AN OVERLAPPING GENERATIONS MODEL OF A PAYROLL TAX FINANCED EMPLOYMENT INSURANCE PROGRAM

by

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Title of Thesis *An Overlapping Generations Model Of A Payroll Tax Financed Employment Insurance Program*

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Abstract

This paper explores the economic and the welfare impacts of a payroll tax financed Employment Insurance program. The paper also addresses questions of the possibility of a welfare maximizing "optimal tax rate," suggesting some interesting policy implications. Importantly, the paper introduces and suggests areas for further research in an effort to resolve the contentious issue of the real world impact of Employment Insurance in Canada.

Dedication

To my parents, Jill and Craig: For ‘making’ me take breaks every so often…

despite my complaints.

I am forever indebted to you (but I’ll try to pay you back as soon as I start making some money!).

I love you.

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List of Abbreviations and Acronyms

OECD	Organisation for Economic Cooperation and Development
GDP	Gross Domestic Product
EI	Employment Insurance (synonymous with Unemployment Insurance)

1 Introduction

Employment Insurance in Canada is a federally administered program designed to help workers to smooth their consumption and to facilitate job search during spells of unemployment. Employment insurance premiums are collected via payroll taxation (the contribution rate of which is split between employees and employers). The premiums collected are then paid out by the government in the form of a government-provided insurance against becoming unemployed. The magnitude of the Canadian of EI program is not only substantial but is growing. In the 2002 Monitoring and Assessment Report, it is noted that "total income benefits paid amounted to $11.5 billion in 2001/02, an increase of 23.9% from 2000/01"[1]. This $11.5 billion in benefits paid amounts to approximately 4.3 percent of Canadian GDP in 2002.

While it is clear that the provision of EI is a significant undertaking, requiring a great deal of attention, the full effects of the program are still not well understood. Understanding the impacts of Employment Insurance (EI) is valuable in assessing government policy in Canada. If, as theory predicts the provision of EI has distortionary impacts (in the absence of private employment insurance markets) then it is important to consider both the direction and magnitude of changes in variables of interest. Any investigation of such impacts requires first, a brief consideration of the theoretical impacts of a publicly provided EI program.

For the purpose of this study, we shall consider an Employment Insurance scheme under which individuals who are working pay a tax that is proportional to their wage bill, and individuals who are not working are "paid" a lump sum benefit (that in equilibrium is proportional to the aggregate wage bill). While this is clearly an oversimplification, it will provide some interesting insight into the impacts of Employment Insurance. In the absence of private insurance markets, theory predicts that given some probability of not working, the availability of a benefit will allow individuals to smooth their consumption across states of employment. They will likely choose to change their savings patterns, such that rather than saving a larger portion of their current income to ensure that they have income in the event that they find themselves not working (that is, rather than "self-insuring"), they will be able to consume more in the early period of their lives because the benefit ensures that they will have adequate consumption capabilities in the working period of their lives irrespective of labour market outcomes.

The paper proceeds as follows. Section two introduces the model and characterizes the economy's general equilibrium. Section three presents the quantitative investigation of the model for varying degrees of program generosity. A brief sensitivity analysis is undertaken in section four. The paper concludes with a summary of key results and presents directions for further research.

2 The Model

The model used in this research will be an overlapping generations model in which the agents live for three periods.

$$U=u(c_1)+E\{\beta[u(c_2)-\psi g(n)]+\beta^2u(c_3)\} \quad (1)$$

A three period OLG model serves as a simple device to capture the dynamic aspect behind saving and work decisions. That is, when individuals are young, they generally

[1] EI Monitoring and Assessment Report 2002, Human Resources Development Canada Website:

do not expect to be in the peak earnings period of their lives. Often they are in school, and if working, will likely earn below average wages. In an individual's middle-aged period, I assume (realistically) that they face uncertainty over the quality of their earnings during the peak earnings period of their lives. In the old age period, earnings are typically lower, reflecting a depreciation of human capital and retirement.

In order to capture this lifecycle pattern of earnings, assume that individuals are endowed with non-labour income y, in each period of their lives. The endowment can be thought of as either (a) a non-market wealth endowment, or (b) base market wages that are determined outside the model (*non* peak-earnings period wages), and not subject to the same tax treatment. It can be consumed in the given period, or saved for the future (which will earn a gross rate of interest: R). Alternatively, an individual can choose to borrow in the first two periods (again, at gross rate of interest: R).

In the first period of their lives they are "the young". In this period their economic choices include only how much of their endowment they will save and carry into period two (in the form of financial assets: a_2). Period two of an individual's life is the "working age" period. This period is generally observed to be the peak earnings period of individuals. During this period, the choice problem becomes more complicated, as the model includes some uncertainty as to whether or not the individual will become employed in the period[2]. There is an idiosyncratic probability of not being employed in this period that is represented by θ. Further, employment levels are denoted n, and range in value from zero to one (the maximum an individual can work is normalized to one). Reducing the utility gain from consumption in period two, an individual bears the cost of

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http://www.hrdc-drhc.gc.ca/ae-ei/loi-law/2002/eimar_2002.shtml.

an additively separable portion of utility that is attributable to the disutility of working. This portion of utility is given weight "ψ" (which is simply interpreted as a weighting parameter on the utility loss attributable to working). The expectations operator on the second and third period utilities is used to capture this uncertainty with respect to employment prospects. Further, discount factors "β" and "β^2" are applied to period two and three respectively. These discount factors can be interpreted as "patience parameters". They account for the rate of discount of the individual between current and future consumption. Period three of an individual's life is their "old age". This period's choice problem is comprised solely of consumption of both the endowment (y), and the savings from period two (with accrued interest).

In this case we shall consider a tax (τ) in which all of the funds collected are redistributed as benefits (B). While it is recognized that this model is an oversimplification of the real world operation of the Canadian Employment Insurance Program, it is introduced to offer insight into the impacts of such a tax. The rules and regulations associated with Employment Insurance in Canada are extremely complicated, but will be abstracted from for the purpose of this examination of the impacts of a payroll tax financed Employment Insurance program. In reality, while taxes collected are earmarked for distribution via EI benefits, the Canadian government has consistently run a budget surplus. The model explored in this paper will restrict the ability of the government to run surpluses, by imposing a balanced-budget restriction. The government budget constraint is simply:

$$\tau wn^*(1-\theta) = B^*\theta$$

[2] I abstract here from the search process, and model solely the impact of Employment Insurance on the variables included in the model.

