GOBIERNO DE CHILE
SUPERINTENDENCIA DE AFP

**Serie Documentos de Trabajo**

Superintendencia de Administradoras de Fondos de Pensiones
Teatinos 317.
Santiago, Chile.

www.safp.cl

**DOCUMENTO DE TRABAJO N°17**

# SEGURO DE CESANTÍA EN CHILE: ¿ESTABILIZA EL CICLO ECONÓMICO?

Rodrigo Cerda
Rodrigo Vergara

Diciembre 2006

GOBIERNO DE CHILE
SUPERINTENDENCIA DE AFP

Los **Documentos de Trabajo** son una línea de publicaciones de la Superintendencia de Administradoras de Fondos de Pensiones, que tienen por objeto divulgar trabajos de investigación económica realizados por profesionales de esta institución, encargados o contribuidos por terceros. Con ello se pretende incentivar la discusión y debate sobre temas relevantes del sistema previsional o que incidan en él, así como ampliar los enfoques sobre estos fenómenos.

Los trabajos aquí publicados tienen carácter preliminar y están disponibles para su discusión y comentarios. Los contenidos, análisis y conclusiones que puedan derivar de los documentos publicados son de exclusiva responsabilidad de su(s) autor(es) y no reflejan necesariamente la opinión de la Superintendencia de A.F.P.

Si requiere de mayor información o desea tomar contacto con quienes editan estos documentos, contacte a: documentosdetrabajo@safp.cl

Si desea acceder a los títulos ya publicados y/o recibir las futuras publicaciones, por favor regístrese en nuestro sitio web: www.safp.cl

The Working Papers series of the Superintendence of Pension Fund Administrators (SAFP) disseminates economic research conducted by the SAFP staff, entrusted or contributed by third parties. The purpose of the series is to contribute to the discussion and debate of relevant issues related to the Pension System, as well as to extend the approaches on these phenomena.

These papers are preliminary research for its discussion and comments. The contents, analysis and conclusions presented in these papers are exclusively those of the author(s) and do not necessarily reflect the position of the SAFP.

To ask for further information or to contact the editor committee, please write to: documentosdetrabajo@safp.cl

To access the papers already published or to receive by e-mail the latest list of working papers published, please register yourself at our website: www.safp.cl

Superintendencia de Administradoras de Fondos de Pensiones
Teatinos 317.
Santiago, Chile.
www.safp.cl

# UNEMPLOYMENT INSURANCE IN CHILE: DOES IT STABILIZE THE BUSINESS CYCLE?[a]

**Rodrigo Cerda[b] and Rodrigo Vergara[c]**

**December 2006**

**Abstract**

We explore the stabilizing effects of unemployment insurance in Chile. A dynamic general equilibrium model is calibrated for the Chilean economy for the 1960-2000 period. We assume that the economy is subject to exogenous technological shocks and that a fraction of the population is liquidity constrained. Our main conclusion is that unemployment insurance has some stabilizing effect on the business cycle, especially on consumption, but that this effect is of the second order of magnitude. We also find that the larger the fraction of the population that is liquidity constrained, the more likely the program is welfare improving. Our results suggest that the objective of stabilizing the business cycle would be more efficiently achieved using alternative instruments.

**Keywords**: unemployment insurance, business cycle.

**JEL classification**: E32, J65.

---

[a] We are grateful for comments received from Will Mullins and from participants at the Superintendency of Pension Fund Administrators (AFP) conference: "Consolidation and Challenges of the Unemployment Insurance in Chile", Santiago, October 6-7, 2005.

[b] Economics Department, Universidad Católica de Chile. Casilla 76, Correo 17, Santiago, Chile. (rcerda@faceapuc.cl).

[c] Economics Department, Universidad Católica de Chile. Casilla 76, Correo 17, Santiago, Chile. (rvergara@faceapuc.cl).

## 1. Introduction

In October 2002 an unemployment insurance fund was introduced in Chile with the stated aim of protecting workers' income levels when they become unemployed. This paper considers the potentially unintended business cycle effects of unemployment insurance, in particular the question of whether this insurance has stabilizing effects in terms of making the business cycle less pronounced.

Stabilizing effects ensue if liquidity constrained agents are allowed access to unemployment insurance funds when they become unemployed in a recession, allowing them to reduce their consumption by less than they would have done if there were no unemployment insurance system. As contributions to the fund are larger in booms than in recessions, this potentially provides an additional stabilizing effect. We assume non-diversifiable aggregate technological shocks that produce fluctuations in variables such as production, employment and consumption. People are assumed to be liquidity constrained and they do not have perfect access to the capital market.

The benefits of reducing business fluctuation have been widely studied in the literature. Lucas (1987) voiced doubts as to the value of these benefits, calculating that the effects on welfare are minimal. He compared his estimate of the benefits of attenuating the volatility of the business cycle with the large welfare benefits that attend economic growth, concluding that the profession would do better by focusing on growth rather than on stabilization policies.

In the case of unemployment insurance the literature has focused on the stabilization and welfare properties of this insurance when markets are incomplete. Based on a model of unemployment insurance Baily (1977) reports results as to how much insurance should be provided, and in what form. Hamermesh (1982) makes use of a model to determine whether current levels of unemployment insurance (UI) in the US are sufficient to overcome the liquidity constraint faced by the unemployed. He finds that a large portion of UI benefits do little to stabilize the economy, because people consume them as if they were fully expected, reducing their saving behavior when employed. Easley, Kiefer and Possen (1985) use a two person, two period general equilibrium model with uncertain productivity in the second period. As agents cannot self-insure the introduction of UI implies a potential Pareto welfare improvement. They also make use of a theoretical model to compare the welfare gains of UI vis à vis a negative income tax. Hansen and Imrohoroglu (1992) study the role of unemployment insurance in an economy with liquidity constraints and moral hazard using a quantitative general equilibrium model. They assume that people cannot borrow in the capital market and that agents face exogenous idiosyncratic employment shocks (there are no aggregate shocks). They conclude that if there is no moral hazard the optimal replacement rate may be as high as 0.65 (similar to that found in the US economy) and that the welfare benefits of UI are large. However, if there is moral hazard and the replacement

rate is not set at the optimal level, the economy can be worse off with UI than it would have been without it.

