The Influence of Stock Market Performance on the Retirement Behaviour of Canadians: The Case of Defined Contribution and Defined Benefit Pension Plans in Selected Industries

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Abstract

With the Canadian population aging, stock markets growing in popularity as conduits for savings, and the volatility of North American stock markets trending higher in recent years, never has the relationship between wealth shocks induced by stock market fluctuations and retirement behaviour been so important. By grouping Canadians based on their participation in defined benefit and defined contribution pension plans, this study attempts to identify how the dot-com and housing booms and busts of the last decade influenced the labour-leisure decision of individuals nearing retirement age. Contrary to popular economic theory, we find that stock market busts are consistent with increases in retirement rates while booms are consistent with decreases in retirement rates. Although these results are statistically significant, we find it difficult to attribute them to pure wealth effects; as such, we conclude that economic factors and organizational incentives, which are likely correlated with stock market booms and busts, work together with our findings to provide a plausible explanation of such unexpected retirement behaviour.

I. Introduction

Like many other developed nations, the population of Canada is aging. According to *The Wealth of Canadians* (2005), low birth rates and increasing life expectancies account for the fact that there is now a higher proportion of seniors in the population than during any other time in the nation's history. As the population ages, the prosperity of Canadians becomes increasingly dependent on stable streams of retirement income, whether provided by private or public sources. However, the extreme demographic shifts that are forecasted to occur in the coming decades suggest that benefits accruing from the current "pay-as-you-go" plans, which include OAS and CPP, will likely need to be curtailed to ensure funding adequacy in the future; therefore, individuals likely will be increasingly reliant on private pools of funds in order to meet their retirement goals over the coming decades.

The Canadian government has encouraged private retirement savings through a myriad of registered plans. Registered Retirement Savings Plans (RRSPs) and

Registered Pension Plans (RPPs) are the most notable among these, accounting for the vast majority of government-sponsored private retirement assets. Both RRSPs and RPPs are invested in such financial instruments as term deposits, Government Investment Certificates (GICs), savings bonds, mutual funds and income trusts, as well as in stocks and corporate bonds. As of 2005, over 60% of assets in registered plans were exposed to the stock market through either direct share ownership or by way of mutual fund holdings (*The Wealth of Canadians* 2005, 13).

These figures demonstrate that a substantial portion of Canadian retirement funds are being channeled into stock markets, and so fluctuations in both Canadian and foreign stock markets[1] are likely to have important consequences for retirement savings. However, just as Canadians are relying more heavily on private pension assets, stock market volatility has increased substantially. Over the past decade, two major boom-and-bust cycles have played out in North American stock markets. First, the dot-com bubble that formed in the late 1990s drove the NASDAQ up over 200% from 1998 to mid-2000 only to be followed by a collapse of 70% over the following two years. Second, the housing and commodity boom that took place from 2005 to 2008 and drove the Toronto Stock Exchange up by 50% was followed by yet another bust that resulted in the index's precipitous fall of as much as 40% by early 2009.

The relatively high and increasing levels of volatility exhibited by stock markets in North America over the past decade, combined with the fact that Canadians are relying on stocks to fund retirement plans now and more so in the future, raises serious concerns regarding the stability of retirement incomes. Therefore, it is important to examine how individuals modify their retirement behaviour as a result of fluctuations in the stock markets and retirement wealth. More specifically, the questions this paper seeks to address are whether stock market booms and busts have discernible effects on individuals' propensity to retire, and if so, what are the directions and magnitudes of these effects.

The structure and organization of the paper is as follows. Section II presents a summary of pertinent literature relating to the impact of wealth effects on retirement behaviour. Section III explains the analytical framework adopted in this study to test our hypotheses. In Section IV we outline our data set and empirical models. Section V presents the results of the empirical analysis, and a discussion of the conclusions reached in this paper is included in Section VI. Section VII provides a comparison of results with that of Coile and Levine (2006), which provides the analytical basis for our own study, and Section VIII finishes with a discussion of further avenues of research that we feel would contribute to this field of literature.

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[1] Registered plans currently have a 30% cap on foreign security holdings, and the U.S. accounts for the vast majority of expatriated funds.

II. Literature Review

Conventional economic theory suggests that the consumption of normal goods, such as leisure, should increase when an individual or household experiences a positive wealth shock and should decrease when they face a negative wealth shock. For individuals nearing retirement age, positive (negative) wealth shocks that are unrelated to wage changes should theoretically induce earlier (later) retirement. Several studies have utilized quasi-experiments to capture how wealth effects stemming from stock market fluctuations influence retirement decisions.

Unexpected Wealth Shocks

Much of the recent literature concerning how exogenous wealth effects influence retirement behaviour is based on lottery winnings and inheritances. A study by Imbens, Rubin and Sacerdote (2001), for example, estimates that the marginal propensity to consume leisure from lottery winnings is approximately 11 percent, with larger effects for people aged between 55 and 65. Indeed, it is quite common throughout literature relating to wealth effects to observe the effect that labour market withdrawal that coincides with positive wealth shocks is amplified as individuals approach retirement age. Therefore, we concentrate on examining labour force results for the near retirement years (the 55+ age range) in our own study. Furthermore, in their study of inheritances, Holtz-Eakin, Joulfaian and Rosen (1993) find that families with one or two earners were three times more likely to withdraw from the labour force if they inherited $150,000 compared to families receiving $25,000 or less. Although these studies are based on broader, largely unexpected wealth effects (at least in the case of lotteries), their findings inform our study because they confirm empirically the conventional view that leisure is a normal good, and that preferences for leisure change throughout the earnings life cycle.

