Public Pensions and Elderly Mortality in Canada: Comparing Means Tested and Universal Eligibility, 1921–1966

J.C. Herbert Emery and Jesse Matheson[1]

January 6, 2010

ABSTRACT

We investigate the impact of two means-tested and one universal public pension programs on the mortality rates of recipient age groups in Canada for the period 1921–1966. We find that only the universal program significantly reduced recipient age group mortality rates. The implied social value of the mortality risk reduction from this program is one-tenth of the value per statistical life associated with contemporary government policy, meaning that Canadians did not need to place a high value on the life of a senior to justify the cost of the universal program.

JEL Classification Numbers: I18, I38, J14, J17, N32

[1] Herb Emery is the Svare Professor in Health Economics in the Department of Economics and Department of Community Health Sciences, University of Calgary, Calgary Alberta, T2N 1N4, hemery@ucalgary.ca. Jesse Matheson is a PhD candidate in the Department of Economics at the University of Calgary. We thank Price Fishback, Chris Auld, J.F. Wen, John Murray, Livio Di Matteo, George Emery, Harry Paarsch, Ken McKenzie, Ken Fyie, Andreea Balan Cohen, Paul Grootendorst, Krishna Pendakur and Chris Bruce for comments.

We investigate the impact of three public pension programs on the mortality rates of recipient age groups in Canada. The Old Age Pension (OAP) introduced in 1927 for Canadians over age 70, and Old Age Assistance (OAA), implemented in 1952 for Canadians aged 65–69, were means tested programs while Old Age Security (OAS), introduced in 1952 for Canadians over age 70, was a universal plan. Our data consist of age-specific mortality rates and pension information by province for the period 1921–1966. Our focus on mortality follows that of a number of studies that estimate the impact of income transfer schemes on mortality to infer the impact of income on health and well-being of the recipient population.[2] We find that only the federal universal OAS of 1952 resulted in a statistically significant and economically important reduction in mortality rates of recipient age groups. We estimate the social value of mortality risk reduction from this program to be one-tenth of the value per statistical life associated with contemporary government policy, meaning that Canadians did not need to place a high value on the life of a senior to justify the cost of the universal program. Our results imply that the higher cost universal pension schemes accomplished more for the well-being of seniors than means tested pension schemes.

[2] According to Fishback, Haines and Kantor (2007, 1), mortality rates are associated with socioeconomic status and poverty, and are commonly used to measure aspects of economic welfare not fully captured by income measures. Income influences a person's health by influencing his/her access to nutrition, housing and medical care (Fishback, Haines and Kantor 2007, Balan Cohen 2008). Economic conditions also create social and psychological stresses which put people at greater risk of disease and death (Brenner 1979, Ruhm 2000, Laporte 2004, Fishback Kantor and Haines 2007). The empirical associations between income, health status and mortality are robust, but the causal relationships remain uncertain. The lower mortality and better health status may arise because of higher income, or it could be that better health status causes higher income and lower mortality. See Duleep (1986), Chapman and Hariharan (1994, 1996), Wilkens et al. (2002), Smith and Kington (1997), Cutler et al. (2006) and Balan Cohen (2008).

Empirical research has drawn conflicting conclusions regarding the impact of transferred income on the mortality of older populations.[3] Fishback and Stoian (2007) found that means tested pension Old Age Assistance (OAA) benefits had no significant impact on American urban mortality rates prior to 1940. They conclude that means tested benefits largely changed who paid for benefits of recipients with no meaningful increase in benefit coverage or generosity. Balan Cohen (2008) found that at the state level, OAA benefits were associated with a sizeable decrease in the mortality of males over age 64 after 1940. Balan Cohen argued that the lack of effect of OAA before 1941 and a sizeable effect after, suggests that OAA benefits before 1941 were too small in value to have resulted in a sufficient increase in income necessary to impact on mortality. Snyder and Evans (2006) found that sharp reductions in social security pension benefits for Americans born after January 1, 1917 following US Legislation in the 1970s reduced the mortality rate of the affected cohort. Showing that the cohort receiving lower pension incomes engaged in more post-retirement part-time employment, they concluded that the reduction in social isolation had a larger impact on mortality than did the reduced income transfer. Conversely, Hadley and Osei (1982) found a negative correlation between transfer income and mortality in older populations, but a positive correlation between earned income and mortality.

The existing literature has not demonstrated the relative effectiveness of means tested versus universal programs for improving the well-being of elderly populations even though the high and rising costs of universal transfer schemes have emerged as a

[3] Two studies examine income transfers and broader population mortality outcomes. Fishback, Haines and Kantor (2007) found a negative relation between per-capita means tested New Deal relief spending and several measures of mortality in the population, but not overall non-infant mortality. Winegarden and Murray (1998) find that over a period from 1878–1913, expanding population coverage of government sponsored health-insurance programs contributed to the observed declines in mortality.

policy challenge.[4] With the exception of Fishback and Stoian (2007), empirical researchers who have estimated the impact of public programs have looked at the presence of a program, or the generosity of benefits, without considering the means tested versus universal eligibility dimension of the program.[5] Theoretical considerations of means testing versus universalism highlight the issues of targeting transfers to the needy, and the administrative, incentive and deadweight costs of the two schemes. Besley (1990) showed that a means tested plan is likely to be more effective at alleviating poverty than a universal plan. Assuming a fixed program budget and no behavioral responses to the program, the gains from a universal plan arise from extending benefits to those individuals discouraged from applying for benefits under the means test, while the costs are the funds unnecessarily expended on individuals with no need for the income support. Feldstein (1987) demonstrated that a universal plan may be superior if the means test induces a large portion of the population to reduce their savings and to under-consume in their retirement years. Further, the universal plan may be superior if the benefit paid by the means tested plan is set below the optimal level, to avoid this savings disincentive. Lindert (2004, 34–36) argued that universalism in tax transfer schemes resulted in lower deadweight costs per dollar taxed and transferred relative to means-tested plans. The lower administration costs and incentive costs of universal schemes

[4] Boadway (1998, 363) argues that universal social programs in Canada are unnecessarily expensive and do relatively little for those who need them most. Fishback and Stoian (2007) highlight that Social Security in the U.S., a universal, contributory pension scheme, is seen as one of the most successful anti-poverty programs in American history. At the same time it has become an expensive program with population aging in the US and social security reform is perennially a public debate.

[5] Fishback and Stoian (2007) limit their analysis to the pre-Social Security period to assess how successful continuation with the means tested (income targeted) OAA pension benefits over the introduction of old age social insurance (OASI) would have been for reducing health and welfare problems associated with poverty amongst the elderly. Their finding that OAA did not reduce senior mortality suggests that the high cost universal social security program was necessary to solve these problems.

fostered economic growth which raised incomes and increased the transfer of resources to needy individuals.

Canadian public pension plans offer a "quasi-experimental" situation for identifying the effects of income transfers on mortality, and the relative effectiveness of means tested versus universal eligibility for alleviating poverty. The OAP, OAA and OAS programs were intended to address the living conditions of Canadian seniors, but they were also introduced to relieve municipal and provincial governments of the financial burden of supporting needy, aged Canadians and to encourage greater uniformity in income support arrangements across provinces. Program cost considerations were an important influence on the choice of a means tested non-contributory pension plan in 1927 and for setting the age of eligibility at 70. While the timing of OAP introduction varied across provinces after 1927, all provinces participated with relatively uniform eligibility requirements and nominal benefit values. With the introduction of the universal OAS in 1952, nominal benefit levels were unchanged from the means tested OAP so we can identify the impact of extending pension benefit coverage without a coincident increase in benefit sizes. Similarly, the means tested OAA extended the same nominal benefit as the OAP under uniform terms of eligibility across all provinces to an age group that was ineligible for pension benefits prior to 1952.

If public expenditure on these plans had a significant impact on the aggregate well-being of pension recipients, we expect to observe a decrease in the mortality rates of recipients over and above that observed for non-recipients. We apply a "differences-in-differences" approach to estimate the correlation between the annual change in mortality rates, by five-year age groups, by province, as well as by pension benefit eligibility and

benefit generosity over the period 1921–1966. Variation in implementation dates across provinces, the type of plan implemented, and changes in age group eligibility allow us to identify the effects of pension benefits on recipient age group mortality. We find that the means tested pensions did not have a significant impact on recipient age group mortality rates, but the universal OAS pension benefits reduced recipient age group mortality rates by 4.9 percent. This estimate suggests that the universal pension resulted in roughly 2,500 fewer deaths of Canadians aged 70 and over per year. We estimate that the value of a statistical life (VSL) implied by the OAS induced mortality risk reduction was around $0.5 million (2005 dollars) which is one-tenth of the VSL associated with contemporary government policy interventions. This means that Canadians did not need to place a high value on the life of a senior to justify the costs of the OAS program.