Imrohoroglu (1989) and Atkenson and Pehlan (1994) argue that the unemployed bear a disproportionate burden of the cost of employment fluctuations during recessions. Both papers focus on the unemployment risk as the main undiversified risk associated with the business cycle. Nonetheless, their estimates of the welfare gains of curbing business cycle fluctuations are also small[1] because the data shows very little time variation in the average duration of US unemployment. Hence, the risk of a long period of unemployment in a recession is relatively small. However, Beaudry and Pages (2001) argue that focusing only on unemployment duration may underestimate the welfare gains of stabilization policies. They conclude that mild variability of aggregate wages may hide important business cycle fluctuations in individual wages and that this source of risk implies substantial welfare costs. They also conclude that attention to the design of unemployment insurance is required if UI is to contribute to diversifying the risk of economic fluctuations. More specifically, they find that unconditional UI can be an inefficient way of reducing the cost of business fluctuations, while a state contingent UI scheme that offers more generous subsidies during recessions than during expansions improves risk sharing and reduces the cost of business cycles. Brown and Ferrall (2003) study the interaction of the business cycle, unemployment insurance and the labor market for young men in Canada. They argue that the design of UI is important, proving that in some cases a poorly designed UI scheme can exacerbate recessions.

The effect of unemployment insurance on the business cycle has not been studied for the Chilean economy. In this paper we use a dynamic general equilibrium model to study the stabilization properties of the Chilean UI program on the business cycle. Specifically we use a real business cycle model with liquidity constrained agents and an economy subject to exogenous technological shocks. The model captures the effect of the unemployment insurance program on fluctuations of output, consumption, investment, the capital stock and employment. It is important to bear in mind that while unemployment insurance has the effect of reducing the liquidity constraint for people that are laid off, hence reducing the volatility of consumption, the taxes used to finance the program are themselves distortionary. We find that in the case of Chile the unemployment insurance program marginally attenuates business cycle fluctuations. Whether the program is welfare improving is found to depend on the fraction of the population subject to liquidity constraints.

The paper is organized as follows. In section 2 we describe the unemployment insurance program in Chile. Section 3 presents the model and section 4 its calibration and simulation. The policy implications of our results are discussed in section 5. Section 6 concludes.

[1] Imrohoroglu (op.cit.) finds that the welfare cost of aggregate fluctuations is about 0.3% of consumption.

## 2. Unemployment insurance in Chile[2]

The unemployment insurance fund in Chile is financed from three sources: workers, employers and the state. Workers contribute 0.6% of their gross income every month, which is deposited directly in their individual accounts. The employer contributes 2.4% of each employee's income, with two thirds of this going to the individual's account, and the remainder going to a 'solidarity fund'. The third source of funding is a yearly fiscal contribution of US$15 million to the solidarity fund, a contribution that can be adjusted yearly.

Every worker that voluntarily leaves his job, or is fired for a reason attributable to him can access his individual unemployment account after having made a minimum of 12 monthly contributions. The maximum number of monthly withdrawals that this worker can make from his account is equal to the number of years that he has been contributing to the unemployment insurance, up to a maximum of five. The amount of the withdrawal falls every month, following a formula stipulated in the law[3] that created the scheme.

It the person is fired for reasons attributable to the firm, in addition to his individual account he also has access to the solidarity fund. However, to be eligible for this he must fulfill additional conditions: first, the individual must have contributed to his unemployment insurance account for at least 12 consecutive months; second, he must be unemployed when he requests this access; and third, his individual account has to be insufficient to cover the minimum payments the UI scheme is designed to provide.

It should be clear that the Chilean UI program bears more resemblance to a mandatory saving program than a real insurance program: all working individuals contribute, but the unemployed are not automatically entitled to payments, and payments are based on individual accounts rather than on the 'solidarity fund.'

---

[2] Note of the editor: This section describes only the unemployment insurance system for the case of indefinite contracts.

[3] For instance if he can make five withdrawals he withdraws 25% of his individual account in the first month, 22.5% in the second, 20% in the third, 17.5%, in the fourth and the remainder in the fifth.

## 3. The model

3.1. Household and firms

Households in this economy maximize the expected value of their utility function from $t = 0$ to infinity. We assume that the utility function is separable between consumption and leisure, and that for individual $i$ in time $t$ it can be represented by:

$$U^i = u(c_t^i) - v(n_t^i) \tag{1}$$

where $u(\cdot)$ and $v(\cdot)$ are strictly increasing mappings that satisfy regular conditions, $c$ is consumption, and $n$ the hours worked. As in Hansen (1985) we assume that labor is indivisible: individuals can either work full time, i.e., $n_t^i = \bar{n}$, or not at all.

There are two types of individuals: those that have access to the capital market and can borrow or save in it to smooth their consumption, which represent a fraction $(1 - \theta)$ of the population, and those that do not have access to the capital market, consuming their income each period, which represent a fraction $\theta$ of the population.

The unemployment insurance consists of an individual account with funds amounting to $\Phi_t$, financed with a payroll tax at rate $\tau$. The individual becomes unemployed with a probability $(1 - p)$, in which case he can withdraw funds from his unemployment insurance account.[4] Individuals do not know ex-ante whether they are going to be unemployed next period. This setup mimics the Chilean unemployment insurance which, as discussed above, provides the right a maximum of five months of decreasing unemployment benefits. As the model time-period is a year, we assume a unique withdrawal from the individual account when individuals become unemployed.

