A Cost-Benefit Analysis of the Privatization of Canadian National Railway

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Abstract

The privatization of Canadian National Railway (CN) represents one of the largest rail privatizations in history. This paper uses cost-benefit analysis to estimate the welfare gains from CN’s privatization. It also shows how these gains are distributed among consumers, producers and government, and between Canadians and non-Canadians. CN’s privatization generated welfare gains of approximately $15 billion (1992 dollars). The Canadian government captured almost half of these gains, while CN shareholders captured most of the rest. Since freight rail service in Canada is basically a duopoly, this research provides support for the argument that privatization can lead to welfare gains in less competitive environments.

Keywords: Privatization, cost-benefit analysis, transportation, railway, distributional welfare impacts.

Introduction

Over the past 30 years, there has been a well-documented global trend of privatizing formerly state-owned enterprises. In Canada, by far the largest transportation privatization has been Canadian National Railway (CN). Was the commercialization and subsequent privatization of CN worth it? This paper uses cost-benefit analysis to estimate the welfare gains to Canadians and examines how these welfare gains are distributed among government, producers (domestic and foreign shareholders of CN) and consumers (shippers).

To some extent the privatization of CN was motivated, as were those around the world, by property rights theory (Alchian, 1965; De Alessi, 1969), which suggests that in competitive environments state-owned enterprises (SOEs) are less productive and less profitable than their private sector equivalents. Empirical support for property rights theory has come from three broad empirical sources. First, it has come from comparisons of samples of state-owned firms to private sector firms in similar circumstances—“like-like” studies (for example, Boardman and Vining, 1989; Gillen, Oum and Tretheway, 1989; Pollitt, 1995; Cowie, 1999). Second, and more recently, support has come from analyses of the performance of firms before and after privatization — “before-after” performance studies (for example, Boubakri and Cosset, 1998; Boardman, Laurin and Vining, 2002; Megginson and Netter, 2001; Chirwa, 2004). Third, support has also come from “before-after” cost-benefit analyses (CBAs) of privatizations (for example, Galal et al., 1994; Boles de Boer and Evans, 1996; Newbery and Pollitt, 1997; Domah and Pollitt, 2001; Pollitt and Smith, 2002).

Unfortunately, there are a number of problems with the existing empirical studies that cast some doubt on their findings in regards to the benefits of privatization. Like-like studies compare firms under different ownership regimes, but do not directly study the effect of
privatization. In addition, like-like studies typically compare a sample of SOEs with a sample of private sector firms from across many different industries. This makes it hard to control well for differences in the firms’ environments, such as the degree of industry competitiveness. Finally, these studies have generally examined firm productivity or profitability, but have not attempted to assess the broader welfare impacts of privatization that are of most interest to policy makers. In sum, like-like studies are only suggestive on the question of the potential social benefits from privatization. Before-after privatization studies also have weaknesses. First, they do not generally control for contemporaneous changes in the operating environment, especially major regulatory changes that often accompany privatization (Wallstein, 2001). These studies also view performance in a limited way, focusing on productivity or profitability. In response to some of these problems, a number of authors have adopted a broader approach to evaluation of privatization and have conducted CBAs of specific privatizations. The main problem with these studies concerns estimation of the counterfactual -- the outcome under (continued) state ownership. This is particularly difficult when privatization occurs at the same time as changes to the firm’s regulatory environment (Boles De Boer and Evans, 1996) or increased competition (Newbery and Pollitt, 1997).

Some scholars argue another important issue is that evidence on superior performance of privately owned firms is much weaker, or even non-existent, in industries that are structurally less competitive (see, for example, Peters, 1993 and Willner, 2003). These scholars make their argument on both theoretical grounds (for one model, see De Fraja, 1991) and on reviews of like-like and before-after studies. This evidence limits the ability to generalize findings concerning the benefits of privatization.
This paper presents a CBA of CN that addresses many of the difficulties with previous privatization studies. A major advantage of studying CN is that Canadian Pacific Railway (CP) provides a plausible benchmark for the construction of a credible counterfactual. Indeed, the availability of a privately-owned comparator that operates in the same industry and is subject to virtually the same external environment is rare. CN and CP have been previously studied extensively together precisely because they provide one of the best comparisons for testing the effects of ownership differences (for example, Caves and Christensen, 1980; Caves et al., 1982; Freeman et al., 1987; Laurin and Bozec, 2001). Following both CN and CP over time gives this analysis some of the advantages of both a like-like and a before-after analysis. Also, of course, given that we use CBA, we measure performance broadly. Another reason to study CN is that it provides insight into the welfare effects of privatization in less competitive environments—where there is no consensus on the potential for efficiency improvements and welfare gains from privatization.¹

The paper is organized as follows: Section 2 presents a brief history of CN and reviews the key changes in the regulation of Canadian railways. Section 3 describes our data sources. Section 4 outlines our methodology and presents our preferred estimate of the overall welfare change attributable to the commercialization and privatization of CN, and of its distribution among the various groups. Section 5 discusses the results and presents many careful sensitivity analyses. A conclusion follows. To preview our findings, we find that the privatization of CN increased efficiency and generated substantial welfare gains—approximately $15 billion in 1992 dollars using our base case assumptions. Government captured slightly less than half of these gains; CN shareholders capture most of the rest, with a bit less than half going to Canadian shareholders and the remainder to non-Canadian shareholders.
Section 2: A Brief History of CN and Its Regulatory Environment

CN was formed as a government-owned corporation through the amalgamation of several financially-troubled, privately-owned railways between 1917 and 1923. Since that time, CN and CP have dominated railway freight services in Canada. During much of the period of public ownership, CN was in various forms of financial stress. The Canadian government swapped CN’s debt for equity or recapitalized it in 1937, 1952 and 1978. With the final recapitalization in 1978, the government imposed a hard budget constraint on CN and mandated that it pay a 20% dividend on any profits earned. Between 1978 and 1989, CN was profitable in nine out of the eleven years and paid $237 million (current dollars) to the federal government (Bruce, 1997: 15). Over time, CN has become more focused on freight transportation. By 1989, it had become primarily a rail freight company with a labor force of approximately 40,000 (Bruce, 1997: 17).