I. Public Pensions in Canada 1921–1970

The purpose of this study is to determine whether the payment of pension income, and the design of pension schemes, reduced the mortality of elderly Canadians. Our approach is to view the introduction and payment of pension benefits as a "natural" or "quasi" experiment. Pension recipients are the "treatment" group while non-recipients are the control group. As defined by Meyer (1995), a natural (or quasi-) experiment induced by a policy change is a situation where the researcher observes plausibly exogenous variation in the explanatory variables. This requires that the policy change is not induced by variation in the outcome measure of interest, or sample selection, where assignment to treatment groups reflects correlation between assignment and outcomes. In the context of our study, first we need to establish that the reasoning underlying pension introductions and designs was not targeted at mortality outcomes. Second, we need to demonstrate that

the assignment to the treatment group was not correlated with the outcome of interest. Finally, we need to establish that the programs were not anticipated to a degree that changes in the behavior of the recipient age groups confound our ability to identify the true effect of the pension income on mortality outcomes. For these reasons, it is informative to review the history of public pension plans in Canada.

The demands to introduce public pensions reflected the perceived extent of poverty amongst elderly Canadians, but not mortality explicitly. The economic condition of elderly Canadians had been a recurring policy issue in Canada since the late nineteenth century (Bryden 1974, 40–43). Over the first forty years of the twentieth century, Canadian attitudes towards government and the state were strongly *laissez-faire* (Guest 1985, Struthers 1994), and little progress was made on public pension development in Canada until the 1920s (Bryden 1974, 76). For the most part, older Canadians were expected to have saved and accumulated for their later years, to have continued working, to have relied on family for support and, where that failed, on outdoor relief provided by municipalities. There were some homes for the aged but they had a small capacity relative to the senior population.

By the 1920s Canadians recognized that poverty among the aged was widespread and chronic and that upturns in the business cycle did little to alleviate these conditions.[6] A special committee of the House of Commons established by the Prime Minister to investigate a pension plan for Canada reported its recommendations in 1924 (Bryden

[6] Bryden (1974, 76). As the published Canadian Census volumes did not report earnings information by age until 1941 and income information until 1951, there is little evidence available on the economic status of seniors prior to the 1927 means tested OAP. In 1924, the House of Commons committee on old age pensions estimated the number of seniors (age 70 and older) in need of support at 98,841, or 37 percent of the senior population. See *Labour Gazette*, August 1924 pp. 665-666. Actual coverage was 35 percent in 1937, when all provinces had implemented the OAP.

1974). While the government accepted that the needs of a sizeable poor elderly population justified a public transfer scheme, debate remained over whether Canada should move towards a non-contributory or contributory (social insurance) pension scheme, and if it was to be non-contributory, whether the pension should be means tested or universally provided. Bryden (1974, 77) argued that the deciding factor for these debates was the expected program costs. Means tested non-contributory pensions administered by the provinces, but supported by federal government cost sharing, were preferred over universal pensions by the government of the day as a strategy for limiting public costs and finessing the problem of legal jurisdiction over senior support that the federal government claimed it would face under a federally administered universal program (Bryden 1974, 106). An important function of the 1927 OAP was to provide financial relief for municipalities and provinces that were already supporting the indigent aged and this was best done with a non-contributory scheme.[7] Contributory plans were assessed as too costly to set up and administer at that time.[8] Similar cost considerations guided the choice of 70 as the minimum age of eligibility instead of 65.

In 1927, the federal government passed the Old Age Pension Act. Provincial participation was voluntary, with the federal government reimbursing provinces 50 percent of the OAP benefits paid. The four western provinces and Ontario had all adopted the OAP by November of 1929 but the remaining provinces only implemented the OAP

[7] *Labour Gazette*, March 1927, 269-270. A contributory (social insurance scheme) would not have addressed this situation since it would have done little for the existing senior population receiving municipal relief (Bryden 1974, 78).

[8] Unlike the provinces that administered programs like Workers' Compensation and mother's allowances, in 1927 the federal government had no administrative experience or infrastructure established for welfare administration.

after 1931 when the federal share of benefit costs increased to 75 percent.[9] Bryden (1974, 84–85) indicated that while the maritime provinces had the greatest need for public pensions due the high proportion of aged population with lower incomes than in the rest of the country, the more limited revenue capacity of these governments due to low incomes in the provinces delayed their adoption of the OAP.

The OAP paid a maximum annual benefit of $240. Under the OAP means test, the pensioner could earn or have other income to a maximum of $125 annually, after which the pension benefit was reduced on a dollar-for-dollar basis. Pensioners could own property, but an annual return on the asset was often assumed into the pensioner's income. Pension eligibility was restricted to British subjects of at least 70 years of age who had lived the past twenty years in Canada and the past five years in the given province. Indians were ineligible for OAP benefits.

While critics of the OAP emerged as early as the 1930s, calling for benefit increases and elimination of the means test, the Depression kept pension reform a low political priority. Bryden (1974, 92) suggested that in the 1930s old age pensioners were well off compared to Canadians collecting municipal relief as their benefits were paid regularly and in cash rather than in part and in kind. However, by the 1940s, rising cost of living with fixed pension benefits stressed pensioners. Pressure began to mount on the federal government to increase pension benefits, and in 1941 the federal finance minister argued that the federal government was constrained by the war effort and called on the provinces to make supplemental payments.[10] In Figure 1 we show that the federal

[9] The OAP was implemented in 1933 in Prince Edward Island, 1934 in Nova Scotia, and 1936 in New Brunswick and Quebec (Bryden 1974, 83).

[10] BC and Alberta raised monthly payments $5, and, by 1950, both offered supplements of $10 per month. Ontario offered a 15 percent supplement (amounting to a $3 maximum), which was replaced in 1947 by a

government increased pension benefits to $300 annually in 1943 and in 1944 increased the total income allowance to $425. Benefits were further increased to $360 in 1947 and to $480 in 1949. Under the new $480 pension, the corresponding income caps were increased to $600 for singles, and a separate $1080 cap was added for married pensioners. These increases did little more than offset inflation and OAP benefits were still seen as deficient.[11]

In 1951 the federal government enacted two new pension programs, the Old Age Assistance Act (OAA) and the Old Age Savings Act (OAS). Both programs were made effective January of 1952, replacing the OAP. The OAS was a federally-funded universal pension, paid to all Canadians aged 70 and over. Unlike the OAP, Indians were eligible for OAS benefits. The pension was funded through a composite of three taxes; a manufacturer's sales tax and income taxes on corporations and individuals.[12] Benefits, $480 annually, and residency requirements were the same as the OAP in 1951. Figure 1 shows that over the next decade OAS recipients received several increases to their annual benefits, reaching $900 in 1963. In 1965 the federal government began a process of lowering the age of eligibility for the OAS benefits so that in 1970 OAS benefits were available to all Canadians over the age of 65.

---

formula paying a supplemental $10 monthly in exceptional circumstances. In 1943 Manitoba and Saskatchewan increased payments by $1.25, and Nova Scotia authorized a means tested increase of up to $10 per month. Other provinces did not offer supplemental payments. The benefit increase in 1944 caused Manitoba to cancel its $1.25 supplement payments; all other provinces kept theirs, with Saskatchewan increasing its supplemental payment to $3 per month (Bryden 1974, 93-97).

[11] See Figure 3. The 1943 Marsh Report concluded that the OAP pension benefits of the time fell short of the minimum income needed for subsistence. Marsh recommended that pension benefits be increased in value, eligibility requirements be relaxed, and means testing be abolished.

[12] Each tax was initially set at a rate of 2 percent, with a $60 annual ceiling on the personal income tax. In 1958 large budget deficits lead to an increase to 3 percent on sales and corporate tax and 4 percent on income tax, increasing the annual ceiling to $120 (Bryden 1974, 105).