We denote by $w$ and $\delta$ the per hour wage and per period rate of depreciation of the capital stock, respectively. In each period there are four types of individuals, as described by the four potential situations presented in Table 1:

[4] In the simulations below we will assume that each period is one year. In the Chilean unemployment insurance program one year of contributions is required to be eligible to the unemployment insurance. The withdrawal period, however, is less than a year. The implicit assumption is that all accumulated funds are exhausted during the year in which the individual is unemployed.

**Table 1**

**Fraction of the population in the four potential employment-access-to-capital markets situations**

| | Works | Unemployed |
|---|---|---|
| **Access to the capital market** | p(1-θ) | (1-p)(1-θ) |
| **Does not have access to the capital market** | pθ | (1-p)θ |

To model the existence of different types of individuals in the labor market, we will assume that households can engage in employment lotteries as in Hansen (1985). The idea is that households know that once the uncertainty is resolved a fraction $p$ will be employed while a fraction $(1 - p)$ will be unemployed. However, individuals do not know ex-ante whether they will be employed or not. To face this uncertainty, individuals engage in contracts assuring a fix payment no matter what the employment status turn out to be, while the employment status is resolved by a lottery. As a result a participant will work (full time) with probability $p$ or will not work with probability $(1 - p)$. The fixed payment is set at $w_t(1-\tau)\bar{n}p$, which is the expected after tax labor income.

As shown in Hansen (1985), the instantaneous expected utility function can be written as:

$$E(U) = \sum_{t=0}^{\infty} \beta^t \left[ u(c_t) - N_t \alpha_0 \right], \tag{2}$$

where $\beta$ is the discount factor, $\alpha_0 = v(\bar{n})/\bar{n}$, and the number of hours worked, $N_t$, is defined by: $N_t = p\bar{n}$. We will assume that $u(c_t) = \ln(c_t)$.

The expected budget constraint and the time paths that emerge from the employment lotteries and capital market access are:

$$c_t + i_t(1-\theta) = (1-\theta) r_t k_t + w_t(1-\tau)\bar{n}p + (1-p)\Phi_t \tag{3}$$

$$k_{t+1} = (1-\delta)(1-\theta)k_t + i_t(1-\theta) \tag{4}$$

$$\Phi_{t+1} = w_t \tau \cdot \bar{n} p + p\Phi_t \tag{5}$$

In summary, the household maximizes (2), subject to (3)–(5). Note that equations (3) and (5) indicates how the unemployment insurance works in our setup. In one hand, it works as additional income if the household becomes unemployed. This case occurs with probability (1-p) and since the amount available in the unemployment insurance at t is $\Phi_t$, the additional unemployment insurance income is (1-p)$\Phi_t$. The way funds accumulated in the unemployment insurance account evolved is described in (5). There are two sources of funds at the beginning of next period. In one hand, p$\Phi_t$ of total initial funds at t are carried over to the next period. In another hand contributions, $w_t \tau \cdot \bar{n} p$, of current workers are saved in the unemployment insurance account.

We also assume a single firm with technology described by a standard Cobb-Douglas production function of the form:

$$Y_t = Z_t (k_t)^{\alpha} (N_t)^{1-\alpha} \tag{6}$$

where $k$ is capital, $N$ is labor and $Z$ represents technology, which is assumed to follow a first order Markov process. In particular, $Z$ obeys the following law of motion:

$$\log(Z_t) = \rho \log(Z_{t-1}) + \varepsilon_t \tag{7}$$

where $\rho$ is the first order autocorrelation coefficient and $\varepsilon_t$ is a random shock with a normal distribution with mean zero and variance $\sigma_{\varepsilon}^2$. We assume that markets clear, i.e., $k_t = k_t^d; N_t = N_t^d; c_t + i_t + \Delta\Phi_t = Y_t$, where the superscript "*d*" denotes demand.

3.2. Optimality conditions

The first order conditions of our problem are:

$$1 = \beta E_t \left[ \frac{c_t}{c_{t+1}} (1 - \delta + r_{t+1})(1 - \theta) \right] \tag{8}$$

$$\alpha_0 c_t = w_t \left[ 1 - \tau + \frac{\mu_t}{\lambda_t} \tau \right] \tag{9}$$

$$w_t = (1-\alpha)\frac{Y_t}{N_t} \tag{10}$$

$$r_t = \alpha\frac{Y_t}{K_t} \tag{11}$$

$$c_t + i_t = Y_t + \Phi_t p - \Phi_{t+1} \tag{12}$$

$$k_{t+1} = (1-\delta)(1-\theta)k_t + (1-\theta)i_t \tag{13}$$

$$\Phi_{t+1} = p\Phi_t + w_t N_t \tau \tag{14}$$

$$Y_t = Z_t (k_t)^{\alpha} (N_t)^{1-\alpha} \tag{15}$$

$$\log(Z_t) = \rho \log(z_{t-1}) + \varepsilon_t \tag{16}$$

Equation (8) is the Euler condition for present and future consumption. Equation (9) states that the marginal rate of substitution between consumption and leisure is equal to the adjusted wage. Equations (10) and (11) are the usual first order conditions for the factor (labor and capital) markets. Equation (12) is the aggregate budget constraint for period *t*. Equations (13) and (14) represent the law of motions for *k* and Φ. Finally, equation (15) is the production function and equation (16) is the technology shock.

## 4. Calibration and Simulation

### 4.1 Business Cycle Observations in Chile

The model is calibrated to reproduce the stylized facts of the Chilean economy. We use Chilean national account statistics from 1960 to 2000 reported yearly, obtained from Diaz, Luders, and Wagner (2005). Table 2 reports several statistics of interest calculated from annual data. All the variables are measured in natural logarithms. To calculate the standard deviations, the series are detrended using the HP filter.