Stock Market Wealth Fluctuations

A study by Cheng and French (2000) uses the results from lottery and inheritance studies to estimate how stock market performance from 1995 to 2000 would have affected labour market activity. Estimating that two thirds of the gains in the market were unexpected, they conclude that labour force participation among the 55 to 64 age bracket was only 116 basis points lower as a result of the bull market in stocks. Although the labour market effect reported in this study is smaller than those reported by others, many of the inherent biases affecting the individual lottery and inheritance studies are corrected by the empirical methods used by Cheng and French. These significant but rather slight aggregate results are corroborated by Hurd et al. (2001), as well as by Corando and Perozek (2003). The latter study finds that individuals holding any stock shares during the late

1990s retired six months before they had expected, but that each $100,000 of unexpected gains produced only an estimated two weeks of early retirement.

Pension Plan Types

In order to mitigate the challenges presented by relying on analysis that is based on aggregated data, several studies have utilized quasi-experiments in order to effectively capture how wealth effects due to stock market fluctuations influence retirement decisions. The results from Sevak (2002) contradict those of Hurd et al. (2001) by finding that men who held defined contribution pension plans in 1998 had increased their retirement rates by approximately 7 percentage points relative to defined benefit pension plan holders, controlling for levels of retirement between the two plans in 1992. The theory of this study, much like ours, is that those people with defined contribution plans participate in the unexpected increase in stock values; to this end, both Sevak (2002) and Cheng and French (2000) report extensive increases in the value of defined contribution pension plans in connection with stock market gains during the late 1990s.

Although these quasi-experimental studies that concentrate on pension plan types do not rely on aggregate data and therefore are more focused in their approach, the methodology is prone to biased results. It could be the case that individuals who choose one type of plan over the other tend to possess a particular set of characteristics that are correlated to their retirement preferences. In controlling for stock holdings, right censoring and other variables related to retirement that could be correlated to wealth effects, Khitatrakun (2001) found that, in the 51 to 61 year old age group, increases in stock market wealth induced a large reduction in retirement age among those who had significant equity holdings and no defined contribution pension plans.

One substantial criticism of the paper by Sevak (2002) is that it fails to control for trends in retirement behavior between defined benefit and defined contribution pension holders. Since there was a significant increase in the number of defined contribution plans from 1992 to 1998 in the 55 to 65 age bracket in the United States (from 38% to 56% of the surveyed population), there may be structural exogenous factors that could manifest in the observed relative retirement rate changes. For example, if those workers who were inclined to participate in defined benefit plans also preferred to remain in the labour market for an extended period of time, then this income preference would contribute to bias that would be attributed to an increased propensity for defined contribution pension holders to retire earlier than defined benefit plan holders.

Unlike the Sevak study (2002), which fails to control for retirement trends between these pension groups, Coile and Levine (2006) uses the upswing and downswing of the technology bubble to provide for a quasi-double experiment, which largely corrects for this omission. Much like us, they analyze retirement rates for defined benefit and defined contribution pension plan holders during the NASDAQ market boom and bust. In our own analysis of the Canadian data, we duplicate the analytical structure used by Coile and Levine (2006) while including the housing/commodities boom-and-bust that occurred from 2005 to 2008 to bolster our results.

III. Analytical Framework

In order to conduct an investigation into whether stock market behaviour affects retirement outcomes, retirees are split into control and experimental groups based on their stock market exposure. Ideally, the retirement savings of those in the experimental group would have substantially more exposure to stock market returns than those of the control group so that any market effects can be adequately captured. Within the RPP framework, there are two broad groupings of employer-sponsored pension types: defined benefit (DB) and defined contribution (DC) plans. Defined benefit plans dictate that the employee will be paid a certain pension, and it is entirely the burden of the employer-sponsor to "top-up" underfunded plans. With defined contribution plans, the employee or an investment agent (acting on behalf of the employee) invests the pension funds earned by the employee, and the final pension payouts are determined solely by the payout achievable from these invested funds. Therefore, unlike with defined benefit plans, there is no pension obligation on the part of the employer with defined contribution plans. As such, defined benefit plan holders have little to no stock market risk in their RPPs while the retirement savings of defined contribution plan holders are subject to relatively higher stock market risks; hence, such groupings satisfy the criteria for workable control and experimental groups.

Ideally, individual data would be used to distribute a population into groups that are comprised of holders of each pension type. This is the approach taken by Coile and Levine (2006); however, Statistics Canada does not produce individual-level data that would identify defined benefit and defined contribution pension plan holders. Therefore, individuals who are employed in certain industries are used in this study as proxies. This approach is appropriate only if certain industries have high levels of participation in either one pension type or the other. In fact, we were able to gather data on pension membership by industry and find that workers employed in the industry groupings of *forestry*, *fishing*, *logging*, *mining*, *oil & gas*, and *agriculture* (by the North American Industry Classification System [NAICS]) are likely to be DC plan holders, while those in the groupings of *public administration* and *utilities* are almost exclusively DB plan holders. The fact that there are a significant number of DB plans within the DC industries means that some of the selection problems that afflicted Khitatrakun (2001) may also be present within our own study; however, this does not affect our conclusions.

Although certain biases are limited or eliminated by using this industry-level data method, a main drawback is that different industries might have different sensitivities to stock market performance, regardless of whether retirees in each industry have principally DB or DC pension plan schemes. For example, individuals in the agricultural sector might be less sensitive to stock market performance and more sensitive to commodity price performance whereas this would likely not be the case for the oil and gas industries. Furthermore, as Coile and Levine (2006) find, individuals who are more educated tend to be more sensitive to financial and real estate market fluctuations compared to those individuals who are less educated, and thus less likely to hold such assets. Therefore, in picking industry groups, not only was pension plan dominance considered, but so were average education and wage levels. This, along with the differing industry classification scheme used between surveys, limits the range of industries that could be analyzed for our purposes. Ideally, all industries would be studied to plot the retirement rate sensitivity to stock market fluctuations along the broader spectrum of DB-DC dominant industries.