Such that the amount of tax revenue collected (equal to the tax rate times the wage bill for those individuals who are working) must be equal to the amount of benefits (equal to the benefit B times the fraction of unemployed individuals).

This tax will be levied and distributed within the working period of the agent's life (that is, there will be no intergenerational transfer). If the agent works, a tax will be levied. If the agent does not work, a benefit will be distributed.

The consumption equations for the three periods are:

$$c_1 = y + Ra_0 - a_1 \qquad \text{(where } a_0=0\text{)}$$
$$c_{2E} = y + (1-\tau)wn + Ra_1 - a_2$$
$$c_{2N} = y + B + Ra_1 - a_2$$
$$c_3 = y + Ra_2 - a_3 \qquad a_3 \geq 0 \text{ (=0 in equilibrium)}$$

This problem can be solved recursively[3]. In period three, the agent does not work or save (as it is the final period of his/her life), thus the utility becomes:

$$v_3(a_2) = u(y + Ra_2 - a_3)$$

In the second period, the agent must choose the optimal level of work effort (time spent working when employed), and the amount that he/she will save for the third period (a_2). The choice problem then becomes:

$$v_2(a_1)=\max_{n,a2}(1-\theta)[u(y + (1-\tau)wn + Ra_1 - a_2) - \psi g(n)] + \theta u(y + B + Ra_1 - a_2) + \beta u(y + Ra_2)$$

In the first period, the individual must choose an optimal level of savings for the second period (note that the individual does not work in this period, and thus has only his/her endowment: y). The choice problem becomes:

$$v_1 = \max_{a1} u(c_1) + \beta v_2(a_1)$$

[3] To ensure that the objective function is concave and that optimal values lie within the interior of the feasible set, it is assumed that (1) u(.) and g(.) are twice continuously differentiable; (2) $u' , g'>0$, $u''<0$, $g''>0$; (3) $\lim_{c\to 0} u'(c) = \infty$, $\lim_{n\to 1} g'(n) = \infty$ and $\lim_{n\to 0} g'(n) = 0$.

From the above choice problems, we can characterize the optimal levels of the variables n, a_1, and a_2 as functions of w (the wage rate) and R (the gross interest rate):

$$(1-\theta)[wu'(y + (1-\tau)wn + Ra_1 - a_2) - \psi g'(n)] = 0 \quad (2)$$

$$-(1-\theta)[u'(y + (1-\tau)wn + Ra_1 - a_2)] - \theta[u'(y + B + Ra_1 - a_2)] + \beta R u'(y + Ra_2) = 0 \quad (3)$$

$$-u'(y - a_1) + \beta v_2'(a_1) = 0 \quad (4)$$

Substituting in for $\partial v_2/\partial a_1$:

$$-u'(y - a_1) + \beta[(1-\theta)Ru'(y + (1-\tau)wn + Ra_1 - a_2) + \theta R u'(y + B + Ra_1 - a_2)] = 0$$

In general equilibrium, w and R will be determined by the following market-clearing conditions:

$$w = F_N(K,N)$$
$$R = F_K(K,N)$$

Where $K = (a_1 + a_2)$, $N = (1-\theta)n$ and capital depreciates fully. This is based on the assumption that we are considering competitive firms with production function F, where F is both increasing and concave in all arguments, and is homogeneous of degree one.

Imposing these market-clearing conditions yields a full characterization of the model's equilibrium.

$$(1-\theta)[F_N u'(y + F_N n + F_K a_1 - a_2) - \psi g'(n)] = 0$$

$$-(1-\theta)[u'(y + F_N n + F_K a_1 - a_2)] - \theta[u'(y + F_K a_1 - a_2) + \beta F_K u'(y + F_K a_2) = 0$$

$$-u'(y - a_1) + \beta[(1-\theta)F_K u'(y + F_N n + F_K a_1 - a_2) + \theta F_K u'(y + F_K a_1 - a_2)] = 0$$

2.1 Functional Forms

For the quantitative analysis, functional forms are required for u, g and F[4].

$$u(c) = \ln(c)$$

[4] The parameter A in the production function is normalized to one.

$$g(n) = \frac{\varphi}{1+\gamma}(n)^{1+\gamma}$$

$$F(K,N) = AK^{\alpha}N^{1-\alpha}$$

The model can now be solved for the endogenous variables n, a_1 and a_2 as functions of the parameters: α, β, ψ, γ, θ, the tax rate τ, and the equilibrium values of w and R.

The use of logarithmic utility functions ensures strict concavity of the indifference curves[5], implying an underlying assumption that the agents in the model are risk averse. This strict concavity also ensures a preference by individuals for consumption smoothing. This inclination towards consumption smoothing should result in a welfare improvement if individuals are given the option of smoothing their consumption over time (a feature that a tax financed employment insurance scheme provides).

The functional form of the labour-leisure choice in utility allows the option of varying degrees of curvature, and varying values of labour supply curve elasticities. The parameter "γ" governs the curvature of the labour supply curve. The elasticity of labour supply is given by "$(1/\gamma)$"[6]. The choice of functional form ensures that g(n) is a strictly convex function in (n)[7] (which is dual to the function being strictly concave in leisure). This feature of the function ensures that the marginal cost of working is increasing (or dual to this is the restriction that the marginal benefit from leisure is decreasing).

The functional form for the aggregate production function is Cobb-Douglas with constant returns to scale. The market-clearing conditions (with functional forms applied) are:

[5] Such that $u'(c_i)>0$, $u''(c_i)<0$.

[6] This fact will be used in the calibration of the model.

[7] That is, $g'(n)>0$, $g''(n)>0$.

$$w = (1-\alpha)(K/N)^{\alpha}$$

$$R = \alpha(K/N)^{\alpha-1}$$

Where $K = (a_1 + a_2)$ and $N = (1-\theta)n$.

