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Public Pensions and Retirement:
International Evidence in the Canadian Context

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Tammy Schirle (University of British Columbia)

Working Paper 2006 A-13

Human Resources and Social Development Canada/Ressources humaines et Développement social Canada
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IC 60135

Human Resources and Social Development Canada/Ressources humaines et Développement social Canada
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Acknowledgements

We thank SSHRC-INE grant # 537-2004-001 for financial support. All opinions expressed in the paper should be attributed to the authors alone, and not to Industry Canada.

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Abstract

This paper examines evidence on the impact of Canada's public pensions on the retirement decisions of the elderly. Public pensions may affect a person's labour market decisions in one of two ways. First, a *wealth* effect exists when public pensions increase a person's total lifetime income, inducing the person to spend fewer years in the labour market and retire at an earlier age. Second, an *accrual* effect may exist if the discounted present value of future pension flows depends on the date of retirement. If so, then the rate of accrual of rights to future pension income may affect the timing of retirement. Through descriptions and simulations, we document the components of Canada's income security system and show how they act independently and in concert to change the incentives to retire. The major contributing factors are: 1. The actuarial adjustment of the Canada/Quebec Pension Plan does not sufficiently compensate for the foregone year of pension receipt, 2. The Guaranteed Income Supplement exacerbates the insufficiency of the actuarial adjustment, 3. For workers 65 and over, the Guaranteed Income Supplement decreases the return to work significantly, 4. Married couples have different incentives because changes in pension entitlements are echoed in survivor benefits, 5. Women have different incentives because they have a different mortality curve and because they are less likely to predecease a spouse. To best place the importance of labour market disincentives on actual retirement behaviour in context, the paper provides a thorough survey and critical review of the international evidence on public pensions and retirement. Through nearly 30 years of research across many countries and dozens of studies, the broad weight of the evidence suggests that the structure of public pensions contributes to the decision to retire. These findings are corroborated in studies of the retirement behaviour of Canadians. The paper concludes with three major findings: 1. The Canadian retirement income security system generates work disincentives, although they are small relative to many European countries, 2. International evidence suggests that work disincentives influence the decision to retire, and 3. The disincentives and the reaction to them are strongest among low-income Canadian seniors.

Résumé

Dans cette étude, les auteurs examinent les données relatives à l'impact des régimes de pension de l'État au Canada sur les décisions des aînés concernant leur retraite. Les régimes de pension de l'État peuvent influer, de deux façons, sur les décisions relatives à la participation au marché du travail d'une personne. Premièrement, il y a un effet de *richesse* lorsque les régimes de pension de l'État font croître le revenu pendant la période de la retraite, ce qui incite la personne à passer moins d'années sur le marché du travail et à prendre sa retraite plus jeune. Deuxièmement, il peut y avoir un effet *cumulatif* si la valeur actualisée du futur revenu de pension dépend de la date du départ à la retraite. Le cas échéant, le montant cumulatif ouvrant droit à la pension peut influer sur le moment du départ à la retraite. Grâce à des descriptions et à des simulations, les auteurs documentent les composantes du système de sécurité du revenu du Canada et montrent comment elles agissent seules ou ensemble pour modifier les incitatifs à la retraite. Les principaux facteurs à l'œuvre sont : 1) le fait que le rajustement actuariel du Régime de pensions du Canada ou de la Régie des rentes du Québec ne compense pas suffisamment

l’année de revenu de pension cédé; 2) le Supplément de revenu garanti accentue l’insuffisance du rajustement actuariel; 3) le Supplément de revenu garanti diminue considérablement le retour au travail dans le cas des travailleurs de 65 ans et plus; les couples mariés ont des incitatifs différents puisque les changements dans le droit à pension se répercutent sur les prestations au survivant; 5) les femmes ont des incitatifs différents car leur courbe de mortalité est différente et parce qu’elles sont moins susceptibles de mourir avant leur conjoint. Afin de bien mettre en contexte l’importance des facteurs de dissuasion au travail sur le comportement réel face à la retraite, les auteurs présentent une enquête complète et un examen critique des données internationales concernant les régimes de pension de l’État et la retraite. Fruit de près de 30 ans de recherches sur de nombreux pays et de douzaines d’études, l’abondante preuve accumulée laisse supposer que la structure des régimes de pension de l’État incite les personnes à prendre leur retraite. Des études sur le comportement des Canadiens face à la retraite corroborent ces résultats. Les auteurs terminent en exposant trois grandes constatations : 1) le système de sécurité du revenu du Canada engendre des facteurs de dissuasion au travail, bien que ceux-ci soient peu importants par rapport à ceux de nombreux pays européens; 2) les données internationales laissent croire que les facteurs de dissuasion au travail influencent les décisions de départ à la retraite; 3) les facteurs de dissuasion et la réaction à leur égard sont plus importants chez les aînés à faible revenu au Canada.

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I. Introduction

The engagement of governments in pensions is internationally pervasive. Mulligan and Sala-i-Martin (2004) observe that 166 countries have some type of public pension program. Given this ubiquity, great interest has arisen in developing an understanding of the economics of public pensions. One branch of this inquiry asks how pensions affect the labour market decisions of the elderly. The motivation may lie in a desire to expand our knowledge of how the existing or future structure of public pensions might affect retirement decisions. Moreover, in some countries there may be an explicit desire to alter the structure of retirement through reforms to public pensions. In either case, a thorough investigation of the effects of pensions on retirement becomes a necessary first step.

An understanding of the effects of public pension programs on labour supply begins with a basic lifecycle model of labour supply. In the simplest model, an individual chooses a path of lifetime consumption and labour supply to maximize utility subject to the constraint that the discounted present value of lifetime income equals the discounted present value of lifetime consumption. The fundamental tradeoff that must be contemplated is between higher consumption (afforded through more work) and higher leisure. If one works more, the higher income allows one to consume more. However, more work implies less time available for leisure. Every worker therefore chooses a lifetime path for work that balances the desire for consumption and leisure.

Public pensions potentially change a worker's decision in two ways. The first is through changing the total lifetime income of the worker (which is equivalent to his or wealth). The discounted present value of benefits net of contributions made to the program is part of the lifetime budget constraint. If the discounted flow of benefits equals the discounted flow of contributions, then public pensions will have no effect on individual behaviour. However, if benefits exceed contributions, then a person's lifetime income is increased by the presence of the program. Assuming leisure is a normal good, this increase in wealth induces a person to reduce labour supply and enjoy more leisure. Although in theory this reduction in labour supply could be spread over an individual's lifespan (i.e. a reduction in the number of hours worked in each period), it is more likely to reduce the number of years that an individuals works.[†] This mechanism is called the *wealth effect*.

Another way public pensions can affect retirement decisions is through the accrual of rights to future pension income. If working an additional year raises the discounted sum of the future benefits, a worker will have a stronger incentive to continue working for the additional year, when comparing the advantages of retirement (more leisure) to the advantages of more work (even high retirement income when she or he does retire). For example, benefits in most countries are based on some function of

[†] Most workers face hours constraints in that employers typically offer jobs only at standard hours of work. For example, Gustman and Steinmeier (1983, 1984) show that the majority of workers face hours constraints that would prevent them from gradually phasing out of full time jobs into retirement.

average lifetime earnings. More work will increase lifetime earnings, which may translate into higher future public pension benefits. Other features of public pensions that change benefits depending on the timing of retirement, such as actuarial adjustments, delayed retirement credits, and means-tested programs, can also influence how extra years of work translate into higher (or lower) future benefits. This channel is called the *accrual effect*.

If pensions were paid based on contributions, then the accrual effect can be made to disappear. This occurs in employer-provided defined contribution plans or in public pension plans such as Sweden's new public system of 'notional' accounts.[‡] The level of the explicit or implicit pension wealth does not depend on the timing of the retirement decision in a contributions-based system, so the accrual effect disappears. Without an accrual effect, the structure of the pension can be said to be 'neutral' with respect to the retirement decision. That is, the decision to retire does not depend on the structure of the system, but instead reflects the individual's undistorted choice about the tradeoff between extra leisure and extra retirement income. With non-zero accrual effects, the retirement decision will be distorted, with a different and suboptimal mix of leisure and income. This non-neutrality generates costs akin to the standard efficiency losses of taxation.

More recent modeling of the effects of retirement benefits on labour supply has focused on the accrual effect. The canonical model comes from Stock and Wise (1990). Utility is derived from income (which affords consumption), with disutility from work. In each period an individual compares the expected present value of lifetime utility from

[‡] See Palmer (2000) for a description of Sweden's system.

retiring immediately to the expected present value of retiring at each future age, trading off income and work. The maximum of the difference in expected present values of retiring at each future age and immediate retirement is called the "option value" of postponing retirement. If the option value is negative, the individual will choose to retire immediately. If the option value is positive, the individual will choose to continue working and retains the option of retiring at a future date. In the next period, any individual who continued to work will determine the option value of postponing retirement again, given any new information. The key insights of the option value model are the forward-looking nature of the decision and the tradeoff between earlier retirement and higher retirement income.

Beyond the narrow economic variables, retirement takes place in a social context. The behaviour of one's spouse and peers could influence the retirement decision. In addition, health may affect retirement either because current work becomes impossible or because future health affects the time period over which pension benefits may flow. The focus of much of the economics literature on the financial motivations for retirement in no way precludes the impact of other factors. Our focus in this paper on the economics of the decision should therefore be interpreted in the broader context of social science research.

We begin by describing Canada's retirement income security system. We pay particular attention to how each component of the system contributes to both the wealth and the accrual effects described above. We then proceed to simulations that lay out the strength and the magnitude of the retirement incentives present in Canada's system, and show how it varies across different individuals. The next question we address is how important these incentives may be for retirement decisions. To do so, we present a comprehensive survey of the international literature on public pensions and retirement. We finish with a summary of the major findings of our study.

II. Canada's Retirement Income Security System

Canada's retirement income security system includes four distinct components. In this section, we provide the institutional detail on each component, describing how it might affect the incentives to retire. The descriptions are not meant to be exhaustive listings of the rules governing benefits. Instead, the focus is on the parts of the rules that have the greatest impact on retirement incentives.

Before beginning the description of the system, we will clarify our use of certain terms. We use *income security* generically to refer to public pension programs for the elderly in any country. When referring to the primary income security program in the United States, we capitalize it and call it by its name of *Social Security*.

A. Canada Pension Plan – Quebec Pension Plan

The largest component of the income security system is the Canada Pension Plan and Quebec Pension Plan (CPP/QPP). The CPP and QPP are earnings-related pensions funded by payroll taxes on employees and employers. The two plans are administered separately by the federal government for the CPP and the Quebec government for the QPP. Most details across the two programs are similar.

The calculation of the benefit is the product of three parts. The first part is determined by earnings histories. The contributory period is the window of time between 1966 or age 18 (which ever is later) and age 60. If retirement occurs after age 60, the contributory period is extended, up to a maximum of age 65. Months in which a disability benefit was received, or were spent caring for a child under age 7, are dropped from the contributory period. The worker may also drop the lowest-earning 15 percent of the months in the contributory period. For work after age 65, the earnings are only included in the calculation if it results in an increased benefit.

In each month in the contributory period, the ratio of earnings to 1/12 of the Year's Maximum Pensionable Earnings (YMPE) is calculated. The YMPE is set annually, and equaled $40,500 in 2004. These ratios are capped at one, so that earnings in excess of the YMPE are not considered for the pension benefit calculation. The final step in the earnings-rated part of the pension formula is to take the average of the ratios over all of the months in the contributory period.

The second part of the benefit calculation aims to update the earnings history to the level of earnings prevailing at the time of retirement. This is accomplished by taking the average YMPE in the five years preceding the time of retirement (the five years includes the year of retirement). We call this the pension adjustment factor.

