

Rates of Return for the Canada Pension Plan



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Executive summary

There is confusion regarding the rates of return earned by the Canada Pension Plan Investment Board (CPPIB), which manages the investable funds of the Canada Pension Plan (CPP) with the returns received by individual Canadian workers in the form of CPP retirement benefits.

The returns of the CPPIB do not in any *direct* way influence the CPP retirement benefits received by individual Canadian workers. CPP retirement benefits are basically determined by the number of years a person works, their earnings in each year (relative to the maximum under the CPP), and the age at which they retire.

The returns to the CPPIB, however, do benefit workers and retirees *indirectly*. Specifically, the returns earned by the CPPIB can reduce the need for higher contribution rates. In addition, sustained over-performance by the CPPIB over time could allow for a reduction in the contribution rate and/or an increase in the benefits paid. However, the opposite is also plausible, whereby under-performance by the CPPIB could necessitate higher contribution rates and/or reduced benefits.

Based on the model employed in this paper (which assumes workers retire at age 65), the real rates of return enjoyed by Canadian workers from their CPP retirement benefits ranged from an incredible 45.5 percent in 1969 to just 3.6 percent in 2015.

Specifically, there was an initial steep decline from the 45.5 percent real rate of return observed for retirees in 1969 to less than one-third that rate in 1989 (12.6 percent). By 2003, the real rate of return for CPP retirees was halved to 6.3 percent. By 2015, the real rate of return for CPP retirees had declined to 3.6 percent.

The projected real rates of return for the CPP continue to fall to 2.1 percent for those retiring in 2037, stabilizing thereafter. In other words, Canadian workers retiring after 2036 (people born in or after 1972) can expect a real rate of return of 2.1 percent from the CPP.

The rates of return noted above are further reduced if certain assumptions are changed. For example, making maximum contributions over the entire course of one's working life (ages 18–65)—rather than assuming zero contributions for the first eight years (which are exempted from the retirement

benefit calculation), as done in the first set of calculations—reduces the real rate of return to 1.7 percent for workers retiring in 2037 or later (compared to 2.1 percent).

A different way to think about the returns received by Canadian workers from their CPP retirement benefits, particularly those borne after 1971, is to compare the expected rate of return (2.1 percent real rate of return) with the required real rate of return for the CPPIB of 4.0 percent. In other words, Canadian workers born after 1971 pay into a fund that must generate a 4.0 percent real rate of return to meet its obligations, a fund which provides a 2.1 real rate of return in the form of CPP retirement benefits.

There are two principal reasons for the decline in the rates of return. The first is the difference in the periods of contribution for Canadian workers, particularly in the early years of the CPP. For instance, in the initial years of the plan, only ten years of maximum contributions were required to receive a full CPP benefit. That period is currently 39 years.

The second principal reason for the decline in the rates of return is the increasing contribution rate to the CPP (i.e., the tax rate). The CPP was launched in 1966 with a contribution rate of 3.6 percent. The CPP contribution rate climbed steadily beginning in 1987, and stabilized at 9.9 percent in 2003. It's worth noting that the stabilized CPP contribution rate is nearly three times higher than the original contribution rate of 3.6 percent.

Introduction

The Ontario government's plan to implement its own stand-alone, mandatory public pension system (Ontario, 2014), coupled with the federal Liberal Party's support for expanding the existing Canada Pension Plan (CPP) (Liberal Party of Canada, 2015: 6–7), have brought an already contentious issue to the fore in 2016. Unfortunately, most of the justifications offered for both the introduction of Ontario's ORPP and the expansion of the CPP are at best arguable and more often than not simply incorrect.¹

One of these misunderstandings pertains to the rates of return experienced by Canadians from the CPP. It's fairly easy for average Canadians to confuse the returns earned by the CPP Investment Board (CPIB), which is tasked with actively investing the investable funds of the CPP, with what they themselves might actually earn from their contributions to the CPP in the form of retirement benefits. Indeed, some advocates for the expansion of the CPP have conflated, or at least not clearly differentiated between, the rates of return earned by the CPIB and the actual returns received by individual Canadian workers in the form of CPP retirement benefits.² This paper clarifies the situation by calculating the rates of return (both real and nominal) received by Canadian workers. In other words, this paper provides information regarding the actual benefits Canadian workers receive from the CPP as well as expected benefits in the future.³

1. For thorough discussions refuting the assertion that Canadians do not save adequately for their retirement, see Hamilton (2015) and Cross (2014). For a quick summary of some of the key reasons for not expanding the CPP, see Lammam and Veldhuis (2016).

2. For example, Simon Fraser University economics professor Rhys J. Kesselman, one of the strongest and most high-profile advocates for the expansion of the CPP, discussed the returns of the CPIB in a *Globe and Mail* opinion piece but failed to specifically acknowledge that those do not directly affect the returns received by CPP beneficiaries in the form of retirement benefits (Kesselman, 2015).

3. We focus exclusively on the retirement pension and therefore exclude post-retirement, death, disability and children's benefits, as well as the survivor's pension.

The first section of the paper provides some general information about the Canada Pension Plan as well as the CPP Investment Board. The second section clarifies the difference between the rates of return earned by the CPPIB and the calculation of benefits for the CPP. The third section outlines the methodology used and presents the calculated rates of return for the CPP starting in 1969 through to projections for 2055. An appendix details the specific methodology and data sources used in the analysis.

Background on the CPP and CPPIB

The Canada Pension Plan (CPP) was created in 1966 and covers all eligible workers outside of Quebec.⁴ The CPP is a mandatory contributory pension plan for Canadian workers over the age of 18.

Contributions are made on earnings in excess of the annual exemption (\$3,500) up to an annual maximum, which in 2016 is \$54,900 (referred to as the Years' Maximum Pensionable Earnings or YMPE). Contributions are currently made based on a 9.9 percent payroll tax. The maximum annual contribution to the CPP in 2016 is \$5,088.60, which is notionally split evenly between employer and employee contributions of \$2,544.30 (CRA, 2015a).⁵

Eligible Canadian workers can start receiving CPP retirement benefits as early as age 60, though this results in lower benefit levels compared with the normal retirement at age 65. Full retirement benefits are provided starting at age 65. Canadians can, however, defer receipt of their CPP benefits until age 70, which results in higher monthly payments (CRA, 2015b).⁶

The target benefit for the CPP is 25 percent of the average industrial wage. In 2016, the average monthly CPP retirement benefit was \$629.33, while the maximum benefit provided was \$1,092.50 (CRA, 2015b).