Here, α is capital's share of output, and $(1-\alpha)$ is labour's share of output.

The market-clearing conditions together with the first-order conditions yield a full characterization of the model in general equilibrium.

$$\frac{(1-\theta)(1-\tau)(1-\alpha)\left(\frac{K}{N}\right)^{\alpha}}{\left[y+(1-\tau)(1-\alpha)\left(\frac{K}{N}\right)^{\alpha} n+\alpha\left(\frac{K}{N}\right)^{\alpha-1} a_1 - a_2\right]} - (1-\theta)\psi n^{\gamma}$$

$$+\frac{\theta\tau(1-\alpha)\left(\frac{K}{N}\right)^{\alpha}\left(\frac{1-\theta}{\theta}\right)}{\left[y+\tau(1-\alpha)\left(\frac{K}{N}\right)^{\alpha} n\left(\frac{1-\theta}{\theta}\right)+\alpha\left(\frac{K}{N}\right)^{\alpha-1} a_1 - a_2\right]} = 0 \tag{5}$$

$$-\frac{(1-\theta)}{\left[y+(1-\tau)(1-\alpha)\left(\frac{K}{N}\right)^{\alpha} n+\alpha\left(\frac{K}{N}\right)^{\alpha-1} a_1 - a_2\right]}$$

$$-\frac{\theta}{\left[y+(1-\tau)(1-\alpha)\left(\frac{K}{N}\right)^{\alpha} n\left(\frac{1-\theta}{\theta}\right)+\alpha\left(\frac{K}{N}\right)^{\alpha-1} a_1 - a_2\right]}+\frac{\beta\alpha\left(\frac{K}{N}\right)^{\alpha-1}}{\left[y+\alpha\left(\frac{K}{N}\right)^{\alpha-1} a_2\right]} = 0$$

(6)

$$-\frac{1}{[y-a_1]}+\frac{\beta(1-\theta)\alpha\left(\frac{K}{N}\right)^{\alpha-1}}{\left[y+(1-\tau)(1-\alpha)\left(\frac{K}{N}\right)^{\alpha}n+\alpha\left(\frac{K}{N}\right)^{\alpha-1}a_1-a_2\right]}$$

$$+\frac{\theta\alpha\left(\frac{K}{N}\right)^{\alpha-1}}{\left[y+\tau(1-\alpha)\left(\frac{K}{N}\right)^{\alpha}n\left(\frac{1-\theta}{\theta}\right)+\alpha\left(\frac{K}{N}\right)^{\alpha-1}a_1-a_2\right]}=0$$

(7)

These constitute three equations in the three unknowns (a_1, a_2, n) as a function of the parameters.

2.2 Calibration of the Model

The model is calibrated in order to match key features of the Canadian economy.

2.2.1 Capital's Share: α

Using quarterly data from 1976 through 1994, labour's share of output in Canada has averaged around 64 percent[8]. This yields a value for capital's share of output equal to 0.36.

2.2.2 Discount Factor: β

The discount factor expresses the value that individuals place on future consumption. The higher is β, the more 'patient' is the individual (that is, he/she places a higher value on future consumption). Prescott (1986) notes that an appropriate value for

[8] A graph illustrating the trend over the period is available in Figure 11 of the appendix.

the discount factor is $\beta = 0.96$[9] if the simulation is based on an annual time frame (generally the case in an infinite horizon model). Since this model is a three-period overlapping generations model, we must make an assumption about the lifespan and division of periods of an individual's life. For simplicity, it will be assumed that individuals live for seventy-five years, and that each period is twenty-five years in length. Thus the discount factor used is $(0.96)^{25} = 0.360397$.

2.2.3 Tax Rate: τ

The model will be examined under various tax rates. In order to ensure that the model captures the varying relationship of the variables in the model and the tax rate, the model will be run using a unit grid of tax. The benchmark calibration will be characterized by a value of $\tau = 5.28\%$, the actual combined employee and employer tax rate in 2002.

2.2.4 Labour Supply Curvature: γ

Labour econometricians commonly assert that labour supply elasticity should lie between 0.5 and 1.5. In an amalgamation of many survey articles discussing the estimated values labour supply elasticity, Benjamin, Gunderson and Riddell note that most articles uncover values lying in the set ranging from 0.10 to 0.90. Keeping within these two ranges, the elasticity of labour supply used will be 0.5 such that the calibrated value is $\gamma = 2.0$.

[9] Prescott, Edward C. "Theory Ahead of Business Cycle Measurement," Federal Reserve Bank of Minneapolis Quarterly Review 10(1986), 9-22.

2.2.5 Probability of Not Working: θ

In the second period of an individual's life, this model allows for one of two labour market outcomes: employment or non-employment. The expectations operator encapsulates the uncertainty over whether and individual will be employed in the second period (the peak earnings period). The calibration of θ is designed to approximate roughly the earnings risk faced by Canadians in their peak earnings years. A crude measure is given by:

$$\frac{Number-of-Persons-Employed}{Population-Aged(15-64)}=(1-\theta)$$

Using Canadian data from 2002[10], the value of θ is calculated as:

$$(1-\theta)=\frac{15{,}411{,}800}{21{,}616{,}000}=0.713$$

$$\theta=(1\text{-}0.713)=0.287$$

2.2.6 Weighting of the Disutility of Work: ψ

The calibration technique used for this parameter is simply an application of a 'conjecture and verification' methodology. Microeconomic evidence indicates that individuals in industrialized countries generally allocate approximately one third of their time to the pursuit of labour market endeavors[11]. Cooley and Prescott note that studies (namely Ghez and Becker (1975) and Juster and Stafford (1991)) have found that "households allocate about one third of their discretionary time–i.e., time not spent

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[10] This data is readily available on the Statistics Canada website.