Apart from the identification and grouping of DB and DC plan holders, significant periods in recent stock market history that are likely to have impacted retirement behaviour are identified and focused on in our study. First, the inclusion of the boom-and-bust approach mirrors Coile and Levine (2006) and consequently corrects for pension trend biases that are a major criticism of the work by Sevak (2002). By incorporating two boom-and-bust cycles into this analysis, we hypothesize that any behaviour exhibited in a boom should be reversed over the bust regardless of pension and retirement trends. Our data show that the most significant, discernable stock market booms over the past two decades have been the dot-com era (1998-2000) and the housing/commodities boom (2005-2008) that led to the 2007 financial crisis. Conveniently (but unfortunately), these two boom periods were each followed by one or more significant bust years. Our analysis seeks to cover both booms and busts, and so data from 1998 to 2008 forms the basis for our analysis. The conditions for a quasi-experiment are therefore present as we analyze differential effects of stock market performance in these boom and bust periods on DB and DC plan holders (as differentiated by industry types).

As reflected in the studies by Coile and Levine (2006), Hurd et al. (2001), and Corando and Perozek (2003), the impact of stock market and wealth changes on retirement behaviour are most discernible for those nearing retirement age (55+). Therefore, this is the age group that is targeted in our study. Furthermore, many studies utilize retirement “rates” as the main behaviour-capturing variable and theoretically cite increases (decreases) in retirement rates among the retirement-age working population as being indicative of positive (negative) wealth changes. Although we have discussed only a potential impact on “retirement behaviour” up to this point, we endeavor to analyze this “behaviour” as a function of a “retirement rate.” This definition will be expanded on in the data section of our paper.

Further to the boom-and-bust framework for behavioural observation, we also seek to examine how stock market fluctuations over the period of analysis affect the general magnitude of retirement trends. We devise two separate models in our examination: 1) how retirement rates change over the boom and bust periods separately, and 2) how retirement rates change as a result of historical stock market movements.

In order to complete our analytical framework, we use several variables that control for factors affecting retirement rates apart from stock market performance. Since our data are industry-based instead of individual-based, we use common industry control variables that may affect retirement rates in any given year; these variables are limited by those in the Statistics Canada's CHASS database, but we believe that the variables most relevant to our analysis have been included.

IV. Model and Data

Empirically, we use the linear probability model throughout this paper. Since we are mainly trying to examine whether there are clear *directions* for the retirement rate during boom and bust periods, we find that the (potential) increased accuracy that might come from an empirical examination using a limited dependent variable framework would be negligible. The complete model that we have chosen is as follows, in two parts:

$$retrate_{it} = \beta_0 + \beta_1 X_{it} + \beta_2 bust_t + \beta_3 boom_t + \varepsilon_t \quad (1)$$

$$retrate_{it} = \beta_0 + \beta_1 X_{it} + \beta_2 lTSX_t + \varepsilon_t \quad (2)$$

where, i=industry
t=time indexed by year
Xit=set of all control variables

The first regression is used to find the directional effects of booms and busts on retirement rates, and the second is intended to confirm the results of the first regression and provide a reasonable estimate of the magnitude of these effects. We run each regression on individual industries that are DC and DB oriented as proxies for pension plan type participation. Then, we run each regression for the combined DC industries as well as for the combined DB industries to obtain aggregated results.

The choice of which industries to include in the study was determined mainly by the availability of data. Since CANSIM's surveys occasionally use different industry groupings for different surveys, the main challenge in collecting data was to make sure that the NAICS industry codes matched for each variable collected in each industry used, and it was of utmost importance that we use industries with sufficiently different pension plan utilizations (DC versus DB). These criteria were met by *forestry, fishing, logging, mining, oil & gas* and *agriculture* with approximately 55% of registered pension plans being of the DC type. *Public administration* and *utilities* had the highest proportion of DB at 95% of registered plans. These figures do not differ significantly year-by-year.

What follows (Table 1) is a description of each variable's data source, its structural form in our regression, and its calculation.

The determination of the boom and bust dummy variables in our model is somewhat detailed and so further elaboration may be instructive. Since the number of retirements is presented from the Labour Force Survey (LFS) annually, we are unable to determine exactly when during a year individuals retire. We assume that retirement occurs at the midpoint of the year for everyone, and so individuals only know the stock market returns for the first half of the year in which they retire. Therefore, our model specifies that annual stock market performance is based on the time period from July of one year to the end of June in the following year instead of on the calendar year.

Another important point about how the boom and bust dummy variables are constructed is that the formula for boom and bust in the dot-com era is different than for during the commodities/housing bubble era. These two eras do share the common characteristics of a boom followed by a bust, but the manner of progression between these two phases was quite dissimilar between the two eras. The dot-com era was marked by a large and quickly-forming bubble in the NASDAQ followed by a significant decrease in the index over a relatively short period of time. We use annual performance measures in the case to reflect the speed of the bubble formation and then collapse; that is, we do not use compounded annual growth rates to compute whether the dummy variable takes on the value of 1 or 0. In the case of the housing/commodities bubble, the expansion was not as extreme and took place over a longer time frame; therefore, we use the 3-year compounded annual growth rate as a benchmark in this case along with a narrower boom/bust range in comparison. A table detailing the dummy variable outcomes is included in the Appendix as Exhibit 1.