The OAA was a means tested pension benefit for Canadians aged 65–69 that operated under the same principles as the 1927 OAP. The federal government covered 50 percent of the pension expenditures and provinces agreed to implement and administer the program as of April 1952. Like the universal OAS, the OAA initially paid a maximum benefit of $480 annually, following the same benefit increases over the next decade. Along with benefit increases, the income allowances for OAA pension amounts were increased. Between 1965 and 1970, the government gradually switched recipients from the OAA to OAS plans, and in 1970 the OAA was eliminated.

The move from provincial administered means tested programs to a federal administered universal pension for Canadians aged 70 and over addressed concerns that the means tested pension failed to meet the income needs of the poor elderly population and provided a strong disincentive to save for retirement (Bryden 1974, 103–104, 107–108, 115). There was also a desire to see uniformity in pension provision across provinces, and to see the federal government assume the full cost of this expensive program. Critics of the means tested program alleged that many elderly who should have been eligible for the OAP pension were not in receipt of the benefits. It was believed that in some provinces the means test was too stringently applied, and that the requirement for undergoing an annual investigation to ensure that the means test was met resulted in many seniors choosing to suffer the problems of poverty over the social stigma of the means test.[13] Bryden (1974, 100) described how the provinces were losing interest in enforcing parents' maintenance legislation which legally obligated children to support

[13] Bryden (1974, 100-101). Marsh (1943) blamed means testing for the pension's failure to eliminate poverty amongst seniors, stating that income from children and dividends on property ownership were often falsely assumed part of an applicant's own income. In many provinces, Marsh (1943, 159) claimed, the test was applied too stringently, leading to the rejection of *"… a large percentage of aged people in need of assistance to maintain them on a minimum level of subsistence."*

elderly parents. Operationally this meant including expectations over contributions that children could reasonably make to their parents well-being when applying the means test, whether the children paid such contributions or not.[14]

By 1950, political demand made it clear that means testing was to be eliminated, the choice of a non-contributory pension over a contributory pension, like OASI introduced in 1935 in the U.S., was a matter of debate. The costs and logistics of setting up and administering a contributory scheme threatened to delay the elimination of the means test resulting in the politically expedient choice of the non-contributory universal demogrant benefit under the OAS. Similarly, the decision to extend means tested benefits to Canadians aged 65 to 69 was a compromise policy development, guided by concerns over program costs. This extension of public pension coverage was deemed manageable due to the relatively small expected size of the eligible 65 to 69 year old population with the means test (Bryden 1974, 105). Also, relative to the over 70 year old age group, much of the 65 to 69 year old age group was capable of supporting themselves through paid work (Bryden 1974, 116).

It seems unlikely that Canadians close to pensionable ages in the 1920s and 1940s could have anticipated these policy developments and altered their work and savings behaviors in ways that would confound the identification of an impact of a pension on their welfare. Bryden (1974, 68–69, 109–117) argued that the 1927 pension plan came about after a sudden and unexpected return of pensions to the policy agenda after 1925. Even though the 1927 legislation followed the 1924 recommendations, much of the policy debate leading up to the legislation focused on whether the pension plan should be

[14] Gratton (1996) suggests that tensions around intra-familial transfers to support aged parents may explain the broad popular support for Social Security in the U.S. in the 1930s.

contributory, and whether the plan should be entirely federal or shared between the federal and provincial governments. There was also uncertainty over basic parameters of the plan such as whether the age of eligibility would be 65 or 70. Except for Canadians already in economically dire circumstances, the existence of a means test that incorporated their children's income would make receipt of a pension an uncertain prospect even if the plan's implementation were anticipated.

Were Canadians able to anticipate the move from a means tested plan to a universal plan in 1952? Again, the sporadic and plodding nature of social policy development in Canada after World War II makes it unlikely that the precise timing would have been foreseen. Perhaps most relevant is the fact that most of the public debate discussed a contributory pension plan as the likely replacement for the means tested OAP. The seemingly abrupt development of a universal non-contributory plan in 1951 was a compromise approach for eliminating the means test when the administrative and constitutional logistics of introducing a contributory scheme seemed too difficult to surmount (Bryden 1974, 120–122). Similarly, rather than reduce the age of eligibility for OAS as a compromise solution for extending pension eligibility in the population, the government chose to introduce the means tested OAA for 65–69 year olds.

II. Framework for Quantifying the Impact of Public Pensions on Mortality

Our empirical focus is on the impact which the 1927 and 1952 Pension Acts may have had on recipient well-being as measured by mortality rates. In this section, we discuss mortality as a measure of health and well-being, and the income and poverty outcomes associated with means tested and universal pension plans.

In the absence of an income measure, mortality can provide a proxy measure of economic welfare. Fishback, Haines and Kantor (2007, 1) highlight that mortality rates are associated with socioeconomic status and poverty, and are commonly used to measure aspects of economic welfare not fully captured by income measures. Fishback and Stoian (2007, 10) argue that since means tested pensions were targeted at the elderly poor, and elderly with low incomes tend to have higher mortality rates (Chapman and Hariharan 1996), mortality rates can be used to assess the effectiveness of redistributive government programs. While significant advances in the understanding and the treatment of infectious diseases have played a major role in the decline of aggregate mortality rates over the twentieth century, deaths in the senior population have been dominated by degenerative conditions associated with the aging of the body. Most treatment for degenerative diseases is long-term and pre-emptive, such as improved nutrition.[15] It is plausible that senior mortality would be influenced by income transfers, which allow them access to necessities like food, shelter and basic medical care.

Census data indicate that the 1951 pension reforms had a significant impact on senior income.[16] Reliance on the universal pension was notable by 1961, when 59 percent of seniors aged 70 and older reported an annual income below $1000. Within this group, 93 percent of all income came from government pension plans. Likewise, for senior age

[15] Armstrong, Conn, and Pinner (1999) have shown that, while seniors benefit from the improved treatment of infectious diseases over the twentieth century, infectious diseases constitute a small number of deaths relative to deaths in younger members of the population.

[16] The proportion of male seniors earning low incomes declined from 38 percent in 1941 to 16 percent in 1961. A similar shift occurred for the female senior labour force, with low-income earners decreasing from 69 percent to 38 percent. This improvement occurred as labour force participation trended down for males over 64 years of age. Females on the other hand saw an increase in senior labour force participation, but this change is dwarfed by the dramatic increase in labour force participation for females in the next youngest age group. See Historical Statistics of Canada, Second Edition. D107-122 and D205-222.

65 to 69, 54 percent reported an annual income less than $1000, and over 50 percent of this group's income came from government pensions.

Through raising incomes, altering work behavior and alleviating poverty, Canadian pensions would have influenced the mortality rates of recipient groups. Following Blundell et al. (1987) and Besley (1990) we can determine which members of the eligible recipient population were most likely to have had their mortality risks influenced by income transfers. Means tested schemes are designed to transfer the largest payment to people with the lowest income. Transfers are smaller for recipients with higher non-transfer incomes, and positive transfers are only made to recipients with income less than a predetermined maximum. If an individual considers the income test required to receive benefits costly, then he will apply for a transfer only if the private cost of the income test is offset by the private benefit of the transfer.[17] If the policy maker does not factor the cost of the income test into the benefit payment, then some of the intended recipients will avoid the means test, and forgo receiving the income transfer.

When the design of the transfer is changed from means tested to universal eligibility without a corresponding change in benefit value, as with the OAP and OAS, the largest incremental income benefits go to members of the target population who did not receive the means tested transfer, as the incremental benefit of the universal pension is decreasing with the size of the means tested benefit paid. Therefore, any mortality effects estimated from the universal OAS will be attributed to those who received little or no benefit under the means tested pension, but had relatively low non-transfer income. This includes individuals who where targeted by the policy maker, but did not undergo

[17] Besley (1990) argues that there is a pecuniary or psychological cost associated with undergoing means testing. This is supported by the observations of Marsh (1943) and empirical work of Bundel, et al. (1988).

the costly means test. Higher income members of the population will receive an equally large income transfer, but, assuming a diminishing marginal impact of income on health, will not experience the same reduction in mortality risk reduction.

Developments of, and changes to, Canada's pension policies allow us to exploit transfer income variation across both the extensive and intensive margins within a recipient group. The extensive margin is represented by changes in the extent of pension coverage between 1921 and 1966. There were three periods of rapid coverage growth. The first took place between 1927 and 1939 as provinces implemented the OAP. The next period is after 1952 when OAS and OAA were implemented. Coverage extended to all members of the 70 and older population, as well as some members of the 65 to 69 population. The 1952 coverage increase is considerable, amounting to 183 percent between 1951 and 1956, and can be primarily attributed to the universal pension plan (see Figure 2). After 1965, the extent of pension coverage increased again as the means tested OAA was gradually replaced by the universal OAS for Canadians aged 65–69.[18] Table 1 shows the variation in the percent of Canadians over age 70 receiving pension income across provinces under the OAP and the subsequent convergence in coverage across provinces with OAS. For OAA, the variation in the extent of pension receipt persisted, albeit for lower levels of coverage than under OAP.