[11] Alternatively, one might consider calibrating this model such that individuals would choose to allocated one third of their time to labour market endeavors--if they were able to do so. In this case, rather than calibrating such that employment was approximately 0.33, the model might be calibrated such that employment was 0.33*(1-θ). This would instead mean calibrating such that n=0.23529. This would change the parameter value of ψ, but will not bear any significant impact on the direction of relationship being examined for the purpose of this paper.

sleeping or in personal maintenance—to market activities"[12]. Thus, the parameter ψ is chosen such that given the other parameters and preferences, the equilibrium (laissez-faire) level of employment (n) in the model is approximately 0.33. The value assigned to ψ in the model is thus 10.2.

2.3 Results

Investigating the equilibrium values for the benchmark tax rate imposed (tax = 5.28 percent: $\tau = 0.0528$), unveils the following values for selected variables (the full list is reported in the appendix).

Table 1: Equilibrium Values (Tax = 5.28 percent)

	Raw Value	Value as a Ratio of Earnings
Assets Invested for Period 2 (a_2)	0.505967	0.25298
Assets Invested for Period 3 (a_3)	0.115679	0.04899 (if employed) 0.05414 (if non-employed)
Employment (n)	0.303	N/A

These values (in conjunction with the equilibrium wage and interest rates) reveal some interesting findings with respect to savings behaviour, and lifetime consumption/earnings profiles. In equilibrium, individuals in the model economy are saving 25.3 percent of their endowment in the first period. In the peak earnings period, employed agents save 4.9 percent of their earnings[13] while non-employed agents save 5.4 percent of their earnings[14]. We can further consider the lifetime consumption profiles of agents in the model under both a laissez-faire regime, and the current equilibrium model. Figure 1

[12] Cooley, T.F. and E.C. Prescott. "Frontiers of Business Cycle Research", Princeton University Press. Princeton, New Jersey: 1995.

[13] Where the wealth of the employed in the peak earnings period is calculated as $(y + (1-\tau)wn + Ra_1)$.

[14] The wealth of the non-employed agent in the peak earnings period is calculated as $(y + B + Ra_1)$.

illustrates the finding that for "lucky" individuals who secure peak earnings period employment, flatten their lifetime consumption profile in response to Employment Insurance. That is, their second period consumption is decreased (a function of the reduction in earnings resulting from the payment of the tax). Non-employed (or "unlucky") agents' consumption profiles become steeper with the EI system in place. Their second period consumption levels become higher (relatively closer to those of employed agents—due to the increased earnings attributable to the EI benefit). Interestingly, we see that the shape of the profiles differ across agents. Those who are not employed in the peak earnings period tend to have the highest levels of consumption in their old age (presumably because they choose to accumulate a large amount of savings in response to uncertainty over employment prospects in the second period, and thus tend to *oversave* beyond the efficient amount that would be required to maintain a relatively flat lifetime consumption profile.). Conversely, agents who are employed in the peak earnings period enjoy the highest consumption in the second period of their lives. This is a result of the combination of first-period precautionary savings, and a higher earnings capacity.

Figure 1: Lifetime Consumption Profiles

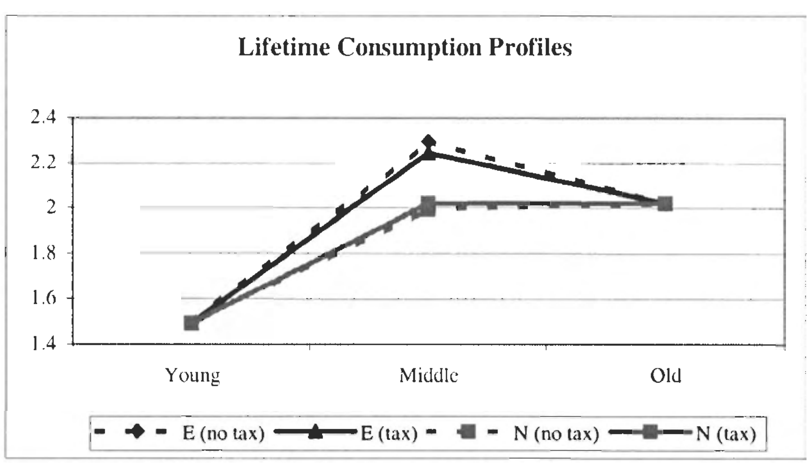
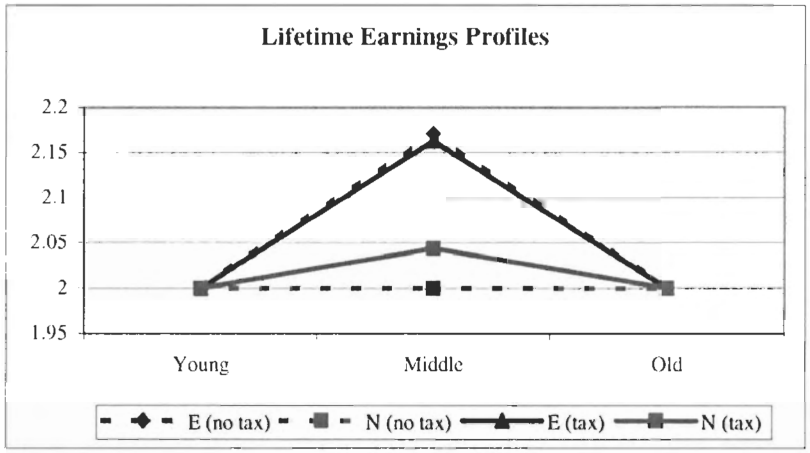


Figure 2: Lifetime Earning Profiles



The earnings profiles reveal the direct effect of the Employment Insurance program: redistribution of earnings across states of employment in the peak earnings period. These profiles also explain why the consumption profiles become more similar in response to the government insurance program.

3 Varying Degrees of Program Generosity

The model developed herein, allows us to identify a potentially important question: "Is there an optimal tax rate?" The answer to this question may provide interesting policy implication for the Canadian Employment Insurance Program[15].

By altering the model to allow the tax rate to vary in the range of $\tau \sim [0,0.70]$ we can examine the relationships between the variables of interest and the degree of generosity of the EI program. In particular, we can determine whether there is, in fact, an optimal tax rate with respect to welfare maximization.

[15] Keeping in mind that in order to provide appropriate and realistic policy suggestions, this simple model would have to be further developed to mimic the Canadian experience. Further, note that by "Optimal" we consider only the maximization of welfare (both individual and aggregate—however, this is applicable to individuals only, as firm behaviour has not been directly modeled).