Table 1 – Variable Information

Variable	***Source***	***Form***	***Definition***
Dependent:			
Retrate	Statistics Canada Labour Force Surveys 1998-2008	Rate between 0 and 1	Retirement rate at time t, calculated as the number of retirements in year t divided by the number of individuals employed in year t-1
Controls:			
Boom	Bloomberg	Dummy	Equals 1 if, at t, trailing 3-year CAGR>12% for TSX from annual midpoints of 2005 to 2008 or if annual performance of NASDAQ>30% during annual midpoints from 1998-2004
Bust	Bloomberg	Dummy	Equals 1 if, at t, trailing 3-year CAGR<0% for TSX from annual midpoints of 2005 to 2008 or if annual performance of NASDAQ<-30% during annual midpoints of 1998-2004
lTSX	Bloomberg	Log	This is the log of the mid-year value of the TSX in each year
Control:			
Log(wage)	CANSIM table 281-0027	Log	Log of the average wage of workers over 55
Log(retage)	Statistics Canada Labour Force Surveys 1998-2008	Log	Log of the average retirement age of workers over 55
Union	CANSIM table 282-0078	Number (%)	Percentage of unionized employees
Unem	CANSIM table 282-0008	Number (%)	Unemployment rate of labour force participants over 55 years old

Industry control variables are chosen to mitigate factors that are likely to affect retirement rates. Wages, average retirement age, union membership, and unemployment of the 55+ age group are all factors that theoretically influence retirement rates. The average retirement age is limited by data that use age ranges rather than actual ages; for example, retirement data are available for the number of individuals retiring in industry *i* in the 55-60 age bracket, 60-65, etc. In order to calculate average age, we use the midpoints of the ranges to be the average retirement ages, and for the 70+ age group, we use an average of 72.5 as the bracket estimate. Furthermore, it is also an important consideration that industries with higher retirement ages will have lower retirement rates. This is due to the way that the retirement rate denominator is constructed and would indicate that significant *logretage* coefficients should be negatively related to retirement rates. Since we use a relatively short time frame in our analysis and concentrate mainly on the signs of the *boom* and *bust* coefficients while accounting for *logretage* in our *lTSX* model, we believe (and the data support) that this construction impacts our results insignificantly.

V. Empirical Results

Our model produces significant, interesting results in several respects. In this discussion, we begin with an analysis of the stock market dummy variable coefficients, which are most relevant to the conclusions of this study, and then we elaborate on the outcome of the control variable coefficients. Table 2 presents a summary of the boom and bust dummy variable coefficients from our first model.[2]

The results of our study show quite clearly that the retirement rate is negatively correlated with booms and positively correlated with busts. Only agriculture fails to exhibit such signs, but the coefficients on the agriculture boom and bust dummy variable are not significant at the 90% confidence level. Furthermore, although the coefficients are not very large, they tend to fall in line with what are reasonable expected magnitudes: for the DC-heavy forestry, fishing, mining, and oil & gas (FFMOG) sector, a typical boom (like one of those experienced over the past two decades) is likely to decrease retirement rates by 196 basis points, while a bust would increase the rate by 176 basis points. For agriculture, the effect of a boom is significant and theoretically increases the rate by about 373 basis points. As for the DB sectors, the bust coefficient for public administration is also significant and large at positive 367 basis points, while the coefficient for boom is comparable to that of FFMOG at negative 125 basis points and is not significant at the 90% confidence level. The coefficients for the utilities regression are small and insignificant.

These findings contradict the economic hypothesis that positive wealth shocks (booms) should lead to increased retirement rates and negative wealth shocks (busts) to decreased retirement rates. The results are consistent in both DB and DC plans, and the results tend to be more significant and larger in magnitude for DC plans; this is expected since, ceteris paribus, DC plan holders are likely more exposed to stock market fluctuations through share holdings in their defined-contribution pension portfolios. However, we observe that bust periods may also significantly influence the retirement trends of even those who are employed in DB-heavy industries. Such a large coefficient for public administrators (for bust, at least) suggests that holdings of stocks outside the “insured” retirement

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[2] Detailed statistical output for the boom and bust regressions can be found in the Appendix, Exhibit 2.

portfolios expose individuals to wealth shocks that can also have an effect on retirement behaviour.

Table 2 – Boom and Bust Dummy Variable Coefficients

Boom and Bust Statistics (Dependent Variable: Retirement Rate)	Coefficient (P-Value)	
Industry	**Boom**	**Bust**
Defined Contribution		
Forestry, Fishing, Mining, Oil & Gas (FFMOG)	-.0196 (0.017)	.0176 (0.022)
Agriculture	.037 (0.157)	-.002 (0.908)
Combined	-.014 (0.126)	.005 (0.526)
Defined Benefit		
Public Administration	-.0125 (0.122)	.0367 (0.004)
Utilities	-.005 (0.86)	.009 (0.861)
Combined	-.0005 (0.972)	.0284 (0.116)

The abnormal results for agriculture may well be indicative of the industry's unique characteristics and expose a potential problem with our methodology. First, many individuals employed in the agricultural industry are self-employed, and therefore, their retirement incomes and behaviour may be far more susceptible to changes in corporate profits and commodities values than those in other industries. If this is the case, then the housing and commodities boom experienced from 2005-2007, as expected, would generate a large, positive change in retirement rates within the agricultural sector. Such a response is consistent with the economic theory that leisure is a normal good. However, busts do not induce an opposite response, as would be expected. The wealth of individuals in certain industries might vary significantly based on factors such as economic exposure to fluctuating commodities prices and economic trends unrelated to stock market performance, which may act to obfuscate but not invalidate our results. The inclusion of a broader set of industries would tend to expose "normal" from "abnormal" industries in this regard. Alternatively, a second factor that might account for the retirement behaviour of those in the agricultural industry is that individuals in this sector tend to retire very late, at an average age of around 70 —the highest of all industries examined. Therefore, retirement motivations for those in the sector might depend to a larger extent on rural property values, personal considerations such as health, and other factors that are not as significant in the majority of other industries.

Our second model is consistent in its results across industries (again, excluding agriculture) and suggests that there is negative correlation between Toronto Stock Exchange performance and retirement rates.[3]

Table 3 – Stock Market Coefficients

Stock Market Coefficients (Dependent Variable: Retirement Rate)	**Coefficient (P-Value)**
Industry	**TSX**
Defined Contribution	
Forestry, Fishing, Mining, Oil & Gas	-.0860 (0.001)
Agriculture	.0398 (0.343)
Combined	-.0361 (0.044)
Defined Benefit	
Public Administration	-.0970 (0.045)
Utilities	-.0124 (0.85)
Combined	-.0468 (0.201)

We observe that significant coefficients exist for the FFMOG and public administration industries, and these coefficients are rather large with a 1% increase (decrease) in the stock market index generating an 8-10% decrease (increase) in retirement rates; such findings corroborate the empirical results of our first model. Furthermore, as previously found, agriculture exhibits a positive correlation that is rather high, but the results turn out not to be significant at the 90% confidence level.