The data show significant volatility that decreases over time. The period from 1986 to 2000 is less volatile in almost all the variables included in the table. These data show more volatility than those reported by Bergoing and Soto (2005) for Chile for the latter period. In their case, output and consumption have standard deviations of approximately

2.2 percent, while investment has a standard deviation of 7.47.[5] On the other hand, our results are less volatile than those reported in Carmichael, Kéita and Samson (1999) for a large set of developing economies including Chile.

**Table 2**
**Business Cycle Statistics: standard deviations of Real GDP, Investment, Consumption, Labor. (%)**

| | $\sigma_Y$ | $\sigma_L$ | $\sigma_C$ | $\sigma_I$ | $\sigma_K$ | $\sigma_{Y/L}$ |
|---|---|---|---|---|---|---|
| 1960-2000 | 5.84 | 3.60 | 8.18 | 14.60 | 1.57 | 4.21 |
| 1960-1980 | 6.27 | 3.00 | 9.39 | 13.35 | 1.28 | 4.42 |
| 1980-2000 | 5.93 | 4.24 | 7.09 | 17.04 | 1.79 | 4.26 |
| 1986-2000 | 3.94 | 2.64 | 4.79 | 11.65 | 1.91 | 3.76 |

The variables are the natural logarithms of GDP (Y), consumption (C), gross fixed investment expenditure (I), capital stock (K), and output per capita (Y/L). The variables are de-trended by using the HP filter using a smoothing parameter equal to 100. The notation $\sigma_{(i)}$ indicates standard deviation.

The standard deviations reported here are also larger than those reported for developed economies (see Hansen, op.cit.). However, there are some similarities with developed economies. First, the volatility of the real capital stock is much lower than the volatility of real output, while investment volatility is about three times that of real output. Second, consumption volatility is slightly higher than the volatility of real output. Third, employment volatility is lower than that of real output.

4.2 Simulation method

The model can be solved numerically by computing the competitive equilibrium and representing it in a recursive form. In that case, the firm and household problems should be solved separately, conditional on a conjectured pricing function. If the conjectured pricing function is correct, we should observe no disequilibrium between the supply and demand obtained from the household and firm problems. On the other hand, if the conjectured pricing function is incorrect, there should be a disequilibrium which is corrected by changing the conjectured pricing function. In this procedure, we iterate on this algorithm until no disequilibrium exists.[6] The problem with this method is that convergence can be slow and may not be obtained as there is no guarantee of a contraction mapping. Hence, we follow an alternative procedure, which will now be explained.

[5] Our measure of volatility differs from Bergoing and Soto (2005) because we use the HP filter while Bergoing and Soto do not.
[6] See Judd (1998), and Mendoza and Smith (2003).

Following Mendoza (2004), we decided to solve a quasi-social planner problem. As we face an economy with distortionary taxes, the social planner's solution may not coincide with the competitive equilibrium solution. In fact, we know from the optimality conditions that the labor supply decision is distorted by the factor $\left[1-\tau+\frac{\mu_t}{\lambda_t}\tau\right]$, where $\mu_t$ is the Lagrange multiplier associated with the UI restriction and $\lambda_t$ is the Lagrange multiplier associated with the individual's budget constraint. Therefore, when $\mu_t$ is approximately equal to $\lambda_t$, the distortion is negligible and the social planner's solution coincides with that of competitive equilibrium. This ratio can be obtained from our computations,[7] which implies that computing the quasi social planner solution can be as good as solving for competitive equilibrium through the iteration procedure described above. This is the procedure we follow here.

To solve the quasi-social planner problem, we write the individual's problem including the firm's optimality and the market clearing conditions in the following single dynamic programming equation:

$$v(k_t,\Phi_t,z_t)=\max_{\{N_t,i_t\}} u\Big((1-\tau_t(1-\alpha)-(1-\theta)\alpha)z_t k_t^{\alpha}N_t^{1-\alpha}+(1-p)\Phi_t-i_t\Big)$$
$$-\alpha_0 N_t+\beta E_t\left[v(k_{t+1},\Phi_{t+1},z_{t+1})\middle|k_t,\Phi_t,z_t\right]$$
$$s.t.$$

$$k_{t+1}=(1-\delta)(1-\theta)k_t+(1-\theta)i_t$$
$$\Phi_{t+1}=\tau_t(1-\alpha)z_t k_t^{\alpha}N_t^{1-\alpha}+p\Phi_t$$

where $v(k_t,\Phi_t,z_t)$ is the value function, $(k_t,\Phi_t,z_t)$ are the state variables, and $(i_t,N_t)$ are the decision variables. The solution method for this dynamic programming equation is the standard linear-quadratic methodology (Cooley and Prescott, 1995) used in the real business cycle (RBC) literature. Therefore, we define the return function of the problem as $r(z_t,k_t,\Phi_t,N_t,i_t)\equiv u\Big((1-\tau_t(1-\alpha)-(1-\theta)\alpha)z_t k_t^{\alpha}N_t^{1-\alpha}+(1-p)\Phi_t-i_t\Big)-\alpha_0 N_t$. We then approximate the return function by a second order Taylor expansion:

$$r(z_t,k_t,\Phi_t,N_t,i_t)\cong r(z_{SS},k_{SS},\Phi_{SS},N_{SS},i_{SS})+(W-W_{SS})^T J_{SS}+(W-W_{SS})^T H_{SS}(W-W_{SS})$$

where $W=[z\ k\ \Phi\ N\ i]^T, W_{SS}=[z_{SS}\ k_{SS}\ \Phi_{SS}\ N_{SS}\ i_{SS}]^T$ and $J_{SS}$, $H_{SS}$ are the Jacobian and Hessian of the function $r(z_t,k_t,\Phi_t,N_t,i_t)$ evaluated at the steady state, respectively. Using

[7] In our computations, the ratio $\mu_t/\lambda_t$ is approximately equal to 0.9.