The CPP is a component of the overall Canadian retirement income system.⁷ It provides a defined retirement benefit to Canadians with work experience. It complements the non-work related benefits provided by programs

4. For general information on the Canada Pension Plan, see <http://www.esdc.gc.ca/en/cpp/index.page?_ga=1.210314966.296529021.1455317179>. The Province of Quebec maintains an independent public pension system that mirrors the CPP. For more information on the Quebec Pension Plan, see <http://www.rrq.gouv.qc.ca/en/programmes/regime_rentes/Pages/regime_rentes.aspx>.

5. Payroll taxes are ultimately paid by employees in the form of lower compensation. So while the CPP payroll tax is notionally split between employers and employees (4.95 percent each), the ultimate cost of the tax is fully borne by employees. For information on this general issue of who ultimately pays payroll taxes, see Ebrahimi and Vaillancourt (2016).

6. Specifically, the retiree's benefits are increased 0.7 percent for each month they delay receiving their CPP benefit after the age of 65; 8.4 percent annually.

7. For discussion of Canada's current retirement system, see Cross (2014) and Mintz (2009).

such as Old Age Security and, for those eligible, the Guaranteed Income Supplement. It also complements the various private savings plans available to Canadians such as registered pensions, registered savings plans, tax-free savings plans, and general savings.⁸

The 1996 reforms to the Canada Pension Plan, which were implemented in 1997, created the Canada Pension Plan Investment Board (CPPIB).⁹ The CPPIB was tasked with and made responsible for investing the available funds of the CPP in order to achieve a higher rate of return than was previously earned. As of March 15, 2015, a net transfer from the CPP to the CPPIB of \$128.3 billion had been completed (CPPIB, 2015: 123).

The initial agreement limited the CPPIB to passive investments. An important reform was introduced in 2006 that allowed the CPPIB to pursue a more active investment management strategy for its investable funds.¹⁰ Critically, the investment performance of the CPPIB does not in any *direct* way influence the benefits received by retirees in the form of their CPP payments. The next section expands upon this differentiation between the returns earned by the CPPIB and the benefits received by Canadian retirees.

8. For information on Old Age Security, see <http://www.esdc.gc.ca/en/cpp/oas/index.page?_ga=1.169607394.296529021.1455317179>. For information on the Guaranteed Income Supplement, see <http://www.esdc.gc.ca/en/cpp/oas/gis/index.page?_ga=1.264323148.296529021.1455317179>. For an overview of the various non-government savings vehicles available to Canadians, see <<http://www.fcac-acfc.gc.ca/Eng/forConsumers/lifeEvents/planningRetirement/Pages/Personal-pargnese.aspx>>.

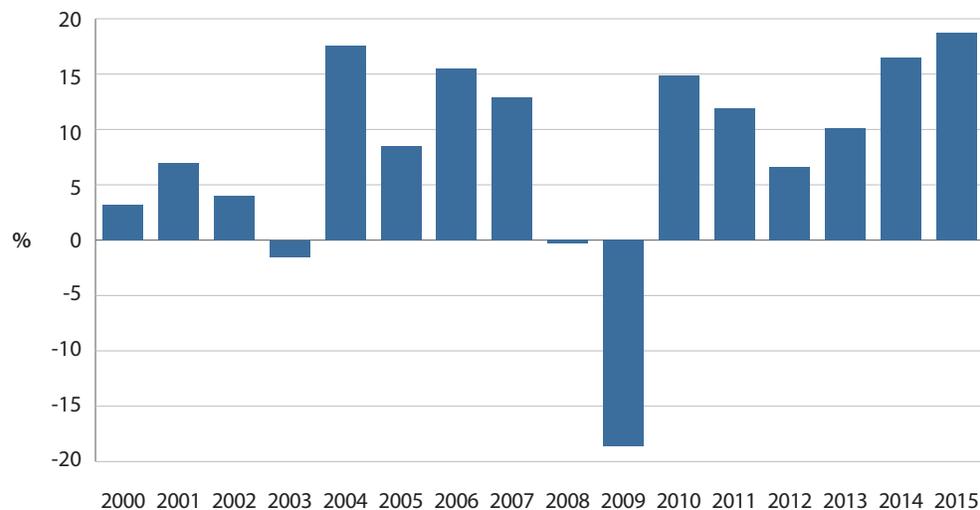
9. For an overview and analysis of the historic reforms to the CPP agreed to in 1996, see Canada (1997). Information on the history, mandate, and performance of the CPPIB is available at <<http://www.cppib.com/en/home.html>>.

10. For a timeline of important reforms and changes made to the CPPIB, see <<http://www.cppib.com/en/who-we-are/our-history.html>>.

Understanding CPPIB rates of return compared to CPP retirement benefits

One of the key sources of confusion regarding rates of return for the CPP is that many Canadians conflate or at least fail to clearly differentiate between the returns earned by the CPPIB and the returns received by individual Canadian retirees from their CPP benefits. **Figure 1** illustrates the rates of return recorded by the CPPIB since 2000. Please note that this includes both the period of passive investment for the CPPIB (up to 2006) and the latter period of more active investment.

Figure 1
CPPIB rates of return



Sources: CPPIB, 2008, 2015.

The CPPIB has performed reasonably well over this time period, reporting an average rate of return of 7.9 percent (figure 1). Further, the CPPIB's 10-year real rate of return of 6.2 percent (CPPIB, 2015), after expenses, is

above the 4 percent real rate of return that the Chief Actuary of Canada assumes in assessing the sustainability of the CPP.¹¹

While not directly comparable to the TSX, due to the composition of investments in the CPPIB versus the TSX, it nonetheless markedly outperformed the TSX. Specifically, over the 16-year period starting in 2000 through to 2015, the CPPIB earned rates of return higher than the TSX in 12 years, or 75 percent of the time. The average annual rate of return for the TSX over this period was 4.2 percent (CPPIB, 2008, 2015). The CPPIB has performed reasonably well in generating positive rates of return for the CPP.