Prior to introducing the tax, the model was run to uncover the laissez-faire equilibrium values of the variables of direct interest. This revealed the following equilibrium values.

Table 2: Equilibrium Values (No Tax)

	Raw Value	Value as a Ratio of Earnings
Assets Invested for Period 2 (a_2)	0.506245	0.25312
Assets Invested for Period 3 (a_3)	0.104907	0.043719
Employment (n)	0.333658	N/A

These values have the following interpretations. The value of assets saved or invested for period two indicates that individuals are choosing to save approximately 25.31 percent of their endowment (income) in the first period of their lives[16]. In the second period of the individuals' lives, they work approximately one third of the time (a commonly asserted value for employment, given the observation that individuals generally allocate two thirds of their time to leisure activities). Further, in period two, the individuals choose to save approximately 4.37 percent of their potential income[17] (this income consists of the endowment, labour income (if they are employed in the second period of their lives), and the accrued value of the assets that they saved/invested for period two).

Upon extending the investigation to varying degrees of program generosity, the following relationships are unveiled.

[16] Calculated as the value of assets invested for Period 2 divided by the endowment in the first period: (0.506245/2)=0253123.

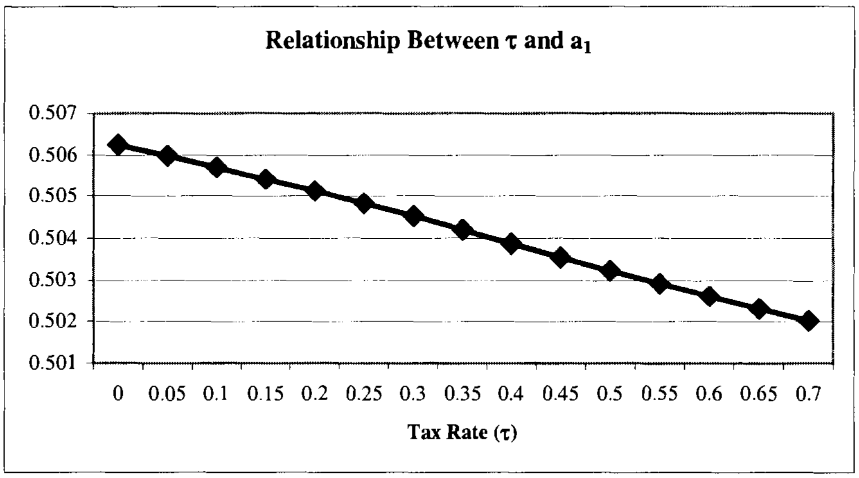
[17] Calculated as the value of assets invested for Period 3 divided by the endowment in the second period plus labour income, plus accrued value of assets: (0.104907/(2+0.333658*0.898861+0.196815*0.506245)=0.043719).

Table 3: Equilibrium Values (Tax = 70 percent)

	Raw Value	Value as a Ratio of Earnings
Assets Invested for Period 2 (a_2)	0.50201291	0.25101
Assets Invested for Period 3 (a_3)	0.27777144	0.13355 (if employed) 0.11434 (if non-employed)
Employment (n)	0.09170211	N/A

These values reveal some interesting behavioural responses to the imposition of a tax/transfer system. First, we see that the savings rate in the first period unambiguously decreases in response to the provision of Employment Insurance benefits[18].

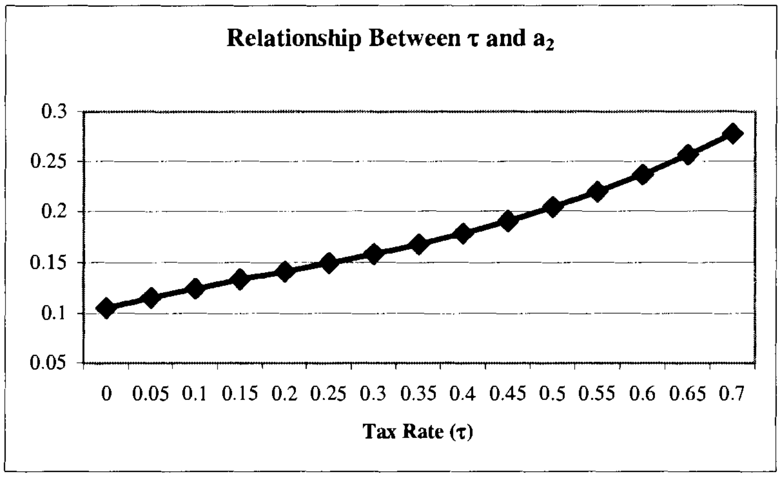
Figure 3: Relationship Between τ and a_1



This relationship makes intuitive sense. If individuals know that they will be compensated by some amount if they are unable to find employment in the working period of their lives, they will be more willing to consume more in the first period (rather than save in anticipation of potential negative income shocks in the second period). This feature illustrates the risk averse nature of the individuals in the model. For a given probability of not being employed in the second period, imposing a tax/transfer system will allow individuals to enjoy more consumption in the first period of their lives, rather than having to undergo a larger amount of precautionary savings. That is, the reduction in the need for self-insurance decreases the propensities of agents to oversave.

Further, we see that savings/investment for the third period increases with the imposition of the tax/transfer scheme[19].

