible counterfactual.
- Under *base-case counterfactual*, the total welfare gains are ~15 billion
  - ΔPS = $8.16 bn ($3.69 bn goes to Canadians) and ΔGS =$6.9bn
  - ΔW = $10.59 bn for Canadians
- Under *conservative counterfactual*, the total welfare gains are ~4.3 billion
  - ΔPS = $2.05 bn ($0.95bn goes to Canadians) and ΔGS =$2.3bn
  - ΔW = $3.25 bn for Canadians