The third part of the benefit calculation adjusts the pension for the age of retirement. The 'full' pension is received if retirement is at age 65. For every month before age 65, an actuarial adjustment of 0.5 percent is deducted from the full benefit. Symmetrically, retirement after age 65 receives a bonus of 0.5 percent per month of delay. These actuarial adjustments are capped at 5 years, meaning that the earliest one can claim regular benefits is at age 60, at a 30 percent (30 percent is 60 months times 0.5) reduction from the full benefit level.

The product of these three parts is then multiplied by the CPP/QPP replacement rate of 25 percent and divided by 12 to arrive at the monthly benefit. This is summarized in the following formula.

```
Monthly Benefit = (earnings rating) x (pension adjustment factor) x (actuarial adjustment) x 0.25 x (1/12)
```

The monthly benefit, once initiated, is updated quarterly for changes in the consumer price index. Upon the death of the recipient, any surviving spouse may be eligible for survivor benefits.[§]

How does the CPP/QPP affect retirement incentives? First, there is a wealth effect embodying the total discounted amount of future benefit flows. This encompasses both the regular benefits and the spousal benefits. Higher wealth (or equivalently, a higher annual flow of retirement income) is predicted by theory to lead to earlier retirement.

In addition, the CPP/QPP pensions have many channels of influence on the accrual incentive to retire. First, if the extra periods at work have high enough earnings so that they are included in the pension calculation, then the retirement pension will be larger when it is eventually taken. This means that more work leads to a higher pension once it is initiated. The 15 percent 'throw-out' rule and the earnings averaging rules help to determine the strength of this impact. Second, the actuarial adjustment depends specifically on the age of retirement. If retirement is delayed one month past age 60, then one month of pension receipt is foregone. However, the actuarial adjustment leads to a higher pension benefit once benefits are eventually initiated. The actuarial adjustment attempts to balance these amounts. Through this actuarial mechanism, the timing of retirement has an effect on the net present value of pension benefits received.

[§] Survivor benefits are paid at a rate of 60 percent of regular benefits if the survivor is age 65 or more, and 37.5 percent plus a fixed amount for survivors under age 65. These amounts differ in the Canada and Quebec Pension Plans.

B. Old Age Security

The Old Age Security (OAS) pension is a uniform demogrant with a maximum benefit of $466.63 per month in September 2004. The pension amount is updated quarterly for changes in the Consumer Price Index, and the income is taxable as regular income. It is available to all individuals over the age of 65 meeting residency requirements.[**] There is a clawback of OAS benefits from very high income individuals: the OAS for an individual is reduced by 15 cents per dollar of personal net income exceeding $59,790 (in 2004). As such the full OAS pension is eliminated when an individual's net income exceeds $96,972 (in 2004).

The effect of the OAS pension on retirement incentives occurs mainly through the wealth effect. The OAS benefit does not depend on the date of retirement directly, so there is no direct accrual effect from working extra years. For those who are subject to the OAS clawback, however, there will be some accrual effect. The accrual effect for them arises because extra work increases the CPP/QPP benefit which then serves to decrease the OAS benefit through the clawback. However, the clawback affects relatively few seniors so this interaction between the CPP/QPP and the OAS is of less general importance.

[**] When first introduced in 1952 OAS was only available to individuals over the age of 70. The eligibility age was reduced to 65 over the last half of the 1960s. To be eligible for benefits, individuals must have been a Canadian citizen or legal resident of Canada at some point before application and must have resided in Canada for at least 10 years after reaching age 18 (if currently in Canada) or twenty years (if currently outside Canada). The benefit is prorated for pensioners with fewer than forty years of Canadian residence (after the age of 18), unless they are "grandfathered" under rules that apply to the persons who were over age 25 and had established attachment to Canada prior to July 1977.

C. Guaranteed Income Supplement

The Guaranteed Income Supplement (GIS) is paid to Canadians from age 65. It is also indexed to prices, but is not taxable income. The pension benefit was set in September 2004 at $560.69 for single individuals and $365.21 for each member of a couple. The unique feature of the GIS is the income test. For each dollar of family income (excepting OAS income), the GIS benefit is reduced by 50 cents for singles and by 25 cents each for married couples. For 2004, 34.5 percent of OAS recipients also received GIS benefits.

The GIS affects retirement incentives in two strong yet distinct ways. First, for those who are age 65 or more and would receive the GIS if they retired, labour market earnings will reduce GIS payments by 50 cents on the dollar. This is in addition to the income taxes that would be payable on the labour market earnings, so continued work past age 65 is strongly discouraged by the GIS.

The second channel through which the GIS affects retirement incentives is more subtle but perhaps even more important. Extra work after age 60 leads to a higher CPP/QPP pension through the actuarial adjustment. However, each dollar of extra CPP/QPP income that is earned will lead to a decrease of 50 cents in GIS income, for those who receive GIS. Essentially, for GIS recipients, the value of the actuarial adjustment is cut in half. For this reason, extra work past age 60 can have a strong impact on the retirement income received in the future. The simulations later in the paper explore this mechanism in more detail.

D. The Allowance

The Allowance is paid in two circumstances. First, it is paid to the 60-64 year old spouses of current OAS recipients. Second, it is paid to 60-64 year old widows or widowers. The amount paid is equal to the OAS pension plus the married component of the GIS pension. Like the GIS, it is clawed back on family income. However, the clawback rates are 75 cents on the dollar for the 'OAS' portion of the Allowance, and 50 cents on the dollar for the 'GIS' portion of the Allowance.

The Allowance affects retirement through the same two channels as described above for the GIS. However, the direct channel of the clawback on labour market earnings is stronger here because of the 75 percent clawback. In addition, the more subtle channel of the interaction with CPP/QPP benefits is much *less* important for the Allowance because the Allowance can only be received for a maximum of five years. This means that only five years' worth of CPP/QPP actuarial adjustments will be effectively reduced, in contrast to the GIS which reduces them for all ages past age 65.

E. Summary

The four components of Canada's retirement income system each separately embody interesting features that influence the decision to retire. However, when the four components are combined, the interactions among the individual components provide some of the sharpest incentives to retire. Describing these interactions is made easier by reference to numerical examples, so we turn next to some simulations.

III. Simulations

The goal of this section of the paper is to quantify the strength of the incentives to retire described in the previous section. To do so, we take a 'typical' individual and calculate his or her income from all four components of Canada's income security system. We then compare the differences in the incentives when we vary his or her private pension income, amount of lifetime earnings, and continuity of lifetime earnings. Finally, we show some policy simulations to demonstrate the sensitivity of the incentive measures to small changes in policy parameters.

We do not aim to provide a comprehensive analysis of the incentives to retire, for that is beyond the scope of the paper. Instead, we use the simulations as an illustrative tool to point out how the components of Canada's retirement income system work individually and interactively to influence the decision to retire. Because of the illustrative nature of the simulations, no attempt should or can be made to infer nationally representative results from the results presented here.

The section begins with a description of the methodology that underlies our calculations. This is followed with the presentation of the simulation results first for the base case, then for several alternative scenarios.

A. Methodology

In order to calculate an individual's pension entitlement, we require several pieces of information. We need a complete earnings history back to 1966 (or age 18), sex, age, marital status, province of residence, and information on private pensions or other income. These pieces of information can then be combined using a pension income calculator to arrive at public pension income in any given year. By recalculating the pension income for all ages after retirement and discounting for time preference and for mortality probabilities, we arrive at a measure of the expected net present value of public pension income. We call this the Income Security Wealth (ISW) corresponding to a particular retirement age. When this calculation is repeated for all potential retirement ages, an age profile for ISW can be described and the rate of ISW accrual from year to year can be derived. Both the level of ISW and its rate of accrual are the objects of our attention.

We use the pension income calculator developed for and described in Baker, Gruber, and Milligan (2003, 2004) for our calculations. The calculator first derives the CPP/QPP benefit, given a lifetime earnings history. Next, it calculates the retirement income for each age during retirement, by assigning the CPP/QPP benefit, OAS, GIS, and the Allowance both to the worker and his or her spouse. We project benefits into the future assuming they remain constant in real terms. All clawbacks are accounted for. The calculator then takes the taxable components of income and applies provincial and federal taxes to arrive at an after-tax measure of retirement income at a given age. The flow of retirement income across ages is discounted using an assumed rate of time preference (three percent real) and sex-specific mortality probabilities (taken from Statistics Canada 2002). The output of the calculator is an age-profile of ISW for all potential retirement ages under consideration.

For our calculations, we seek to define a 'typical' individual in order to characterize retirement incentives. We consider someone in 2002 who is 55 years old and lives in Ontario. This implies that the year of birth was 1947, and that the first year of work eligible for the CPP/QPP is 1966 at age 19. The worker is contemplating retirement at some age between 55 and 70. For the earnings history, we take a series of average weekly earnings and annualize it.[††] In our base case, we assume that the worker earned in every year from age 22 to the present, with no interruptions. From 18 to 21 we assume zero earnings (proxying for years in school). This means that there are three zeros in the earnings history, from ages 19 (in 1966) to 21 (in 1968). When projecting earnings into the future from 2002, we assume that earnings stayed constant in real terms at the 2002 level. We also assume in our base case that the worker has no income outside of earned income and public pension income – this means no Registered Retirement Savings Plans, employer-provided pensions, or other sources of income. Finally, we assume that the CPP pension is not taken until retirement – no work occurs after the CPP pension is taken.[‡‡]

[††] There is no consistent series covering the entire time period necessary for our analysis. We build our series from three CANSIM II series: V78310 for 1965 to 1983, V250810 for 1984 to 2000, and V1597104 for 2001 and 2002.

[‡‡] Under the CPP and the QPP, you must have stopped work in the month the pension is taken. After that, work may begin again and the pension is not changed.

We simulate our base case for married and single males and females. The married couples are assumed to each have the same birth year and earnings history. When considering the retirement age of the husband, we hold constant the wife's retirement age at 60. Similarly, when considering the wife's retirement age, we hold constant the husband's retirement age at 60. This base case is not meant to produce results that are representative for the Canadian economy. Instead, the aim here is to demonstrate how the incentives vary in one simple case. A more complete and representative analysis featuring the fullness of heterogeneity we observe in the Canadian labour force is beyond the scope of this paper.

In addition to the base case, we conducted three sets of simulations in which we varied the base scenario in different dimensions. In the first, we try adding sequentially higher amounts of private pension income to examine the effects of the GIS and Allowance clawbacks. In the second, we look at differences across workers of different wage levels by running simulations with an earnings history comprised of earnings that are only a certain percentage of the average weekly earnings. Finally, we twist the earnings history in a different way by studying the effect of 'incomplete' earnings histories in which the worker had absences from the labour market. These extra simulations will help to provide more information on how the retirement incentives vary across individuals.

Table 1 presents a basic description of our base simulated individuals. We consider the case of a single man or woman, with no income aside from public pensions.

The first two rows show the probability of living to a certain age, given that the individual is currently age 60. Females display greater longevity, with the probability of surviving until age 95 at more than twice than for males, 0.113 to 0.039. Average life expectancy from age 55 (the age at which the conditional probability of living is 0.50) is 84 for females, and 79 for males. The full survival curves, conditional on surviving to age 55, are shown in Figure 1. Not only are females different because they have a higher probability of survival, but they shape of the survival curve is also different. For example, after age 84, the drop in probability of survival is greater for women than for men. Because the lifetime pension measures we use will compare positive and negative flows across ages, both the level *and* the shape of the survival curves will play a role.