Figure 4: Relationship Between τ and a_2



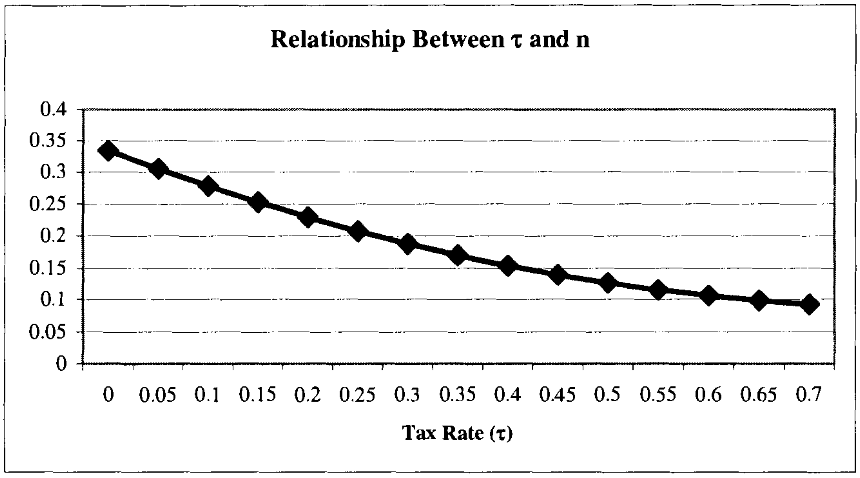
This is another intuitively predictable result. As individuals are given a higher potential peak earnings period income, they have an ability to save more for their old age (third period). Of interest here however, is that this findings is not necessarily in line with the variety of papers on employment insurance. For example, Heer (2002) found that "an increase in unemployment compensation decreases savings and aggregate wealth unanimously"[20] (clearly not the case here).

In the second period, the individual has choices not only over how much to save for the third period, but over how much labour to supply. The equilibrium level of

[18] The savings rate as a proportion of earnings decreases from 25.31 percent to 25.1 percent.
[19] This occurs whether the individual works in the second period or not. If working, the individual saves 13.35 percent of his/her income. If not working, the individual saves 11.43 percent of his/her income (an increase from the original 4.37 percent savings under the laissez-faire regime).
[20] Heer, Burkhard. "The German Unemployment Compensation System: Effect on Aggregate Savings and Wealth Distribution". Review of Income and Wealth Series 48, Number 3, September, 2002, pp 391.

employment is a decreasing function of the tax rate. This phenomenon is predicted by theory, which states that the provision of Employment Insurance may induce individuals to spend more time "not employed" (either searching for work, or not)[21].

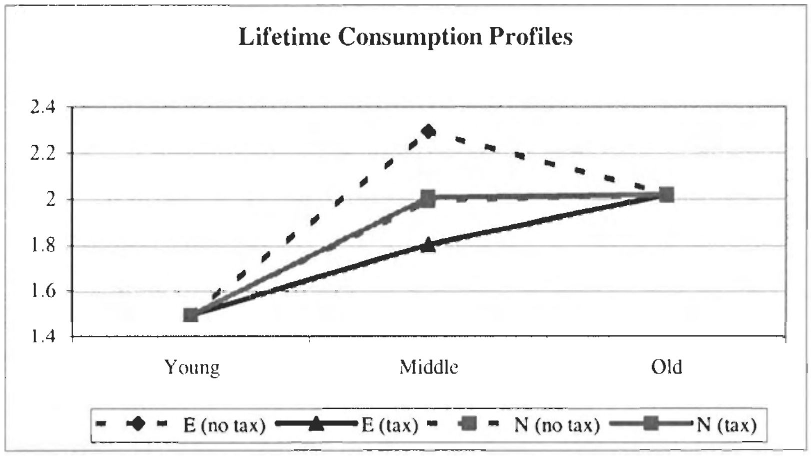
Figure 5: Relationship Between τ and n



While employment levels are decreasing as the tax/transfer system is imposed, so too are the aggregate second period consumption levels. Individuals are, however, still able to smooth their consumption within the peak earnings period of their lives. That is, when working, they earn a lower take home wage (due to the payroll tax), and when not working, they earn a benefit equal to the amount taxed away if employed (such that c_{2N} is increasing with the tax, and c_{2E} is decreasing with the tax). In addition to smoothing their consumption within the middle-aged period, individuals are able to smooth their lifetime consumption profiles. They choose to increase their first and third period consumption levels in response to the tax.

[21] Note the distinction between the use of the work "unemployment" and the words "not employed". In the case of the former includes only those individuals who are not working but are actively searching for work. The latter includes all individuals who are not working.

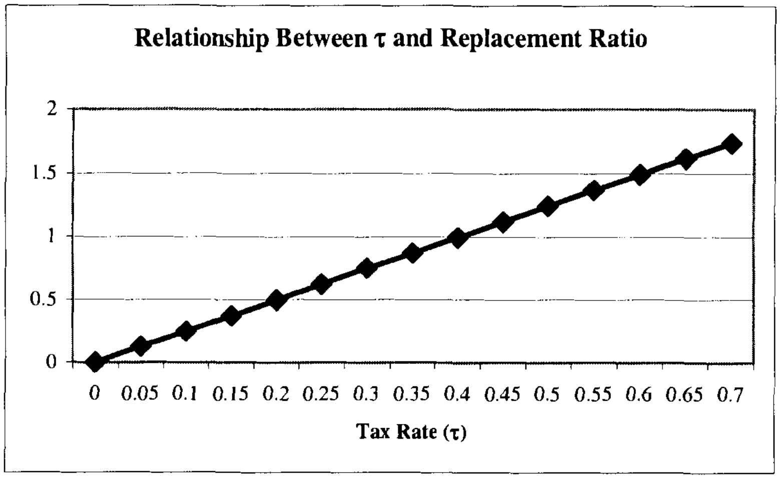
Figure 6: Lifetime Consumption Profiles



These consumption profiles reveal a peculiarity associated with high program generosity levels. As the generosity increases beyond appropriate levels, the consumption behaviour of agents is reversed such that "unlucky" individuals (because they are provided with such a high benefit level) are now able to consume more than agents who are employed in the peak earnings period (because these agents are taxed at, in this case seventy percent, leaving them with relatively low earnings). This phenomenon is further explained by the changes in EI replacement ratios. At tax levels exceeding 40-45 percent, the replacement ratio exceeds one, so that the supposedly unlucky agents who are unable to secure peak earnings employment are now compensated more than they would be if they were working![22]