The 1967 National Transportation Act significantly reduced the scope of rate regulation of the two railways with the exception of grain transportation. However, the Act permitted the railways to co-operate in rate setting, exempting them from antitrust investigation (Bonsor, 1995). In 1983, The Western Grain Transportation Act shifted the burden of the so-called Crow Nest Pass rates for grain (price controls that provided large shipper subsidies) from the railways to the taxpayer (Heaver and Waters, 2004). Since the beginning of our data (1981), there have been two major policy regime changes in the Canadian rail industry in addition to the privatization of CN: (1) The 1987 National Transportation Act (NTA) allowed shippers located on only one of the railways’ lines greater access to the other’s line, it allowed confidential negotiation of rates, it encouraged reliance on market forces and arbitration rather than on regulation of most non-grain rates, and it allowed both railways somewhat greater freedom to abandon uneconomic branch lines; (2) The 1996 Canada Transport Act extended the 1987 NTA
provisions and allowed both railways to eliminate low density lines, resulting in the formation of more short-line railways.

In spite of the improvements in the regulatory regime by the early 1990s both CN and CP were markedly less productive and profitable than their U.S. counterparts (Waters, 1997). Both faced increasing inter-modal competition from trucks and ships. The 1987 National Transportation Act marked a transition from a period of tacit collusion to one of more direct intra-modal competition (Bonsor, 1995). While both railway companies experienced rapid improvements in total factor productivity throughout the 1980s and into the 1990s, these gains were more than offset by relative declines in real output prices relative to input prices, leading to a deterioration in financial performance (Waters, 1997).

Section 3: Data

Most of our data are drawn from the annual reports of *Rail in Canada* 1981-2003, which contain detailed data on output, revenues, and costs for both CN and CP in Canada, along with the number of Canadian employees and their remuneration (Statistics Canada, 1981-2003). Table 1 summarizes the key variables and their sources. We measure output by revenue tonne-kilometres of Canadian freight, which represents more than 95% of CN’s and CP’s revenue-generating output and approximately 90% of overall revenues. The revenue and cost data are for the Canadian freight and non-freight activities combined and therefore inflate the freight figures. However, since welfare changes are calculated as the differences between CN’s and CP’s costs, any measurement errors are likely to be minimal.

****Insert Table 1 about here****
All revenue and cost data are converted to constant 1992 dollars using the GDP (Gross Domestic Product) Implicit Price Deflator for Canada (International Monetary Fund, International Financial Statistics, frequency: annual, with 1992 = 100). Data on annual or hourly remuneration, which is used to estimate employee welfare impacts, are deflated to 1992 dollars using the Consumer Price Index – All Items (CPI).

The cost of employment benefits or miscellaneous costs are extraordinarily high in some years because they include restructuring costs which must be expensed in the year that they are announced for accounting purposes. In practice, though, these amounts are paid out over several years: for example, “the majority of payments related to workforce reductions are expected to occur over the next six years” (Canadian National Railway Company, 1998). Where benefits or miscellaneous costs are unusually high we smooth the data to make the figures better reflect cash flows. Specifically, we estimate the amount by which the recorded cost in that year is excessive and spread that amount over that year and the following five years.

A new CEO of CN, Paul Tellier, was appointed in October 1992 with the understanding that he would privatize it. The goals of the top management explicitly changed with his appointment and CN began to be run on a more commercial basis (Bruce, 1997; Canadian National Railway Company, 1995). CN was privatized in November of 1995. For the purpose of this study, we treat the pre-1992 period as one of government operation, 1992 as a transition year, and 1993 as the beginning of the commercialization-privatization period. Our data end in 2003, but the effects of privatization continue beyond this date.

Section 4: Methodology and Results

Following Jones et al. (1990), the change in total welfare due to a privatization can be written:
\[ \Delta W = V_{sp} - V_{sg} + (\lambda_g - \lambda_p)Z \]  

(1)

where \( W \) is social welfare, \( V_{sp} \) is the value to society of the firm under private operation, \( V_{sg} \) is the value to society of the firm under government operation, \( Z \) is the sale price of the firm, and \( \lambda_g \) and \( \lambda_p \) are shadow multipliers on government revenue and private funds, respectively. We initially assume that there is no difference between the two shadow multipliers and focus on the difference between the first two terms of equation (1).

### 4.1 Cost savings at CN due to commercialization-privatization

Suppose commercialization and privatization (hereafter commercialization-privatization) simply resulted in lower costs (due to greater X-efficiency) for CN’s Canadian operations, relative to what would have been achieved under continued government ownership. Also, suppose that demand is perfectly inelastic and privatization has no effect on CP. The difference between the first two terms of equation (1) will consist of the present value (PV) of the cost savings (relative to the counterfactual) at CN, less any costs of the privatization itself:

\[ V_{sp} - V_{sg} = C_g^{CN} - C_p^{CN} + F - T \]  

(2)

where \( C_i^{CN}, i = g, p, \) are the 1992 PVs of CN’s Canadian freight rail operating costs under unchanged government ownership and under ‘private ownership’, respectively, from 1993 through 2003 (the end of our data), \( F \) represents the 1992 PV of the projected future gains attributable to privatization from 2004 on, and \( T \) is the 1992 PV of the transactions costs of privatization.