The rest of Table 1 shows pension flows at a particular age. Because the earnings for our simulated male and female are assumed to be the same, these pension flows could be for a single person of either sex. The third row displays the OAS entitlement, expressed in 2002 dollars. It pays $5,328 per year, starting at age 65. The next 4 rows of the table show the CPP entitlement (the simulated individual is from Ontario) and the GIS entitlement if the worker retires at age 60 (in 2007) or age 65 (in 2012). If taken at age 60, the CPP pays $6,335 annually. The full GIS amount in 2002 is $6,336, so the CPP payments reduce the GIS payments by $3,167.50 ($6335*0.50), leaving $3,169 in GIS payments starting at age 65. If the same individual continues to work until age 65, the CPP entitlement grows to $9,501.[§§] This supplemental $3,166 in CPP leads to a reduction in the annual GIS payment of $1,583 ($3,166*0.50), which leaves GIS

[§§] Note that this is greater than the $9,465 maximum pension available in 2002. The pension for our simulated individual is higher because he or she will reach age 65 in 2012, when the maximum pension will be larger.

payments of $1,586 annually. This example gives some preliminary indication of how the GIS and CPP interact with each other to change retirement incentives. The extra CPP benefit received for delayed retirement from age 60 to 65 is reduced by half through the GIS. How this change in *annual* pension flows changes the *lifetime* totals is the subject of the simulations that follow.

B. Base Case Results

The results for the base case are presented in Table 2. The first column shows the level of ISW in 2002 dollars for each case at age 55. The columns across the table contain the year-to-year accrual of ISW across different potential ages of retirement, from the point of view of the 55 year old in 2002. So, for example, the age 57 column contains the difference in ISW for retirement at age 57 and at age 58. At the right end of the column, we report the final level of ISW at age 70. Down the table we consider four family types: single and married males, and single and married females.

We start with the single male. For ages 55 and 56, the rate of accrual is $1,269 and $1,073. The dropout provision plays an important role here. Fifteen percent of months may be dropped from the CPP/QPP calculation. From ages 19 to 59, there are 41 years, which generates just over six years of dropouts. Since we assumed no earnings between ages 19 and 21, this means that someone retiring at age 55 has three 'zero' earnings years from ages 19 to 21, then 5 more from ages 55 to 59 before claiming the CPP/QPP at age 60. The six dropout years cancel six of the zero years, but two zero years remain in the calculation. An extra year of work at age 55 therefore replaces one of the zero years. This generates the positive accrual.

At age 57, however, the accrual changes to being very close to zero. The reason again is driven by the dropout provision. Retirement at age 57 means that there are three zero years before claiming at 60. When added to the three zero years from ages 19 to 21, the three years from ages 58 to 60 combine to total six years of zero earnings, which is equal to the number of dropout years. If retirement is delayed one year, therefore, the extra year of work no longer crowds out a zero year from the calculation but instead crowds out a high earnings year. Because the difference in earnings between the extra year of work and the year that is replaced is small, the benefit to continued work drops sharply at this age. Similar explanations underlie the small positive accruals at ages 58 and 59.

It is important to stress that the drop in the accrual at age 57 is specific to the setup of this simulation. If a different number of low earnings years were in the earnings history, the drop would be elsewhere in the profile. The main thrust to be learned here is that the benefit to working an extra year between ages 55 and 59 depends heavily on the difference between the extra year of earnings and the year that it replaces in the CPP/QPP calculations. Later in this section, we demonstrate this more directly by showing the accrual paths for simulated individuals with several years of work interruptions.

At age 60, the accrual turns negative, reaching -$1,544. There is still a benefit from extra work through the replacement of a bad earnings year in the dropout mechanism. However, there are negative thrusts that dominate in this simulation which come from two intertwined sources. First, at age 60, extra time at work means that a year of CPP/QPP benefit receipt is foregone. In compensation, the year of delayed retirement leads to an actuarial adjustment of the CPP/QPP benefit when it is taken. Ideally, the actuarial adjustment will compensate the worker for the foregone pension income in that year. The second influence on the accrual rate after age 60 is the effect of the CPP/QPP actuarial adjustment on the GIS benefit. The extra six percent of the pension that is awarded for delaying retirement is counted as income when calculating the GIS benefit. This means that 50 cents on the dollar for the actuarial adjustment disappears from the GIS payment. This affects every GIS payment from age 65 until death. Effectively, this shrinks by half the benefit of the actuarial adjustment and tilts the incentives toward negative values. We explore this further below in simulations where the individual is not in receipt of the GIS to separate out the effects of the GIS and the CPP/QPP actuarial adjustment.

At age 65, the accrual becomes more sharply negative at -$6,503. The reason for the jump down at age 65 is again the GIS. The extra year of work at age 65 produces an increase in the CPP/QPP benefit through the actuarial adjustment, which would decrease the GIS as discussed above. However, extra work at age 65 also produces earned income which directly decreases the GIS payment. In fact, at the assumed level of earnings, equal to the average weekly wage in Canada, the GIS is pushed to zero as it decreases by

50 cents on the dollar of earned income. From ages 65 to 69, the accrual stays negative, but diminishes in absolute value. The decrease is driven by the fact that there are ever fewer years over which the pension will be received. So the extra year of work may change future pension flows, but there are fewer years over which those flows are received.

The second row shows the same simulations, but for a married man. At ages 55 and 56, the accrual is higher than in the single man case. This occurs because the higher CPP/QPP benefit that is earned with extra work pays off not only in a higher benefit for the husband, but also in a higher survivor pension for his wife after he dies. This amplifies the accrual effect seen for the single man. After reaching age 65, the accrual is more negative for the married man, reaching -$7,904. Earned income after reaching age 65 directly claws back the GIS, and a married family has a higher GIS payment if retired. For this reason, extra work after age 65 hurts the married man more because both his and his wife's GIS payments are reduced as he earns income.

The third and fourth rows repeat the exercise for females. Because the same earnings profile is used as for the males, the observed differences are driven solely by differences in mortality probabilities. While it is certainly not typical for females to have the same earnings history as males, forcing them to be equal in this simulation allows us to isolate the influence of non-earnings factors by holding the earnings history constant. Because females live longer on average, changes in pensions have longer lasting effects on women. At ages before 60, the female accrual is higher than the corresponding male simulation because the increment to the CPP/QPP pension earned by an extra year of work is received over more years, on average. This makes the payoff to extra work higher.

From age 60 on, working an extra year means forgoing a year of CPP/QPP receipt, but gaining a higher CPP/QPP pension in every subsequent year. The net present value of the 'investment' in an extra year of work will be different for men and women not only because women are more likely to live longer, but also because the shape of their survival curve differs from men. This leads to the results for ages 60 plus that are observed in the table. The accrual for females is less negative from 60 to 64, but more negative after age 65.[***] This result is driven solely by differences in mortality across males and females.

The difference between single and married females is less pronounced than was the case for single and married men. This is a result of the survivor pension. For males, it is more likely that the female will out-survive him. This means that any increment to his CPP/QPP pension will be reflected in her survivor pension. However, for females, it is less likely that the husband will out-survive her. While in expectation there will be some survivor benefit received by her husband, it is smaller in expected value than the survivor benefit of a surviving wife. This serves to shrink the difference between single

[***] This occurs because the probability of surviving to very old ages drops more quickly for females than for males. Thus, the positive returns to extra work at very distant ages is discounted very heavily for both males and females, while the foregone pension benefit is discounted more heavily for males than for females. This results in a more negative accrual for females. At age 69, males again become less negative, but this is driven by the exhaustion of GIS benefits – the CPP pension for retirement at age 70 is so large that the entire GIS pension is clawed back.

and married females, as the extra work by the married female does not lead to a big boost in her husband's expected future survivor benefits.

C. Extended Simulation Results

To complement the simulations in the base case, we present several extended simulation results to illuminate and clarify some of the pathways through which Canada's retirement income security system affects retirement incentives. In all cases, we performed the extended simulations on the single male. We made this choice to try to simplify the environment, allowing us to focus more easily on the factors under consideration in a particular simulation. Without spouses, there are fewer 'moving parts' in the simulations. The male-female and married-single differences in the extended simulations look very similar to the corresponding difference in Table 2.

The first extended simulation considers single men with different amounts of private pension income. Because private pension income is included as income for the GIS calculation, those with higher private pension income will receive less GIS. Over some threshold, the private pension will be sufficient to completely crowd out the GIS payments. The no-GIS case is of great interest when compared to the base case, because with no GIS payments the pure effect of the CPP/QPP can be seen in isolation from its interaction effect with the GIS. This gives a better picture of the channels through which the incentives are generated.

The private pension simulations are presented in Table 3. The same columns appear as were seen in Table 2, with ISW at age 55, the accrual rates by age, and finally the age 70 ISW level. In the first row, we repeat the base case results for the single male for comparison. In the subsequent four rows we show the results for differing levels of annual private pension income, from $2,000 in the 2nd row to $8,000 in the 4th row.[†††] In all cases, we assign the private pension income to the man starting at the age of retirement.

In the rows for $2,000 to $6,000, the single male still receives GIS upon retirement. This means that the higher CPP/QPP pension resulting from the extra work between ages 55 and 59 will diminish the GIS payment. This serves to attenuate the gain from extra work in this age range relative to the no-GIS case in the last row. As one moves from the base case of $0 of private pension income to $6,000, the gain from an extra year of work is actually slightly *smaller* for higher private pension income. This occurs because the higher private pension income pushes the worker into a higher tax bracket during his retirement years in this simulation. This means that his gain in CPP/QPP income from working an extra year is taxed at a higher rate when he has a private pension income, thus diminishing his accrual rate between ages 55 and 59.

For the $8,000 row, the accrual is much higher than the other rows, reaching $1,603 at age 55. This occurs because at $8,000 of annual private pension income in

[†††] Obviously, many Canadians earn more than $8,000 in private pension income. We do not show higher amounts because they show very little difference when compared with the $8,000 case. This is because the GIS payments are already at zero in the $8,000 case, so extra pension income only affects ISW through possibly higher income taxes, and through the OAS clawback for the top few percent of seniors.

these simulations, the single male receives no GIS payments. Thus, the differences we see in row 5 are driven by the removal of the impact of the GIS on retirement incentives. At ages 55 to 59, the worker no longer sees half of his CPP/QPP gain from continued work taken away from his GIS payment. This generates the stronger work incentives at all ages for the $8,000 case.

At age 61, the ordering of the magnitude of the incentives in the base case compared to the $6,000 case is reversed. At age 60, a delay in retirement leads to an increased actuarial adjustment to the CPP/QPP pension. For those with higher private pension income, there is less GIS income to be affected by the CPP/QPP actuarial adjustment, so the accrual is less negative for those with higher private pension income. At age 61 however, the increased CPP/QPP payment the individual receives leads to the person no longer being eligible for a GIS payment. As such, the individual receives the full actuarial adjustment by delaying retirement one more year, eliminating the effect of the GIS and resulting in a positive accrual.

From age 65, the negative accrual becomes monotonically smaller with increasing private pension income. This results from the direct impact of the private pension income and earnings on the GIS. With a larger private pension income, there is less GIS to be clawed back by earned income. This diminishes the negative effect of the GIS on work incentives.

The second set of extended simulations varies the earnings history of the single man. Instead of assigning him the full average weekly earnings in each year, we study cases in which he earned 80 percent, 60 percent, 40 percent, and 20 percent of the national average. Importantly, the smaller wages in each earnings history are applied only to years prior to age 55; from age 55 we assume that earnings are at the full national average. We make this perhaps odd assumption in order to hold as much constant as possible to isolate the effect we wish to consider: What is the impact of having a low earnings history compared to a high earnings history on work incentives at older ages?

The results of this simulation appear in Table 4. Again, in the first row we have reproduced the single man base case results from Table 2. Rows 2 through 5 show the earnings histories of 80 percent through 20 percent of the average earnings. Several factors combine here to generate the observed patterns. At ages before 60, extra work generates higher CPP/QPP income at retirement through the earnings formula. An extra year of work will replace a low-earnings year in the formula, resulting in a higher CPP/QPP benefit. The differences across rows in Table 4, therefore, are driven by differences in the level of the low-earnings years that are being replaced. For the simulation with 20% of the average earnings in each year, the gain to continued work is positive up to age 61, because the extra year of work is replacing a year of very low earnings. For the simulation with earnings at 80% of the average earnings level, an extra year of work generates higher accruals than in the base case, but still turns negative at age 60 as the negative effect of the CPP/QPP actuarial adjustment and the GIS interaction still dominate.