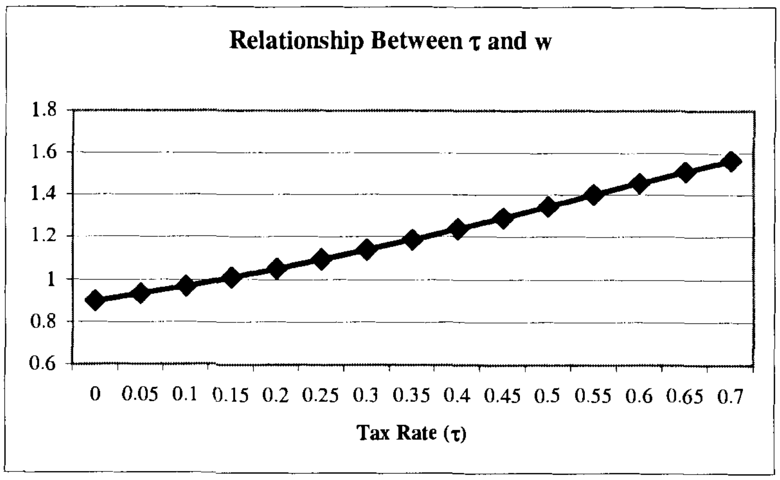
[22] This fact helps to explain the fact that a tax rate of approximately 40 percent is the welfare-maximizing tax rate in the model (which will be further discussed shortly).

Figure 7: Employment Insurance Replacement Ratio



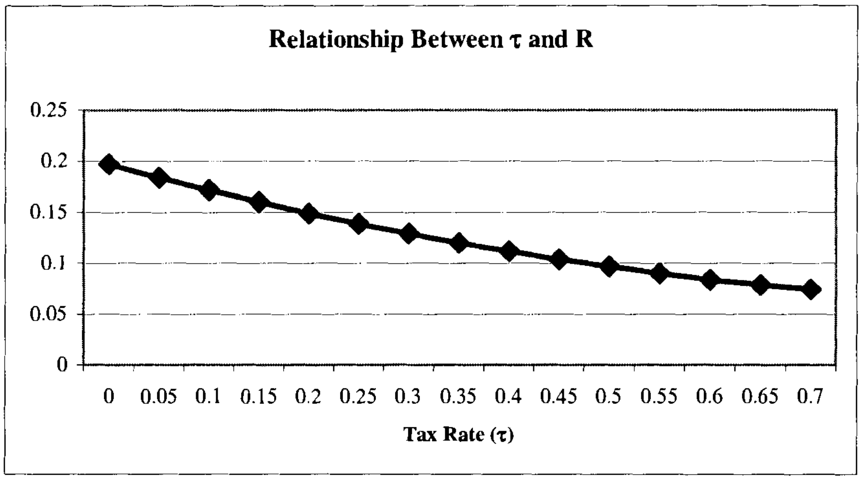
The equilibrium wage rate increases upon imposition of the welfare state. This is likely a result of the reduction in employment levels associated with increases in the generosity of the EI program. This reduction in the labour input makes it more valuable (such that the marginal product of labour is increasing in the tax rate).

Figure 8: Relationship Between τ and w



As expected, the opposite is the case with respect to the equilibrium interest rate: it is a decreasing function of the tax. The explanation for this phenomenon follows from the fact that increases in the tax rate lead to increases in capital in the model economy. While individuals choose to reduce their first period savings (a_1), they increase their second period savings (a_2) by a larger amount. Since the total capital in the economy is simply the sum of a_1 and a_2, this yields increases in the overall level of capital in the economy, and thus decreases in the marginal product of capital. The reduction in the interest rate associated with increasing program generosity is illustrated below.

Figure 9: Relationship Between τ and R



Applying the parameter and equilibrium variable values into the individual's lifetime welfare function:

$$U=\ln(c_1)+E\{\beta[\ln(c_2)-(\psi/(1+\gamma))(n)^\wedge\{1+\gamma\}]+\beta^2\ln(c_3)\}$$

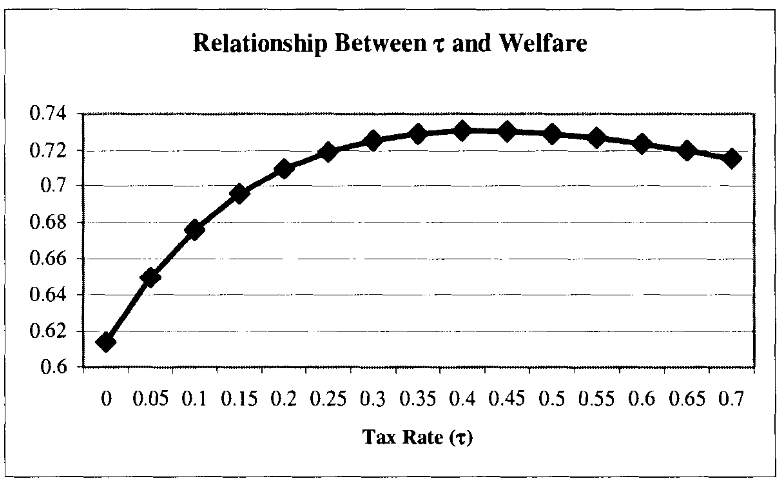
yields the finding that welfare increases with the imposition of the payroll tax financed Employment Insurance program. This is not a surprising outcome, since both the first and third period consumption capabilities increase with the imposition of the tax (and the disutility associated with working is reduced due to the reduction in employment). Table 4 provides a summary of the above-discussed relationships between the variables and the tax rate τ.

Table 4: Summary of Relationships

$\partial a_2/\partial \tau < 0$
$\partial a_3/\partial \tau > 0$
$\partial n/\partial \tau < 0$
$\partial c_1/\partial \tau > 0$
$\partial c_{2E}/\partial \tau < 0$
$\partial c_{2N}/\partial \tau > 0$
$\partial c_2/\partial \tau < 0$
$\partial c_3/\partial \tau > 0$
$\partial w/\partial \tau > 0$
$\partial R/\partial \tau < 0$
$\partial U/\partial \tau > 0$

Upon developing the model, we discover that rather than simply being an increasing function of the tax rate, the welfare of the representative agent in this model is a concave function exhibiting a maximum. This relationship is revealed in the following figure, which illustrates that there is a tax rate beyond which the welfare of the representative agent actually decreases for increases in the tax rate.

