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Money and Real Fluctuations: Calibrating a Cash in Advance Model for the Chilean Economy

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Abstract

In this paper we assess the ability of a cash-in-advance model to replicate the behavior of the macroeconomics variables of the Chilean economy for quarterly data spanning between Q1:1986 and Q1:2000. The monetary models that we studied are able to replicate the phase shift and correlation with GDP of many macroeconomics variables such as consumption, price level and productivity. However, there are some other variables in which the model fails; namely money and capital stock. Introducing an “erratic” monetary growth rate improves the ability of the model to replicate the behavior of consumption. A sensitivity analysis shows that the main determinant of output volatility is the standard deviation of technology shock. Other deep parameters do not have an important quantitative effect on the cyclical behaviour of the macroeconomic variables.

JEL Classification: E32, E37, E50.

Keywords: monetary fluctuations, real business cycles, general equilibrium.

I. Introduction

Over the last 20 years, dynamic general equilibrium models have become one of the main tools in modern macroeconomic analysis. Since the seminal work of Kydland and Prescott (1982) many extensions to the baseline model have been made in order to assess many issues originally not analyzed in this model. Such extensions include the analysis of the labour market, open economies, the introduction of money and, fiscal and monetary policy analysis (see Hansen (1985), Mendoza (1991), Cooley and Hansen (1989) and (1992) and Chari *et al.* (1991) and (1995)).

The final objective of this literature is to construct a framework to understand and predict the effects of alternative policies. Previously, it is necessary to check that the framework used to analyze these policies, is able to account for the stylized facts in the economies under study. This exercise has been done for a variety of real business cycle models to assess their ability to mimic the behaviour of the macroeconomic variables of USA. However, the efforts to assess the performance of these models in developing economies, such as Chile, are still insufficient.¹ An important question that remains unanswered is what the effect is of the money fluctuations over the volatility of the main macroeconomic series in a developing economy. In this context, this paper has two objectives. The first is to assess the ability of a cash in advance model to replicate the behaviour of the macroeconomic variables of the Chilean economy for quarterly data spanning between Q1:1986 and Q1:2000. The second objective of this paper is to assess the changes that arise in the behaviour of these variables, in the context of a cash in advance economy, when the monetary growth rate behaves as is observed in the Chilean data.

To achieve the objectives of this paper, we generate artificial data from the Cooley and Hansen (1989) cash in advance model calibrated with the Chilean economy data. Then, we compare the statistical properties of this artificial data with those that are observed in the real data. To achieve the second objective of this paper, it is necessary to compare the results of two versions of the theoretical model: one where the

monetary growth rate is constant and another where the monetary growth rate is “erratic”.

The structure of the paper is the following. In the next section, we provide a brief description of the Chilean economy regarding its cyclical behaviour. In section III we describe the model that we will use to analyze the data. In section IV we report the results of the simulations and compare them with what is observed in the real data. Finally, in section V, we highlight the main findings.

II. Characterizing the Chilean Business Cycle

The objective of this section is to provide a description of the cyclical behaviour of the more important macroeconomic variables of the Chilean economy. The period of analysis spans between Q1:1986 and Q1:2000. In order to reach this objective, it is necessary to isolate the cyclical component (c_t) of the series (y_t), which is the sum of a growth component (τ_t) and a cyclical component, that is, $y_t = \tau_t + c_t$ for $t=1, \dots, T$. This is done using the Hodrick & Prescott (H-P) filter.²

The general idea behind the H-P filter is to balance two opposing objectives: minimize the sum of the squared deviations of the actual series from the trend and, minimize the sum of the squares of the trend component’s second differences. Therefore, the H-P filtering problem is to choose the growth component, τ_t , to minimize the following loss function:

$$\text{Min}_{\{\tau_t\}} \sum_{t=1}^T (y_t - \tau_t)^2 + \lambda \sum_{t=2}^{T-1} [(\tau_{t+1} - \tau_t) - (\tau_t - \tau_{t-1})]^2 \quad (1)$$

where the parameter λ reflects the weight of the second objective. When $\lambda \rightarrow \infty$, the growth component approaches a linear trend, and when $\lambda \rightarrow 0$ the growth component is simply the series.³ For quarterly data is usual to choose $\lambda = 1600$.