CN’s 1993-2003 Canadian freight rail operating costs under ‘private ownership’ are CN’s actual, annual observed costs. So \( C_p^{CN} \) is simply the PV of CN’s total costs in constant 1992 dollars, from 1993 through 2003, discounted back to 1992:
\[ C_{g\,CN}^{\ast} = \sum_{t} \frac{\text{ATC}_{t\,CN}^{CN}}{(1 + s)^t} Q_{t\,CN}^{CN} \]  

(3)

where \( t = 1 \) for 1993, \( = 2 \) for 1994, \( \ldots \), \( t = 11 \) for 2003; \( s \) is the real social discount rate (SDR); \( \text{ATC}_{t\,CN}^{CN} \) is CN’s actual average total cost (in 1992 dollars per revenue-tonne kilometre) in year \( t \); and \( Q_{t\,CN}^{CN} \) is CN’s actual Canadian freight rail output in revenue-tonne kilometres in year \( t \).

To compute what CN’s costs would have been under government ownership, we begin by comparing the real average total costs (ATCs) per revenue-tonne kilometre of freight shipped for CN versus CP over the four-year period immediately prior to the change in management at CN, 1988 through 1991. We find that CN’s real ATC is, on average, 6.66% higher than CP’s real ATC during this period. We then assume that if there were continued government ownership, CN’s real ATCs would remain higher than CP’s by this same percentage in subsequent years. Thus, we construct a series of annual, counterfactual real ATCs for CN by inflating CP’s actual real ATCs by 6.66%. Next, we multiply these counterfactual real ATCs for CN by CN’s actual annual outputs to arrive at CN’s 1993-2003 counterfactual total operating costs for freight rail services in Canada. Finally, we discount these real costs at the real social discount rate, \( s \), to obtain the PV of CN’s counterfactual 1993-2003 total costs, \( C_{g\,CN}^{\ast} \):
\[
C_g^{CN} - C_p^{CN} = \sum_{t} \frac{(1.066 \cdot ATC_t^{CP} - ATC_t^{CN})}{(1 + s)^t} Q_t^{CN}
\] (5)

We use a real SDR of 3.5 \%. The ATCs are computed by dividing total costs (variable costs plus fixed costs, as defined in Table 1) by freight output (revenue tonne kilometres). Using equation (5), the total estimated present value of the cost savings from 1993-2003 is $3,114 million in 1992 dollars—just over $3 billion. As seen from Figure 1, the estimated cost savings due to commercialization-privatization are negligible in 1993 and 1994, they take a step up in 1996 and another step up in 1999, after which the savings remain fairly constant through 2003.

****Insert Figure 1 about here****

To calculate \( F \), the PV in 1992 dollars of the projected future gains attributable to privatization from 2004 forward, we estimate a continuation benefit, \( CB \), that represents the real annual savings expected from privatization in 2004 and subsequent years. We measure this as the average of our calculated annual savings due to privatization from 1999 through 2003:

\[
CB = \frac{\sum_{99-03} (1.066 \cdot ATC_t^{CP} - ATC_t^{CN})Q_t^{CN}}{5}
\] (6)

Relative to the counterfactual, we find the average savings for 1999 through 2003 are $614 million in 1992 dollars; see Figure 1. We then divide by the SDR to find the 2003 present value of this perpetuity, and then discount this value back to 1992:

\[
F = \frac{1}{(1 + s)^{11}} \frac{CB}{s}
\] (7)

Using a real SDR of 3.5\% yields a PV of the projected future cost savings of $12,015 million in 1992 dollars. Conservatively, this method presumes that CN’s output will not grow in the future.
Finally, we calculate the total cost of organizing the sale of CN by multiplying $1.0125 (the amount that the government agreed to pay per share sold to the underwriters; RBC Dominion Securities, 1995) by the 83.8 million shares sold (Bruce, 1997: 149). This gives a total cost of $84,8475 million in 1995 dollars. We deflate this by the GDP deflator to find the cost in 1992 dollars, and then discount this back to 1992 using our SDR of 3.5%. This method estimates the transactions costs were approximately $73 million in 1992 dollars.

Combining our estimates yields a total welfare change of $15,056 million ($3,114 + $12,015 – $73 million), which is approximately $15 billion in 1992 dollars. This estimate implicitly assumes that any decrease in CN’s costs has no impact on prices, CN’s output or CP’s output.11 These assumptions are supported by a variety of evidence; see Figure 2. The faster decline in CN’s ATCs relative to CP’s ATCs following privatization is driven by CN’s faster reduction in average fixed costs, not average variable costs. There is no reason to expect that relative marginal costs change and, therefore, that there is any effect on prices or output shares. Indeed, from 1986-2003 CN’s and CP’s prices (computed as average revenues per revenue-tonne kilometre) are very similar, differing by no more than 2% in any year. Furthermore, the downward trend in freight prices is slower after privatization than before. Concerning output, CN’s market share is consistently about 13 percentage points higher than CP’s market share in terms of both output and revenues. While there are slight year-to-year variations, there is no discernable change in the trend. This evidence is consistent with experts’ views that the railways seek to maximize their revenues, regardless of the structure of their costs (confirmed in a private conversation with William Waters). Because many costs are common to multiple products, it may be difficult for the railways to even know their incremental costs (Waters, 1985: 110).