this quadratic approximation, in addition to approximating the evolution of unemployment insurance by means of a first order Taylor expansion, we can write the Bellman equation as:

$$v(k_t, \Phi_t, z_t) = \max_{\{N_t, i_t\}} \left[1 \; W^T\right] \begin{bmatrix} Q_{11} & Q_{12} \\ Q_{21} & Q_{22} \end{bmatrix} \begin{bmatrix} 1 \\ W \end{bmatrix} + \beta E_t \left[ v(k_{t+1}, \Phi_{t+1}, z_{t+1}) \middle| k_t, \Phi_t, z_t \right]$$

$s.t.$

$$k_{t+1} = (1-\delta)(1-\theta)k_t + (1-\theta)i_t,$$
$$\Phi_{t+1} = \tau(1-\alpha)k_{SS}^{\alpha} N_{SS}^{1-\alpha} z_t + \tau(1-\alpha)\alpha z_{SS} k_{SS}^{\alpha-1} N_{SS}^{1-\alpha} k_t + \tau(1-\alpha)^2 z_{ss} k_{SS}^{\alpha} N_{SS}^{-\alpha} N_t + p\Phi_t,$$

where

$$Q_{11} = r(z_{SS}, k_{SS}, \Phi_{SS}, N_{SS}, i_{SS}) - W_{SS}^T J_{SS} + W_{SS}^T H_{SS} W_{SS}, Q_{12} = \frac{1}{2}(J_{SS} - H_{SS} W_{SS}) \; Q_{22} = \frac{1}{2} H_{SS},$$

Finally, to solve the problem, we guess a quadratic value function, and solve it using successive iterations of the Ricatti equation (see Ljunqvist and Sargent, 2001).

4.3 Calibration of the parameters

We assume that $\delta$ (the rate of depreciation of the capital stock) is 5.3%, as estimated by the Chilean Ministry of Finance.[8] The discount factor $\beta$ is assumed to be 0.99. The share of capital in production ($\alpha$) is set at 0.4. We estimated the production function residual using Chilean data from 1960 to 2000 by:

$$\log(Z_t) = \log(Y_t) - \alpha \log(k_t) - (1-\alpha)\log(N_t)$$

The first-order autocorrelation coefficient for $Z_t$ is 0.95, indicating high serial correlation in this series. Hence we used this value for the parameter $\rho$. The standard deviation of the error ($\varepsilon_t$) is estimated to be 0.099. Finally, for $p$ (the probability of being employed) we use 0.9.[9]

[8] Ministry of Finance (2005).

[9] According to the Ministry of Finance (op.cit.) the natural unemployment rate in Chile is close to 8%, which would imply a p of 0.92.

### 4.4 Simulation Results

In the simulations, we use different values of $\theta$ and we compute our statistics using 2,000 simulations, where each simulation was done by drawing a technological shock from the normal distribution specified above. Each simulation has 45 periods. Table 3 presents the simulation results obtained from our model when $\theta = 10\%$ (i.e. 10% of the population is excluded from the capital market).

To focus on analyzing the impact of introducing UI, it is instructive to compare the results in the first row of the table (where there is no UI) with the results in the other rows. The table shows that as we increase the tax rate (ie. the size of the UI program), volatility decreases, especially in the case of consumption. However, this effect is less clear in the case of output and investment. In fact, the volatility of these variables shows a marked fall only when the tax rate is greater than 3 percent. A related result is that as we increase the tax rate, the steady state consumption level decreases due to the distortions such an increase introduces into the labor supply decision. There are thus two effects of increasing the tax rate which have opposing effects on individuals' welfare: (1) consumption volatility falls, but at the cost of (2) lowering the steady state level of consumption. As shown in the table, the overall impact is a fall in individual welfare. It should be noted that this last result depends on the specification of the utility function, which in this case is linear in labor and logarithmic in consumption.

Table 4 shows the results of a similar exercise, but for the case in which $\theta$ (the fraction of individuals with no access to capital markets) increases to 20% of the population. The volatility of consumption here is larger than that reported in Table 3. It is of interest to note that even though the steady state level of consumption decreases as we increase the size of the UI program, total welfare initially rises as the effect of the lower volatility more than offsets the labor market distortion introduced by the UI program. The initial positive impact on welfare later becomes negative as the distortions imposed on steady state consumption become larger.

From these results we conclude that in economies with a larger fraction of population with no access to the capital market, an unemployment insurance scheme can be welfare improving as the distortionary effect of the tax used to finance the UI scheme is more than compensated by the benefits of reducing the liquidity constraint. As the unemployment insurance program becomes larger, i.e. the tax rate increases, the distortionary effect dominates and welfare decreases.

**Table 3**
**Simulation results for various tax rates**
**($\theta$ = 0.1 and 2,000 simulations)**

| | $\sigma_Y$ | $\sigma_C$ | $\sigma_I$ | $\sigma_K$ | $\sigma_L$ | $\sigma_{Y/L}$ | Css ($\tau$ = 0, 100) | Welfare ($\tau$ = 0, 100) |
|---|---|---|---|---|---|---|---|---|
| $\tau$ = 0.00 | 4.04 (1.03) | 3.88 (0.94) | 5.02 (1.16) | 2.70 (0.29) | 1.52 (0.39) | 2.96 (0.67) | 100 | 100 |
| $\tau$ = 0.01 | 4.04 (1.04) | 3.84 (0.95) | 5.02 (1.18) | 2.65 (0.29) | 1.52 (0.39) | 2.96 (0.68) | 99.97 | 99.75 |
| $\tau$ = 0.02 | 4.03 (1.09) | 3.81 (1.00) | 5.01 (1.22) | 2.62 (0.31) | 1.52 (0.40) | 2.96 (0.72) | 99.95 | 99.53 |
| $\tau$ = 0.03 | 4.01 (1.08) | 3.79 (1.00) | 5.01 (1.22) | 2.58 (0.31) | 1.52 (0.40) | 2.96 (0.72) | 99.93 | 99.47 |
| $\tau$ = 0.04 | 4.01 (1.09) | 3.74 (1.00) | 4.98 (1.22) | 2.54 (0.30) | 1.51 (0.40) | 2.96 (0.72) | 99.91 | 99.32 |
| $\tau$ = 0.05 | 3.98 (1.07) | 3.68 (0.99) | 4.94 (1.21) | 2.50 (0.30) | 1.50 (0.40) | 2.95 (0.71) | 99.88 | 99.30 |
| $\tau$ = 0.10 | 3.96 (1.06) | 3.54 (0.99) | 4.92 (1.20) | 2.31 (0.31) | 1.47 (0.39) | 2.94 (0.72) | 99.77 | 99.03 |