Once data is filtered, we study the statistics focused on by the literature (see Kydland and Prescott (1982, 1990)), i.e., standard deviation and cross correlation of different variables with real GDP.⁴

Following Bergoeing and Suárez (1998); who compare the Chilean business cycle with those of Argentina, USA and a sample of OECD countries; we characterize the business cycle of the Chilean economy for quarterly time series (Q1:1986 - Q1:2000). In Table 1 we report the statistics of interest. In this table the first two columns show the series volatility (amplitude of fluctuations), whereas the other columns reflect the degree, direction and phase shift of the correlation between series and real GDP. Salient features of these figures are:

- Investment, Government Purchases and Imports of Goods and Services present high volatility with respect to the real GDP. Exports and Imports are pro-cyclical.
- Private Consumption and Imports are highly pro-cyclical, and their cycle coincides with GDP cycle. Also, we can make a distinction between consumption of non-durable and durable goods, Bergoeing *et al.* (2000) found the durable consumption volatility to be 12.06%, and non-durable consumption volatility to be 1.60%.
- Government Purchases and the long-term interest rate are considered to be uncorrelated with GDP cyclical component because the contemporaneous correlation coefficient, $\rho(t)$, is close to ± 0.10 , the range usually used as the limit in the literature (e.g. Kydland and Prescott (1990)).

- There is a great coincidence between GDP and M1 cyclical behaviour, in fact M1 leads the real GDP cycle by a quarter.⁵ However, notice that the monetary policy instrument is the interest rate, which is counter-cyclical and leads GDP cycle in two periods. M2A money definition is pro cyclical, but it lags the GDP cycle by a quarter.
- Consumer Price Index and Producer Price Index are counter-cyclical, as are the inflation rates for these indices.
- Unemployment is counter cyclical and lags the GDP cycle by a quarter.

Table 2 shows an additional analysis comparing the cyclical behaviour of the Chilean economy with those of Canada and USA. From this table, we can see that the Chilean business cycle does not differ greatly from those of the mentioned countries. In all of these countries, investment is highly volatile; price level is counter cyclical in Chile as in USA, but in this last country the inflation rate is pro-cyclical. Monetary aggregates are less volatile in USA as is productivity. In Canada, non-durable consumption is more volatile than in the other countries. In regard to foreign trade, exports are more volatile in USA than in Chile, and US imports are less volatile than Chilean imports. In Chile and Canada the net exports are counter cyclical.

Given this characterization of the data, we present, in the next section, a brief revision of the theory that we will use to study this data.

III. A Monetary Model

The model that we use to analyze the data was introduced by Cooley and Hansen (1989). In order to isolate the effect of money fluctuations on the dynamics of the economy, we study simulations of two alternative rules for the monetary growth rate: a constant rate and an “erratic” rate. Now, we describe the model in detail.

A Cash in Advance Model

The *cash-in-advance* model was first studied by Lucas and Stokey (1983, 1987). This theory makes a distinction between *cash goods* and *credit goods*. To get “cash intensive” goods (cash goods) it is necessary to hold monetary balances, leading to a *cash-in-advance* constraint.

The economy we study is populated with a large number of identical agents who exist forever and each has identical preferences described by the following utility function:

$$E_0 \sum_{t=0}^{\infty} \beta^t (\log c_t + A \log l_t), 0 < \beta < 1 \quad (2)$$

where c_t represents consumption and l_t is leisure in period t . E_0 is the expectation operator subject to all information available at time zero. β is the subjective discount factor and parameter A is the substitution elasticity between leisure and consumption. In each period the representative agent is endowed with one unit of time, which can be allocated between leisure, l_t , and work hours, h_t , i.e., $h_t + l_t = 1$.