****Insert Figure 2 about here****
4.2 Distribution of the welfare gains

Having estimated the total change in welfare due to commercialization-privatization, we wish to calculate how this change is distributed across buyers (shippers), CN’s shareholders, and the Canadian government:

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

(8)

where $\Delta CS$ is the change in consumer surplus accruing to shippers, $\Delta PS$ is the change in producer surplus (shareholders’ profits), and $\Delta GS$ is the change in the government surplus (government revenues minus expenditures).12

Shippers are potentially affected by price changes. It makes sense to estimate the change in their consumer surplus as equal to the PV of the difference in price (measured by average revenue) between the actual and counterfactual cases, for 1993 through 2003, times the CN output for each year plus the PV of the projected impact on buyers from 2004 on, $F^{CS}$: 13

$$\Delta CS = \sum_{t} \left( \frac{P_{t}^{p,CN} - P_{t}^{g,CN}}{(1+s)^{t}} \right) Q_{t}^{CN} + F^{CS}$$

(9)

where $t = 1$ for 1993, $= 2$ for 1994, ..., $t = 11$ for 2003, where $s$ is the real SDR; $P_{t}^{g,CN}$ is CN’s estimated real price in year $t$ under government ownership (in 1992 dollars of revenue per revenue-tonne kilometre shipped); and $P_{t}^{p,CN}$ is CN’s actual real price in year $t$. However, our earlier discussion suggests that CN’s prices are the same as they would have been under government ownership and, therefore, we estimate $\Delta CS = 0$. To the extent that prices are actually lower than they would have been under government ownership, we underestimate the total welfare gain and the benefits to shippers in particular.
If $\Delta CS = 0$, then the total welfare gain is the sum of government surplus and producer surplus. Earlier we estimated the welfare gain focusing on the PV of the cost savings under commercialization-privatization relative to continued government ownership. Given that prices and outputs are the same in the factual and counterfactual, the change in costs is the same as the change in profits and consequently the change in welfare can be written as:

$$\Delta W = \Delta \Pi^{93-95} + \Pi^p - \Pi^g - T$$

where $\Delta \Pi^{93-95}$ denotes the 1992 PVs of the profits under the period of commercialization prior to privatization relative to the counterfactual, and $\Pi^i$, $i = g, p$, are the 1992 PVs of CN’s Canadian freight rail profits under unchanged government ownership and under private ownership, respectively, from 1996 on.

For future purposes, it is useful to decompose the profits of CN after privatization (1996 and beyond) into the PV of all current and future anticipated profits at the time of privatization, $\Pi^e_p$, and the PV of all unanticipated profits, $\Pi^u_p$. The sale price, $Z$, should reflect the PV of the future, anticipated after-tax profits under private ownership, less any underpricing:

$$Z = (1 - \tau) \Pi^e_p - U$$

where $U$ is the 1992 PV of the amount of underpricing and $\tau$ is the tax rate on CN profits.\(^{14}\)

The change in government surplus due to commercialization-privatization, $\Delta GS$, equals the PV of the change in profits due to commercialization from 1993 to 1995, $\Delta \Pi^p_{93-95}$, plus the PV of the sale price at privatization, $Z$, taxes on the profits to shareholders from underpricing the share offering, $U$, and the PV of the corporate taxes on the future (anticipated and unanticipated) profits under private ownership, $\tau \Pi^e_p$, less the PV of the profits after 1996 under the counterfactual case of continued government ownership, $\Pi^g$, and the sale transactions costs, $T$:
\[ \Delta G = \Delta \Pi_{93-95} + Z + (0.6 \times 0.75t^c + 0.4t^w)U + \tau (\Pi_p - \Pi_g) - T \]  

(12)

where \( t^c \) is the marginal tax rate on capital gains in Canada and \( t^w \) is the withholding tax rate on foreigners’ capital gains. Approximately 60 % of the shares were initially sold to Canadians and 40 % were sold to foreigners (Bruce, 1997: 144). Between 1990 and 1999, Canadians were taxed on 75 % of their capital gains.

To estimate the change in government surplus, we rewrite equation (12) as:

\[ \Delta G = \Delta \Pi_{93-95} + Z + (0.6 \times 0.75t^c + 0.4t^w)U + \tau (\Pi_p - \Pi_g) - (1 - \tau) \Pi_g - T \]  

(13)

The PV of the cost savings during the commercialization (1993-95) period, \( \Delta \Pi_{p,93-95} \), is $80 million. The sale price, \( Z \), equals $1,907 million. This is calculated by multiplying the number of shares sold (83.8 million) by the prices of the two installments: $16.25 on 17 November 1995, and $10.75 on 26 November 1996, then deflating these amounts into 1992 dollars and discounting back to 1992.

As a simplifying assumption, we assume that everyone who obtained shares at the offer price sells them immediately, pays taxes on the gains (equal to the underpricing), and then repurchases at the market price. CN was underpriced by $4 per share (24.62 %), based on the closing price at the end of the first day. Multiplying this amount by 83.8 million (the number of shares sold), deflating by the GDP deflator, and discounting back to 1992 using a 3.5% SDR implies that there was underpricing of approximately $288 million in 1992 dollars. Assuming that 75% of the capital gains to Canadians are taxed at a marginal tax rate, \( t^c \), of 40%, the government receives $52 million (0.4×0.6×0.75×$288 million) in incremental capital gains tax revenues (in 1992 dollars) from the initial Canadian shareholders. Assuming that non-residents pay withholding tax, \( t^w \), equal to 15% of their capital gains, the government receives $17 million
(0.15×0.4×$288 million) in withholding taxes from the initial foreign shareholders. Thus, the government recoups $69 million of the $288 million underpricing.

To find the tax revenues on the incremental profits following privatization, \( \tau (\Pi_p - \Pi_g) \), we multiply each year’s real discounted, estimated cost savings due to commercialization-privatization from 1996 on by the prevailing, combined federal-provincial corporate tax rate reported by CN and sum them.\(^\text{16}\) This yields a PV of $6,015 million in 1992 dollars.

We do not have a direct estimate of the after-tax profit under continued government ownership (the counterfactual) from 1996 on, \((1-\tau)\Pi_g\). However, it is likely to range between zero and the PV of all expected future after-tax profits under private ownership at the time of privatization, \((1-\tau)\Pi_p^e\).

If \(\Pi_g\) equals zero, equation (13) implies the change in government surplus is about $7,998 million in 1992 dollars. In the other extreme, where no efficiency gain from privatization is anticipated (\(\Pi_g\) equals \(\Pi_p^e\)), we use equation (11) to estimate \((1-\tau)\Pi_g\) as \(Z + U\), the actual sale price of $1,907 million plus the amount of underpricing, $288 million. Substituting this amount ($2,195 million) and our other estimates into equation (13) implies the change in government surplus is approximately $5,803 million. Without further information, we estimate the change in government surplus as the average of the two extremes, or $6,901 million.