However, the returns of the CPPIB do not in any *direct* way influence the benefits received by individual Canadian workers in retirement. The returns to the CPPIB certainly benefit workers and retirees *indirectly*. Specifically, the returns earned by the CPPIB reduce the need for higher tax rates (contribution rate) now and in the future. In addition, sustained over-performance by the CPPIB over time could theoretically allow for a reduction in the contribution rate and/or an increase in the benefit rate. However, the opposite is also plausible, whereby under-performance by the CPPIB could necessitate higher contribution rates and/or reduced benefits. Clearly, though, unlike individual RRSP, TFSA, or pension accounts, there is no *direct* relationship between the rates of return earned in the CPPIB and the benefits received by eligible retirees.

Calculating CPP retirement benefits

CPP retirement benefits are calculated based on the contributions of a worker to the CPP over the course of his or her working life (ages 18–65).¹² The following section provides a simplified example of how CPP retirement benefits are calculated for a hypothetical person (following Yih, 2016). The resulting calculation is accurate in terms of a person's hypothetical CPP retirement benefit; however, the calculation of the actual CPP retirement benefit is more complicated. This example is nonetheless a fair representation of the CPP retirement benefit calculation. A more detailed description of the actual benefit calculation is presented in the appendix.

The simplest way to understand the CPP retirement benefit calculation is to conceptualize it as a 39-point system. Each point is earned based on a

11. The real rate of return assumptions by the Chief Actuary range from 3.9 percent to 4.0 percent. In the most recent report (for 2012), the real rate of return assumption ranges from 3.2 percent in 2016 to 4.0 percent in 2019 and thereafter (Canada, 2013).

12. Note that workers can voluntarily choose to retire early and receive reduced monthly CPP retirement benefits starting at age 60, and alternatively can voluntarily extend their working life and forego CPP retirement benefits to age 70 in exchange for higher monthly payments.

year of work during a person's normal work life (age 18–65) which, excluding early or late retirement, results in 47 years of potential employment. The CPP benefit calculation includes a “general dropout provision,” which allows individuals to exempt a certain number of their lowest-earning years.¹³ Such an exemption necessarily increases the ultimate retirement benefit. Currently, workers are able to “drop” or exclude eight of their lowest-earning years.¹⁴ The result of exempting the eight lowest-earning years means that the remaining 39 years are used to calculate an individual's retirement benefit under the CPP, hence the 39-point system referred to previously.

Canadian workers earn a full point in each year they make the maximum CPP contribution. Effectively this means that the individual's earnings in that year exceeded the Year's Maximum Pensionable Earnings (YMPE; see Appendix for more details). As described previously, CPP contributions are only made on income above the basic exemption (the Year's Basic Exemption) and below the maximum allowable level of income (the YMPE).

For example, in 2015, for a worker to receive a full point they had to earn more than \$53,600, which was the maximum level of income eligible for CPP contributions in 2015. A worker who earned \$35,912 in 2015, for instance, would have received 67 percent of a point or 0.67.

This process is repeated for each year a person contributed to the CPP. The total number of points earned is then divided by 39, which produces a ratio representing the actual average level of contributions of the worker over their working life relative to the maximum allowable level of contributions over the same period.

This ratio is then multiplied by 25 percent of the Maximum Pensionable Earnings Average (MPEA) in the year the person retires to calculate the person's base pension. Note that the MPEA is calculated as an average for the previous five years rather than just the year of retirement, which is the Year's Maximum Pensionable Earnings.

For example, a person who earned the full 39 points and retired in 2016 would receive the full monthly pension of \$1,092.50, or \$13,110 annually. The math behind these figures is as follows:

- 1 Number of points divided by 39: in this case $39/39 = 1.0$.
- 2 Calculate the MPEA using the current year as well as the previous four years: $(\$54,900 + \$53,600 + \$52,500 + \$51,100 + \$50,100)/5 = \$52,440$.
- 3 25% (target benefit for the CPP) multiplied by the MPEA:
 $0.25 \times \$52,440 = \$13,110$.

13. This is the “general dropout provision;” there are also provisions for child-rearing and disability periods.

14. This works out to an exclusion ratio of 17 percent for retirements in 2014 and later; it was 15 percent before 2012.

An alternative example is worth considering, given the complexity of the benefit calculation. Assume the person from the first example above, who earns 67 percent of the YMPE consistently over the course of his or her working life. The calculation would be revised as follows:

- 1 Number of points divided by 39: in this case $26.13/39 = 0.67$.
- 2 Calculate the MPEA using the current year as well as the previous four years: $(\$54,900 + \$53,600 + \$52,500 + \$51,100 + \$50,100)/5 = \$52,440$.

Unlike the previous example, however, the MPEA is now adjusted to reflect the ratio calculated above: 0.67. The MPEA now becomes \$35,134.80.

- 3 25% (target benefit for the CPP) multiplied by the MPEA:
 $0.25 \times \$35,134.80 = \$8,783.70$.

The key for the purposes of this paper is the fact that nowhere in the calculation for CPP retirement benefits does the return of the CPPIB *directly* factor in. It is simply not *directly* related to the calculation of CPP benefits.

Rates of return from the CPP

The model employed in this paper follows the general approach used by both Professor Godbout and his colleagues (2014) as well as the Office of the Superintendent of Financial Institutions (OSFI) in their rate of return analyses for individual CPP contributors (Canada, 2013).¹⁵ The specific goal of those papers as well as the analysis undertaken in this paper is to calculate the rate of return received by representative individuals in the form of CPP retirement payments relative to the contributions made over the course of a person's working life. The approach used to calculate the rate of return (ROR) for representative individuals relies on an internal rate of return (IRR) that equates the value of a person's contributions over time with the benefits received in retirement.