In this model labour is assumed to be indivisible⁶, which means that the representative agent only can work some given positive time fraction, h_0 . The agent sells contracts which specify a probability of working in a given period, π_t . Given that all agents are identical, they will choose the same π_t . Therefore, a fraction π_t of the agents will work h_0 hours, and the remaining $(1 - \pi_t)$ agents will be unemployed during period t . A lottery determines which of the agents work and which do not. Thus, per capita work hours in period t are given by:

$$h_t = \pi_t h_0 \quad (3)$$

The expected utility of the representative agent is:

$$\begin{aligned} u(c_t, h_t) &= \log c_t + \pi_t A \log(1 - h_t) + (1 - \pi_t) A \log(1) \\ &= \log c_t + h_t A (\log(1 - h_t)) / h_0 \end{aligned} \quad (4)$$

We can rewrite (4) as:

$$u(c_t, h_t) = \log c_t - B h_t, \quad \text{where } B = -A (\log(1 - h_0)) / h_0 \quad (4.1)$$

The representative agent must choose consumption (c_t), investment (i_t) and nominal money holdings (m_t) subject to the following budget constraint:

$$c_t + i_t + \frac{m_t}{p_t} \leq w_t h_t + r_t k_t + \frac{(m_{t-1} + (g_t - 1)M_{t-1})}{p_t} \quad (5)$$

The capital letters denote per capita quantities that are determined in equilibrium but are not influenced by the actions of any individual agent, and lower-case letters denote quantities associated with a particular agent. In equilibrium they will be the same.

Equation (5) tell us that agent expenditure must satisfy a budget constraint. The budget includes income from capital and labour, currency carried from the previous period and a transfer equals to $(g_t - 1) M_{t-1} / p_t$, where $(g_t - 1)$ is the monetary growth rate and p_t is the price level.

The consumption choice must satisfy the following cash in advance constraint:

$$p_t c_t \leq m_{t-1} + (g_t - 1) M_{t-1} \quad (6)$$

The law of motion for the capital stock is:

$$k_{t+1} = (1 - \delta)k_t + i_t, \quad 0 \leq \delta \leq 1 \quad (7)$$

where δ is the depreciation rate.

The law of motion for the monetary stock is:

$$M_t = g_t M_{t-1} \quad (8)$$

where M_t is the per capita money supply in period t , and g_t is the monetary growth factor, which is decided by the monetary authority.

In order to reach the objectives of this paper we study two versions for the money growth factor: firstly, g_t is assumed to be constant and, secondly, g_t evolves according to an AR(1) process:

$$\log(\mathbf{g}_{t+1}) = \alpha \log(\mathbf{g}_t) + \xi_{t+1} \quad (9)$$

where ξ_t is an i.i.d. random variable with expected value $(1 - \alpha)\log(\hat{g})$ and variance σ_{ξ}^2 . Note that $\log(\hat{g})$ is the unconditional expectation of the logarithm of the growth rate g_t . Finally, it is assumed that g_t is revealed to all the agents at the beginning of period t . As in Cooley and Hansen (1989), the motivation behind the selection of an AR(1) process for the money growth rate is simplicity.

Equation (9) is very important for the objective of the paper because it reflects the erratic behaviour of monetary growth. That equation is estimated from the Chilean data.

There is a firm that produces output, Y_t , using a constant returns-to-scale technology on capital (K_t) and work (H_t):

$$Y_t = \exp(z_t) K_t^{\theta} H_t^{1-\theta}, \quad 0 \leq \theta \leq 1 \quad (10)$$

where z_t is an exogenous technology shock that follows a law of motion given by:

$$z_{t+1} = \gamma z_t + \varepsilon_{t+1}, \quad 0 \leq \gamma \leq 1 \quad (11)$$

where ε_t is an i.i.d. random variable with mean zero and variance σ_{ε}^2 . We assume that z_t , like g_t , is revealed to all agents at the beginning of period t .

The firm seeks to maximize profit, which is equal to $Y_t - w_t H_t - r_t K_t$. The necessary first order conditions for the firm's problem yield the following functions for the wage rate and rental rate of capital:

$$w(z_t, K_t, H_t) = (1 - \theta) \exp(z_t) K_t^{\theta} H_t^{-\theta} \quad (12)$$

$$r(z_t, K_t, H_t) = \theta \exp(z_t) K_t^{\theta-1} H_t^{1-\theta} \quad (13)$$

If g is greater than 1, both M and p will growth without limit. Because the solution method requires that all variables fluctuate around a constant mean (steady state), it is necessary to introduce the following change of variables: $\tilde{m}_t = m_t/M_t$ and $\tilde{p}_t = p_t/M_t$.

From here on, Model 1 will refer to the model with constant monetary growth rate, and Model 2 to the model with an “erratic” monetary growth rate.