Assuming no effect on shippers, competitors or employees, we estimate the total gain to shareholders as a group, \(\Delta PS\), as equal to the total welfare gain due to commercialization-privatization, $15,056 million, minus the increase in government surplus, $6,901 million, which equals $8,155 million. Shareholders gain from the initial underpricing and they benefit from subsequent unanticipated efficiency improvements. Evidence from a variety of sources clearly indicates that the market underestimated the gains from privatization. For example, abnormal
(market adjusted) cumulative buy and hold returns to CN shareholders from 3 days after privatization to 5 years after privatization were 66.5% (Boardman, Laurin and Vining, 2002).

4.3 Distribution of the gains to Canadians and non-Canadians

At privatization, Canadians owned 60% of the shares, but within weeks their ownership share had dropped to 35% (Bruce, 1997: 147). A decade later, Canadians owned 55% of CN. Since the change in ownership from 35% back up to 55% appears to have occurred gradually, we estimate that, on average, Canadians have owned 45% of CN since the first few weeks after privatization. As above, we assume everyone who obtained shares at the offer price sold them immediately, paid taxes on the gains from underpricing, repurchased the shares at the market price and held them indefinitely. Canadian shareholders receive 60% of the gains from underpricing, which amounts to $121 million after-tax, and 45% of the difference between the PV of the after-tax profits from late 1995 on and the cost of purchasing the (trading) shares, which we estimate is $3,571 million, for a total of $3,692 million. Foreign shareholders receive 40% of the gains from underpricing, which amounts to $98 million after withholding tax, and 55% of the difference between the PV of the after-tax profits and the cost of purchasing the (trading) shares, which we estimate as $4,365 million. In sum, we estimate that aggregate Canadian welfare increases $10,593 million and foreign welfare increases $4,463 million, ignoring any shadow pricing.

Section 5: Sensitivity Analysis and Discussion

Our estimate of the total welfare gain due to privatization is large. Its value and the estimates of the distribution of these gains depend on a number of key assumptions. In this section we first
perform a simple check of our welfare estimate. Subsequent subsections contain various sensitivity analyses.

5.1 A check of our welfare estimate

We estimate that if CN had remained in government ownership it would have been worth $1.97 billion, while its value at sale was $3.95 billion, representing a difference of nearly $2 billion in 1992 dollars. In contrast, we estimate that the privatization of CN created a welfare gain of over $15 billion in 1992 dollars, which is much higher. Of our $15 billion welfare increase, we estimate that $13 billion reflects unanticipated cost savings. Shareholders receive the after-tax value of this, which amounts to about $7.9 billion. As a reality check, this amount can be compared to the unanticipated increase in the market value of CN.

On 31 March 2006, there were 532.7 million shares outstanding, each worth $54, which implies a market value of $28.766 billion. Converting this amount into real 1992 dollars and discounting back to 1992 at the SDR yields a PV of $13.6 billion. CN was sold for $1.907 billion in 1992 dollars implying the unanticipated increase in producer surplus equals $11.7 billion, which is higher than our estimate, thereby suggesting that our estimate is not too high. One potential reason the estimate based on the stock price is higher than our estimate is that we focus on CN’s Canadian freight operations while CN’s stock price reflects its acquisition of Illinois Central and all of its US and worldwide activities.

5.2 Sensitivity to the discount rate and projected growth rate of CN output

Our preferred estimate of the SDR for Canada is 3.5%. However, some economists argue that the SDR should be set equal to the real marginal return in the private sector. For Canada, this equals just over 5%, using a measure from the corporate bond market as suggested by Moore et al. (2004). Some argue that one should use the real average return to a stock market index like
the S&P-TSX as a proxy. This equals about 7.5% over the period we study, although we prefer the use of the bond rate because of the equity premium puzzle, survivor bias, the need for a measure of marginal rather than average returns, and difficulties in estimating the effective corporate marginal tax rate (see Moore et al. 2004: 801). To test the sensitivity of our results to alternative measures of the SDR, we discount using rates of 3.5, 5.5 and 7.5%.

Earlier, we conservatively assumed the future growth rate of CN output from 2004 on is zero. However, our data show some growth in CN output over the past two decades. For the 1984-2003 period, which roughly corresponds to the beginning of the recovery from the recession of the early 1980s to the beginning of the recovery from the recession that began in 2001-2, the average annual CN output growth rate is 1.14%. It is 0.32% from 1984 to 1991 and 1.9% during the 1993-2003 post-privatization period. To test the sensitivity of our results to alternative future growth rates of CN output, we use rates of zero, one and two percent per year.

As shown in Table 2, our results are quite sensitive to the choice of the SDR and of the projected future growth rate of CN output. This is attributable to the large effect of projected future cost savings. At a 3.5% SDR with a two percent projected growth rate, the estimated change in world welfare is $31,076 million, but it is only $5,955 million at a 7.5% SDR with a zero projected growth rate. The overall welfare change is always positive, but can vary fivefold depending on the choice of these two key parameters.

5.3 Sensitivity to shadow prices on government revenues and private capital

In equation (1), $\lambda_g$ and $\lambda_p$ are shadow multipliers on government revenue and private investment funds, respectively. Earlier we assumed that there is no difference between these two shadow multipliers and implicitly set each equal to unity. However, distortions in the economy imply

|****Insert Table 2 about here****|
that neither is likely to be unity. Galal et al. (1994) suggest a central estimate of $\lambda_g = 1.33$, while Boardman et al. (2006: 429) suggest that $\lambda_g = 1.4$ approximately. Moore et al. (2004) estimate $\lambda_p = 1.1$ for the U.S., assuming the SDR equals 3.5% and the real rate of return on private capital equals 4.5%, and imply $\lambda_p = 1.16$ for Canada, assuming the SDR equals 3.5%, the real rate of return on private capital equals 5.3%, and using other data from Moore et al. (2001).