Changes along the intensive margin, represented by increases in real benefits, are less dramatic. In Figure 3 we show the average pension benefit paid and average personal incomes for all Canadians in 1992 constant purchasing power. Following an initial increase in the first five years of the OAP, there was little change in average (real) benefits prior to 1957. In 1951 approximately half of Canadians over the age 70 qualified

[18] The contributory Canada Pension Plan was introduced in 1966.

for the means tested OAP, and the average pensioner received 91 percent of the maximum benefit. This indicates that the universal plan had little impact on the incomes of Canadians who had been OAP recipients. There was also little change in the gap between average personal income and pension benefits; pension benefits averaged about 35 percent of average personal income in Canada. Government increases to the OAS benefits from 1957 to 1968 decreased the income gap between pensioners and average Canadian earners to 40 percent, suggesting that the purchasing power of pensioners increased after 1957.

III. Mortality and Pensions: Data and Method

To examine the effectiveness of government initiated pension plans in reducing mortality among recipients, we use data from various Canadian government publications of vital statistics for nine provinces for the period 1921 to 1966.[19] Mortality rates (deaths per thousand) for each year and province are calculated by five-year age groups.[20] For each year in the study, we have 126 province/age combinations, totaling 5,600 observations.

Figure 4 presents the Canadian overall mortality rate for 1921 to 1970. Mortality rates declined for all age groups in the period of our study, and aggregate Canadian mortality decreased by roughly 30 percent. Figure 5 presents mortality rates for OAS recipient age groups in Canada over the same period. There is a distinct and significant decrease in the level of mortality in 1952. In a similar plot for non-recipient age groups an obvious level effect is not observed. In Figure 6 we display the year-over-year percentage change in mortality rates for OAS recipients versus non-recipients. The 1952

[19] We limit our study to 1921 to 1966 as the introduction of the contributory Canada Pension Plan, Medicare, and the Guaranteed Income Supplement introduce considerable complexity to the policy environment. We exclude Newfoundland which joined the Canadian Confederation in 1949.
[20] The youngest age group is 20–25, and the oldest covers seniors 85 years of age and older.

mortality decrease was large for recipients relative to non-recipients, and relative to mortality changes in any former or later years.

The panel structure of our mortality data allows us to address these inherent and systematic differences across age groups. Our data set is suitable for the application of a "differences-in-differences" approach to identifying the effects of pension income on mortality. We identify a pension effect as changes in the level, and/or trend, of mortality rates of pension recipient age groups over and above that of non-recipient age groups after accounting for age group, year and province specific effects. For example, in Figure 5, mortality rates for pension eligible age groups show a drop in their mortality rates after implementation of the universal OAS plan. This same decrease in mortality rates is not as apparent for non-eligible age groups.

The dependent variable for all of our empirical specifications is the first-differenced logarithm of the mortality rate. We apply two different approaches to incorporating pension plan measures as explanatory variables. First, we define dummy variables which equal 1 only in the year of introduction of a given pension plan in a given province, and 0 otherwise. We refer to this as an estimate of the *level effect* of a pension plan since it would represent a shift in the constant term for the level of the mortality rate for recipient age groups. Next, we introduce dummy variables that equal 1 if a defined pension plan is in place in a given province and year, and 0 otherwise, to determine if pension benefits accelerated the trend decline in mortality rates for recipient age groups, relative to non-recipient age groups. We refer to this relationship as the *gradient effect*.

A general specification for differences-in-differences estimation is:

$$\Delta \log(M_{ijt}) = \beta_1 + \beta_2 OAS_{ijt} + \beta_3 OAP_{ijt} + \beta_4 OAA_{ijt} + age_i + prov_j + year_t + e_{ijt}$$

where M_{ijt} is the mortality rate (deaths per thousand) of age group *i*, in province *j* in year *t*. The dependent variable is the first difference of the logarithm of the mortality rate. The binary pension variables *OAS*, *OAP* and *OAA* model the three pension plans. For the level effect estimation, OAS_{ijt}, OAP_{ijt} and OAA_{ijt} equal one for pension eligible age groups in the year each plan was implemented, and zero otherwise. Explicitly, *OAP* equals 1 for $i \geq 70$ and t=*implementation year*, where *implementation year* varies by province. *OAS* equals 1 for $i \geq 70$ and $t = 1952$, and 0 otherwise. *OAA* equals 1 for $64 < i < 70$ and $t = 1952$, and 0 otherwise. To estimate the gradient effect, the pension variables equal 1 if age group *i* in province *j* was eligible for the respective plan in year *t*, and zero otherwise. *OAP* equals 1 for $i \geq 70$ and *implementation year* $\leq t < 1952$, where *implementation year* varies by province. *OAS* is 1 for $i > 70$ and $t \geq 1952$, and 0 otherwise. *OAA* equals 1 for $64 < age < 70$ and $t \geq 1952$, and 0 otherwise. age_i, $prov_j$ and $year_t$, control for age, province, and year fixed effects, and e_{ijt} is the random error term.

The estimated pension coefficients for the level effect and gradient effect specifications are shown in Table 2. In Columns (1) and (2) we report the level effect estimates, with estimated coefficients for unweighted observations in Column (1) and weighted least squares estimates in Column (2), where the observations are weighted by the age group population size in their respective province. Standard errors are adjusted for age/province clustering in the data.[21] The OLS estimates in Column (1) indicate that all three pension plans reduced mortality rates for recipient age groups. OAS and OAP

[21] Observations across groups are independent, but not necessarily within groups. Failure to account for the clustered observations leads to biased estimates of the standards errors for coefficient estimates. Adjustments are made using the *cluster* post-estimation command in STATA.

both had statistically significant effects but the magnitude of the coefficient estimate for the universal OAS pension was more than double that of the means tested OAP. In Column (2) we show that after weighting the observations by the size of provincial age group populations, only the OAS had a statistically significant effect on mortality rates and the estimated effect is less than half of that in column (1). The means tested OAP and OAA appear to have had no measurable impact on the mortality risk of eligible age groups in Canada while the universal OAS reduced the level of recipient age group mortality rates by 4.9 percent.[22]

In Columns (3) and (4) we report OLS coefficient estimates for the gradient effect specification. The estimated coefficients for unweighted observations are reported in Column (3) and the estimated coefficients weighted by province/age group population sizes are reported in Column (4). As with the level effect estimates, standard errors are adjusted for clustered observations. The coefficient for each pension policy indicator is interpreted as the annual change the growth of mortality rates for age groups eligible to be pension recipients under that policy. The coefficients in (3) suggest that all pensions were correlated with a faster reduction in mortality rates. Estimates for the 1952 pension reforms are statistically significant. However, when observations are weighted by age group population size, the estimated coefficients of the two 1952 pension reforms remain negative, but are small in magnitude and statistically insignificant.[23]

[22] When we estimate the model including restricted sets of recipient age groups, we find that the size of mortality reduction was only 3 percent when we exclude observations for age groups above the 70–74 year old age group. The estimated reduction is 4.3 percent if we include only 70–79 year olds.

[23] Bertrand, Duflo and Mullainathan (2004) demonstrate that with differences-in-differences estimators, serial correlation may bias estimates of the standard errors for the coefficient estimates downward, leading to an inappropriate inference of statistical significance. In the event that first differencing the mortality rate did not adequately address serial correlation in the mortality rates, we employ two of Bertrand et al.'s suggested procedures that sacrifice information in the time-series in favor of eliminating serial correlation. Applying these procedures to the gradient effect specification revealed that serial correlation is not a

Although not reported here, we also look at the effect of changes in the real dollar value of benefit payments on recipient mortality rates. To do this we replace the pension variables in our estimating equation with the first difference in the real value of average benefits paid.[24] The resulting coefficient estimates are small and statistically insignificant. Further, the negative effect associated with benefit increases in the universal OAS can be accounted for when controlling for the initial year of implementation (level effect).