Let $V(z, g, \tilde{m}, K, k)$ be the value function of the representative agent problem. We can write the individual’s problem as the solution of the following Bellman’s equation:

$$V(z, g, \tilde{m}, K, k) = \max\{u(c, h) + \beta E[V(z', g', \tilde{m}', K', k') | z, g, \tilde{m}, K, k]\} \quad (14)$$

Subject to:

$$c + i + \frac{\tilde{m}'}{\tilde{p}} \leq w(z, K, H)h + r(z, K, H)k + \frac{(\tilde{m} + g - 1)}{\tilde{p}g} \quad (14.1)$$

$$c \leq \frac{(\tilde{m} + g - 1)}{\tilde{p}g} \quad (14.2)$$

$$z' = \gamma z + \varepsilon' \quad (14.3)$$

$$g' = g = \hat{g} \quad (\text{Model 1}) \quad (14.4)$$

$$\log(g') = \alpha \log(g) + \xi' \quad (\text{Model 2}) \quad (14.5)$$

$$k' = (1 - \delta)k + i \quad (14.6)$$

$$K' = (1 - \delta)K + I \quad (14.7)$$

And subject to c, i, \tilde{m} being non-negative, and $0 \leq h \leq 1$. Primes denote next period values.

A *Stationary Competitive Equilibrium* for this economy consists of a set of the decision rules $c(s), i(s), \tilde{m}'(s)$ and $h(s)$, where $s = (z, g, \tilde{m}, K, k)$ are the state variables of the dynamic programming problem; a set of aggregate decision rules, $I(S)$ and $H(S)$, where $S = (z, g, K)$; a pricing function $\tilde{p}(S)$, and a value function $V(s)$ such that:

- i) the functions V, I, H and \tilde{p} satisfy (14)-(14.7) and c, i, \tilde{m}' , and h are the associated set of decision rules;
- ii) $i = I, h = H$ and $\tilde{m}' = 1$ when $k = K$ and $\tilde{m} = 1$; and
- iii) the functions $c(s)$ and $i(s)$ satisfy: $c(s) + i(s) = Y(S)$, for all s .

All these conditions characterize an economy where agents, both households and firms, behave optimally and all markets are clear.

Parameterisation of the Model

Now we describe the procedures that we used to assign values to the deep parameters of the model, i.e. β , γ , σ_ε , $\log(\hat{g})$, σ_ξ , α , θ , h_0 , δ , A .

To obtain the discount factor β , we use the Euler equation for consumption $\beta=1/(1+r)$. Using the quarterly deposit rate, we obtained an average β of 0.9859.⁹ When we use annual deposit rate we obtain a quarterly average β of 0.9851.

Since the technology shock, z_t , is not directly observed in the data, it is obtained in an indirect way using the production function given by equation (10), and solving for z :

$$z_t = \log Y_t - \theta \log K_t - (1 - \theta) \log H_t \quad (15)$$

Once the values for z are obtained, we estimate equation (11). We obtain a value for γ of 0.99 and a value for the standard deviation for residuals, σ_ε , of 0.017872.

In order to obtain the parameters associated to the law of motion of $\log(g)$ we run the following regression:

$$\Delta \log M_t = \gamma_0 + \gamma_1 \Delta \log M_{t-1} + \eta_t \quad (16)$$

to obtain the following result:

$$\Delta \log M_t = 0.016219093 + 0.14908857 \Delta \log M_{t-1} \quad (17)$$

where γ_0 represents $(1 - \alpha)\log(\hat{g})$ and γ_1 represents α . The standard deviation associated to the residuals of equation (16) is 0.044268. Here we use the M1 aggregate for M_t .

To obtain θ we use the Euler equation:

$$\theta = \frac{[1 - \beta(1 - \delta)] i_t}{\beta \delta y_t} \quad (18)$$

where i_t / y_t is the investment output ratio. The computation of θ is made using a quarterly depreciation rate, δ , equal to 2.5%. We obtained an average capital share equal to 0.40.

The parameter associated to indivisible labour, h_0 , is obtained assuming that total available hours per week are 112 (16 daily hours, 7 days a week). Also, if we consider that any worker must work 48 hours per week, h_0 , is the weekly work-hour to leisure-hour ratio.