The assumptions used for the representative individuals are similar to those used in Godbout et al. (2014). All individuals have a January 1 birthday, start work on their 18th birthday, and work full-time. Effectively, this means that contributions are made throughout the entire year. All retirements are at 65 unless the retirement took place prior to 1970, in which case the retirement age was 68 in 1967, 67 in 1968, and 66 in 1969. All retirements are effective January 1 of each year. Life expectancy at age 65 is determined by the average of male and female life expectancies.¹⁶

To maintain simplicity and facilitate comprehension, the following features of the CPP are explicitly excluded from our calculations: disability and survivor benefits, the child rearing dropout, actuarial age adjustments (for non-65 retirements), and the death benefit. Including these features would change the IRRs but not the overall results.¹⁷

15. Although the OSFI does not provide details of how they calculate returns, our overall results match theirs closely.

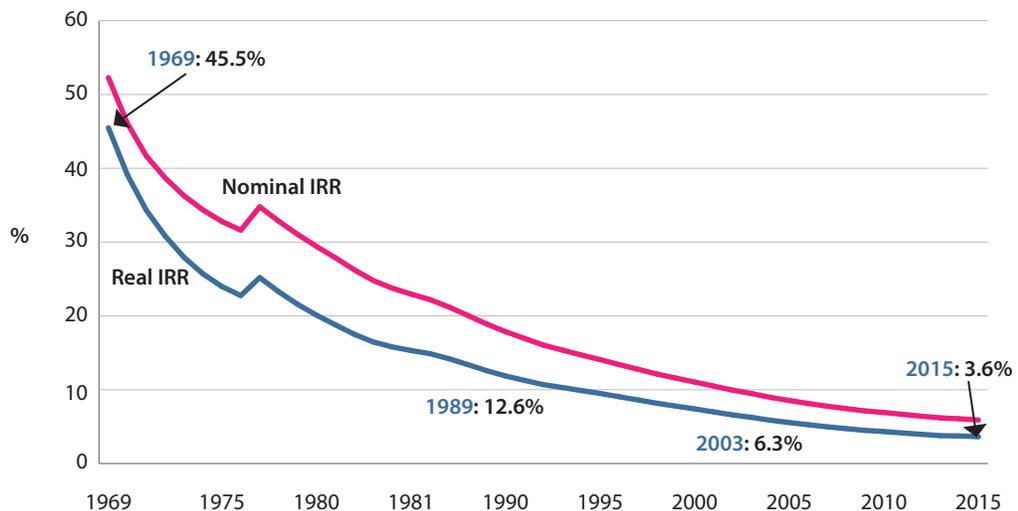
16. We investigated the possibility of using different life expectancy series and found small, consistent differences in year-to-year results and no differences in overall results. Note that returns presented are representative of the cohort as a whole but are not representative of all individuals within the cohort, as some will have shorter and longer life expectancies based on personal characteristics such as sex or being a smoker.

17. See Canada (1998, 2013) for internal rate of return calculations done by the Office of the Superintendent of Financial Institutions.

Like Godbout et al., this study assumes that the representative individuals used to calculate the rates of return earned sufficient income each year during their working lives to make the maximum contribution to the CPP, thus making them eligible to receive the maximum CPP benefit in retirement. It also assumes that the representative individuals did not earn enough to contribute anything during their dropout years. For an individual retiring in 2015, for instance, it means that although the person was eligible to contribute at age 18, he or she did not earn enough income to make contributions until age 26. From age 26 onwards, the person earned at least the YMPE and made maximum contributions for 39 years, which results in a maximum CPP benefit in retirement.¹⁸

Figure 2 and **table 1** present the results from the rate of return analysis for the period 1969 through to 2015. They include both the nominal and real (inflation-adjusted) rates of return. The discussion below focuses on the real rates of return, though similar results exist for the nominal rates of return. Also, recall that the years in the figure indicate the year in which the person retired. Note that table 1 indicates both the year of retirement and the implied year of birth, assuming retirement at age 65.

Figure 2
Internal rate of return for representative individuals, 1969–2015



Sources: Modeling and calculations by the authors. Sources used to build the model were: Canada, 1997, 1998, 2013, 2014, 2016; Canada Revenue Agency, 2015a, 2015b; DR Pensions Consulting, 2016; Runchey, 2016; Godbout et al., 2014; Yih, 2016.

18. While these assumptions yield the largest retirement benefit, they do not yield the highest rates of return. For example, an agent consistently earning 70 percent of the YMPE would realize a slightly higher internal rate of return (3.79% instead of 3.63% in 2015 and 2.23% instead of 2.13% in 2037). The shape of the curves in figures 2 and 3 are essentially the same in both cases however.

Table 1
Nominal and real rates of return, 1969–2015 year of retirement

Year of retirement	Year of birth	Nominal IRR	Real IRR
1969	1903	52.3%	45.5%
1970	1905	46.1%	39.1%
1971	1906	41.7%	34.3%
1972	1907	38.7%	30.8%
1973	1908	36.3%	27.9%
1974	1909	34.4%	25.7%
1975	1910	32.8%	24.0%
1976	1911	31.6%	22.8%
1977	1912	34.8%	25.2%
1978	1913	32.8%	23.3%
1979	1914	31.1%	21.6%
1980	1915	29.4%	20.1%
1981	1916	27.9%	18.8%
1982	1917	26.2%	17.5%
1983	1918	24.8%	16.5%
1984	1919	23.8%	15.8%
1985	1920	23.0%	15.3%
1986	1921	22.2%	14.9%
1987	1922	21.2%	14.2%
1988	1923	20.1%	13.4%
1989	1924	18.9%	12.6%
1990	1925	17.9%	11.9%
1991	1926	16.9%	11.3%
1992	1927	16.0%	10.7%
1993	1928	15.4%	10.3%
1994	1929	14.7%	9.9%
1995	1930	14.1%	9.5%
1996	1931	13.4%	9.1%
1997	1932	12.8%	8.6%
1998	1933	12.1%	8.2%
1999	1934	11.6%	7.8%
2000	1935	11.0%	7.4%
2001	1936	10.5%	7.0%
2002	1937	9.9%	6.6%
2003	1938	9.5%	6.3%
2004	1939	9.0%	5.9%
2005	1940	8.5%	5.6%
2006	1941	8.1%	5.3%
2007	1942	7.8%	5.0%
2008	1943	7.4%	4.7%
2009	1944	7.1%	4.5%
2010	1945	6.9%	4.3%
2011	1946	6.7%	4.1%
2012	1947	6.4%	4.0%
2013	1948	6.2%	3.8%
2014	1949	6.1%	3.7%
2015	1950	5.9%	3.6%

Note: All individuals are assumed to retire at age 65 except for 1969, when retirement was at age 66.