The variables are the natural logarithms of GDP (Y), consumption (C), gross fixed investment expenditure (I), capital stock (K), and output per capita (Y/L). The variables are de-trended by using the HP filter using a smoothing parameter equal to 100. The notation $\sigma_{(i)}$ indicates standard deviation. The standard deviations of the estimates appear in parentheses.

**Table 4**
**Simulation results for several tax rates**
**($\theta$ = 0.2 and 2,000 simulations)**

| | $\sigma_Y$ | $\sigma_C$ | $\sigma_I$ | $\sigma_K$ | $\sigma_L$ | $\sigma_{Y/L}$ | Css ($\tau$ = 0, 100) | Welfare ($\tau$ = 0, 100) |
|---|---|---|---|---|---|---|---|---|
| $\tau$ = 0.00 | 3.82 (0.93) | 5.35 (0.95) | 3.55 (0.84) | 5.01 (0.28) | 1.39 (0.16) | 3.90 (0.77) | 100 | 100 |
| $\tau$ = 0.01 | 3.80 (0.92) | 5.26 (0.94) | 3.52 (0.83) | 4.96 (0.27) | 1.39 (0.16) | 3.88 (0.76) | 99.98 | 102.01 |
| $\tau$ = 0.02 | 3.78 (0.90) | 5.19 (0.92) | 3.47 (0.82) | 4.90 (0.28) | 1.38 (0.16) | 3.86 (0.74) | 99.96 | 100.09 |
| $\tau$ = 0.03 | 3.82 (0.98) | 5.17 (1.00) | 3.50 (0.89) | 4.85 (0.29) | 1.39 (0.18) | 3.89 (0.81) | 99.94 | 100.05 |
| $\tau$ = 0.04 | 3.77 (0.95) | 5.07 (0.99) | 3.44 (0.83) | 4.78 (0.28) | 1.37 (0.16) | 3.85 (0.81) | 99.91 | 100.14 |
| $\tau$ = 0.05 | 3.74 (0.91) | 4.98 (0.93) | 3.42 (0.82) | 4.71 (0.27) | 1.37 (0.16) | 3.83 (0.76) | 99.90 | 99.83 |
| $\tau$ = 0.10 | 3.68 (0.93) | 4.67 (0.97) | 3.29 (0.81) | 4.41 (0.27) | 1.36 (0.16) | 3.77 (0.80) | 99.78 | 99.69 |

The variables are the natural logarithms of GDP (Y), consumption (C), gross fixed investment expenditure (I), capital stock (K), and output per capita (Y/L). The variables are de-trended by using the HP filter using a smoothing parameter equal to 100. The notation $\sigma_{(i)}$ indicates standard deviation. The standard deviations of the estimates appear in parentheses.

4.5 Impulse response functions

We now consider the dynamics of the model in two cases: (1) the absence of unemployment insurance and (2) a 3% tax on labor income to provide for unemployment insurance. To do so, we examine the impulse-response functions of our variables of interest when a negative 1% technological shock occurs.

Figures 1 to 6 plot the response of consumption, investment, capital stock, hours of work, unemployment insurance and GDP. The variables experience the negative effects of the technological shock as can be seen in the figures. However, what emerges from these figures is that the variables' time paths do not differ significantly in the presence or absence of unemployment insurance: some smoothing is observed when there is unemployment insurance, but the difference between the two cases is small.

To conclude, the impulse response functions indicate that although introducing UI results in some smoothing of the business cycle, the effect is of the second order of magnitude.

## 5. Policy implications

The main objective of unemployment insurance is to decrease the earnings volatility of a specific fraction of the population: the unemployed. In our numerical simulations we consider whether such a policy −targeted to a specific group− transmits its income stabilization properties to the rest of the economy.

The Chilean experience is of interest for two reasons. First, Chile is an economy which underwent large economic shocks during the 20$^{th}$ century, making a reduction in the volatility of the business cycle an important objective. Furthermore, for an economy susceptible to large shocks decreasing the volatility of the business cycle might imply considerable welfare gains. Therefore, Chile is a case study for economies facing large economic shocks, which is often the case for developing economies. Second, Chile recently implemented an unemployment insurance program based on individual accounts as opposed to the standard government transfer-financed system. Hence, the Chilean case permits analysis of the impact of unemployment insurance based on individual accounts, hitherto absent from the literature.

From an economic policy perspective, our results (Table 3) suggest that as we increase the size of the unemployment insurance program, the volatility of the main economic variables declines, but only slightly. This result indicates that even in an economy with large shocks, in which there are large potential gains from stabilizing the business cycle, a stabilization policy aimed at a small fraction of the population has very little stabilizing power. Additionally, the UI policy lowers welfare. This is because the unemployment insurance program has two macroeconomic effects which operate in opposing directions. On the one hand, it reduces consumption volatility and therefore increases welfare. However, on the other hand it distorts labor supply decisions by affecting the marginal rate of substitution between consumption and labor, which reduces welfare. In Table 3, the latter effect is larger.