To obtain A, we follow Hansen (1985), who calibrates this parameter in such a way that h_t gives the leisure share in steady state. To be able to do this, we first obtain the share of leisure from the occupation data taken from the INE (National Statistics Institute), which gives an average leisure share of 60.63%. Thus, the value of A that allows h to replicate the steady state leisure share is 1.563. Table 3 contains a summary of the parameter values.

Solving the Model

To solve the model we use an algorithm developed by Hansen and Prescott (1995). The optimal policy rules associated to the decision variables for Model 1 are the following:

$$\mathbf{I} = 0.9972 + 2.0151 z - 0.0298 K \quad (19.1)$$

$$\tilde{\mathbf{p}} = 1.1558 - 0.4555 z - 0.0223 K \quad (19.2)$$

For Model 2, the policy rules are:

$$\mathbf{I} = 0.9939 + 2.0151 z + 0.1691 \log g - 0.0298 K \quad (20.1)$$

$$\tilde{\mathbf{p}} = 1.1539 - 0.4555 z + 0.0989 \log g - 0.0223 K \quad (20.2)$$

IV. Results

In this section we provide the results obtained from the simulation of the model under both alternative monetary growth rules. Also, we include a sensitivity analysis describing how much parameters affect results.

*Simulation Results*¹⁰

We ran 1200 simulations and obtained the statistics of interest for each of them. The results are reported in tables 4 and 5. A comparison regarding the volatility of both models with volatility in the real data is provided in Table 6. Both models fails to replicate GDP, investment, average work hours, unemployment and productivity volatility. However, Model 2 performs better than Model 1 replicating non-durable consumption volatility. A result, which was also found by Cooley and Hansen (1989), is that when money grows at an erratic rate, consumption becomes more variable relative to income and price level becomes quite volatile. Also, the correlations between these variables and output become smaller in absolute value. The direction and phase shift of the simulated variables is summarized in Table 7. In this table we can see that both models replicate direction and phase shift of almost all the variables: only failing to do so for capital stock and money. The simulation results reported in tables 4 and 5 correspond to the average value through all the simulations of the statistics of interest. We construct confidence intervals¹¹ for the statistics as well as reporting the median and a p-value corresponding to the rate at which the simulated statistics are greater than the statistic obtained from real data. These results are reported in tables 8 and 9. In Table 8, we can see that output volatility in Model 1 is outside of the 95% confidence interval, as are work hours, money, price level, unemployment and productivity. This result tell us that is very unlikely that Model 1 is able to generate the volatility observed in the data. On the other hand, in Table 9 we can see that Model 2 fails too in replicate output, hours and price level volatility. However, Model 2 improves the mimic of consumption and productivity. Even though Model 2 successfully replicates M1 volatility, it fails to replicate the direction and phase shift of this monetary aggregate.

Sensitivity Analysis

Here we assess how these results change when the values assigned to the deep parameters of the model are modified. We examine these parameters constructing confidence intervals using the same data that we used to assign values in the baseline simulations. The parameters that we consider in the analysis are compiled in Table 10.

In our first analysis we vary only the shock standard deviation maintaining constant the rest of the parameters. That is, we first simulate the model using lower limits for standard deviation of shocks, then we use upper limits, and lastly we study combinations of the two. When we use only the lower limit of the shocks standard deviation, volatility for most of the variables falls compared to the baseline simulation, specially output volatility. Analogously, when we use only the upper limit of the shock's standard deviation, volatility for most of the variables rises. In tables 11 to 14 we summarize the statistics that we obtain.

When we run simulations combining different limit values for the rest of the parameters, we do not obtain results that differ significantly from those of the baseline model. However, we could establish that the technology shock standard deviation is the main parameter in the determination of output volatility. On the other hand, the monetary shock only plays a role in the determination of money holdings, price level, inflation and consumption. Therefore, "erratic" monetary growth in this model doesn't have an impact on output volatility, but it does have an impact on price level and consumption.

We also do a similar exercise mixing the parameters values for β , θ , δ and A . Changing the parameter values affects the model solution. In fact, there are 44 different combinations, but the solution algorithm converges for only eight of them.¹² However, as can be seen in tables 15 and 16, the results are not significantly different from the baseline results.

V. Concluding Remarks

In this section we highlight the main findings of this paper which can be summarized as follows.