The final simulations appear in Table 5. In this set of simulations we examine the impact of having different amounts of work interruptions on the accrual of ISW. At the top of the table we reproduce the base case. In the subsequent four rows we substitute increasing numbers of zero earnings years into the earnings history at ages before 55. In the 2^{nd} row, we replace earnings with a zero in all years ending in a 4 or 9. In the third row we then replace all earnings in years ending in a 3 or 8 with a zero. We continue this pattern down to the last row in which earnings in four out of every five years have been replaced with a zero. For ages from 55 on, we do not replace earnings with zeros so that the potential earnings from continued work are the same across all five rows. This isolates the effect of interruptions in the earnings histories from having low earnings years after age 55.

For ages 55 to 59, the benefit of continued work is very similar across all four rows with work interruptions. This occurs because there are so many zero years in the earnings history that an extra year of work post-55 always replaces a zero year in the CPP/QPP formula. This highlights the important impact of work histories featuring interruptions – they tend to increase the work incentives because continued work brings a larger boost in the CPP/QPP earnings rating. From age 60 to age 64, the benefit of continued work varies down the table, with less negative (and more positive) accruals for the simulations with more earnings interruptions. Again, this makes sense because these workers are more likely to be replacing zeros in their CPP/QPP calculation than workers with complete earnings histories. After age 65, the direct effect of earnings on the GIS takes all of the accruals to be negative. The accruals for the simulations with more interrupted histories are less negative because they continue to be able to use their extra years of earnings to replace zero earnings years in their CPP/QPP calculation.

D. Policy Simulations

The final set of simulations we present aim to illustrate the sensitivity of the incentive measures to small changes in policy parameters. It is beyond the scope of this paper to analyze or recommend any policy alternatives, so the interpretation of these results should remain narrowly focused on their illustrative power.

We examine the effect of four separate policy changes. We describe each policy change briefly:

- Policy Simulation A: Change the actuarial adjustment in the CPP/QPP from 0.5 percent per month to 0.7 percent per month.
- Policy Simulation B: In the CPP/QPP, grant a full 'throw-out' year for every year of work starting at age 60.
- Policy Simulation C: For the GIS clawback calculation, use the CPP/QPP pension entitlement from age 60 rather than the actual CPP/QPP income.
- Policy Simulation D: For the GIS clawback calculation, exempt labour market earnings from the income measure.

The results of the simulations are presented in Table 6. Policy A changes the actuarial adjustment in the CPP/QPP. This should be expected to increase the annual accruals because delayed retirement results in a larger actuarial adjustment than under the status quo case. Indeed, the simulations show that accruals at every age from the age of entitlement at age 60 are higher than under the status quo system, averaging $1,307 higher.

Policy B increases throw out months ‘earned’ from work after turning 60 from 0.15 under the status quo up to 1 full month for every month worked. Because the base case worker has almost the maximum amount of CPP/QPP, the ability to throw out extra years does not have a substantial impact. In simulations not shown here, for workers with more incomplete earnings histories the impact of this policy is greater.

The third policy change is policy C. This change aims to counteract the interaction between the GIS and the CPP/QPP actuarial adjustment by making GIS payments no longer depend on the age the CPP/QPP is claimed. This is achieved by using the CPP/QPP entitlement from age 60 in the clawback calculation for the GIS. That is, the actual CPP/QPP income received is not used but instead a ‘fictive’ amount calculated as though the individual had retired and claimed CPP/QPP at age 60 is used instead. As expected, this policy change has a substantial impact on the key age 60-64 range. No longer does extra CPP/QPP earned through the actuarial adjustment have a negative impact on future GIS receipts. Over the five years from 60 to 64, the average increase in the accrual is $2,582.

Policy D is the final policy change we consider. This policy exempts earned income from the GIS clawback calculation. For those age 65 and older, the clawback of the GIS on earned incomes provides a strong disincentive to stay in the labour force. With the exemption, the final row of Table 6 makes clear that for those aged 65 and over there is a substantial improvement in the accrual with earned income exempted from the GIS calculation. The improvement averages to $3,755 over the ages 65 to 69.

These policy simulations have demonstrated that the incentive measures discussed in this paper are sensitive to small changes in policy. A full evaluation of various policy alternatives potentially would be very informative, but is beyond the scope of this paper.

E. Summary of Simulations

The simulations in this section have attempted to demonstrate how Canada's income security system generates disincentives to remain in the work force at older ages. The profiles of the simulated individuals are not meant to be particularly representative of Canadian older workers overall, but instead were chosen to bring forward different interesting features of the retirement income system that affect work incentives. In summary, there are several factors that account for the patterns of accruals across different individuals in the simulations. They are:

- Accruals increase when extra work replaces a low earnings year through the CPP/QPP formula.

- Accruals are larger (in absolute value) for married individuals because extra CPP/QPP benefits also increase survivor pensions.
- Accruals are different for women because any change in the flow of pension income is received over more years of life and because of differences in the shape of the survival curve.
- Accruals decrease because the CPP/QPP actuarial adjustment does not sufficiently compensate for the foregone year of pension receipt.
- Accruals decrease because the actuarial adjustment of the CPP/QPP decreases eventual GIS payments.
- Accruals decrease because earnings directly reduce the GIS and Allowance benefits received.

It is important to stress that these simulated accruals are not overly large compared to many other countries. One way to compare the accruals across countries is to calculate the implicit tax on (or subsidy to) continued work at each age as the ratio of the accrual to earnings. In our base case simulation for single males, continued work at age 55 implies a subsidy rate of 3.6% while continued work at age 65 implies a tax rate of 18%. These implicit taxes are similar for individuals in the United States (Diamond and Gruber, 1999). However, in France the subsidy rate to continued work at 55 for a relatively comparable individual is 75% while continued work at age 60 implies a tax rate of 66% (Blanchard and Pélé, 1999). In Belgium, the subsidy rate for continued work at 55 is only 0.2% while the tax rate for continued work at age 60 is 59% (Pestieau and Stijns, 1999).

Within our Canadian results, the most striking feature is that the disincentives to continue working are strongest among GIS recipients, who represent the bottom one third of the income distribution among individuals age 65 and over. This is exemplified by the simulations presented in Table 3, whereby accruals are most negative among individuals with the lowest private pension income. These findings suggest that the work disincentives are strongest among the worst off retirees; perhaps those who would benefit most from a few extra years of work to increase subsequent retirement income.

IV. International Evidence

In order to best understand the role played by the retirement incentives uncovered in the simulations, we provide in this section a detailed review of the empirical evidence on public pensions and retirement. The scope of the review covers the main international evidence in order to provide context for the Canadian evidence. Broad surveys on Social Security are provided by Feldstein and Liebman (2002) and specifically on the labour market impact of social insurance programs by Krueger and Meyer (2002).

Empirical work estimating the effects of income security programs on labour supply can be roughly divided into four groups. The first set of studies tried to estimate the retirement impact of pension wealth without focusing on the substitution effect of pension accruals. Contemporaneous with the first group of studies, several papers take a more 'structural' approach by estimating parameters from an explicit model of behaviour. A sharp break in the nature of the research occurred in the early 1990s as a result of the confluence of three factors. First the Health and Retirement Study became available for researchers in the United States, which provided much richer data to study retirement. Second, the Stock and Wise (1990) 'option value' framework introduced the dynamic and forward looking nature of the retirement decision. Finally, expanded computing power facilitated analysis of vast arrays of micro data in the Health and Retirement Study and from other sources. Following this break, the third set of studies built on the earlier work by incorporating dynamic measures of pension accruals into the analysis. Finally, the fourth set of studies has attempted to use natural experiments – policy changes – to estimate the sensitivity of retirement decisions to changes in incentives. To summarize the results of the body of research, we have provided a listing of each study and its core result in Table 7.

A. Research on Related Topics

Before embarking on a tour through the evidence on public pensions and retirement, we briefly review some Canadian research on two related topics in order to provide more context. The first is the effect of private pensions. Pesando and Gunderson (1988 and 1991) map out pension wealth profiles for common employer-provided pensions in Canada (flat benefit and final earnings plans) with the goal of identifying the incentives to work created by the structure of pensions plans. Unlike Lazear (1983), who finds that pension wealth peaks at the date that an individual first qualifies for early retirement, Pesando and Gunderson (1991) find that there is no clear peak age for pension wealth, and in fact the pension wealth profiles exhibit discontinuities. Given these profiles, Pesando and Gunderson (1988) argue that mandatory retirement bans and related legislation limit the ability of employers to design pension plans that create work disincentives through postponed retirement provisions that reduce pension wealth for retirement at older ages.

The second related topic is mandatory retirement. Kesselman (2004) and Gunderson (2003) provide thorough overviews of mandatory retirement practices in Canada. Kesselman (2004) argues against contractual mandatory retirement (i.e. within an agreement between employers and employees in the form of a pension or collective agreement) as this often forces workers to leave their jobs earlier than desired and that banning mandatory retirement could help reduce the pressures associated with earlier retirement (e.g. fiscal pressures or potential skill shortages). Gunderson (2003) argues against age discrimination but does not oppose contractual mandatory retirement as it may be preferred by workers and employers. Grierson and Shannon (2004) provide evidence that banning mandatory retirement in Canada would have little effect on the share of older people working, using the implementation of mandatory retirement bans in Manitoba and Quebec to identify this effect.

B. Early Evidence on Pension Wealth and Retirement

The first body of research on public pensions and retirement we examine is characterized by a focus on the level of pension wealth rather than the dynamic incentives that are featured in later work. Below, we review the main findings and provide a critical analysis of the key papers in the literature. We start with research that uses time series data, and therefore relies on variation in income security parameters or benefits over time to identify the effect of income security programs on labour supply. For example, Pellechio (1979) uses Canadian time series data from 1946 to 1975 to determine the effect of ISW on retirement using OAS, as well as the introduction of CPP/QPP, on non-participation rates of individuals age 65 and over. He finds that ISW has a positive and marginally significant impact on non-participation and that the introduction of CPP/QPP had a positive but insignificant impact on non-participation rates.

However, use of time series data can be misleading in determining the impact of income security programs. Over this period, there was a general tendency for participation rates of the elderly to decline and for benefit generosity to increase. The positive association found between ISW and non-participation may spuriously reflect the coincidence of the two trends which may have been changing for unrelated causes.[‡‡‡] In addition to this, the introduction of CPP/QPP coincides with a reduction in OAS eligibility age to 65 and the introduction of GIS. The effects CPP/QPP relative to these other programs cannot be easily disentangled.

[‡‡‡] A linear time trend is included in Pellechio's model. The coefficient on the time trend is positive but not significantly different from zero.

Studies that use cross-section data covering individuals in one year of data use differences in income security benefits across individuals to identify the effects of income security programs. Since policies are the same for everyone at a given point in time, cross-sectional variation in income security benefits actually reflects differences in individual characteristics – such as earnings histories and marital status – that determine benefits. As such, these studies may actually be identifying the effects of these characteristics on labour supply rather than the effect of income security programs.

To overcome this problem, many studies have tried using panel data to identify the parameters from changes in income security programs over time that influence the benefits individuals receive. The use of panel data, however, will not necessarily overcome the identification issues associated with cross-sectional or time series data. Boskin (1977), for example, uses a sample of white married males in their sixties from panel data to estimate the effects of Social Security benefits on the probability of retirement and finds that benefits have a positive and significant effect on retirement. However, when time effects are controlled for, the Social Security benefits are found to have a much smaller or insignificant effect, indicating that the original estimates are largely picking up general trends in benefits and retirement over time, and that identification of the effects of Social Security benefits is relying on differences between individuals.