We also consider the potential confounding effect of an influenza outbreak occurring in January and February of 1951 in Atlantic Canada (McDonald, 1967). This will compromise our estimation strategy if the impact on incremental deaths was large, disproportionately affected pension recipient age groups. After removing deaths due to influenza and pneumonia from aggregate Canadian deaths[25], we find a large decrease in mortality between 1951 and 1952 for recipient age groups over non-recipient age groups remains. We re-estimated the level effect parameters for the 1952 pensions, restricting the data to only age groups greater than 50 years, and removing the maritime provinces. These restrictions have little impact on our results; the maximum difference is a reduction of one percent in the magnitude of our level effect estimates (when Atlantic provinces are omitted). We conclude that the 1951 influenza outbreak does not cause a significant bias in our estimated level effects.

IV. Discussion of Results

problem for our estimates. Note that the serial correlation bias of differences-in-differences models does not arise in the level effects case, as the treatment is applied to, at most, one year for any given group.

[24] The variables used where the first difference in real benefits paid within a province, in 1952 Toronto dollars.

[25] As many pneumonia deaths result from an onset of influenza, and vice versa, we consider both causes of death as in Viboud et al (2006).

From these estimates we conclude that the primary benefit of public pensions on recipient age group mortality risk came from the level effect associated with extending pension coverage through the universal OAS program. The lack of impact of the means-tested plans, and a significant impact of the universal pension plan is consistent with the Blundell et al.'s (1987) finding that significant costs (psychic or pecuniary) associated with undergoing a means test can lead to less than optimal benefit uptake. The lack of an impact of the means tested plan is consistent with Fishback and Stoian's (2007) argument that rather than providing income to seniors who would not have otherwise had their basic needs met, the means tested plan shifted the burden of responsibility from one tax base to another. Prior to 1927, municipalities, charitable organizations and family would have provided relief to many in dire need. The means tested OAP kept levels of income support the same but changed which level of government financed the pension. Or, as Gratton (1996) argued, public pensions substitute for support that individuals would have received from children. Our results do not support Balan-Cohen's (2008) argument that it is the value of benefits provided under a means tested plan that mattered. The Canadian case demonstrates that the extension of coverage, rather than the enrichment of pension benefits achieved the reduction in mortality.

The results of our empirical work imply that, insofar as mortality rates provide us with a measure of well-being, moving from a means tested plan to a universal plan improved the well-being of aged Canadians. That said, our empirical results do not imply that the universal plan was superior to the means tested plan in any sense other than it resulted in a larger reduction of mortality. Nor, can we conclude that universal eligibility was necessary to achieve these mortality gains. In Table 3 we report the death reduction

and cost per death avoided, for each of the pension plans, implied by the estimated level effects. The estimated level effect is a 4.9 percent reduction in the mortality rate of recipients for the universal OAS and a 0.2 and 0.8 percent reduction for the means tested OAA and OAP respectively. These translate to reductions in the numbers of senior deaths of 2,500 per year for the universal OAS, 225 per year for the OAP and less than 25 per year for the OAA.

Compared to having continued with the means tested OAP after 1951, the total incremental cost of having universal benefit eligibility under the OAS was $1.15 billion (2005 dollars) in 1951, or $1,805 (2005 dollars) per Canadian over age 69.[26] To value the OAS induced reduction in mortality risk, we can calculate the Value per Statistical Life (VSL) associated with the number of lives "saved".[27] The VSL is interpreted as a measure of the marginal rate of substitution between wealth and mortality risk in a given time period (Hammitt 2007, 229). In valuing the OAS reduction in mortality risk for recipient age groups, we do not observe an individual's willingness to pay to reduce mortality risk. Instead, we observe what Canadian taxpayers were willing to pay to reduce mortality risk. Hence, we are looking at the social, rather than private, willingness to pay for mortality reduction. To calculate this social VSL, we compare the OAS incremental cost per person over age 69 in 1951 to the reduction in the recipient age

[26] The incremental cost is calculated as (total population over age 69 in 1951)*(1-portion of population collecting OAP in 1951)*$480/CPI. In 1951, 50 percent of the over 69 population of 638,200 received OAP benefits. With a CPI (2005=100) of 0.133 the total incremental cost of the OAS was about $1,151,639,097 (in 2005$) in 1951.

[27] In time series studies like ours, we can only identify the number of lives saved in a one year period. We cannot infer anything about the number of life-years saved or the quality of life associated with extension of life. See Hammitt (2007, 233). Viscusi (1994a, 1994b) pointed out that if expenditure on health is endogenous to the policy implemented, standard life-value estimates, as referred to above, underestimate policy benefits. In our context, if employment increases the risk of poor health for seniors, who therefore spend more on health related goods under the means tested plan than the universal plan, then the life-value does not reflect the full benefit of the universal policy.

group mortality rate. The VSL for the OAS induced mortality risk reduction was just under $500,000 (2005 dollars) (dW/dMR=$1805/0.003164).

A VSL of $500,000 (2005 dollars) means that to economically justify the mortality risk reduction that was gained with the universal OAS, Canadians did not need to place a high value on the life of senior. The literature on value of life estimation yields estimates between $1.03 million and $13.2 million per VSL (2005 Canadian dollars, see Viscusi, 1994a and Landefeld and Seskin, 1982), with a common benchmark VSL being between $5 million and $7 million.[28] This finding of a low value placed on saving the life of a Canadian over age 70 is consistent with the findings of Cropper et al. (1994) and Johannesson and Johannesson (1997). A comparison of the OAS VSL of $500,000 to a benchmark VSL of $5,000,000 suggests that saving the life of a Canadian aged 70 and over was one-tenth the value of saving a working age Canadian. Cropper et al. (1994) found from a survey of American households that saving one 20 year old was valued as equivalent to saving seven 60 year olds, while Johannesson and Johannesson (1997) found in their survey of 1000 Swedes that saving one 30 year old's life was valued as equivalent to saving the lives of 35 to 41 70 year olds.

Conclusion

We have examined the impact of early government pension plans on the welfare of recipients as measured by mortality rates. We found a negative average treatment effect from the implementation of all pension plans on mortality rates, but only the effect associated with the universal Old Age Security pension was economically and

[28]While there is some debate as to whether the lives of the elderly should be valued at these benchmarks due to considerations like their shorter life expectancies, some suggest discount factors for VSL's for older individuals of 25 to 30 percent. See Hammitt (2007, 229). According to Alberini et al. (2007), Health Canada uses a benchmark VSL of $5 million for Canadians under age 65 and 75 percent of that value for Canadians over age 65.

statistically significant. The OAS reduced recipient age group mortality rates by 4.9 percent, roughly 2,500 fewer deaths of Canadians aged 70 and over per year. We estimate that the value of a statistical life (VSL) implied by the OAS induced mortality risk reduction was around $0.5 million (2005 dollars), which is one-tenth of value per statistical life (VSL) associated with contemporary government policy interventions. This means that Canadians did not need to place a high value on the life of a senior to justify the costs of the OAS program.

Even though the introduction of universal pension eligibility did not reflect that Canadians placed a particularly high value on the life of elderly Canadian, it is worth asking whether the same mortality reductions could have been achieved at a lower program cost. For example, following Boadway's (1998) analysis and alternative pension reforms proposed prior to 1952, maintaining a means tested pension, but raising the eligible income threshold may have accomplished the same benefit as the universal OAS, but without the costly "overpayment" of benefits to relatively well-off Canadians over age 70.

References

Alberini, Anna., Maureen Cropper, Alan Krupnick, and Nathalie B. Simon, "Does the Value of Statistical Life Vary with Age and Health Status?: Evidence from the U.S. and Canada," *Journal of Environmental Economics and Management*, 48 (2004), 769–92.

Armstrong, Gregory L., Laura A. Conn, and Robert W. Pinner, "Trends in Infectious Disease Mortality in the United States During the 20th Century." *Journal of the American Medical Association*, 281(January 1999), 61–66.

Balan-Cohen, Andreea, "Healthy, Wealthy and Wise? The Impact of the Old Age Assistance Program on Elderly Mortality in the United States." Mimeo, Dept. of Economics, Tufts University, (2008).

Bertrand, Marianne., Esther Duflo, and Sendhil Mullainathan, "How Much Should We Trust Difference-In-Difference Estimates?" *Quarterly Journal of Economics*, 119 (February 2004), 249–275.

Besley, Timothy, "Means Testing Versus Universal Provision in Poverty Alleviation Programmes," *Economica*, 57 (February 1990), 119–129.