VI. Discussion of Results and Conclusions

Drawing on these insights from the study of industries and pension plans, we believe that the results present compelling conclusions regarding why stock market behaviour induces these highly consistent yet peculiar and unexpected changes in retirement rates. For all industries except agriculture, the vast majority of employees are not in control of labour decisions except whether to work, to quit, or to retire. The decision to decrease retirement rates during a boom may

[3] Detailed statistical output for the TSX regressions can be found in the Appendix, Exhibit 3.

stem from an unwillingness to retire due to improved workplace opportunities (monetary and personal) arising from the boom. For example, more overtime might be offered by companies in certain industries when the economy is in a stage of expansion, thereby increasing the compensation for someone who is on the cusp of retirement; this might theoretically induce the employee to remain in the workforce. Furthermore, employees might even be called back from retirement to work on a part-time basis, thus decreasing the net retirement rates. On the other hand, busts may cause companies to cut costs, and so those individuals who are very close to retirement may be offered incentives to retire or their positions may be terminated. If the retirement incentives or disincentives provided by firms overshadow the wealth effects arising from stock market changes, which are highly correlated with economic performance, then this theory presents a plausible explanation of the signs exhibited for the boom and bust results.

Furthermore, this theory accounts for why agriculture might be an outlier and presents a reason industries might need to be examined on a case-by-case basis. Individuals in the agricultural industry are far more likely to be business owners rather than employees compared with almost any other industry. For owners, the wealth effects arising from a commodities-induced stock market boom could cause an increase in retirement rates that would far outweigh any decrease in retirement rates stemming from the desire to continue working. Also, when a boom turns to bust, there is no sharp decrease in retirement rates, but instead the farmers or other agricultural workers simply seem to retire again at the normal rate.

In order to explore these possibilities, we have carried out means tests for retirement rates and ages, which are provided in Exhibit 4. The test results show that retirement ages and rates for the FFMOG and public administration industries behave as expected, while the retirement patterns for agriculture and utilities are inconclusive. This means that, as expected, the average retirement rate during boom years is lower than that for bust years for the two corroborating industries, and for retirement age, the inequality is reversed so that the average retirement rate is higher in boom years than in bust years.

Another significant point about the results of the empirical work is that stock market trends are found to have a statistically significant effect on DB pension plans for public administration but not for the utilities industry. It must be noted that we cannot explain why stock market fluctuations are found to affect individuals in one industry and not the other. However, we potentially have assumed erroneously that, through our use of DB and DC plans for our quasi-experiment, savings for retirement are exclusively obtained from Registered Pension Plans. It may be the case that, for public administrators in particular, a large proportion of the savings relied upon to fund retirement is held outside of RPPs. In this case, large non-RPP investments in stocks would explain the significant results for public administrators during bust years. The employees in the utility industry may rely more heavily on their DB RPP funds for retirement. We were unable to obtain Canadian data regarding the wealth composition of individuals nearing retirement age by industry, and so this issue may constitute a basis for future papers if the data become available.

VII. Comparisons to Coile and Levine (2006) and Areas for Further Research

Since our topic and analytical methodology closely resemble that of Coile and Levine's "Bulls, Bears and Retirement Behavior," a comparison of results may shed some light on the validity of our own work and inform an analysis of areas for future research. Coile and Levine examine the largely unanticipated boom and bust stock market performance of the late 1990s (the technology bubble) and its effect on Americans' retirement behaviour. Their experiment, unlike our industry-based study, involves determining whether individuals are DB or DC plan holders and then segments groups of individuals based on their education level, as a proxy for the amount of retirement wealth invested in stock markets. Their conclusion is as follows for their first model (analogous to our own model 1):

> Overall, the figures provide no support for the hypothesis that workers who were more likely to be affected by the drop in the stock market in 2000 reduced their retirement relative to other workers and inconsistent support at best for the hypothesis that these workers increased their retirement rate in the boom period of the late 1990s. (17)

And for model 2:

> In the full CPS sample, a 10% rise in the S&P 500 is associated with a 0.10 percentage point increase in the annual retirement rate, although the effect is not statistically significant. (19)

In essence, they reach inconclusive results that do not contradict our own; however, if their results for Model 2 were statistically significant, this would not be the case.

Although their results provide little support that wealth effects originating from stock market fluctuations significantly influence retirement rates, their analysis of U.S. financial census data uncovers an important point regarding stock market wealth holdings: only a narrow segment of U.S. households hold sizable stock assets, and a small minority of these households own the vast majority of equity wealth. Therefore, although we control for income (as a proxy for wealth) in our model, it may very well be that, in Canada, the ownership of stock market wealth might fit the same pattern, and so even industry data might present too broad an aggregation to get an accurate read on wealth effects. Unfortunately, this implies that using stock market fluctuations to capture wealth effects on retirement is fraught with a significant problem: if most individuals invest only a small amount of retirement wealth in stock markets, they are not likely to change their behaviour due to stock market fluctuations; and, if few (or a small segment of) individuals make up for the vast majority of stock market holdings, then it is likely that these individuals will also own large stakes in other asset classes, which means that only a small proportion of their retirement wealth would be tied up in stocks. Either way, the proposition that stock market wealth would be found to influence retirement behaviour becomes a very difficult proposition to prove for any segment of the population.