An influential paper by Boskin and Hurd (1984) uses U.S. panel data from the Retirement History Survey (RHS) from 1969-1973, a time when Social Security benefits grew rapidly due to ad hoc changes to U.S. Social Security legislation and the over-indexation of benefits. The rising benefits would have created an unexpected increase in Social Security wealth which could be expected to induce early retirement. Using a sample of white married men, Boskin and Hurd estimate the probability of retirement by age (59-65). They claim their results strongly support the hypothesis that unexpected changes in Social Security wealth have a positive effect on retirement and that younger individuals too young to claim benefit and with low assets would be little affected by the changes in SSW. However the positive estimates of the marginal effects of Social Security wealth on retirement are not statistically significant. In fact, only negative effects are statistically different from zero. Furthermore, since their econometric model controls for cohort effects and estimates the retirement probability by age, they effectively absorb any changes over time in benefits across individuals, and therefore rely on variation in benefits related to cross-sectional differences in individual characteristics for identification.

Boskin and Hurd (1978) also use U.S. panel data from the RHS (1969-1971) to estimate the probability of making the transition from work to retirement. Using a sample of white married males age 62-65, they find that higher Social Security benefits imply a higher probability of retirement. However there appear to be several identification issues for their econometric model. The main identification issue is a lack of clarity about the identification of the effect of Social Security benefits. First, they include gross wages, Social Security benefit levels, and net wages in the model. Given that the latter two variables are actually functions of the gross wage, it is not clear how they can disentangle the effects of each variable separately. Second, they use instrumental variables to control for the fact that tastes for work may influence both Social Security benefits (through work habits and the marginal tax rate) and the probability of retirement. However, the instruments are merely a nonlinear combination of past wages and other income which implies they are not picking up any exogenous variation in benefits.

Diamond and Hausman (1984) use the U.S. National Longitudinal Survey of Older Men (1966-1978) to determine the effects of bad health, unemployment, and permanent income on retirement in two stages. First, they use a sample of males age 45-69 to estimate hazard models for the transition into retirement. The find that Social Security benefits, interacted with age indicators to account for age-related provisions, have large positive effects on the probability of retirement. However, since age indicators do not enter the hazard model separately, the Social Security variables may simply be picking up spikes in the retirement hazards not related to Social Security programs. Furthermore, the key finding of this study is that simulations based on these results imply roughly half of all retirements of men age 62-64 are due to the availability of reduced Social Security benefits. However, this is based on a comparison of estimated retirement rates to estimated retirement rates setting the Social Security benefit to zero, effectively eliminating any general age effects of retirement decisions which should not be attributed to Social Security. It also appears to be the case that their model is largely picking up the general trend of increasing Social Security benefits and decreasing participation rates. For example, when the model is estimated using a sample from 1973-1978 (a period with relatively large drops in participation rates and relatively large increases in Social Security benefits) the effect of Social Security is much higher than in the full 1966-1978 sample. In the second stage, Diamond and Hausman use a probit model and a competing risks model to estimate the probability of older unemployed workers entering either retirement or new employment. Similar to the first stage, they find that higher Social Security benefits (interacted with age) lead to a higher probability of retirement.

Burtless (1986) uses U.S. panel data from the RHS to estimate the age at which an individual retires. He uses an econometric model that describes the utility maximizing behaviour of individuals when choosing their retirement age and allows for anticipated increases in Social Security benefits to affect individuals differently than unanticipated increases in benefits. Based on a sample of men aged 58 to 63 in 1969, (excluding farmers, disabled men, men who retired before age 54, and men receiving substantial income from welfare programs, federal civil service pensions and railroad retirement benefits,) Burtless finds that increasing Social Security benefits by 20 percent (10 percent in 1969 and 1972) have a short run effect of reducing the expected retirement age by 0.09 years (roughly 1 month) and a long run effect of reducing the retirement age by 0.17 years (roughly 2 months) and increasing the probability of retirement at ages 62 and 65 by about 2 percent. Given these estimates, Burtless concludes that the observed decline in retirement ages and employment of older males over this period cannot be explained by Social Security alone. As with other studies in this era, however, Burtless's reliance on changes in Social Security over time should make us question whether the results found merely reflect a spurious correlation between rising benefits and falling retirement ages.

A few recent studies follow methodologies comparable to this early set of studies. Compton (2001) attempts to determine the effect of Canada's income security programs on retirement decisions using data from the Survey of Labour and Income Dynamics 1993-1996. Compton uses a sample of individuals age 50 and over to estimate a hazard model for entry to retirement and uses a sample of individuals age 55 and over to estimate an ordered probit for exit from full time employment to full time employment, partial retirement, or full retirement. A weakness of this approach is the lack of sufficient historical earnings information to accurately construct the earnings history and pension entitlement of each individual.

The key covariate used to identify the effect of income security programs in these models is the individual's expected CPP benefits. Overall, Compton finds that income security programs have no effect on retirement decisions. It is not clear, however, whether an individual's benefits are measured appropriately. To measure expected benefits, Compton estimates the CPP/QPP benefit level that an individual could expect at age 60 using reported benefits from SLID, and then imputes this amount for individuals in the sample (even if they are over age 60). While the estimation procedure does account for the fact that she can only observe CPP/QPP benefits among recipients, the variables used in estimating CPP/QPP are not exogenous to the retirement decision and are also included in the econometric models. This leaves the identification of the retirement effect to depend on the shapes of the assumed distribution, which is a fairly tenuous base for inference. Furthermore, Compton attempts to separate wealth and substitution effects by including variables for investment income and home ownership in the model. It is not clear that investment income can capture wealth effects, nor is it clear that these variables can capture the wealth effects of income security programs. Finally, the results show insignificant effects of financial incentives on retirement only because the standard errors are very large. The lack of precision means that large effects cannot be ruled out based on this evidence.

Tompa (1999) investigates various determinants of individuals' decisions to take up CPP/QPP retirement benefits. Tompa uses a sample of individuals turning age 60 between 1987 and 1994 from the Longitudinal Administrative Databank at Statistics Canada, a subset of the T1 Family File (T1FF is a yearly cross-sectional file of all tax filers and their families) to estimate a hazard model for the duration from age 59 to the age of first take-up of benefits. Tompa finds that for women, higher levels of CPP/QPP income actually reduce the likelihood of taking up CPP/QPP, while for men the level of CPP/QPP income is insignificant for the take-up decision. It is not clear, however, that Tompa's analysis provides us with much information about how levels of CPP/QPP benefits affect the take-up decision, and especially retirement, since the CPP/QPP income variable included in the model is the observed benefit an individual is collecting, not the benefit that a person would be entitled to at each age. Tompa does find that poor job prospects, health and joint retirement decisions are important determinants of CPP/QPP takeup.

C. Structural Models of Retirement

Structural estimation involves a more explicit use of an economic model of behaviour. The advantage of structural estimation is that one may study the long run equilibrium effects of changes in policy and perform policy experiments on the model, once the structural parameters are estimated. The disadvantages of this approach are a sometimes less rigorous attention to the identification of parameters and the requirement of sometimes strong assumptions about the ‘correct’ specification of the model.

Fields and Mitchell (1984) estimate a structural model to determine the effects of several changes to Social Security in the US introduced in 1983. The reforms included raising the normal retirement age, delaying cost of living adjustments, lowering early retirement benefits and increasing late retirement payments. To obtain the parameter values of the structural model, they use a sample of white, married, male private sector employees between age 59 and 61 in 1969, following individuals to 1979, to estimate a conditional ordered logit model of retirement ages. Retirement age is defined as the age at which a worker left his 1969 job. To make the data relevant to the early 1980s, they inflate earnings profiles to reflect the increase in average wages between the 1970s and 1982, inflate private pension benefits for inflation, apply tax formulas for 1982, and use 1982 Social Security benefit rules to calculate benefits. They find that the reforms mentioned above would have a positive impact on the average retirement age. For example, increasing the normal retirement age from 65 to 68 would on average increase retirement ages by 1.6 months. While it is not clear that the data used to estimate this model is appropriate, the interesting point to take from this study is that a three year increase in the normal retirement age is not expected to increase retirement ages by three years, rather it may only increase retirement ages by a couple months.

Similar to Fields and Mitchell (1984), Gustman and Steinmeier (1985) also estimate a structural model to examine the effects of the U.S. program reforms in 1983. Their model is more parsimonious in that they use a modified life-cycle model with a CES utility function over consumption and leisure (individual characteristics will affect the weight placed on leisure) and the standard lifetime budget constraint, but allow individuals to work full time or part time (at a lower wage). They use a sample of white males who are not self-employed when working full-time from the RHS (1969-1975) to estimate the parameters of this model. They find that increasing the normal retirement age from age 65 to age 67 would reduce the probability of entering retirement at age 65 by roughly 4 percentage points. At age 67, the probability of entering retirement would increase by roughly 1 percentage point, indicating results similar to Fields and Mitchell (1984) whereby increasing the normal retirement age will not increase the average retirement ages by the same amount.

To summarize, the structural modeling line of research has yielded significant insights into what would happen under proposed ‘counterfactual’ reforms. By estimating deep structural parameters governing behaviour, a good base is made for inference about reforms such as extending the retirement age.

D. Estimation of Accrual and Level Effects of Pensions

A newer generation of studies attempts to estimate the effects of income security programs on labour market behaviour by estimating reduced form models that incorporate both the incentives for an individual to continue working and measures of income security wealth using cross section or panel data. This literature follows the work of Stock and Wise (1990) whereby individuals' decision to retire depends on the option value of continuing to work. That is, an individual will compare the expected present value of retiring to the value of continued work with the option to retire in the future. Recent studies have several features in common; these features be discussed here prior to discussing the individual papers.

The reduced form models typically take the form of a probit model in which the dependent variable is dummy variable indicating whether an individual enters retirement. The key explanatory variable is a forward looking measure intended to capture the incentives of income security programs and is measured in one of three ways. First, the simplest measure is referred to as a single year accrual which captures the effect of another year of work on future income security benefits. This is defined as the expected present discounted value of income security benefits if a person were to retire in the next year, less the expected present discounted value of benefits if a person were to retire in the current year. The single year accrual measure will be positive if continuing to work for an additional year increases the future benefits from income security benefits.

A second incentives measure, peak value, accounts for the income security benefits accrual possible if the individual retires many years into the future. For this measure, the expected present discounted value of benefits for all possible future retirement ages is evaluated and an optimal date of retirement based on these benefits is determined. The peak value is then the expected present discounted value of benefits if the individual retires at this optimal date less the value if the individual retires immediately.

The third incentives measure is similar to the peak value but for this measure the expected present discounted value of wage and non-labour income in addition to benefits for all possible future retirement ages is evaluated to determine an optimal date of retirement. Furthermore, an indirect utility function is placed over wages and benefits, often using behavioural parameters estimated by Stock and Wise (1990). The option value is then the expected present discounted value of indirect utility over wages and benefits if the individual retires at an optimal date less the value if the individual retires immediately. While this third measure is more parsimonious than the first two, it is computationally cumbersome and requires relatively more assumptions regarding individuals' expectations of future income.

In these retirement models there are several identification issues. First, individuals are more likely to prefer retirement as they age. A linear age variable will potentially capture this effect if preferences for leisure evolve linearly with age. Wage earnings may also proxy for differences in the preference for work. However, both age and wages enter in the calculation of income security benefits in the incentives measures. As such, including age and wage measures as covariates may make it more difficult to isolate the effects of program incentives from worker heterogeneity. We can expect that the inclusion of such variables will result in understating the effect of program incentives. Similarly, the option value measure, as it captures the full financial incentive on retirement of both future wage earnings and income security benefits combined, may reflect in part this wage proxy for heterogeneity, rather than the financial retirement incentives.

A second issue arises because it is common to find that the retirement rate at the 'normal' retirement age (or age of first eligibility for benefits) is much larger than predicted rate based on financial incentives alone. This likely reflects a liquidity constraint – many employees have not saved enough to retire without receiving Social Security or employer-provided pension benefits. Inclusion of indicator variables for each age allows for such jumps in retirement rates, but we might not be able to isolate the effect of financial incentive measures from plan eligibility ages.