Blundell, Richard., Vanessa Fry, and Ian Walker, "Modeling the Take-Up of Means-Tested Benefits: The Case of Housing Benefits in the United Kingdom," *The Economic Journal*, 98 (Supplement 1987), 58–74.

Boadway, Robin, "Redistributing Smarter: Self-Selection, Targeting and Non-Conventional Policy Instruments," *Canadian Public Policy*, 24 (September 1998), 363–369.

Brenner, M. Harvey, “Mortality and the National Economy: A Review and the Experience of England and Wales 1936–1976.” *Lancet* II, (September 1979), 568–573.

Bryden, Kenneth, *Old Age Pensions and Policy-Making in Canada*, (McGill-Queen’s University Press, Montreal and London, 1974)

Chapman, Kenneth S., and Govind Hariharan, "Controlling for Causality in the Link from Income to Mortality," *Journal of Risk and Uncertainty,* 8 (January 1994), 85–93.

Chapman, Kenneth S., and Govind Hariharan, “Do Poor People Have a Stronger Relationship between Income and Mortality Than the Rich? Implications of Panel Data for Health-Health Analysis,” *Journal of Risk and Uncertainty* 12 (January 1996), 51–63.

Cropper, Maureen L., Sema K. Aydede, and Paul R. Portney, “Preferences for Life Saving Programs: How the Public Discounts Time and Age.” *Journal of Risk and Uncertainty* 8 (May 1994), 243–265.

Cutler, David M., Angus Deaton, and Andriana Lleras-Muney, “The Determinants of Mortality,” *Journal of Economic Perspectives*, 20 (Summer 2006), 97–120.

Department of Labour, *Labour Gazette* (King’s Printer, Ottawa, 1924).

Feldstein, Martin S., “Should Social Security be Means Tested?” *Journal of Political Economy*, 95 (1987), 468–484.

Fishback, Price V., Michael R. Haines, and Shawn Kantor, “Births, Deaths, and New Deal Relief During the Great Depression,” *The Review of Economics and Statistics*, 89 (January 2007), 1–14.

Fishback, Price V., and Stoian, A., "Welfare Spending and Mortality Rates for the Elderly Before the Social Security Era 1929–1938," Mimeo, Department of Economics, University of Arizona, (2007).

Gratton, Brian, "The Poverty of Impoverishment Theory: The Economic Well-Being of the Elderly, 1890–1950," *The Journal of Economic History*, 56 (March 1996), 39–61.

Guest, Dennis, *The Emergence of Social Security in Canada*, (University of British Columbia Press, Vancouver, 1985)

Hadley, Jack, and Anthony Osei, "Does Income Affect Mortality? An Analysis of the Effects of Different Types of Income on Age/Sex/Race-Specific Mortality Rates in the United States," *Medical Care*, 20 (September 1982), 901–914.

Duleep, Harriet O., "Measuring the Effect of Income on Adult Mortality Using Longitudinal Administrative Record Data," *Journal of Human Resources*, 21 (Spring 1986), 238–251.

Hammitt, James K., "Valuing Changes in Mortality Risk: Lives Saved Versus Life Years Saved," *Review of Environmental Economics and Policy*, 1 (2007), 228–240.

Johannesson, Magnus, and Per-Olov Johannesson, "Is the Valuation of a QALY Gained Independent of Age? Some Empirical Evidence," *Journal of Health Economics* 16 (October 1997), 589–599.

Landefeld, J. Steven, Eugene P. Seskin, "The Economic Value of Life: Linking Theory to Practice," *American Journal of Public Health*, 72 (June 1982), 550–566.

Laporte, Audrey, "Do Economic Cycles Have a Permanent Effect on Population Health? Revisiting the Brenner Hypothesis," *Health Economics*, 13 (2004), 767–779.

Lindert, Peter H., *Growing Public: Social Spending and Economic Growth Since the Eighteenth Century*, (Cambridge University Press, 2004)

McDonald, J.C., 1967, "Influenza in Canada," *Canadian Medical Association Journal*, Vol. 97, No. 10, pp. 522–527.

Marsh, Leonard, *Report on social security for Canada*, (University of Toronto Press, Toronto and Buffalo, 1943)

Meyer, Bruce D., "Natural and Quasi-experiments in Economics" *Journal of Business & Economic Statistics*, 13 (April 1995), 151–161.

Ruhm, Christopher J., "Are Recessions Good for Your Health?" *Quarterly Journal of Economics*, 115 (May 2000), 617–650.

Smith, James P., and Raynard Kington, "Demographic and Economic Correlates of Health in Old Age," *Demography* 34 (February 1997), 159–170.

Snyder, Stephen E., Evans, William N., "The Effect of Income on Mortality: Evidence from the Social Security Notch," *The Review of Economics and Statistics*, 88 (2006), 482–495.

Struthers, James, *The Limits of Affluence: Welfare in Ontario 1920–1970*, (University of Toronto Press, Toronto, 2004)

Viboud, Cecile, Theresa Tam, Douglas Fleming, Mark A. Miller and Lone Simonsen, 2006. "1951 Influenza Epidemic, England and Wales, Canada, and the United States," *Emerging Infectious Diseases*, Vol. 12, No. 4, pp. 661–668.

Viscusi, Kip W., "Mortality effects of regulatory costs and policy evaluation criteria," *RAND Journal of Economics*, 25 (Spring 1994a.), 94–109.

Viscusi, Kip W., "Risk-Risk Analysis," *Journal of Risk and Uncertainty*, 8 (January 1994b), 5–17.

Wilkins Russell, Jean-Marie Berthelot, and Edward Ng, "Trends in mortality by neighbourhood income in urban Canada from 1971 to 1996," *Health Reports*, 13 (Supplement 2002), 45–72.

Winegarden, C. R., and Murray, John E. "The Contributions of Early Health-Insurance Programs to Mortality Declines in Pre-World War I Europe: Evidence from Fixed-Effects Models" *Explorations in Economic History*, 35 (October 1998), 431–446.

Table 1: Percent of Provincial Recipient Age Populations Receiving Pension Benefits, and Maximum and Average Benefits Paid, Under OAP, OAS and OAA, 1951 and 1956

	OAP (1951)			OAS (1956)		OAA (1956)		
	(1)	(2)	(3)	(1)	(2)	(1)	(2)	(3)
PEI	49%	$494	$414	98%	$494	18%	$475	$329
NS	59%	$494	$447	98%	$494	26%	$475	$407
NB	67%	$493	$433	99%	$493	38%	$477	$439
PQ	53%	$486	$449	100%	$486	31%	$477	$454
ON	37%	$488	$445	98%	$488	13%	$467	$442
MN	46%	$486	$460	96%	$486	16%	$476	$474
SK	46%	$485	$448	95%	$485	16%	$467	$455
AB	48%	$485	$440	95%	$485	17%	$476	$445
BC	44%	$493	$439	96%	$493	13%	$472	$472

Canada Tables C-287, C-66, C-313.

Notes:
Column 1 reports percent of the eligible age group population receiving pension benefits.
Column 2 reports the maximum benefit, in 1952 Toronto dollars*.
Column 3 reports the average benefit paid, in 1952 Toronto dollars*.
* Nominal benefits are adjusted using cost of living indexes for major cities, as reported in Emery and Levitt (2002) and *Historical Statistics of Canada*, Tables K23–32. The Emery and Levitt indexes are spatially adjusted to Toronto 1913 purchasing power for 13 cities over the period 1900–1950. The Historical Statistics of Canada indexes for cities are not spatially adjusted but cover 1940–1975. To splice these indexes together, we calculate, by city, the implied inflation rate over the period 1940–1950, which was common to the two sets of indexes. The Emery and Levitt indexes are extended by applying the Historical Statistics inflation rate by city and multiplying by the ratio of the two sources' indexes for 1940–1950. This method assumes that the only driver of differences in indexes between provinces after 1950 is price changes within each province rather than changes in relative prices across locations.