One serious complicating factor in analyzing the retirement changes stemming from stock fluctuations is that the stock market is highly correlated with economic factors, and economic factors are in turn highly correlated to business conditions and retirement incentives within business organizations. It is therefore very difficult to untangle empirically the multicollinearity implicit in these relationships, and thus it is uncertain where the line is drawn between attribution to “incentive effects” and “wealth effects.” We do believe that the DB-DC approach does improve the focus on the latter effect, but it remains unknown to what degree this is true. To determine whether incentive effects, such as early retirement or part-time rehiring, would significantly impact retirement rates during boom and bust years, further research could focus on the correlation between booms or busts and the number of these incentive schemes promulgated by corporations. Due to the esoteric nature of such a study, a focused approach towards certain corporations or employees would likely prove to be the most efficient manner of analysis.

In our own quasi-experiment, these issues become more complicated because we use industries as proxies. If Statistics Canada published panel data that identified whether individuals held DB or DC plans, we could have used individual-level data instead of industry-level data, and consequently would be able to address a fundamental weakness of our study— that it hinges on very few observations. Therefore, future studies would benefit from such data, if it were to become available. Furthermore, by using individual-level data, such as in Coile and Levine (2006) for the U.S. case, the independent variables relating to personal characteristics would likely be far more robust to retirement rates than the relatively few industry control variables that were available through Statistics Canada’s industry-level data. Such difficulties might be ameliorated in future studies, again, dependent on the availability of the data.

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Appendix

Exhibit 1

Year	Boom	Bust
1998	0	0
1999	1	0
2000	1	0
2001	0	1
2002	0	1
2003	0	0
2004	0	0
2005	1	0
2006	1	0
2007	1	0
2008	0	1

Exhibit 2

Boom Bust Model

DC Industries
Forestry, Logging, Fishing, Mining, Oil & Gas

```
. reg  retrate logwage logretage union unem boom bust

      Source |       SS       df       MS              Number of obs =      11
-------------+------------------------------           F(  6,     4) =   14.33
       Model |  .002713369     6  .000452228           Prob > F      =  0.0112
    Residual |  .000126267     4  .000031567           R-squared     =  0.9555
-------------+------------------------------           Adj R-squared =  0.8888
       Total |  .002839636    10  .000283964           Root MSE      =  .00562

------------------------------------------------------------------------------
     retrate |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     logwage |  -.1904585   .0340146    -5.60   0.005    -.2848983   -.0960188
   logretage |   .0581687   .1262022     0.46   0.669    -.2922247    .4085621
       union |  -.3067414   .1397933    -2.19   0.093    -.6948699     .081387
        unem |  -.3676549   .1864308    -1.97   0.120    -.8852697    .1499598
        boom |  -.0196489    .004967    -3.96   0.017    -.0334395   -.0058584
        bust |   .0175659   .0048402     3.63   0.022     .0041273    .0310045
       _cons |   .8405559   .5375119     1.56   0.193    -.6518165    2.332928
------------------------------------------------------------------------------
```

Agriculture

```
. reg  retrate logwage logretage union unem boom bust

      Source |       SS       df       MS              Number of obs =      11
-------------+------------------------------           F(  6,     4) =    1.85
       Model |  .001676301     6  .000279384           Prob > F      =  0.2870
    Residual |  .000603982     4  .000150996           R-squared     =  0.7351
-------------+------------------------------           Adj R-squared =  0.3378
       Total |  .002280284    10  .000228028           Root MSE      =  .01229

------------------------------------------------------------------------------
     retrate |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     logwage |  -.0436281   .0686597    -0.64   0.560    -.2342579    .1470017
   logretage |  -1.055629   .4891164    -2.16   0.097    -2.413634    .3023757
       union |  -1.055322   .4504032    -2.34   0.079    -2.305842    .1951972
        unem |   2.468628   1.167574     2.11   0.102    -.7730758    5.710332
        boom |   .0372945   .0214141     1.74   0.157    -.0221606    .0967496
        bust |  -.0016057    .013082    -0.12   0.908    -.0379271    .0347157
       _cons |   4.696264   2.218259     2.12   0.102    -1.462611    10.85514
------------------------------------------------------------------------------
```

DC Combined

```
. reg  retrate logwage logretage union unem boom bust

      Source |       SS       df       MS              Number of obs =      22
-------------+------------------------------           F(  6,    15) =    6.33
       Model |  .007112698     6  .00118545            Prob > F      =  0.0018
    Residual |  .002810575    15  .000187372           R-squared     =  0.7168
-------------+------------------------------           Adj R-squared =  0.6035
       Total |  .009923274    21  .000472537           Root MSE      =  .01369

------------------------------------------------------------------------------
     retrate |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     logwage |  -.0670325   .0317279    -2.11   0.052    -.1346589    .0005939
   logretage |  -.2017109   .2151526    -0.94   0.363    -.6602978     .256876
       union |   .0887095   .1375495     0.64   0.529    -.2044702    .3818893
        unem |  -.0384143   .3964996    -0.10   0.924    -.8835332    .8067046
        boom |  -.0143163   .0088412    -1.62   0.126    -.0331609    .0045284
        bust |   .0054207   .0083552     0.65   0.526     -.012388    .0232294
       _cons |   1.212494   .9589908     1.26   0.225    -.8315464    3.256535
------------------------------------------------------------------------------
```

DB Industries
Public Administration

```
. reg  retrate logwage logretage union unem boom bust

      Source |       SS       df       MS              Number of obs =      11
-------------+------------------------------           F(  6,     4) =   17.17
       Model |  .005216165     6  .000869361           Prob > F      =  0.0080
    Residual |  .000202562     4  .000050641           R-squared     =  0.9626
-------------+------------------------------           Adj R-squared =  0.9065
       Total |  .005418727    10  .000541873           Root MSE      =  .00712

------------------------------------------------------------------------------
     retrate |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     logwage |  -.0336423   .0348722    -0.96   0.389    -.1304631    .0631785
   logretage |   .2452235   .2021771     1.21   0.292    -.3161102    .8065572
       union |  -.7302496   .2806414    -2.60   0.060    -1.509435    .0489358
        unem |  -.1155878   .3595397    -0.32   0.764     -1.11383    .8826543
        boom |  -.0124549   .0063605    -1.96   0.122    -.0301145    .0052047
        bust |   .0366621   .0062351     5.88   0.004     .0193507    .0539734
       _cons |  -.2011094   .7905168    -0.25   0.812    -2.395936    1.993717
------------------------------------------------------------------------------
```