Gruber and Wise (2004) provide a country-by-country analysis of retirement behaviour that follows the standard approach described here. The goal of the Gruber and

Wise volume is to provide comparable estimates of the effect that income security programs have on retirement behaviour across countries, following up on the work of Gruber and Wise (1999) which identified the income security program incentives to retire early in several countries.

In each chapter, the authors from the country estimate the probability of entering retirement as it depends on the incentives found in each country's income security programs. The retirement probits for each country include a measure of the incentives that income security programs provide (i.e. the one year accrual, peak value or option value measure), a control variable for income security wealth, and controls for age, earnings, industry sector, and demographics such as sex and education. The common finding among most of the country analyses (some of which are described in more detail below) is that the retirement incentives inherent in most income security programs are strongly related to retirement and this finding rarely depends on whether age indicators or a linear age variable is used in the specification. In a few cases, however, the estimated effect of incentives is not statistically significant and of the wrong sign. In many cases, the effect of income security wealth is not statistically significant from zero and is often of the wrong sign. These results may partly be due to relatively little variation in income security wealth in some countries, while there is more variation in the incentives measures. However, the overwhelming impression from the twelve country studies is the consistency of a positive impact of ISW levels on retirement and a negative impact of higher accruals.

Baker, Gruber and Milligan (2004) provide the Canadian analysis of the effect of income security programs on retirement behaviour. The primary data source used in this analysis is the Longitudinal Worker File developed by the Business and Labour Market Analysis Division of Statistics Canada. The data set combines information from three administrative data files: the T-4 file of Revenue Canada, the Record of Employment file of HRDC and the Longitudinal Employment Analysis Program of the from Statistics Canada. The Longitudinal Worker File provides information on individuals' wages and salaries, 3-digit industry codes, province and size of establishment for each job the individual holds in a given year, their age, sex and job tenure. The focus of the analysis is the period 1985-1995. Separate samples of males and females aged 55-69 in 1985 are drawn, and then younger cohorts of individuals are added as they turn 55 in 1986-1995. The sample excludes agricultural workers, individuals in other primary industries and individuals with missing age, sex, or province variables. The sample is selected conditional on working (defined as positive T-4 earnings). If an individual has positive earnings in one year and zero earnings in the next, the year of positive earnings is considered the retirement year.[§§§]

In the empirical analysis, incentives measures are constructed as described above. There are a few things to note about the income profiles required in the construction of these measures. While earnings histories are available for each individual back to 1978, information on earnings back to 1966 and in the future must be imputed for the purposes of calculating CPP/QPP entitlements. Similarly, several assumptions regarding spouses

[§§§] Baker, Gruber and Milligan (2003) test other definitions of entry to retirement that include EI earnings with labour market earnings, or included earnings below a minimum threshold with zero earnings, and do not find that the different definition significantly affects the direction of the results.

are required to impute non-labour income profiles. For OAS entitlement, the authors are not able to deal with residency requirement. For CPP/QPP entitlements, the authors are not able to account for years spent using disability benefits or years spent caring for children.

Baker, Gruber and Milligan (2004) provide several specifications for the retirement probit, estimated separately for men and women, using either the one year accrual, peak value or option value incentives measures and either a linear age variable or age indicator variables. In all specifications they find that income security wealth has a positive and significant effect on retirement and that incentives to continue working have a negative and significant effect on entry to retirement. The largest estimates for men are found when using the one-year accrual measure with a linear age variable, whereby a US$1,000 increase in accrual is associated with a 2.21 percentage point decline in retirement rates. A US$1,000 increase in accrual is associated with a 1.52 percentage point decline in retirement when age indicator variables are included in the model. The reduced effect of these incentives when age dummies are included in the model may be associated with these variables picking up the effect of the income security program's eligibility ages. For example, the size of the estimate for the age 60 indicator is consistently and substantially larger than the age 59 indicator, implying that the availability of CPP/QPP benefits may have some impact on retirement decisions beyond what can be explained by the changes in financial incentives alone. As discussed above, however, it is impossible to separate the effect of program eligibility from general tastes and trends in retirement behaviour.

In a complementary analysis, Baker, Gruber and Milligan (2003) find similar, although slightly smaller effects of income security programs on retirement behaviour when using a sample of men age 55-64. For example, they find that a $1,000 increase in the one-year accrual results in a 0.98 percentage point decrease in retirement rates among men, compared to the 1.52 percentage point decrease associated with a US$1,000 increase in the one-year accrual in the comparable specification described above. The smaller estimates result in part from a much richer set of controls for the earnings of each individual. This provides one of the main findings of the paper – that richer earnings controls may attenuate some of the estimated parameters observed in the literature.

The 2003 piece also extends their 2004 analysis by checking the results in subsamples of the main data to see if the pattern of results across samples conforms with the patterns predicted by theory and economic intuition. They find that the incentives measures have a larger effect among individuals with a lower probability of being covered by an employer-provided pension plan (RPP) than individuals with a high probability of RPP coverage. Furthermore, the incentives measures have the largest effect on individuals in the lowest average lifetime income quartile. In contrast, among men in higher income quartiles, the incentives measures have a positive or insignificant effect. These estimates indicate that individuals likely to be more dependent on income from income security programs are more sensitive to program rules. It also suggests that the work disincentives bite hardest among those who may most need extra income in their retirement years.

Coile and Gruber (2004) find similar results to Baker, Gruber and Milligan (2003, 2004) for the United States using data from the Health and Retirement Survey (1992-1998). The HRS is a survey of individuals age 51-61 in 1992 and their spouses. They construct person-year observations for each year between 1980 and 1997 in which the individual is between the ages of 55 and 69 and working at the beginning of the year, using information from the earnings histories available in the HRS. To note, they exclude any individuals that would have retired prior to age 55 or appear to have re-entered the labour force following retirement.

Coile and Gruber (2004) also provide several specifications for their probit model, comparable to Baker, Gruber and Milligan (2004), but find that Social Security has a much smaller effect. In all specifications, Social Security wealth has a positive estimated effect, however the effect is not always significantly different from zero. The results for the incentives measures are more ambiguous. When using a linear age variable in the regression, a $1000 increase in the one year accrual variable is associated with a positive effect on retirement rates (0.0015 percentage point increase) among men.[****] The negative effect of the peak value and option value incentives measures are significant in most specifications, however the peak value does not significantly affect retirement rates among women. Interestingly, probits using age indicator variables consistently demonstrate relatively large increases in retirement rates at age 60, similar to those in

[****] There is also a positive but insignificant effect when age indicator variables are used in the regression.

Canada, yet the individuals in this study are not eligible for Social Security benefits until age 62.[††††]

Coile and Gruber (2000) estimate similar retirement models that incorporate both Social Security and private (employer-provided) pension incentives, and find that the results differ from those for Social Security alone. The incentives variables used in their probit models include income from private pensions, derived from the pension determination information in the HRS.[‡‡‡‡] In comparison to the results using only Social Security, incorporating pensions results in a negative and significant coefficient on the one-year accrual variable. Furthermore, the effect of the peak value incentives is half as large and the coefficient on Social Security wealth is significant when pensions are included in the incentives measure, suggesting that people are less responsive to changes in pension incentives than Social Security wealth.

Coile and Gruber (2000) also provide specifications with additional control variables including an indicator of poor health, affecting the magnitude and significance of their estimates. Limited attention has been paid to the role of health in Canada. Campolieti (2002) estimates probit models for the participation of older workers in Canada as it depends on an indicator of disability status, but does not control for public pensions or any other form of income in models. Magee (2002) uses information in SLID to determine the effects of self-reported health and disability on several reasons for

[††††] There are much larger spikes in the estimated retirement rates at age 62 and 65 than at age 60.
[‡‡‡‡] They omit observations that are missing pension data, thereby dropping 40% of the observations used in the income security analysis. Most of these omitted observations were individuals from smaller firms with lower retirement rates, earnings, education and tenure.

job separation and finds that health or work-related disability does not have a significant effect on the probability of job separation due to retirement. These results may not tell us much about retirement, however, since job separation due to illness and disability is also a possible response to the job separation question and those who separate from a job due to illness and simultaneously retire may not be associated with retirement in this study.

Several studies using European data have found results similar to those for the U.S. and Canada. Börsch-Supan (2000) uses data from the German Socio-Economic Panel (1984-1996) to estimate retirement probits similar to those found in Gruber and Wise (2004). Using a sample of 55 to 70 year old men and women, they find that the incentives to delay retirement created by income security programs (measured using the option value) have negative and significant effects on the probability of retirement. Furthermore, their simulations suggest that if Germany were to move to an actuarially fair benefit formula, early retirement would occur less frequently. The model does not separately control for income security wealth. Interestingly, there are no spikes in the pattern of estimated coefficients reported for age indicators despite spikes in Germany's distribution of retirement ages at age 60 and 65. This would indicate that observed increases in retirement at these ages are due solely to the incentives found in income security programs and in the absence of these programs there would merely be a pattern that reflects older workers being more likely to retire than younger workers.

Börsch-Supan (2000) also uses country level data to provide a qualitative investigation into the relationship between the incentives found in income security programs and labour force participation in Europe. Börsch-Supan finds that in almost all cases spikes in the distribution of retirement ages can be identified with ages in which certain pension rules start of cease to apply, as these rules often create kinks in the income security accrual profiles. (Here, income security accrual is measured as the percentage change in income security wealth for one year of delayed retirement for the average worker within a country.)

Blöndal and Scarpetta (1998) attempt to provide a quantitative cross-country time series analysis of the relationship between income security program incentives and retirement behaviour in their work for the OECD. They estimate labour force participation rates of older men (55-64) using an accrual rate (measured as the percent change in old-age pension benefits for a 55 year old male by working for 10 more years), replacement rates of unemployment, disability, old-age pension and special early retirement benefits, the unemployment rate of prime age males, the share of the prime age population in the total working age population, union density, and the standard age of entitlement to old-age pensions as explanatory variables. They find that higher accrual rates are significantly associated with higher participation rates.

While in theory this type of cross-country analysis could be useful as it relies on cross-country variation in income security programs to identify the effects of these programs, in practice it is not clear that this type of analysis is informative as it requires extreme simplifications of very complex programs in order to measure variables in a way that would be comparable across countries. For example, in this study, the accrual rate is measured for a specific type of individual who delays retirement for a long period of time. In many countries, accrual profiles are highly non-linear. As such, unless accrual profiles in all countries are linear it is not clear that the analysis will adequately measure the incentives provided by income security programs. As an example, based on calculations of the accrual rate using income security wealth calculations by Blanchet and Pelé (1999, Table 3.5) the accrual rate for a 55 year old postponing retirement until 65 is -25% while the accrual rate for postponing retirement until 60 is 7% and postponement until age 57 is 16%. In this case, the accrual rate used by Blöndal and Scarpetta would not properly capture the retirement incentives contained in France's income security programs.

E. Natural Experiments

As discussed earlier in this section of the paper, the key problem with using cross-sectional and time series data for the study of retirement is the difficulty in ensuring that the estimated effects of income security programs are not merely picking up differences across individuals or general trends retirement and benefits over time. One potential solution to this problem is to identify natural experiments – situations in which program changes affect one group in the population (the treatment group) but not a different yet similar group (control group) – and see how the treatment group behaves differently in response to program changes. In general, these studies have shown mixed evidence on the effect of income security programs on retirement behaviour.

One of the first examples of natural experiments being used to identify the effects of income security programs on labour supply is a study by Krueger and Pischke (1992) in which they rely on a change to U.S. Social Security provisions in 1977 that reduced benefits for some individuals based only on their year of birth. Specifically, prior to 1977, a situation referred to as double indexation existed because average monthly earnings (AME) were increasing with inflation and under the benefit calculation rules, the replacement rate attached to each bracket in the benefits formula was set to increase with inflation. As a result, workers who postponed retirement could increase their benefits at a rate greater than what would be actuarially fair. To eliminate this double indexation, the amendment introduced a new benefit formula in which average indexed monthly earnings (AIME) are used instead of AME (AIME is indexed to average wage growth) and the replacement rates were held constant while the brackets for each replacement rate were adjusted for changes in the average annual wage. These amendments were phased in over 5 years. The affected group, therefore, was individuals born 1917-1921. This group became known as the 'notch generation.' In effect, these changes resulted in an exogenous and unexpected reduction in ISW for the notch generation that can act as an experiment for identifying the effects of ISW.