In Table 4 we change a key assumption: we assume that a larger fraction of the population is credit constrained. In this exercise, the standard deviation of consumption decreases from 5.35% to 4.67% when the contribution to the unemployment insurance program goes from 0% to 10% of labor income. More interestingly, welfare increases when contributions to the program are low. In this case, the lower volatility of consumption more than offsets the labor market distortion.

There are two reasons behind this result. Firstly, since a larger fraction of the population is credit constrained, the economy as a whole faces greater consumption volatility. In such an environment, economic instruments that permit reductions in the volatility of consumption (e.g. the unemployment insurance program) are more valuable. Secondly, even though the Chilean UI program introduces a labor market distortion, it is not as large as in alternative unemployment insurance programs. Indeed, in the Chilean system upon becoming unemployed, individuals recover most of their contribution[10] by drawing on their individual accounts.

In summary, our study suggests that an unemployment insurance program is more likely to be welfare improving in economies: (1) where the credit constrained make up a large fraction of the population, (2) that are subject to large technological shocks, and (3) in which the design of the unemployment insurance system is based on less distortionary programs, such as one based on individual accounts.

## 6. Conclusions

This paper studies the effects of unemployment insurance on the business cycle. We consider whether the unemployment insurance program that was introduced in Chile in October 2002 has had stabilizing effects on the business cycle, simulating the presence of this insurance over the 1960-2000 period. We use a dynamic general equilibrium model à la Hansen (1985), where the economy is subject to exogenous technological shocks which produce fluctuations in output, investment, consumption and employment. The model also has a fraction of the population that is liquidity constrained: individuals who do not have access to the capital market and hence cannot save, forcing them to consume their income, thus making their consumption more volatile. Such individuals cannot replicate the unemployment insurance program in the capital market, which makes this program potentially welfare improving.

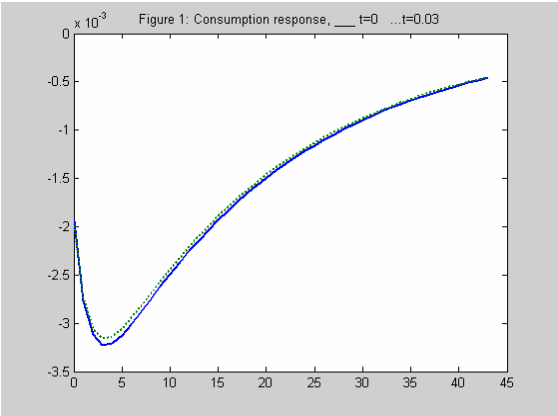
Our results show that unemployment insurance reduces the volatility of the macroeconomic variables under consideration, especially the volatility of consumption. However, the effect is rather small. We conclude that the most appropriate justification for the current unemployment insurance program in Chile is that advanced when it was

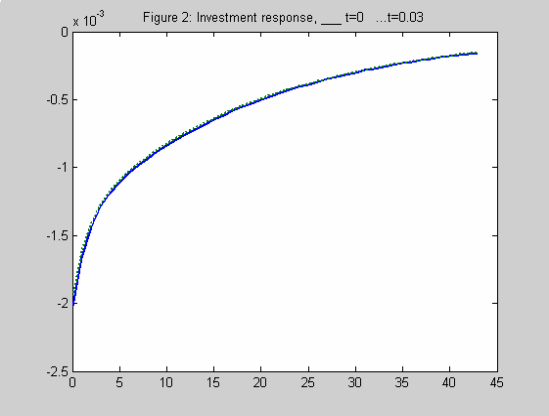
[10] They do not recover all because part goes to the solidarity fund.

created: that it improves the welfare of the poor when they are unemployed. The possible additional justification explored in this paper – the stabilization of the business cycle – does not seem to be large enough to be considered an important achievement of the program.

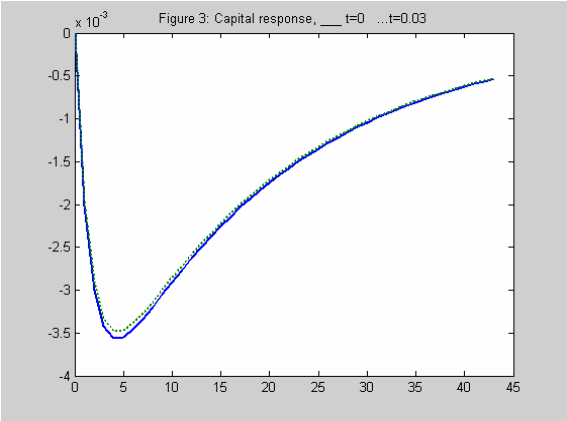
We also conclude that the larger the population with liquidity constraints the more likely that the unemployment insurance program is welfare improving. This is because on the one hand the program loosens the constraint for those that are liquidity constrained, but on the other it is funded via distortionary taxation. The larger the fraction of the population that is liquidity constrained, the more important the welfare improving first effect. We also find that as the tax rate increases, the distortionary effect becomes more significant and the likelihood that the program will reduce welfare rises.

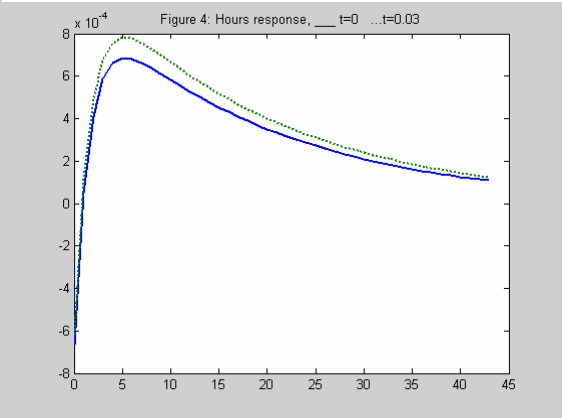
A final consideration relates to the potential instruments that an economy like Chile, which faces large exogenous shocks, has at hand for stabilizing the business cycle. This paper suggests that the unemployment insurance is not an efficient way of attaining this goal. Although not the topic of this paper, it is likely that policies such as Chile's current fiscal structural balance,[11] or a price-smoothing fund for the commodities it produces[12] are more efficient means of smoothing the business cycle.