Using the higher values of these shadow multipliers changes our estimate of the gain in Canadian welfare from $10,233$ million 1992 dollars to:

$$\Delta W_{\text{Canadian}} = \lambda_g \Delta GS + \lambda_p \Delta PS_{\text{Canadian}} = 1.4 \times 6,901 + 1.16 \times 3,692 = \$13,944 \text{ million 1992}. $$

Using the lower estimates of these multipliers yields an estimated gain in Canadian welfare of:

$$\Delta W_{\text{Canadian}} = \lambda_g \Delta GS + \lambda_p \Delta PS_{\text{Canadian}} = 1.33 \times 6,901 + 1.1 \times 3,692 = \$13,240 \text{ million 1992}. $$

Consequently, using these shadow multipliers increases the estimated gain in Canadian welfare by 25 to 32%. From a Canadian welfare perspective, of course, the shadow multiplier on the gain in foreign producer surplus is zero. There is some controversy over the magnitude of these shadow prices and whether they should be used in developed, relatively non-distorted countries. Canada was experiencing fiscal retrenchment in the mid-1990s, so treating the shadow multiplier on government revenue as greater than one might make some sense, and since we use a relatively low SDR, arguably we should use a shadow price of capital that is greater than unity as well.

### 5.4 Sensitivity to alternative counterfactuals

The estimated overall welfare gains are insensitive to the number of years chosen prior to 1992 to construct the counterfactual. However, there is an alternative potential approach to estimate the counterfactual. Figure 2a clearly show that CN’s ATC disadvantage relative to CP decreases throughout the 1980s. As an alternative counterfactual, we assume that this trend would continue at the same rate. During 1981-1991, CN’s ATC falls on average by 1.062% per year faster than
CP’s. Consequently, the counterfactual ATC for CN in 1993 equals CN’s actual ATC in 1992 times CP’s rate of decrease in ATC for 1992-1993 minus 1.062%.\textsuperscript{19} CN’s ATC in each subsequent year (through 2003) uses a similar formula.\textsuperscript{20} As before, for subsequent years, we create a continuing benefit based on the average of the estimated annual cost savings for 1999-2003.

This approach provides a considerably lower measure of the overall welfare gain to privatization—$4,346 million in $1992. For the first three years after commercialization, but before privatization (1993-1995), CN’s actual costs are higher than our new counterfactual estimates, producing a net welfare loss of $445 million in $1992. CN enjoys small efficiency gains in 1996 and 1997, while 1998 shows a small loss relative to the counterfactual. After that (1999-2003), there are significant cost savings that average just over $200 million per year (undiscounted). As before, most all the overall welfare gain comes from the discounted value of the continuing benefit. Unlike our preferred counterfactual, the estimated welfare impacts are very sensitive to the period used to estimate the average percentage difference in the annual changes in CN’s and CP’s ATC. Because of this and because CN and CP’s ATCs behave quite similarly over the 1988-1991 period, we prefer our original counterfactual.

5.5 Sensitivity of the estimates of government surplus and producer surplus

Two reasons suggest that we may overestimate the gains to the Canadian government and therefore to Canadian welfare, and one reason why we may underestimate it. First, we assume that CN’s effective corporate tax rate remains at 38.37% after 2003. However, corporate tax rates have been trending down in Canada, as elsewhere. A lower effective corporate tax rate implies smaller gains for the government and larger gains for producers (shareholders). Assuming the tax
rate after 2003 is 35%, the estimate of the increase in government surplus falls by about $400 million.

Second, the estimate of government surplus is based partially on estimating \((1-\tau)\Pi_g\) using the sale price plus underpricing, \(Z + U\). The private sector uses a higher discount rate than the SDR, so the future expected profits discounted using the SDR will give a larger number than if we had used the private sector’s discount rate. Consequently, we underestimate the PV of future expected, after-tax profits under government ownership and overestimate the gains to the government (and to Canadian welfare). The magnitude of this effect is roughly $600 million.\(^{21}\)

Equation (12) implicitly assumes that shareholders hold their shares indefinitely. In practice, the government will receive capital gains taxes on the (now) 55% of the shares that are Canadian-owned when they are sold. We therefore underestimate the gain to the government. Very rough calculations suggest that this equals approximately $1.4 billion in 1992 dollars.\(^{22}\) The net effect of these three adjustments is less than $0.5 billion.

### 5.6 Effects on CN employees

Our analysis assumes that CN employees experience neither a gain nor a loss in welfare due to privatization. To the extent that employees earned rents prior to 1992, and these rents are reduced afterwards, some of what the estimated efficiency gains may be a transfer from employees to shareholders or to the government, and our estimate of the aggregate welfare gain may be too high. Figure 3 shows that both CN and CP reduce their employees throughout our dataset, with faster reductions at CN, especially during the 1984-1995 period. However, it is unclear that employment at CN is lower than it would have been without privatization. While CP’s rate of employment decrease is virtually unchanged before and after 1992, CN has a slower rate of employment decrease after 1992.
Turning to compensation, there is little evidence that commercialization-privatization reduces CN employees’ rents. Prior to 1992, compensation at CN grew more slowly than at CP (0.35% per year from 1982-1991, versus 0.68% per year at CP), but from 1993-2003 the average annual rate of growth at CN is higher than at CP (1.98% versus 1.03%). Pay at the two railways was roughly equal in 1991, but was 12% higher at CN by 2003. The data on real wages, which grew slightly over the entire period (less than one percent per annum, on average), are similar. Prior to 1992, CN’s real wages actually decrease, but post-1992 they increase at a faster rate (over 1% a year) than at CN. If we take compensation growth minus wage growth as a rough indication of the increase in hours worked, there is faster growth in hours worked pre-1992 than post-1992 at CN, so there is little evidence that CN employees are having their rents reduced at a faster rate post-privatization by being required to work harder. Given the evidence on CN’s relatively slower decrease in employment and faster increases in compensation and wages following privatization, we see no evidence that CN employees were adversely affected by privatization.