Krueger and Pischke use a sample of 60-68 year old males from the March CPS (1976-1988) to estimate logit models for labour force participation rates that control for both ISW and the growth in ISW for delaying retirement one year, as well as age and time effects. Their findings suggest that the negative relationship typically found between ISW and labour supply is spurious. For example, when year effects are not controlled for, ISW is found to have a negative effect on participation rates and the growth in ISW for delayed retirement has a positive and significant effect. However, when time effects are accounted for, both ISW and growth in ISW have an insignificant and positive effect on participation. Furthermore, they use logit models controlling for coverage by the 1977 changes in benefits (similar in concept to a DD estimator) and find that the changes had a negative effect on labour force participation rates and weeks worked and a positive effect on the proportion of individuals reporting being retired.

Several natural experiments have been found in Canada. Baker and Benjamin (1999a and 1999b) rely on differences in the timing of program changes in CPP and QPP to identify the effects of income security programs on retirement behaviour. Baker and Benjamin (1999a) look at the introduction of early retirement provisions in CPP/QPP which were introduced earlier in Quebec (1984) than the rest of Canada (1987). Using a standard Differences in Differences (DD) analysis (with the control group defined by geography), they found that while the introduction of these provisions significantly increased the rate of CPP take-up, it did not have a significant impact on labour force participation, indicating that those taking up the early pension benefits were only marginally attached to the labour force and the new provisions did not affect labour force behaviour.

One problem with this type of analysis, however, is that it is only able to capture the immediate effects of policy changes. In this case, many individuals age 60-64 at the time that early retirement provisions were introduced would have already planned their retirement based on their savings, employer-provided pensions, and the previously existing policy rules. As such, only individuals with little other income would have the immediate incentive to collect benefits. Younger cohorts would have time to adjust their lifetime leisure-consumption plans and employers may adjust their pension provisions in light of the changes to CPP/QPP.[§§§§] Thus, while no immediate effects on labour supply are found, a long-run analysis may find some effect.[*****]

Baker and Benjamin (1999b) consider the effect of the elimination of the earnings test in CPP (1975) and QPP (1977) for individuals age 65-69, potentially making work more attractive. The DD estimator used here again relies on geography to define the control group. A DDD estimator, which uses individuals age 60-64 as an additional control group, is also used. From their analysis, it is clear that the removal of the earnings test resulted in higher take-up rates but had no significant effect on retirement, employment or participation rates. From the DDD analysis, they conclude that the removal of the test is associated with large shifts from part year full time work to full year full time work among older men. However, it is not clear that the 60-64 year old group is a suitable control group because forward-looking 60-64 year olds would find their incentives affected by this policy change as well.

Baker (2002) uses DD estimators to determine the effect that the introduction of the SPA in 1975 had on the labour market behaviour of married men (age 65-75 with

[§§§§] Gruber (2000) tests whether early retirement provisions affected younger males and found no effect.
[*****] For example, Baker and Benjamin (1999a) demonstrate that after the early retirement provisions were introduced, retirement hazards at age 60-64 increased. However, it is not possible to disentangle general trends in retirement from the long-run effects of policy change.

spouses age 60-64) and women (age 60-64 with spouses age 65-75). For the control groups, it is assumed that any individuals who did not immediately qualify for SPA benefits (i.e. men with younger or older spouses, single men, and women with younger spouses or younger women with spouses over 65) would not be affected by the policy change. Baker finds that men eligible for the SPA experienced a relative decline in their labour force participation with the introduction of the program. Among eligible women, they find some negative effect of the SPA on women's participation in that participation rates of SPA eligible women did not rise with the participation rates of other women. This finding is not consistent across control groups, however, and the largest effects are found when women age 60-64 with spouses under age 65 are used as control groups. Given that the spouses in the treatment group (men 65-75) were affected by the elimination of the earnings test in 1975, these results could be biased by the contemporaneous reform.

In summary, evidence based on natural experiments has been mixed and largely inconclusive. In some cases, such as the study of the 'notch' generation in the United States by Krueger and Pischke, little effect of income security programs was found. In other cases, such as Baker's study of the Spouse's Allowance in Canada, a strong and significant effect was found. The weakness of this approach for the study of retirement may lie in the time necessary to respond to a change in policy. The short run impact may differ from the long run impact.

V. Conclusions

This paper has described Canada's retirement income security system and provided an empirical context in which to understand its impacts on the retirement decisions of elderly Canadians. In the simulations, we find that many components of the system act independently and in concert to change the incentives to retire. While these incentives are not large compared to some European countries, it is worth reflection that they are strongest for those who receive the GIS. Moreover, Baker, Gruber, and Milligan (2003) find that the reaction of these lower-income individuals to the work disincentives is stronger than it is for higher-income individuals. Since GIS recipients are from the bottom one third of the senior income distribution, this means that the strongest disincentives are faced by those who perhaps might most benefit from some extra income in their retirement years.

Looking at the international empirical research record, we find a fairly consistent and robust pattern of evidence suggesting that financial incentives in public pension programs affect retirement decisions. While other factors such as family, health, and community likely enter the decision to retire in addition to the financial motive, the clearest and most direct policy lever to affect retirement decisions is through the structure of public pension programs. This means that decisions made in the presence of these work disincentives differ from those that would be made under a ‘neutral’ system, implying a policy-induced inefficiency.

We close by noting that some inefficiency in the provision of retirement income to seniors may be unavoidable in a practice. As with the provision of many public programs, there is a trade-off between equity and efficiency. For many low-income seniors, the retirement income security system in Canada provides a significant portion of their total income and contributes significantly to poverty alleviation. Sensible reforms will seek a balance between equity and efficiency improvements.

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Table 1: Basic Statistics on Simulated Individuals

	Ages				
	60	65	75	85	95
Male Probability of living to age, given alive at 55	0.959	0.895	0.662	0.299	0.039
Female Probability of living to age, given alive at 55	0.975	0.938	0.796	0.493	0.113
Annual OAS entitlement	0	5328	5328	5328	5328
Annual CPP entitlement if claim CPP at 60	6335	6335	6335	6335	6335
Annual GIS entitlement if claim CPP at 60	0	3169	3169	3169	3169
Annual CPP entitlement if claim CPP at 65	0	9501	9501	9501	9501
Annual GIS entitlement if claim CPP at 65	0	1586	1586	1586	1586

Note: All dollar values in 2002 Canadian dollars. All reported entitlements are annual flows at 2002 rates for singles.

Table 2: Base Case Simulations

	ISW at 55	accruals 55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	ISW at 70
Males																	
Single	142109	1269	1073	71	23	16	-1544	-2737	-3430	-4050	-4488	-6503	-6328	-6147	-5955	-4794	98585
Married	249141	1637	1355	93	39	13	-1064	-1929	-2577	-3201	-3749	-7904	-7762	-7790	-7850	-7492	200960
Females																	
Single	174951	1457	1233	81	28	17	-1084	-2452	-3202	-3886	-4392	-6573	-6465	-6352	-6232	-4787	132342
Married	250039	1654	1340	104	49	-1	-734	-1886	-2602	-3297	-3917	-8114	-8045	-8152	-8295	-7662	200481

Note: All dollar values in 2002 Canadian dollars. Reported are the one-year accruals of ISW from ages 55 to 69, as well as the age 55 and age 70 ISW level amounts.

Table 3: Private Pension Simulations

	ISW at 55	accruals 55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	ISW at 70
Base Case	142109	1269	1073	71	23	16	-1544	-2737	-3430	-4050	-4488	-6503	-6328	-6147	-5955	-4794	98585
Private Pension Amount																	
$2,000	131118	1007	844	54	24	15	-2341	-2884	-3332	-3787	-4175	-5563	-4719	-3129	-3335	-3512	96285
$4,000	117926	902	756	47	20	15	-2025	-2531	-2999	-2769	-1194	-2324	-2609	-2866	-3087	-3282	93980
$6,000	104481	898	764	47	12	20	-544	350	-88	-516	-889	-2033	-2333	-2604	-2838	-3048	91679
$8,000	96950	1603	1360	84	24	32	1079	603	151	-291	-673	-1743	-2056	-2341	-2590	-2813	89379

Note: All dollar values in 2002 Canadian dollars. Reported are the one-year accruals of ISW from ages 55 to 69, as well as the age 55 and age 70 ISW level amounts. The simulations are for single males.

Table 4: Range of Earnings Simulations

	ISW	accruals															ISW
	at 55	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	at 70
Base Case	142109	1269	1073	71	23	16	-1544	-2737	-3430	-4050	-4488	-6503	-6328	-6147	-5955	-4794	98585
Earnings History																	
80%	137017	1359	1186	329	283	274	-994	-1943	-3031	-3652	-4152	-6378	-6196	-6009	-5815	-5624	96654
60%	127608	1358	1241	582	565	558	-318	-851	-1640	-2284	-3388	-6227	-6027	-5836	-5632	-5433	94276
40%	116777	1367	1272	848	825	832	132	-299	-723	-1176	-1579	-5271	-5293	-5641	-5433	-5218	91420
20%	105946	1367	1319	1100	1100	1091	582	260	-76	-450	-789	-4745	-4618	-4493	-4529	-4506	88559

Note: All dollar values in 2002 Canadian dollars. Reported are the one-year accruals of ISW from ages 55 to 69, as well as the age 55 and age 70 ISW level amounts. The simulations are for single males.

Table 5: Work Interruption Simulations

	ISW at 55	accruals 55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	ISW at 70
Base Case	142109	1269	1073	71	23	16	-1544	-2737	-3430	-4050	-4488	-6503	-6328	-6147	-5955	-4794	98585
Years Worked																	
80%	132187	1366	1359	1367	1358	1367	-713	-1496	-2838	-3529	-4008	-5965	-5799	-5630	-5881	-5157	97988
60%	123610	1367	1358	1367	1359	1366	-126	-662	-1363	-2052	-3140	-5910	-5726	-5545	-5365	-5182	95356
40%	115018	1358	1367	1359	1366	1359	226	-218	-656	-1152	-1539	-4974	-5280	-5460	-5263	-5068	92443
20%	105082	1367	1359	1366	1359	1367	626	301	-50	-438	-766	-4564	-4444	-4352	-4450	-4685	89078

Note: All dollar values in 2002 Canadian dollars. Reported are the one-year accruals of ISW from ages 55 to 69, as well as the age 55 and age 70 ISW level amounts. The simulations are for single males.

Table 6: Illustrative Policy Simulations

	ISW at 55	accruals 55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	ISW at 70
Base Case	142109	1269	1073	71	23	16	-1544	-2737	-3430	-4050	-4488	-6503	-6328	-6147	-5955	-4794	98585
Policy																	
A	134174	1131	950	55	24	15	1253	-249	-2116	-3072	-3853	-6027	-5917	-5799	-3985	-3133	103451
B	142109	1269	1073	71	23	16	-1484	-2688	-3403	-4035	-4484	-6516	-6333	-6155	-5963	-4582	98918
C	140747	1974	1669	107	36	28	944	-205	-846	-1428	-1805	-4983	-5139	-5268	-5362	-5431	115038
D	142109	1269	1073	71	23	16	-1544	-2737	-3430	-4050	-4488	-2347	-2375	-2395	-2401	-1436	117358

Note: All dollar values in 2002 Canadian dollars. Reported are the one-year accruals of ISW from ages 55 to 69, as well as the age 55 and age 70 ISW level amounts. The simulations are for single males. Policies A through D are described in the text.