Source: Modeling and calculations by the authors. See figure 2.

The real rates of return (as well as the nominal rates) enjoyed by Canadian workers from their CPP retirement benefits fell at a decreasing rate almost continuously, from an incredible 45.5 percent in 1969 to 3.6 percent in 2015 (figure 2).

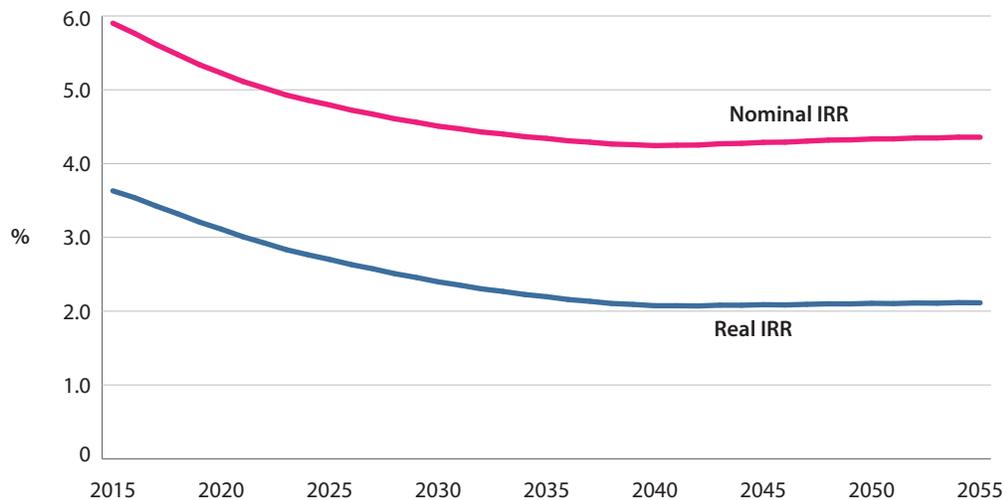
Specifically, there was an initial steep decline from the 45.5 percent real rate of return observed for people who retired in 1969 to less than one-third that rate just 20 years later in 1989 (real rate of return of 12.6 percent). By 2003, the real rate of return for people retiring in that year had halved to 6.3 percent. By 2015, the real rate of return for CPP retirees had decreased to 3.6 percent.

The increase in the real (and nominal) rate of return in 1977 is due to the end of the transitional phase-in period of the CPP and the activation of the provision allowing contributors to exclude or drop a share of their lowest income-earning years, which had the effect of briefly increasing individual rates of return.¹⁹

Figure 3 and **table 2** present the projected rates of return for future retirees from 2015 through to 2055. The analysis includes both real and nominal rates of return. The emphasis is again placed on the real rates of return, though the results are similar for the nominal rates of return.

The real rates of return fall from 3.6 percent for individuals retiring in 2015 to 2.1 percent for those retiring in 2037, stabilizing thereafter. Recall that individuals are all assumed to retire at age 65. Canadian workers retiring after 2036 (people born in or after 1972) can expect a real rate of return of 2.1 percent from the CPP.

Figure 3
Internal rate of return for representative individuals, 2015–2055



Source: Modeling and calculations by the authors. See figure 2.

¹⁹ The general dropout provision requires a minimum 120 month contribution period (Godbout et al., 2014: 366).

Table 2
Nominal and real rates of return, 2015–2055 year of retirement

Year of retirement	Year of birth	Nominal IRR	Real IRR
2015	1950	5.9%	3.6%
2016	1951	5.8%	3.5%
2017	1952	5.6%	3.4%
2018	1953	5.5%	3.3%
2019	1954	5.3%	3.2%
2020	1955	5.2%	3.1%
2021	1956	5.1%	3.0%
2022	1957	5.0%	2.9%
2023	1958	4.9%	2.8%
2024	1959	4.9%	2.8%
2025	1960	4.8%	2.7%
2026	1961	4.7%	2.6%
2027	1962	4.7%	2.6%
2028	1963	4.6%	2.5%
2029	1964	4.6%	2.5%
2030	1965	4.5%	2.4%
2031	1966	4.5%	2.4%
2032	1967	4.4%	2.3%
2033	1968	4.4%	2.3%
2034	1969	4.4%	2.2%
2035	1970	4.3%	2.2%
2036	1971	4.3%	2.2%
2037	1972	4.3%	2.1%
2038	1973	4.3%	2.1%
2039	1974	4.3%	2.1%
2040	1975	4.2%	2.1%
2041	1976	4.2%	2.1%
2042	1977	4.3%	2.1%
2043	1978	4.3%	2.1%
2044	1979	4.3%	2.1%
2045	1980	4.3%	2.1%
2046	1981	4.3%	2.1%
2047	1982	4.3%	2.1%
2048	1983	4.3%	2.1%
2049	1984	4.3%	2.1%
2050	1985	4.3%	2.1%
2051	1986	4.3%	2.1%
2052	1987	4.3%	2.1%
2053	1988	4.3%	2.1%
2054	1989	4.4%	2.1%
2055	1990	4.4%	2.1%

Note: All individuals are assumed to retire at age 65.

Source: Modeling and calculations by the authors. See figure 2.

An alternative way to examine the rates of return from the CPP is contained in **table 3**, which shows the average rate of return for specific periods over the 1967 to 2055 time period. As is easily observed, the average real rates of return for the CPP drop precipitously from 58.0 percent for the first three years of retirement benefit receipt (1967–1969) to less than half that rate for the following decade (1970–1979): 27.5 percent. The average rate of return is almost halved again for the following decade (1980–1989): 15.9 percent. The average rate of return (real) continues to decline over the proceeding time periods, although at a slower rate. The average real rate of return essentially stabilizes at roughly 2.1 percent starting in the 2030s; specifically, it is 2.2 percent on average from 2030 to 2039, falling to 2.1 percent, on average, for the following two decades.