Figure 10: Relationship Between τ and Welfare



In fact, we can conclude that any tax rate beyond approximately 40 percent will yield reductions in the welfare of individuals in the economy. While an Employment

Insurance tax rate of 40 percent seems absurd, this consideration provides us with an interesting policy implication. If the purpose of providing employment insurance is to ensure that the lifetime welfare levels of individuals in the economy is maximized, it may be the case that Canada's tax rates have been systematically lower than they *should have been.*

4 Sensitivity Analysis

By undertaking a sensitivity analysis, we can examine the dynamics of the model when parameter values are varied. This section offers a brief sensitivity analysis of the benchmark model (in comparison to the laissez-faire model) under varying labour supply elasticities. An example of why this is of interest is the common assertion in labour economics literature that females tend to have more elastic supply curves than do males. The purpose of this investigation is to consider the impact of say, higher proportions of males or females in an economy such that the aggregate labour supply elasticity is different. This is accomplished by varying the parameter γ[23]. The sensitivity analysis will consider a value of the labour supply elasticity reflecting a more inelastic curve: 0.1 (with an associated γ value of 10).

The responses of agents to the introduction of the benchmark tax value (5.28 percent) from a laissez-faire origin are illustrated in the following table.

[23] Note that there are various reasons for differing labour supply elasticities. The difference between males and females is selected only as an example.

Table 5: Response to the Imposition of the Benchmark EI Program (varying γ)

	% Response (γ = 10.0)	% Response Benchmark (γ = 2.0)
First Period Savings (a_1)	-0.514 %	-0.055 %
Second Period Savings (a_2)	1.324 %	10.269 %
Employment (n)	-1.655 %	-9.189 %

This table reveals interesting implications for the benchmark assumption of labour supply elasticity equal to 0.5 (resulting in a value of $\gamma = 2.0$). If the benchmark model had been selected to reflect a more inelastic labour supply curve, there would have been a larger reduction in first period savings in response to the EI program, a smaller increase in the second period savings, and a smaller reduction in chosen employment levels. Thus, the savings behaviour responses would yield a smaller increase in the aggregate capital in the economy, thus the reduction in the interest rate would be smaller. The fact that the employment response is smaller in magnitude while peculiar, is likely a result of significantly smaller wage responses in the model exhibiting a more inelastic labour supply curve.

5 Concluding Remarks and Directions for Further Research

This model and the associated results have shed some light on a case in which Employment Insurance may, in fact, be a valid endeavor for a government to undertake as a welfare improving policy. Individuals in this model have all been unambiguously made better off in terms of lifetime welfare (up to the optimal tax rate of approximately 40 percent). While this model may be too simple to take the quantitative results at face value, the qualitative results uncovered may be more robust.

Throughout the course of the paper, various directions for further research have been suggested. To summarize, the following are appropriate modifications to the model that might yield the same intuitive results in a more realistic framework:

(1) Incorporate the more specific rules and regulations of the Canadian Employment Insurance program into the model;

(2) Investigate aspects that may introduce heterogeneity across individuals in the model economy;

(3) Model various parameters that have been taken as exogenous in this model, as endogenous (i.e. - Model the relationship between the introduction of the program and the probability of not being employed in the second period[24].)

(4) Introduce firm decision-making processes explicitly into the model.

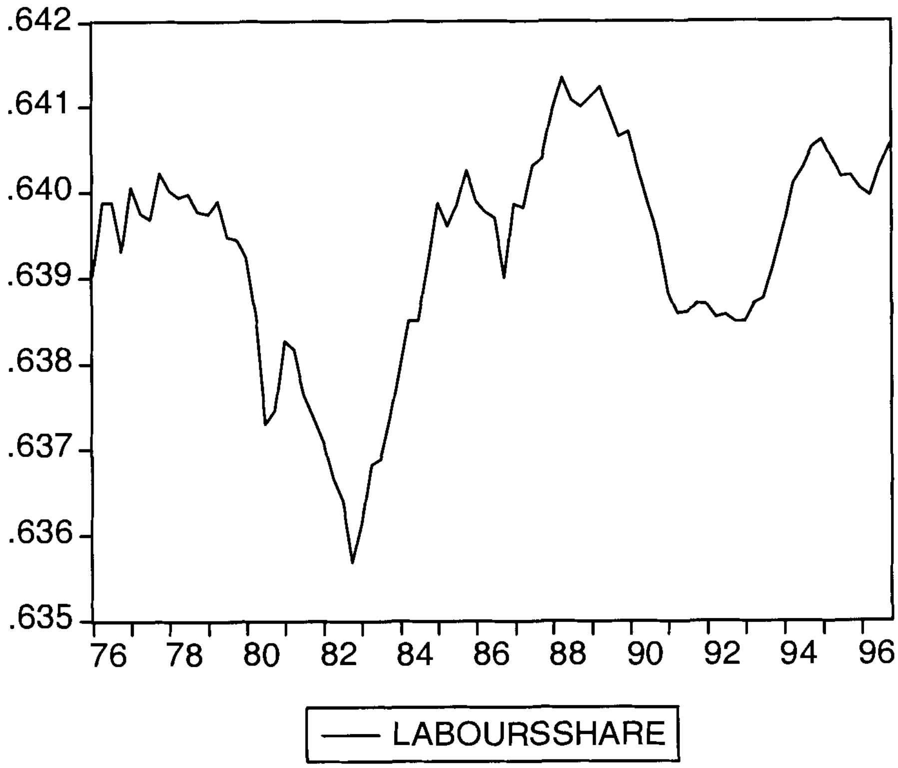
While these extensions would provide further insight, the scope of the paper has been limited to the simple model in an effort to reveal broadly applicable findings. Rather than over-complicating the model restrictions, this method allows for the generalized inference that enables the thorough discussion of policy implications presented herein.

[24] This follows along the lines of a casual inference that is commonly made that firms will be more inclined to lay off workers if they know that they can collect Employment Insurance benefits. This will yield a positive relationship between the value of τ and the value of θ.

6 Appendix

Figure 11: Labour's Share

The average value for labour's share over the period of 1976(quarter 1) through 1996 (quarter 4) is: 0.6393.



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