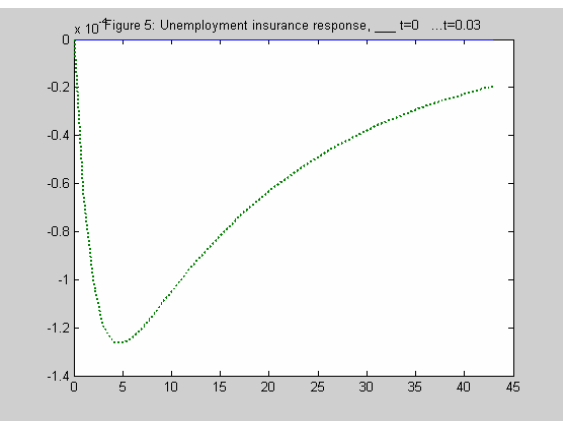


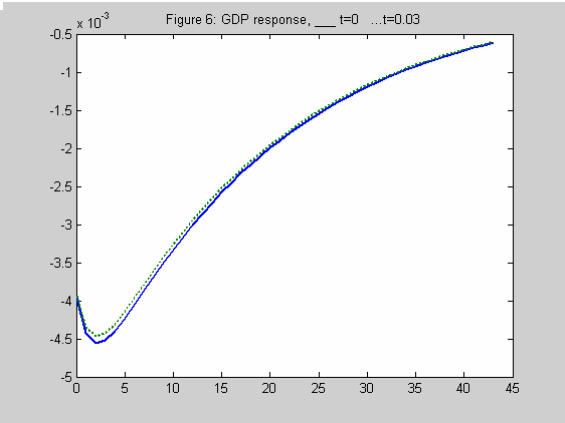




[11] Where the government saves in above-trend-growth periods and dissaves in recessions (see Marcel, et. al, 2000).
[12] Such as the current copper compensation fund.




## References


Atkenson, A. and Phelan, C. (1994). "Reconsidering the Cost of business Cycles with Incomplete Markets". *NBER Macroeconomics Annual* 1994, MIT Press, Cambridge, MA., pp. 187 – 207.

Baily, M., (1977). "Unemployment Insurance as Insurance for Workers". *Industrial & Labor Relations Review* 30 (July), pp 495 – 504.

Beaudry, P., and Pages, C. (2001). "The Cost of Business Cycles and the Stabilization Value of Unemployment Insurance". *European Economic Review* 45, pp.1454-1572.

Bergoing, R., and Soto, R. (2005). "Testing Real Business Cycle Models in an Emerging Economy". In R. Chumacero and K. Schmidt-Hebbel editors, General Equilibrium Models for the Chilean Economy, Central Bank of Chile, Santiago, pp.221-259.

Brown, L. and Ferral, C. (2003). "Unemployment Insurance and the Business Cycle". *International Economic Review* 44 (3), pp. 863-894.

Carmichael, B., Kéita, S., and Samson, L. (1999). "Liquidity Constraint and Business Cycle in Developing Countries". *Review of Economic Dynamics* 2, pp.370-402.

Cooley, T. and Prescott, E. (1995). "Economic Growth and Business Cycles," in T. Cooley (ed.) Frontiers of Business Cycle Research, Princeton University Press.

Diaz, J., Luders, R., and Wagner, G. (2005). La República en Cifras, forthcoming.

Easley, D., Kiefer, N. and Possen, U. (1985). "An Equilibrium Analysis of Optimal Unemployment Insurance and Taxation". *Quarterly Journal of Economics* 100 (supplment), pp 989 – 1010.

Hamermesh, D. (1982). "Social Insurance and Consumption: An Empirical Inquiry". *American Economic Review* 72 (March), pp 101 – 113.

Hansen, G. (1985). "Indivisible Labor and the Business Cycle". *Journal of Monetary Economics* 16 (November), pp 309 – 27.

Hansen, G. and Imrohoroglu, A. (1992). "The Role of Unemployment Insurance in an Economy with Liquidity Constraints and Moral Hazard". *Journal of Political Economy* 100 (1), pp.118-142.

Imrohoroglu, A. (1989). "Cost of Business Cycles with Indivisibilities and Liquidity Constraints". *Journal of Political Economy* 97 (December), pp 1364 – 1383.

Judd, K. (1998). Numerical methods in Economics, The MIT Press, Cambridge, Massachussetts.

Ljunqvist, L. and Sargent, Th. (2001). Recursive Macroeconomic Theory, The MIT Press, Cambridge, Massachusetts.

Lucas, R., 1987. Models of Business Cycles. Basil Blackwell, New York.

Marcel, M., Tokman M., Valdés R. and Benavides, P. (2001). "Balance Estructural del Gobierno Central: Metodología y Estimaciones para Chile: 1987 – 2000", Estudios de Finanzas Públicas, Budgetary Office, Ministry of Finance, September.

Mendoza, E., and Smith, K.A. (2003). "Margin Calls, Trading Costs and Asset Prices in Emerging Markets: the Financial Mechanics of the 'Sudden Stops' Phenomenon", NBER Working Paper Nº 9286.

Mendoza, E. (2004). "Sudden Stops in an Equilibrium Business Cycle Model with Credit Constraints: A Fisherian Deflation of Tobin's q". Draft, april.

Ministry of Finance. (2005). "Acta. Resultados del Comité Consultivo del PIB Tendencial" (July 22). Santiago.
(In http://www.dipres.cl/novedades/Acta_PIB_Tendencial_Julio_2005.html)