Utilities

```
reg  retrate logwage logretage union unem boom bust
```

Source	SS	df	MS
Model	.043905633	6	.007317605
Residual	.004387835	4	.001096959
Total	.048293468	10	.004829347

Number of obs =	11
F(6, 4) =	6.67
Prob > F =	0.0437
R-squared =	0.9091
Adj R-squared =	0.7729
Root MSE =	.03312

retrate	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
logwage	-.0703904	.1275717	-0.55	0.610	-.4245861	.2838053
logretage	1.02168	.9012824	1.13	0.320	-1.480682	3.524041
union	-1.444545	1.229012	-1.18	0.305	-4.856829	1.96774
unem	1.759347	.4911008	3.58	0.023	.3958329	3.122862
boom	-.0053253	.0282707	-0.19	0.860	-.0838173	.0731668
bust	.0089091	.047695	0.19	0.861	-.1235133	.1413316
_cons	-2.747016	3.65168	-0.75	0.494	-12.88571	7.391674

DB Combined

```
. reg  retrate logwage logretage union unem boom bust
```

Source	SS	df	MS
Model	.047935768	6	.007989295
Residual	.010377593	15	.00069184
Total	.058313361	21	.002776827

Number of obs =	22
F(6, 15) =	11.55
Prob > F =	0.0001
R-squared =	0.8220
Adj R-squared =	0.7509
Root MSE =	.0263

retrate	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
logwage	.0184888	.0591201	0.31	0.759	-.1075228	.1445003
logretage	-.2346949	.3917697	-0.60	0.558	-1.069732	.6003425
union	-.9564454	.4195818	-2.28	0.038	-1.850763	-.062128
unem	1.822651	.2945978	6.19	0.000	1.194731	2.450571
boom	-.0005162	.014493	-0.04	0.972	-.0314073	.0303749
bust	.0284086	.0170117	1.67	0.116	-.007851	.0646682
_cons	1.638362	1.542062	1.06	0.305	-1.648465	4.92519

Exhibit 3

TSX Model

DC Industries

Forestry, Logging, Fishing, Mining, Oil & Gas

```
. reg  retrate logwage logretage union unem ITSX

      Source |       SS       df       MS              Number of obs =      11
-------------+------------------------------           F(  5,     5) =   16.37
       Model |  .002676186     5  .000535237           Prob > F      =  0.0041
    Residual |   .00016345     5   .00003269           R-squared     =  0.9424
-------------+------------------------------           Adj R-squared =  0.8849
       Total |  .002839636    10  .000283964           Root MSE      =  .00572

------------------------------------------------------------------------------
     retrate |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     logwage |  -.0934527   .0319948    -2.92   0.033     -.175698   -.0112074
   logretage |   .0166966   .1279376     0.13   0.901    -.3121774    .3455706
       union |  -.5922813   .1533168    -3.86   0.012    -.9863949   -.1981678
        unem |  -.2711241   .1740143    -1.56   0.180    -.7184421    .1761938
        ITSX |  -.0860865   .0119236    -7.22   0.001    -.1167371   -.0554359
       _cons |   1.407503   .5624944     2.50   0.054    -.0384353     2.85344
------------------------------------------------------------------------------
```

Agriculture

```
. reg  retrate logwage logretage union unem ITSX

      Source |       SS       df       MS              Number of obs =      11
-------------+------------------------------           F(  5,     5) =    1.42
       Model |  .001338619     5  .000267724           Prob > F      =  0.3545
    Residual |  .000941665     5  .000188333           R-squared     =  0.5870
-------------+------------------------------           Adj R-squared =  0.1741
       Total |  .002280284    10  .000228028           Root MSE      =  .01372

------------------------------------------------------------------------------
     retrate |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     logwage |  -.1169146   .0734204    -1.59   0.172    -.3056477    .0718186
   logretage |  -.8133453   .4501112    -1.81   0.131    -1.970393    .3437023
       union |  -.6566659   .4123267    -1.59   0.172    -1.716585    .4032536
        unem |   1.505115   1.028797     1.46   0.203    -1.139492    4.149722
        ITSX |   .0397697   .0380006     1.05   0.343    -.0579139    .1374533
       _cons |   3.664601   1.970761     1.86   0.122    -1.401402    8.730603
------------------------------------------------------------------------------
```

DC Combined

```
reg  retrate logwage logretage union unem ITSX

      Source |       SS       df       MS              Number of obs =      22
-------------+------------------------------           F(  5,    16) =    7.78
       Model |  .007030574     5  .001406115           Prob > F      =  0.0007
    Residual |    .0028927    16  .000180794           R-squared     =  0.7085
-------------+------------------------------           Adj R-squared =  0.6174
       Total |  .009923274    21  .000472537           Root MSE      =  .01345

------------------------------------------------------------------------------
     retrate |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     logwage |  -.0065794   .0356249    -0.18   0.856    -.0821009     .068942
   logretage |  -.1706508   .2125819    -0.80   0.434    -.6213043    .2800027
       union |   .0336555   .1198089     0.28   0.782     -.220328    .2876389
        unem |   .1349068   .3515754     0.38   0.706    -.6103998    .8802134
        ITSX |  -.0360791   .0165266    -2.18   0.044     -.071114   -.0010441
       _cons |   1.125326   .9339168     1.20   0.246    -.8544895    3.105141
------------------------------------------------------------------------------
```