5.7 Effects on CN’s competitors

Our estimates of the welfare gains due to the commercialization-privatization of CN assume that there is no effect on CP. However, if CN becomes a more efficient competitor, this may spur CP to likewise become more efficient (Bruce (1995: 151-2)) and suggests we have underestimated the welfare gains. However, the evidence of any effect on CP is weak. Generally, CP’s costs fall after the privatization of CN at about the same rate as they did before until 1998, after which cost reductions slow at both firms. Employment, compensation and wages at CP appear unaffected.

5.8 Negative externalities and quality effects
There have been a number of high profile accidents at CN; for example, a toxic spill in 2005 and a 2006 derailment (which killed two employees). However, systematic appropriate data are hard to find. Evidence from Transport Canada and Statistics Canada indicates that while accidents and fatalities have increased over time, this has more to do with increased activity than decreased safety. Data are not broken down by company.

5.9 Effects on US acquisitions and operations

This paper focuses on the welfare gain stemming from efficiency improvements in CN’s Canadian freight business. Privatization also enhanced CN’s ability to make acquisitions in the US, such as Illinois Central in 1999. This would probably have been impossible if it had remained a SOE. These acquisitions may have a positive impact on the efficiency of CN’s Canadian operations and are reflected in our estimated welfare impacts. However, they may also increase producer surplus and government surplus by amounts that are not reflected in our aggregate estimate, since our data include only Canadian operations. If U.S. acquisitions became more efficient due to CN ownership, there are gains to Canadian shareholders through stock price appreciation and to the Canadian government through taxes on incremental corporate profits that are not reflected in our estimates.

Conclusion

This paper use cost-benefit analysis to estimate the welfare gains from the privatization of CN. One unique characteristic of this study is that we can construct a more plausible counterfactual than in other CBAs because of available data for CP, which is in the same industry at the same time and subject to similar external forces. We find gains in aggregate welfare of just over $15 billion in 1992 dollars. Most of these gains were unanticipated at the time of privatization and
are projected to occur after 2003. We argue that consumers (shipper) were not affected because prices and quantities did not change relative to the counterfactual. We also argue that effects on employees were negligible. The welfare gains were divided between producer surplus and Canadian government surplus, with shareholders gaining some $8.16 billion and the government netting $6.9 billion. $3.69 billion in producer surplus gains went to Canadians and $4.46 went to the rest of the world. In aggregate, the gains to Canadians were $10.59 billion.

Our aggregate welfare estimate is conservative, in that we assume CN’s output growth is zero after 2004, there are no efficiency gains outside of Canada, and there are no (beneficial) impacts on CP. On the other hand, our results are quite sensitive to the SDR. However, even using a 7.5% SDR, the welfare gain is about $6 billion of which $4.3 billion goes to Canadians. Changes in negative externalities and quality effects are hard to measure. With shadow pricing of government revenue and Canadian private investment funds, the gain in Canadian welfare increases by 25-32%, depending on the values of the multipliers.

While it is now fairly well accepted that privatization leads to efficiency and welfare improvements in competitive environments, the evidence of such gains in non-competitive environments is mixed. Since freight rail service in Canada at the aggregate level is basically a duopoly, this paper provides some additional support for the argument that privatization leads to welfare gains in less competitive environments. Future research that disaggregates the welfare impacts of CN’s commercialization-privatization according to the extent of competition in its various product markets may shed more light on this issue.
Notes:

1 Since 1995, CN has held between 51% and a 53% share of freight transport revenues generated in Canada; CP has held between 38% and 39%. The remaining 10% is generated by short-line railroads (Statistics Canada, 1995-2003).
2 For histories of the regulation of the Canadian rail industry, see Bonsor (1995), the Canadian Transportation Act Review Panel (2001) and Heaver and Waters (2004).
3 CN continued to own oil and gas assets, non-rail real estate, and a subsidiary that manufactured transport equipment. These were mainly divested prior to privatization. The manufacturing subsidiary was finally sold in 1996 (Canadian National Railway Company, 1995, 1996).
4 Both Bonsor and Waters have confirmed this in private communications.
5 Three CN numbers are deemed excessively high (benefits in 1992 and 1998, and miscellaneous costs in 1996) and four CP numbers are deemed excessively high (benefits in 1991 and 1992, and miscellaneous costs in 1995 and 1999). These amounts exceed the previous year’s amounts by at least $190 million, often much more.
6 Because this adjustment is simply time shifting and does not affect the total amounts it has little effect on the welfare estimates.
7 For an unusual item at time t we compute the excess as the difference between its reported value at time t and the average of the same series at t-1 and t+1. We then spread this excess over year t and the following five years. Thus the value for the series at time t equals the average of the series at t-1 and t+1 plus one sixth of the excess, and the value for the series at time t+i equals the reported value plus one sixth of the excess (for i = 1,2, ...,5).
8 Using four years is somewhat arbitrary, but our results change by less than 1% if we use only three years (1989-1991) to construct the counterfactual and are 9% higher if we use five years (1987-1991).
9 This is our best estimate of the SDR, using updated Canadian data and the method suggested in Moore et al. (2004) based on an optimal growth rate model.
10 Beginning the calculation in 1996, the first year after actual privatization, only changes this total by $80 million 1992 dollars or less than 3% of the total present value of these cost savings.
11 Even if prices decreased due to privatization, this is unlikely to have a significant impact on the overall measured welfare gains as the gain would be second order; see Newbery and Pollitt (1997: 280)
12 We assume that there are no significant welfare effects on employees or on rivals (CP) for reasons discussed below. Also, we assume there are no significant changes in any externalities associated with CN’s operations.
13 For the reasons given above, we assume that change in ownership does not affect CN’s output.
14 For a discussion of underpricing generally, and especially in the context of privatization, see Laurin, Boardman and Vining (2004).
15 The marginal tax rate varies from province to province. In 1995, it was 39.89% in Ontario, 34.55% in Alberta and 40.62% in B.C. We use 40% as an estimate of the average marginal tax rate in Canada.
16 CN reported a combined federal-provincial corporate tax rate, τ, of 44.4% from 1995 through 2001; 42.37% in 2002; 40.37% in 2003 and 38.37% in 2004 (Canadian National Railway Company, 1995-2004). We use the latter rate on all the incremental profits (cost savings) projected forward from 2004.
17 Confirmed in correspondence with Mark Hallman, Director of Public Affairs, CN, 5 July, 2006.
18 45% of the difference between the after-tax profits and the sum of the sale price and the underpricing.
19 CN’s counterfactual ATC in 1993 = CN’s actual ATC in 1992× (the ratio of CP’s ATC in 1993 to CP’s ATC in 1992 minus 1.062).
20 For 1994-2003, CN’s counterfactual ATC in year t = CN’s counterfactual ATC in year t-1× (the ratio of CP’s ATC in year t to CP’s ATC in year t-1 minus 1.062).
21 To estimate the bias we multiply our estimate of \((1-\tau)\Pi_c\), which equals \((Z+U)/2\), by the ratio of our preferred estimate of the private sector’s real discount rate, 5.5%, to our preferred estimate of the SDR, 3.5 %, and subtract our estimate of \((1-\tau)\Pi_c\).
22 The market value of CN on 31 March, 2006 is $28,766 million current dollars. The market value one day after privatization was $2,598 million. If the 55% of the shares owned by Canadians were sold, Canadians would realize capital gains of 0.55 × (28766-2598) = $14,392 current dollars, 50% of which is currently taxable. Assuming a marginal tax rate of 40%, this would yield 0.5 × 0.4 × 14392 = $2,878 current dollars of tax revenue. Deflating into 1992 dollars and discounting back to 1992 yields a real PV of $1,389 million.
23 We ignore CN’s 2003 figure which is an outlier and looks like a mistake.
References


Figure 1: CN Total Costs (Smoothed): Actual, Counter-Factual and Difference (millions of 1992 $s)
Figure 2a: CN and CP Smoothed Average Total Costs (ATC; 1992 $s per Revenue Tonne-Kilometre of Output)

Figure 2b: CN and CP Smoothed Average Fixed Costs (AFC; 1992 $s per Revenue Tonne-Kilometre of Output)

Figure 2c: CN and CP Average Variable Costs (AVC; 1992 $s per Revenue Tonne-Kilometre of Output)
Figure 2d: CN and CP Average Revenues (AR; 1992 $s per Revenue Tonne-Kilometre of Output)

Figure 2e: CN and CP Market Shares (Revenues; Total Revenue in 1992$s of Each Railroad as a Percentage of the Sum of the Two Railroads’ Revenues)

Figure 3: CN and CP Rail Employment in Canada, 1982-2003
Table 1
Description of the data

<table>
<thead>
<tr>
<th>Variable</th>
<th>Measure</th>
<th>Source</th>
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<tbody>
<tr>
<td>Output(^1)</td>
<td>Revenue-tonne kilometres of freight</td>
<td>RIC(^2) Table 9</td>
</tr>
<tr>
<td>Revenue(^3)</td>
<td>Dollar amount</td>
<td>RIC Table 1-1</td>
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<td><strong>Variable costs</strong></td>
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<td>Fuel(^4)</td>
<td>Overall cost of diesel ($)</td>
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<td>Direct Labour</td>
<td>Labour used for transportation or equipment maintenance</td>
<td>RIC Table 11</td>
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<td><strong>Fixed costs</strong></td>
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<tr>
<td>Indirect Labour</td>
<td>Road maintenance plus general administrative services</td>
<td>RIC Table 11</td>
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<tr>
<td>Benefits Capital(^5)</td>
<td>Total expenditures on “ways and structures” and “equipment” minus labour costs for “ways and structures” and maintenance of “equipment”</td>
<td>RIC Table 1-1</td>
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<td>Miscellaneous</td>
<td>Total rail operating expenses minus the above costs</td>
<td>RIC Table 1-1</td>
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<td><strong>Other Railroad Data</strong></td>
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<tr>
<td>Employment</td>
<td>Number of employees in Canada</td>
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<td>Annual compensation</td>
<td>Average annual pay</td>
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<td>Hourly compensation</td>
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<td><strong>Other Variables</strong></td>
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<td>Privatization</td>
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<tr>
<td>Transactions</td>
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<tr>
<td>Cost</td>
<td>Cost per share x number of shares sold</td>
<td>RBC Dominion Securities 1995</td>
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<tr>
<td>Cost per share</td>
<td>$1.0125 (the amount that the government agreed to pay to the underwriters for each share sold)</td>
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<tr>
<td>Number of shares sold at privatization</td>
<td>83.8 million</td>
<td>Bruce 1997: 149</td>
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</table>

Note 1: Railways produce multiple outputs but the data do not allow us to disaggregate output by type of freight, its origin or destination.
Note 2: RIC = Rail in Canada (2003). The table numbers may differ in other years.
Note 3: Freight revenues are approximately 90 % of total revenues
Note 4: Freight fuel costs represent about 98 % of total fuel costs
Note 5: Does not include investment on new track, although it does include depreciation on new track
Table 2
Sensitivity analysis on the SDR and the future growth rate of CN output

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<thead>
<tr>
<th>SDR</th>
<th>ΔW</th>
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<th>ΔPS</th>
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<td>Future Growth Rate = 2%</td>
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