Table 3
Average real rates of return for the CPP by discrete period

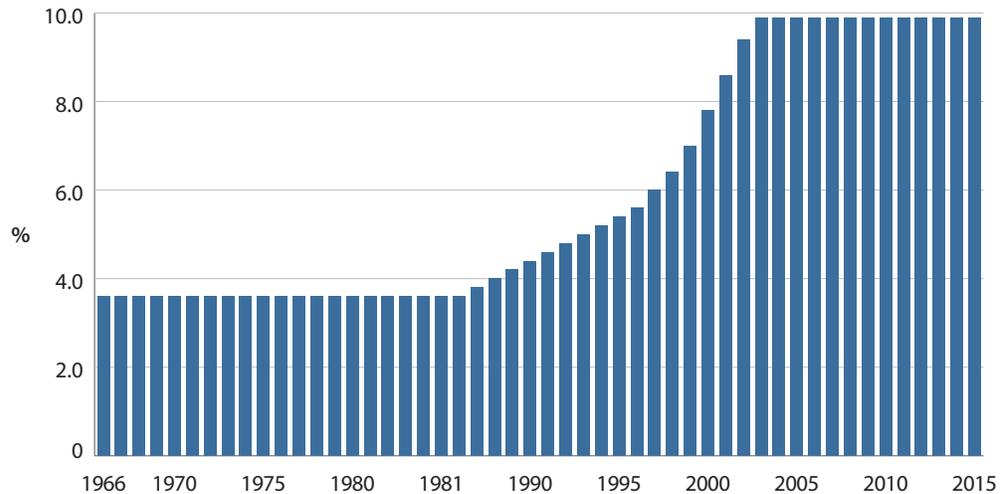
Period	Average real rate of return
1967–1969	58.0%
1970–1979	27.5%
1980–1989	15.9%
1990–1999	9.7%
2000–2009	5.8%
2010–2015	3.9%
2015–2019	3.4%
2020–2029	2.8%
2030–2039	2.2%
2040–2049	2.1%
2049–2055	2.1%

Source: Modeling and calculations by the authors. See figure 2.

There are two principal reasons for the decline in the rates of return observed in figure 2, which is extended to figure 3 (documented in tables 1 and 2). The first is the difference in the periods of contribution for Canadian workers, particularly in the early years of the CPP. For instance, in the initial years of the plan, only ten years of maximum contributions were required to receive a full CPP benefit. That period is currently 39 years (47 years of work minus 17 percent for the general dropout). Put simply, workers in the initial period of the CPP contributed significantly less to the program relative to their benefits than later groups of workers. For example, according to Godbout et al.'s calculations, the rate of return for a retiree in 1970 drops from 36.1 percent to 10.9 percent if the current eligibility and benefits calculations are applied (2014: 369).

The second principal reason for the decline in the rates of return is the increasing contribution rate to the CPP (i.e., the tax rate). The CPP was launched in 1966 with a contribution rate of 3.6 percent. The rate climbed steadily beginning in 1987 and stabilized at 9.9 percent in 2003 (figure 4). It's worth noting that the stabilized CPP contribution rate of 9.9 percent is nearly three times higher than the original contribution rate of 3.6 percent, indicating a sizeable increase in contributions for comparable benefits.

Figure 4
CPP contribution rate



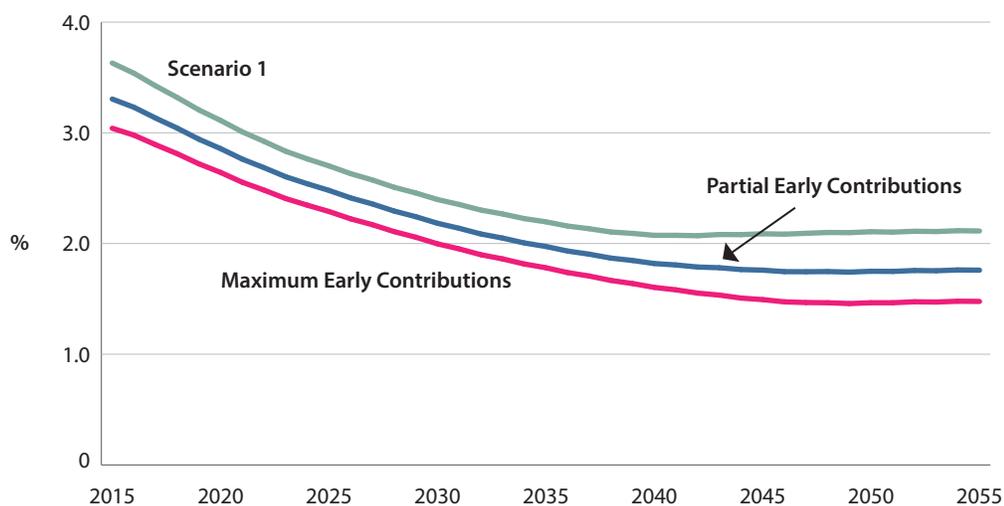
Source: DR Pensions Consulting (2016).

Alternative scenarios

Recall that the CPP allows individuals to exempt a portion of their low earning periods from the retirement benefit calculation, which effectively increases their pension. The previous calculations in this paper, which are parallel to the model used by Godbout et al., assume no contributions to the CPP in the exempted periods. Assuming zero contributions for the first eight years of the contributory period followed by 39 years of maximum contributions yields a stable real rate of return of 2.1 percent for those retiring in 2037 and later. This is illustrated in **figure 5** by the line labeled **Scenario 1**.

However, any contributions made during the exempted eight years serve to lower the rates of return from the CPP by increasing the amount contributed without influencing the resulting benefits.²⁰

Figure 5
Internal real rates of return for representative individuals, three scenarios, 2015–2055



Note: Scenario 1: no contributions for the first 8 years and maximum contributions for 39 years; Partial Early Contributions: half the maximum contributions for 8 years and maximum contributions for 39 years; Maximum Early Contributions: maximum contributions for entire 47 year contributory period.

Source: Modeling and calculations by the authors. See figure 2.

20. An alternative scenario is to reduce the number of years in which a worker earns sufficiently to contribute to the CPP. At the request of one of the reviewers of this paper, this scenario was modeled. Specifically, a worker is assumed to retire at age 65 after working only 30 years. The result is that the internal rate of return curve shifts relative to those shown in figure 5. Specifically, rates for 1967 through 1996 are the same as Scenario 1, slightly higher (0.1 to 0.4 percentage points) between 1997 and 2008, slightly lower (0.1 to 0.5 percentage points) between 2009 and 2030 and are higher from 2031 onwards with a 0.3 percentage point premium as of 2039. After 1996 and relative to the Scenario 1 curve in figure 5, the IRR return curve for those that work only 30 years has a higher initial return, falls faster, and finishes with a slightly higher return.