Table 2: Gradient and Level Effect Specifications for Estimating Pension Effects on the First Differenced Logarithm of the Mortality Rate

	Level Effect		Gradient Effect	
	(1)	**(2)**	**(3)**	**(4)**
OAS (1952)	-0.103 (0.024)*	-0.049 (0.016)*	-0.023 (0.005)*	-0.012 (0.017)
OAA (1952)	-0.047 (0.031)	-0.002 (0.018)	-0.011 (0.003)*	-0.013 (0.012)
OAP (1927)	-0.034 (0.013)*	-0.008 (0.009)	-0.002 (0.006)	0.010 (0.017)
Observations	5600	5600	5600	5600
Number of age/province groups	126	126	126	126

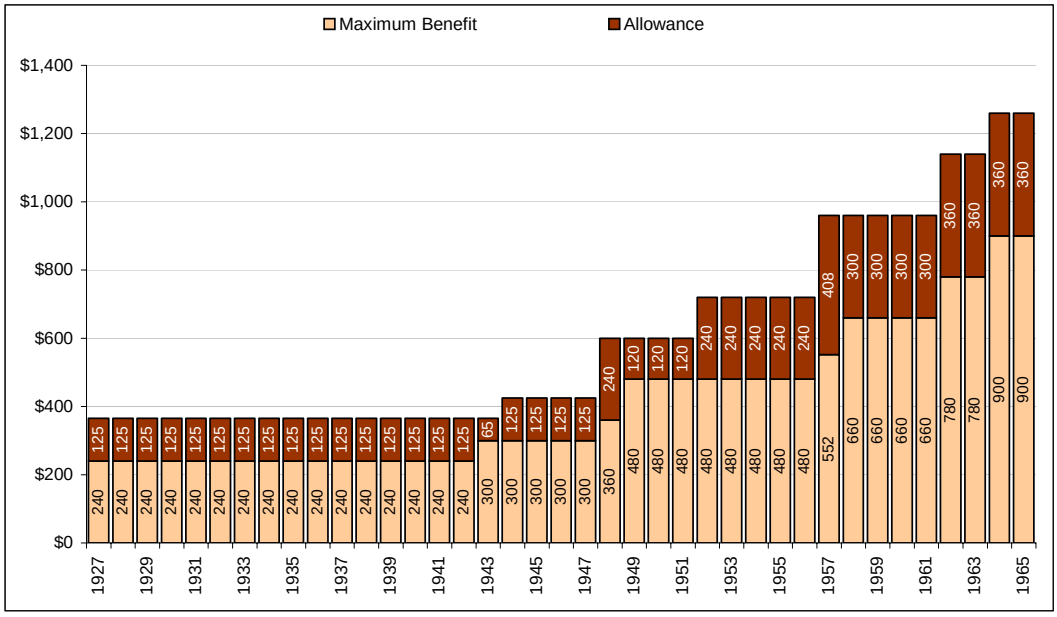
Standard errors in parentheses: * significant at size 5%. All regressions control for year, age group and province fixed effects. All regressions report standard errors adjusted for clustered observations by age/province groups. Regressions (2) and (4) weight by province/age group population. Actual implementation dates for OAP differed by province. See text.

Table 3: Reduction in Deaths and Value per Statistical Life as Implied by the Level Effect

	Level Effect	Implied Change in Deaths per Thousand	Implied Deaths Avoided	Implied Value of Statistical Life
OAS (1952)	-0.049	-3.935	2,511	$458,615
OAA (1952)	-0.002	-0.057	25	
OAP (1927)	-0.008	-0.761	225	

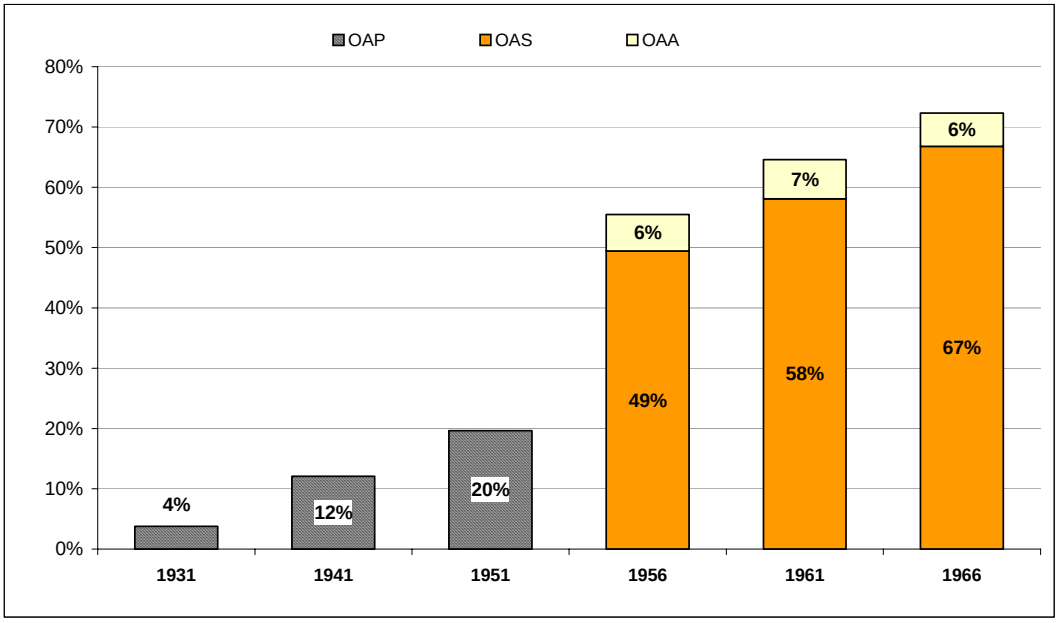
Notes: Change in deaths per thousand is calculated by multiplying the estimated level effect by Canadian mortality rates in the year prior to implementation. For the OAS and OAP plans, mortality rates are the average mortality rates for age groups 70–74, 75–79, 80–84 and 85–89, weighted by age group population. Implied deaths avoided are the product of the change in deaths per thousand and the population of the recipient, for the year prior to implementation. Value per Statistical Life is calculated as outlined in Hammit (2007): dividing the incremental expenditure per recipient by the reduction in mortality risk.

Figure 1: Income Thresholds and Maximum Pension Benefits for Means Tested Pension Recipients



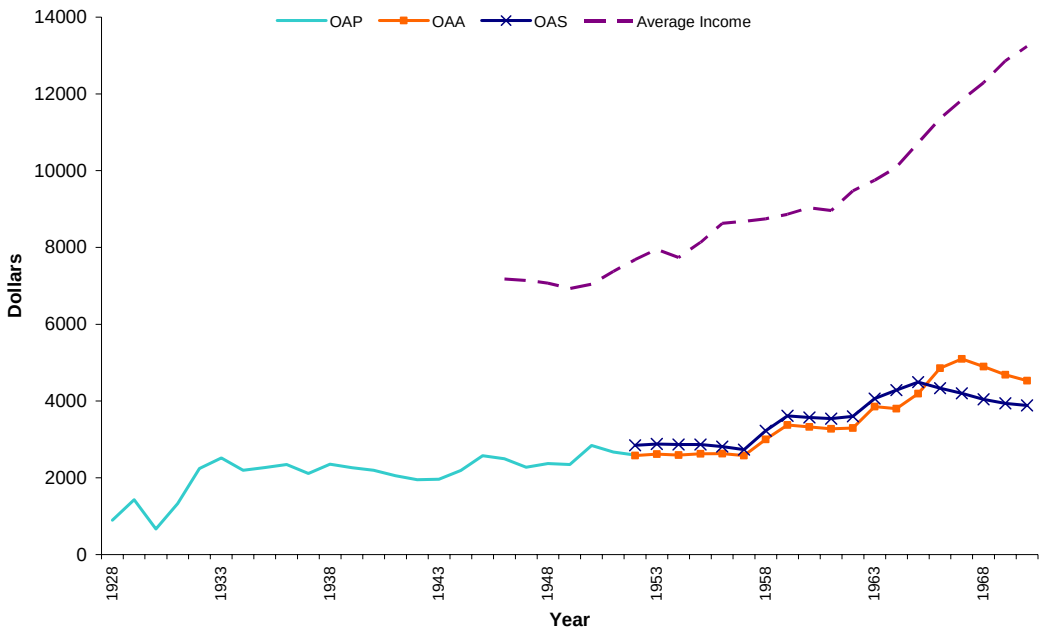
Source: *Canada Year Book* 1921–1965. Current dollars.