DB Industries
Public Administration

```
. reg  retrate logwage logretage union unem ITSX

      Source |       SS       df       MS              Number of obs =      11
-------------+------------------------------           F(  5,     5) =    2.42
       Model |  .003834562     5  .000766912           Prob > F      =  0.1771
    Residual |  .001584165     5  .000316833           R-squared     =  0.7077
-------------+------------------------------           Adj R-squared =  0.4153
       Total |  .005418727    10  .000541873           Root MSE      =   .0178

------------------------------------------------------------------------------
     retrate |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     logwage |   .1417223     .10453     1.36   0.233    -.1269805    .4104252
   logretage |   .2622029   .5260394     0.50   0.639    -1.090025     1.61443
       union |   -.803566   .6595767    -1.22   0.277    -2.499062    .8919299
        unem |   .2648475   .8120595     0.33   0.758    -1.822618    2.352313
        ITSX |  -.0969502   .0363854    -2.66   0.045    -.1904819   -.0034186
       _cons |  -.1539253   2.038471    -0.08   0.943    -5.393981     5.08613
------------------------------------------------------------------------------
```

Utilities

```
. reg  retrate logwage logretage union unem ITSX

      Source |       SS       df       MS              Number of obs =      11
-------------+------------------------------           F(  5,     5) =    9.55
       Model |  .043716963     5  .008743393           Prob > F      =  0.0135
    Residual |  .004576505     5  .000915301           R-squared     =  0.9052
-------------+------------------------------           Adj R-squared =  0.8105
       Total |  .048293468    10  .004829347           Root MSE      =  .03025

------------------------------------------------------------------------------
     retrate |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     logwage |  -.0676717   .1339791    -0.51   0.635    -.4120759    .2767324
   logretage |   1.014083   .8224379     1.23   0.272    -1.100061    3.128227
       union |  -1.635381   .8351408    -1.96   0.108    -3.782178     .511417
        unem |   1.722108   .3502903     4.92   0.004     .8216577    2.622558
        ITSX |  -.0124014   .0620874    -0.20   0.850    -.1720022    .1471993
       _cons |  -2.479866   3.230935    -0.77   0.477    -10.78525    5.825516
```

DB Combined

```
. reg  retrate logwage logretage union unem ITSX

      Source |       SS       df       MS              Number of obs =      22
-------------+------------------------------           F(  5,    16) =   12.11
       Model |  .046125965     5  .009225193           Prob > F      =  0.0001
    Residual |  .012187396    16  .000761712           R-squared     =  0.7910
-------------+------------------------------           Adj R-squared =  0.7257
       Total |  .058313361    21  .002776827           Root MSE      =   .0276

------------------------------------------------------------------------------
     retrate |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     logwage |   .0809358   .0757813     1.07   0.301    -.0797135     .241585
   logretage |  -.2564646   .4118229    -0.62   0.542     -1.12949     .616561
       union |   -1.05116   .4335713    -2.42   0.028    -1.970291   -.1320303
        unem |   1.738002   .2946896     5.90   0.000     1.113288    2.362716
        ITSX |  -.0468333   .0351011    -1.33   0.201    -.1212443    .0275778
       _cons |   1.943987   1.605935     1.21   0.244    -1.460444    5.348418
------------------------------------------------------------------------------
```

Exhibit 4

Means Test - Retirement Rates

Industry

Year	**FFMOG**	**Agriculture**	**Pub Admin**	**Utilities**	**Boom**	**Bust**
1998	0.0950	0.0453	0.1464	0.3582	1	0
1999	0.0801	0.0546	0.1310	0.1346	1	0
2000	0.0712	0.0470	0.1240	0.1598	1	0
2001	0.0882	0.0641	0.1656	0.1510	0	1
2002	0.1148	0.0599	0.1662	0.1718	0	1
2003	0.0714	0.0742	0.1216	0.1358	0	0
2004	0.0874	0.0587	0.1070	0.0925	0	0
2005	0.0708	0.0320	0.0971	0.1216	1	0
2006	0.0581	0.0438	0.1115	0.1326	1	0
2007	0.0569	0.0412	0.1117	0.1530	1	0
2008	0.0740	0.0211	0.1434	0.1323	0	1
Averages						
Boom	0.07	0.04	0.12	0.18		
Bust	0.09	0.05	0.16	0.15		
Ztest (Boom)	0.087469455	0.123170019	0.092296478	0.80686866		
Ztest (Bust)	0.995933733	0.421326162	0.999979679	0.373418797		

Criteria: Test Bust>Boom if coefficient on Bust positive and Boom negative. Test Boom>Bust if coefficient on Boom positive and Bust negative.

Test Results:	Success	Fail	Success	Fail

Means Test - Retirement Ages

Industry

Year	**FFMOG**	**Agriculture**	**Pub Admin**	**Utilities**	**Boom**	**Bust**
1998	63.9784	69.1285	61.5076	60.2143	1	0
1999	63.4919	69.8063	61.7624	61.2875	1	0
2000	62.4271	68.5852	61.1183	59.1171	1	0
2001	62.8847	68.1445	62.2133	60.4991	0	1
2002	62.2531	69.1547	60.9575	60.3682	0	1
2003	61.6037	67.1817	62.8115	61.2336	0	0
2004	63.9787	67.6443	61.2374	60.0458	0	0
2005	63.7070	70.0562	61.4427	60.6723	1	0
2006	64.6108	68.2919	63.4923	60.2316	1	0
2007	62.8311	70.0873	61.4299	62.1086	1	0
2008	64.7178	67.9690	60.6331	60.5443	0	1
Averages						
Boom	63.51	69.33	61.79	60.61		
Bust	63.29	68.42	61.27	60.47		
Ztest (Boom)	0.737007301	0.97667955	0.653815283	0.551893125		
Ztest (Bust)	0.458240782	0.15034858	0.048142918	0.327740554		

Criteria: Test Bust<Boom if coefficient on Bust positive and Boom negative. Test Boom<Bust if coefficient on Boom positive and Bust negative.

Test Results:	Success	Fail	Success	Success