For example, making contributions at half the maximum level for the first eight years (which are exempted for the benefit calculation) and at the maximum level for the next 39 years would yield a 1.9 percent real rate of return for workers retiring in 2037. This is illustrated by the line labeled **Partial Early Contributions** (figure 5). The real rate of return in 2037 would be 0.2 percentage points lower than the rate of return calculated in the first scenario, which again assumes no contributions in the exempted (dropout) years. The real rate of return declines further to an average of 1.8 percent for those retiring in 2040 and beyond.

Finally, the line marked **Maximum Early Contributions** assumes workers contribute the maximum in each of their 47 working years, eight of which are then exempted or dropped from calculating their CPP retirement benefit (figure 5). In other words, this scenario again increases the amount of contributions without affecting the benefit levels received. The real rate of return in 2037 is further reduced to 1.7 percent. Recall that the original scenario calculated a real rate of return for retirees in 2037 of 2.1 percent. The real rate of return for the Maximum Early Contributions scenario further declines to 1.5 percent for those retiring in 2043, when it stabilizes. Simply put, the real rates of return decline as the scenario is made less generous (figure 5).

Conclusion

There is clearly confusion regarding the rates of return earned by the CPPIB, which manages the investable funds of the Canada Pension Plan with respect to returns received by individual Canadian workers in the form of CPP retirement benefits. This is not to say that the CPPIB has not performed well. Indeed, the CPPIB's rate of returns over time are impressive and well above the required rates of return used by the Chief Actuary of the CPP to determine its solvency.

The returns of the CPPIB do not, however, in any *direct* way influence the benefits received by individual Canadian workers in retirement. The returns to the CPPIB certainly benefit workers and retirees *indirectly*. Specifically, the returns earned by the CPPIB reduce the need for higher tax rates (contribution rate) now and in the future. In addition, sustained over-performance by the CPPIB over time could theoretically allow for a reduction in the contribution rate and/or an increase in the benefits paid.

However, the opposite is also plausible, whereby under-performance by the CPPIB could necessitate higher contribution rates and/or reduced benefits. Clearly, though, unlike individual RRSP, TFSA, or pension accounts, there is no *direct* relationship between the rates of return earned in the CPPIB and the benefits received by eligible retirees.

Individual CPP retirement benefits are a function of the annual earnings of a worker over their working life (18–65) coupled with whether or not they retire at 65. Those that choose early retirement receive a reduced CPP retirement benefit while those choosing to extend their employment beyond 65 receive an upward adjustment in their CPP retirement benefit.

Based on the model employed in this paper, the real rates of return enjoyed by Canadian workers from their CPP retirement benefits fell at a decreasing rate almost continuously from an incredible 45.5 percent in 1969 to 3.6 percent in 2015.

More specifically, there is an initial steep decline from the 45.5 percent real rate of return observed for retirees in 1969 to less than one-third that rate just 20 years later in 1989 (real rate of return of 12.6 percent). By 2003, the real rate of return for CPP retirees is halved to 6.3 percent. By 2015, the real rate of return for CPP retirees fell to 3.6 percent.

The projected real rates of return for the CPP fall from 3.6 percent for individuals retiring in 2015 to 2.1 percent for those retiring in 2037, stabilizing thereafter. In other words, Canadian workers retiring after 2036 (people born in or after 1972) can expect a real rate of return of 2.1 percent from the CPP.

An alternative way to examine the rates of return from the CPP is by examining the average rates of return for specific periods over the 1967 to 2055 time period. The average rate of return for the CPP drops precipitously from 58.0 percent for the first three years of retirement benefit receipt (1967–1969) to less than half that rate for the following decade (1970–1979): 27.5 percent. The average rate of return is almost halved again for the following decade (1980–1989): 15.9 percent.

The average rate of return (real) continues to decline over the proceeding time periods, although at a slower rate. The average real rate of return essentially stabilizes at roughly 2.1 percent starting in the 2030s; specifically, it is 2.2 percent on average from 2030 to 2039, falling to 2.1 percent, on average, for the following two decades.

The rates of return noted above are further reduced if certain assumptions are changed. For example, making contributions at half the maximum level for the first eight years of working life (which are exempted from the pension benefit calculation) and at the maximum level for 39 years would yield a 1.9 percent real rate of return for workers retiring in 2037, slightly lower than the 2.1 percent real rate of return calculated in the previous scenario (assumes no contributions in the first eight years).

Alternatively, the real rate of return in 2037 is further reduced to 1.7 percent when workers are assumed to make the maximum contribution to the CPP throughout their working life (ages 18–65). Recall that the original scenario calculated a real rate of return for retirees in 2037 of 2.1 percent.

A different way to think about the returns received by Canadian workers from their CPP retirement benefits, particularly those born after 1971, is to compare the expected rate of return (2.1 percent real rate of return) with the required real rate of return for the CPPIB of 4.0 percent. In other words, Canadian workers born after 1971 pay into a fund that must generate a 4.0 percent real rate of return to meet its obligations, a fund which provides a 2.1 real rate of return in the form of CPP retirement benefits.

There are two principal reasons for the decline in the rates of return. The first is the difference in the periods of contribution for Canadian workers, particularly in the early years of the CPP. For instance, in the initial years of the plan, only ten years of maximum contributions were required to receive a full CPP benefit. That period is currently 39 years.

The second principal reason for the decline in the rates of return is the increasing contribution rate to the CPP (i.e., the tax rate). The CPP was launched in 1966 with a contribution rate of 3.6 percent. The CPP contribution rate climbed steadily beginning in 1987 and stabilized at 9.9 percent in 2003. It's worth noting that the stabilized CPP contribution rate is nearly three times higher than the original contribution rate of 3.6 percent.

Appendix

Methodology, assumptions, and sources

The following section summarizes the model used and data sources relied upon in the analysis presented in this paper. It also defines key terms used in the study.

Canada Pension Plan retirement benefit calculation

The paper provided a simple description of how CPP retirement benefits are calculated. The actual calculation is more complicated and is described below.