Figure 2: Percentage of Canadians Age 65 and Over Receiving Pension Benefits by Pension Plan



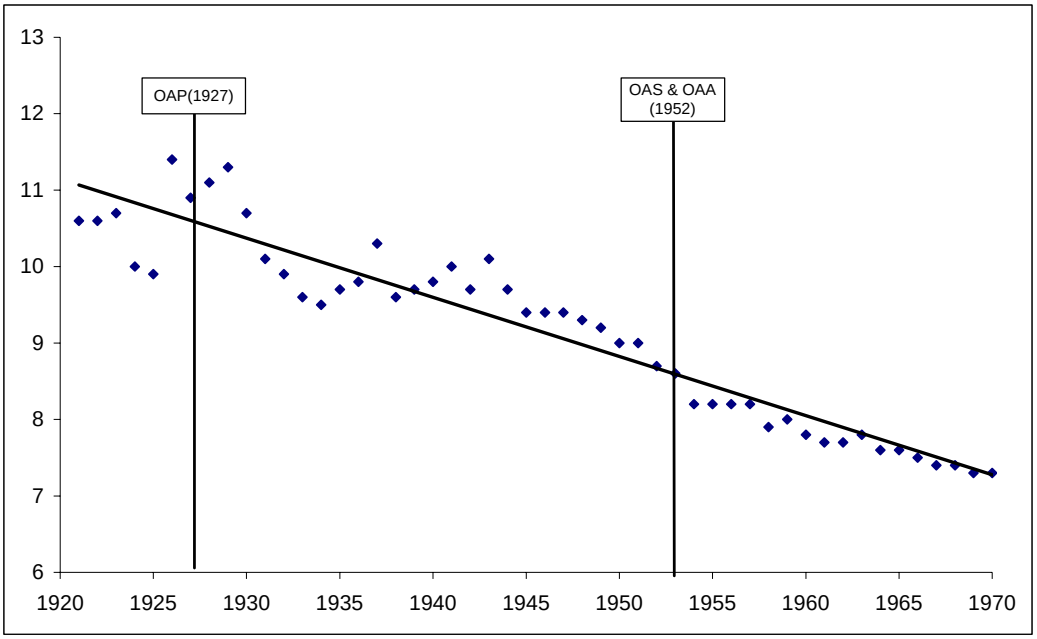
Source: Population: *Census of Canada* 1931–1966*;* Coverage: *Historical Statistics of Canada* Tables C-287, C-66, C-313.

Figure 3: Pension Benefits Paid Per Recipient and Average Personal Income of Canadians, 1927–1970 (Constant 1992 Dollars)



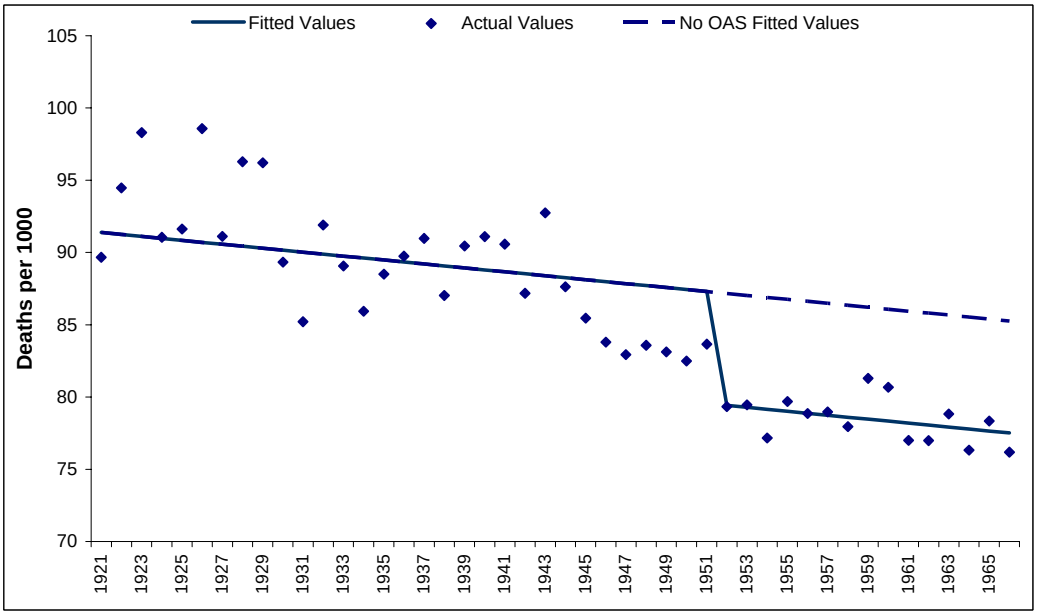
Source: Average Personal Income: *Economic Reference Tables* (1991), Published by Canadian Department of Finance (Table 16). Average Benefit Paid is determined by dividing Total Pension Payments by the number of recipients as reported in the *Historical Statistics of Canada, Second Edition*: OAS: recipients C66-78, payments C79-91. OAP: recipients C287-299, payments C300-312: OAA: recipients C313-325, payments C326-338.

Figure 4: Overall Mortality Rate for Canada, 1921–1970 (deaths per 1000)



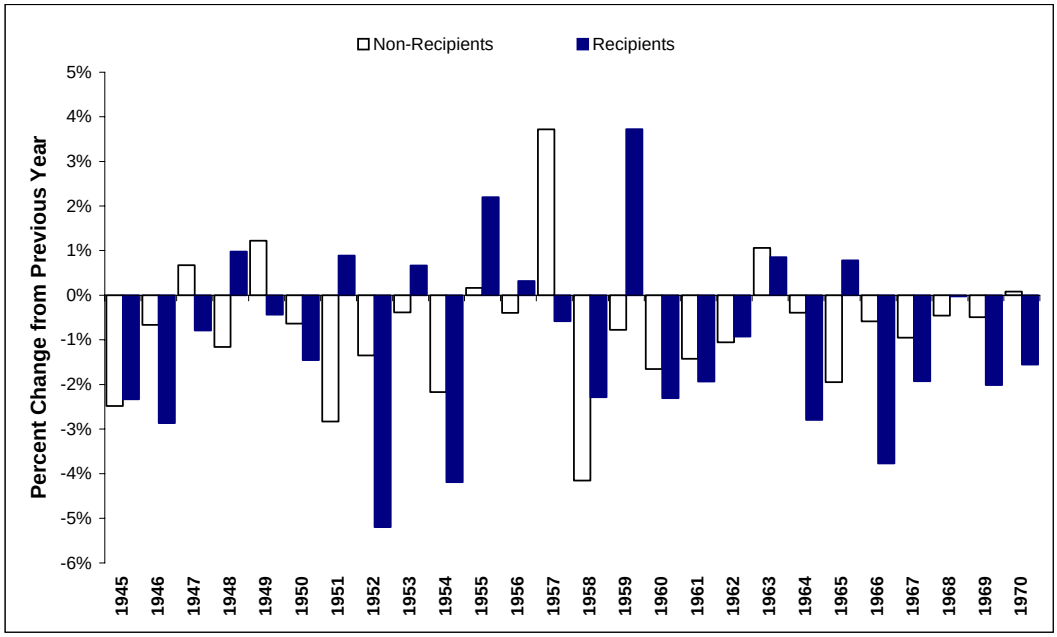
Source: See data appendix.

Figure 5: OAS Recipient Mortality Rates, Canada 1921–1970 (deaths per 1000)



Source: See data appendix. Mortality rates are the population weighted average for Canada, age groups 70 years and older.

Figure 6: Percent Change in Mortality Rates from Previous Year, Recipient versus Non-Recipients, Canada 1945–1970



Source: See data appendix. Recipients are age groups 70 years and older, non-recipients are all age groups 50 to 64 years of age.

Data Appendix

Mortality Rates by Province and Age Group

1921–1970 data:

Canada. *Vital Statistics*. Dominion Bureau of Statistics. Ottawa, Issues 1921–1970.

Average Income by Province

Personal Income Per Capita, Canada and Provinces:

Canada, 1991. *Economic Reference Tables*, Canadian Department of Finance, p.29

Pension Data

All coverage and total payment information from Statistics Canada's *Historical Statistics of Canada*, Catalogue No. 11-516-XWE.

Historical Statistics of Canada Reference Tables

	Coverage	Payment
OAP	C287–299	C300–312
OAS	C66–78	C79–91
OAA	C313–325	C326–338

Maximum pension benefits and income thresholds come from volumes of *Canada Year Book* 1921–1965

Population by Age

Statistics Canada, *Census of Canada*, Issues 1931–1966.

Canada, *Population 1921–1971: Revised Estimates of Population, by Sex and Age Group, Canada and the Provinces*. Statistics Canada, Catalogue No. 91-512.