Table 7: Summary of Retirement Studies

Paper	Primary Data Source	Analysis	Key Results
Boskin (1977)	U.S., PSID (1968-72)	Estimate the effect of Social Security benefits on the probability of retirement using a logit model.	• An increase in benefits from $3000 to $4000 per year raises the probability of retirement from 7.5 to 16%.
Pellechio (1979)	Canadian time series data (1946-1975), Economic Council	Estimates effect of ISW from OAS and introduction of CPP on nonparticipation rates age 65+ using a 2SLS model	• A $2300 increase in ISW (1971 dollars) raises the nonparticipation rate from 67.9 to 73.2 (6.1 percentage points). • Introduction of CPP/QPP raised the nonparticipation rate.
Boskin and Hurd (1978)	U.S. RHS (1969-1971)	Estimate the effect of Social Security benefits on the probability of retirement using a logit model with instrumental variables.	• A $1000 increase in benefits raises the probability of retirement by 8 percentage points over two years. (The estimated probability of retirement is 11.5%.)
Diamond and Hausman (1984)	U.S. NLS of Older Men, (1966-1978)	Estimate hazard models for the transition into retirement and probit models for the transition from unemployment to either retirement or employment.	• About half of all retirements of men age 62-64 are due to the availability of reduced Social Security benefits.
Boskin and Hurd (1984)	U.S. RHS (1969-1972)	Estimate effect of ISW on the probability of retirement by age using a logit model that captures cohort effects.	• A US$10000 increase in ISW (in 1969 dollars) raises the retirement rate by 7.8 percentage points. • The increase in Social Security benefits can account for the entire 8.2 percentage point decline in participation rates of older men from 1968 to 1973.

Table 7: Summary of Retirement Studies (continued)

Fields and Mitchell (1984)	U.S. RHS (1969-1979)	Estimate the effect of Social Security program reforms using a structural model.	• Increasing the normal retirement age from 65 to 68 would on average increase retirement ages by 1.6 months.
Gustman and Steinmeier (1985)	U.S. RHS (1969-1975)	Estimate the effect of Social Security program reforms using a structural model.	• increasing the normal retirement age from 65 to 67 would reduce the probability of retirement at 65 by 4 percentage points while increasing the probability of retirement at 67 by 1 percentage point.
Burtless (1986)	U.S. RHS (1969-1979)	Estimate short and long run effects of Social Security benefit increases on retirement age using an econometric model that accounts for anticipated and unanticipated benefit increases.	• In the short run, increasing benefits by 10% in 1969 and 1972 reduced the retirement age by 0.09 years • In the long run, increasing benefits above their 1969 level by 20% reduced the retirement age by 0.17 years (2 months) and raised the likelihood of retirement at ages 62 and 65 by 2%.
Tompa (1999)	Canadian LAD (1987-1994)	Estimates the effect of CPP/QPP benefits on CPP/QPP take-up using duration models.	• For women, higher levels of CPP income actually reduce the likelihood of taking up CPP. • For men, the level of CPP income has no effect on the CPP/QPP take-up decision
Compton (2001)	Canadian SLID (1993-1996)	Estimates the effect of CPP/QPP benefits on entry to retirement using hazard and ordered probit models	• Finds income security programs have no effect on retirement

Table 7: Summary of Retirement Studies (continued)

Paper	Primary Data Source	Analysis and Identification	Findings
Blondal and Scarpetta (1998)	Various sources	Estimate labour force participation rates across countries to determine the effects of income security program incentives on retirement behaviour	• Increasing the pension accrual rate by 10 percentage points would increase labour force participation rates of men 55-64 by1.3-2.5 percentage points.
Coile and Gruber (2000)	US HRS (1992-1998)	Estimate retirement probit models to determine the effects of Social Security wealth and incentives to continue work based on Social Security and private pensions.	• A US$1000 increase in incentives is associated with a 0.00025-0.00044 percentage point decrease in the retirement rate among men when pensions are included in the incentives measures and a 0.00065 to -0.00047 percentage point change when pensions are not included. • A US$10000 increase in Social Security wealth is associated with a 0.025-0.057 percentage point increase in retirement rates among men when pensions are included in the incentives measures and a 0.32-0.41 percentage point increase when pensions are not included.
Börsch-Supan (2000)	Germany GSOEP (1984-1996)	Estimate retirement probit models to determine the effect of incentives to continue work based on income security programs, controls for random effect.	• An increase in incentives is associated with a decrease in the retirement rate. • Introducing an actuarially fair benefit formula to Germany's pension system would cause retirement at ages 59 and below to drop from 28.6% to 18.5%.

Table 7: Summary of Retirement Studies (continued)

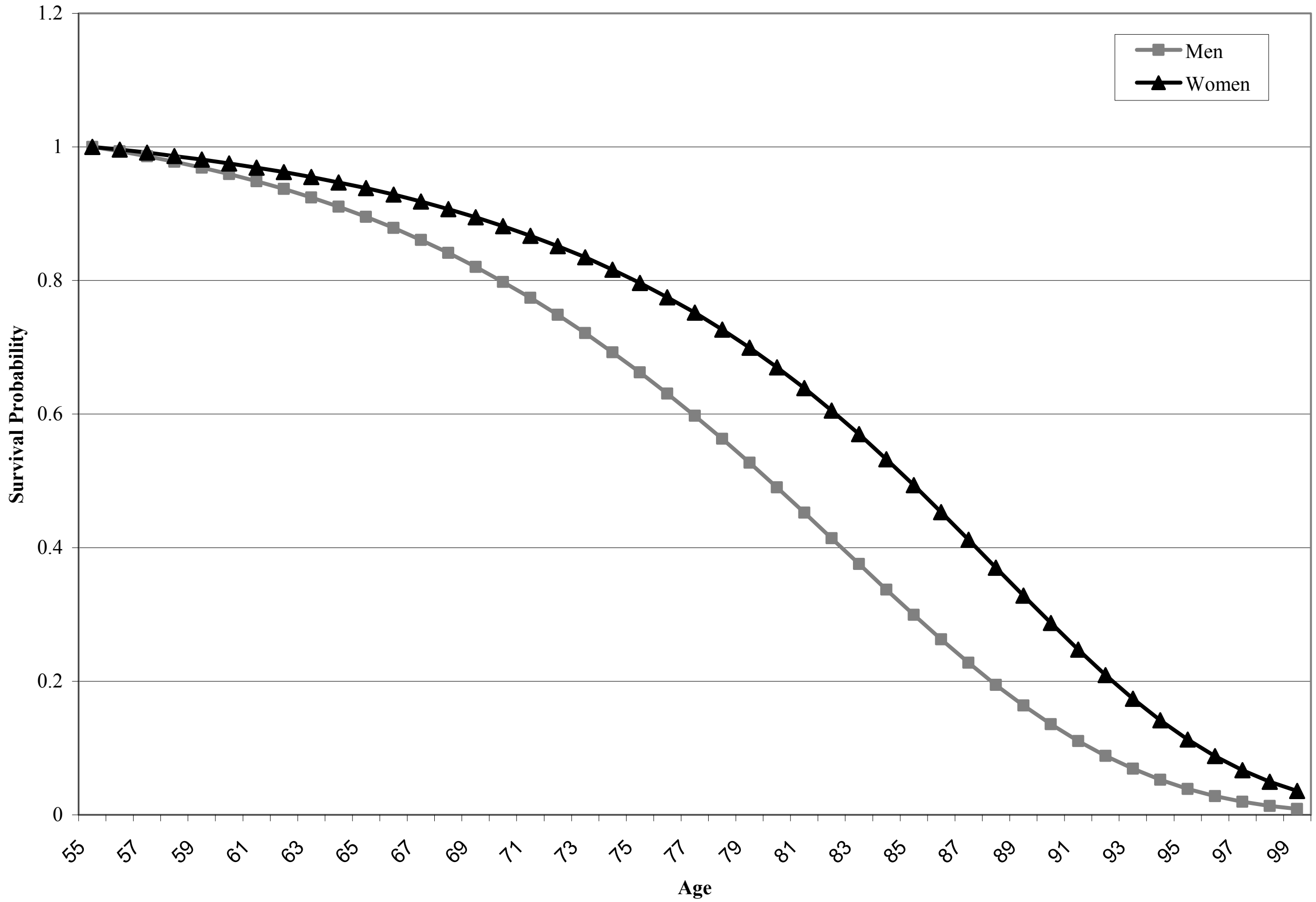
Baker, Gruber and Milligan (2003)	Canadian LWF (1978-1996)	Estimate retirement probit models to determine the effects of income security wealth and associated incentives to continue work.	• A $1000 increase in income security wealth accrual is associated with a 0.19-2.43 percentage point decrease in the retirement rate among men and a 0.01-3.48 percentage point decrease among women. • A $10000 increase in income security wealth is associated with a -0.32 to 0.69 percentage point change in the retirement rate among men and a -0.12 to 0.83 percentage point change among women.
Coile and Gruber (2004)	US HRS (1992-1998)	Estimate retirement probit models to determine the effects of Social Security wealth and associated incentives to continue work.	• A US$1000 increase in Social Security wealth accrual is associated with a -0.0005 to 0.0015 percentage point change in the retirement rate among men and a -0.00005 to 0.0006 percentage point change among women. • A US$10000 increase in Social Security wealth is associated with a 0.11 to 0.35 percentage point increase in the retirement rate among men and a 0.18 to 0.26 percentage point increase among women.
Baker, Gruber and Milligan (2004)	Canadian LWF (1978-1996)	Estimate retirement probit models to determine the effects of income security wealth and associated incentives to continue work.	• A US$1000 increase in income security wealth accrual is associated with a 0.67 – 2.21 percentage point decrease in the retirement rate among men and a 0.24-2.06 percentage point decrease among women. • A US$10000 increase in income security wealth is associated with a 0.01-0.09 percentage point increase in the retirement rate among men and a 0.02-0.09 percentage point increase among women.

Table 7: Summary of Retirement Studies (continued)

Paper	Primary Data Source	Analysis and Identification	Findings
Krueger and Pischke (1992)	U.S. March CPS (1976-1988), cohort level data	Estimate effect of ISW and one year accrual for delayed retirement on retirement indicators using a logit model. Identification from 'Notch generation'.	• Growth in U.S. Social Security benefits in the 1970s could explain less than 1/6 of the observed decline in male labour force participation rates (based on the largest estimates).
Baker and Benjamin (1999a)	Canadian SCF Individual files, (1982-83 and 1985-1990)	D-D analysis, estimate effect of introducing early retirement provisions to CPP/QPP on labour force participation of older men.	• Introduction of early retirement provisions led to a significant increase in benefit take-up among men age 60-64, but did not increase the incidence of early retirement.
Baker and Benjamin (1999b)	Canadian SCF Census family files, (1972, 74, 76, 78 and 80).	D-D analysis, estimate effect of eliminating retirement test (tax-back of earnings) from CPP/QPP on labour supply of older men.	• Eliminating the retirement test led to large shifts from part year full time work to full year full time work among older men.
Baker (2002)	Canadian SCF Census family files, (1972, 74, 76, 78 and 80), excludes Quebec.	D-D analysis, estimate effect of introducing SPA on labour market attachment of older individuals	• The participation rates of SPA eligible men fell 7-11 percentage points relative to other men between 1972 and 1980. 6-7 percentage points of this decrease are attributable to the introduction of the SPA. • The participation rates of SPA eligible women remained fairly constant from 1972 to 1980 while the participation rates of other women rose. 4-9 percentage points of the 5-10 percentage point divergence in participation rates may be attributed to the introduction of the SPA.

Note to Table 7: Data set acronyms used include: CPS Current Population Survey; HRS Health and Retirement Survey; LWF Longitudinal Worker File; NLS National Longitudinal Study; PSID Panel Study of Income Dynamics; RHS Retirement History Survey; SCF Survey of Consumer Finances; SLID Survey of Labour and Income Dynamics

Figure 1: Male and Female Survival Probabilities



Source: Statistics Canada (2002)