Your CPP retirement benefit is based on the contributions you make over your contributory period. In simple terms, your contributions are summed, divided by the number of months in your contributory period, and multiplied by 25 percent to arrive at your initial monthly benefit.

Before your contributions are summed they are all increased to the value they would have had if they were made in your year of retirement (see “Adjusted Pensionable Earnings” below for an example). Once your contributions have been adjusted, the 17 percent with the lowest value are removed. In addition to this “general dropout” there are similar dropouts available for child-rearing and disability periods during your contributory period. The pension benefit increases when these low earning periods are dropped out because the concurrent months are also dropped from the calculation. Once your contributions are adjusted and dropouts are made to your contributions and months, summed contributions (see “Total Adjusted Pensionable Earnings”) are divided by summed months to arrive at average monthly pensionable earnings. This average is multiplied by 25 percent to arrive at your initial monthly benefit. The benefit is then increased annually by the consumer price index.

Year’s Maximum Pensionable Earnings (YMPE)

The YMPE for a calendar year is the maximum to which employment earnings are subject to contributions for purposes of the CPP. It is increased each year to match increases in the Industrial Aggregate (as published by Statistics Canada), subject to the calculated value being rounded down to the next lower multiple of \$100. YMPE growth rates for 2017 onward come from OSFI (Canada, 2013: 68).

Maximum Pensionable Earnings Average (MPEA)

The MPEA is the average YMPE in the year of retirement and the four previous years. The five-year average has been in place since 1999, a four-year average was used in 1998 and 1997, and previous years used a three-year average (Canada, 2013: 70; Godbout et al., 2014: footnote 8 and table 2).

Year's Basic Exemption (YBE)

The YBE is the minimum annual employment earnings required to participate in the CPP; contributions are waived on earnings up to the YBE. The YBE was 12 percent of YMPE when the CPP was set up, declined to 9.5 percent in 1975, and ranged between 9.4 and 9.9 percent between 1976 and 1996. It was frozen at \$3,500 in 1998 and was equal to 6.5 percent of the YMPE in 2015. It is projected to be 4.8 percent in 2025 and 2.1 percent in 2050 (Godbout et al., 2014: 365, 369, 375).

Contribution rate

The CPP contribution rate was 3.6 percent between 1966 and 1986, increased by 0.2 percentage points per year to reach 5.6 percent in 1996, and was gradually increased to 9.9 percent in 2003 where it has remained since. There are no current plans to further increase the rate (Godbout et al., 2014: 365, 369, 375; DR Pensions Consulting, 2016).

Maximum contribution

CPP contributions are calculated as employment earnings (up to the YMPE) less the basic exemption (YBE) times the contribution rate. Results are rounded to the nearest penny. A contributor pays the maximum contribution for the year when their employment earnings meet or exceed the YMPE. For example, anyone with employment earnings of \$53,600 or higher in 2015 will have paid \$4,959.90 into the CPP. The calculation is: \$53,600 less \$3,500 equals \$50,100 times 9.9 percent equals \$4,959.90. Self-employed people pay the entire amount directly while employees pay half through payroll deductions and the other half indirectly through employer contributions (Canada, 2016).

Unadjusted Pensionable Earnings (UPE)

Employment earnings prior to the adjustment performed when calculating the initial CPP benefit.

Adjusted Pensionable Earnings (APE)

In effect, this calculation brings past earnings up to the value they would have had if they were made in the year of retirement. Specifically, the calculation is $UPE/YMPE \times MPEA$, so the 2005 calculation for someone who retired in 2015 and earned 90 percent of the YMPE (\$36,990) in 2005 would be: $\$36,990/\$41,100 \times \$51,120$, for a 2005 APE of \$46,008. This same calculation is done for all years in the contributory period (Runchey, 2016).

Total Adjusted Pensionable Earnings (TAPE)

TAPE is the sum of Adjusted Pensionable Earnings for the entire Contributory Period.

Contributory period

A CPP member's contributory period begins the later of the month they turn 18 or January 1966, and ends the month they turn 65 or the month before their CPP pension starts.

Dropout provision

All CPP members are eligible to drop their lowest earning years for the purposes of calculating their CPP pension. This provision generally increases the pension. As of 2014, 17 percent of earnings can be dropped. The ratio was 16 percent in 2012 and 2013 and 15 percent prior to 2012 (Godbout et al., 2014: 366, 369, 373; DR Pensions Consulting, 2016).

Pension calculation

The CPP benefit in the first year of retirement is determined by taking 25 percent of average pensionable earnings (determined using TAPE). For example, someone who retired in 2015 and made maximum contributions over their entire non-dropout contributory period would receive \$12,780 in CPP pension payments in 2015.

Pension benefit indexation

CPP retirement benefits are adjusted each year in January if there is an increase in the cost of living as measured by the Consumer Price Index. Historical increases are from DR Pensions Consulting (2016) and future increases were taken from the 26th actuarial report on the CPP (Canada, 2013).

Life expectancy

Life expectancy at age 65 determines how long representative agents receive benefits. Historical and projected mortality rates are from OSFI (Canada, 2014). We chose to use "cohort life expectancies," i.e., those that factor in mortality improvements. Had we chosen "period life expectancies" for mortality rates, average life expectancy at age 65 in 2050 would be 23.4 rather than 24.2 years and the real IRR in 2050 would be roughly 0.1 percentage points lower.

Cash Flows (nominal)

A cash flow is the series of negative values for contributions paid by the agent and positive values for pension payments received by the agent. For example, the agent that retired in 2015 will have made 39 years of contributions (from 1976 through 2014). In nominal terms, the negative values in the cash flow run from \$270 in 1976 to \$4,851 in 2014. Full-year pension benefit payments

run from \$12,780 in 2015 to \$19,850 in 2036 and there is a partial-year payment of \$6,086 in 2037.

Cash flows (real)

Real cash flows are nominal cash flows adjusted to 2015 dollars using the historical CPI increase used for the CPP and the assumptions about future price increases in the 26th CPP Actuarial Report.

Internal rate of return

The internal rate of return presented in this report is calculated as the value of r that satisfies the equation:

$$\sum_{n=0}^N \frac{C_n}{(1+r)^n} = 0$$

where the series of cash flows provide the values for C_n and N is the number of periods.

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