- The Chilean business cycle is not significantly different to those of other economies, i.e., Canada and USA.
- The monetary models that we studied are able to replicate the phase shift and correlation with GDP of many macroeconomic variables, i.e., consumption, price level, and productivity. However, there are some of them for which the models fail, such as money and capital stock.
- Introducing an “erratic” monetary growth rate improves the ability of the model to replicate the behaviour of consumption. As in Cooley and Hansen (1989), consumption and price level become more volatile and, the contemporaneous correlation between these variables and GDP falls in absolute value, getting closer to what is observed in data.
- Both versions of the model fail to replicate the volatility of many variables under study. For example, Model 1 fails to replicate work hours, money, price level, unemployment and productivity.
- The sensitivity analysis shows that the main variable in the determination of output volatility is the standard deviation of technology shock. The other deep parameters don’t have an important effect on the cyclical behaviour of the macroeconomic variables.
- The cash-in-advance economy that we have studied does not consider many arguments usually argued for giving to money a role in the determination of the economic activity. An example is the role of liquidity in the determination of interest rates and so, in the determination of investment. Further research along the lines of this paper should try to assess the quantitative impact of these other channels in the context of a dynamic general equilibrium model.

References

Bergoeing, R. and J. Suárez (1998). “¿Qué Debemos Explicar?: Reportando las Fluctuaciones Agregadas de la Economía Chilena”. Working Paper, ILADES-Georgetown University, May.

Bergoeing, R.; Soto, R. and M. Alós (2000). “Modeling Economic Fluctuations in Chile with Business Cycle Models”. Incomplete draft for comments, ILADES-Georgetown University, January.

Bravo, K. and C. Oyarzún (2001). “Consumption and Asset Return Dynamics in the Chilean Economy”. Manuscript not published, University of Concepción.

Chari, V. V.; Christiano, L. J. and P. J. Kehoe (1991). “Optimal Fiscal and Monetary Policy: Some Recent Results”. *Journal of Money, Credit and Banking*, volume 23, n°3, August, pp. 519-539.

_____ (1995). “Policy Analysis in Business Cycle Models”. In “Frontiers of Business Cycle Research”, edited by Thomas F. Cooley, Princeton University Press, pp. 357-391.

Chumacero, R. (2000). “¿Qué Debemos Pedirle a un Candidato? Un Aporte a la Discusión en Torno a la Tasa de Desempleo”. *Revista de Análisis Económico*, Vol. 15, N° 2, December, pp.

Cooley, T. F. and G. D. Hansen (1989). “The Inflation Tax in a Real Business Cycle Model”. *American Economic Review*, September, pp. 733-748.

_____ (1992). “Tax Distortions in a Neoclassical Monetary Economy”. *Journal of Economic Theory*, n° 58, pp. 290-316.

_____ (1995). “Money and the Business Cycle”. In “Frontiers of Business Cycle Research”, edited by Thomas F. Cooley, Princeton University Press, pp. 175-216.

Cooley, T. H. and E. C. Prescott (1995). "Economic Growth and Business Cycles". In "Frontiers of Business Cycle Research", edited by Thomas F. Cooley, Princeton University Press, pp. 1-38.

Hansen, G. D. (1985). "Indivisible Labor and the Business Cycle". *Journal of Monetary Economics*, n° 16, pp. 309-327.

Hansen, G. D. and E. C. Prescott (1995). "Recursive Methods for Computing Equilibria of Business Cycle Models". In "Frontiers of Business Cycle Research", edited by Thomas F. Cooley, Princeton University Press, pp. 39-64.

Kydland, F. E. and E. C. Prescott (1982). "Time To Build and Aggregate Fluctuations". *Econometrica*, volume 50, n° 6, November, pp. 1345-1370.

_____ (1990). "Business Cycles: Real Facts and a Monetary Myth". *Quarterly Review*, Federal Reserve Bank of Minneapolis, USA, www.mpls.frb.org.

Lucas, R. E. and N. L. Stokey (1983). "Optimal Fiscal and Monetary Policy in an Economy without Capital". *Journal of Monetary Economics*, volume 50, n° 3, May, pp. 491-513.

_____ (1987). "Money and Interest in a Cash-in-advance Economy". *Econometrica*, n° 12, pp. 55-93.

Mendoza, E. (1991). "Real Business Cycles in a Small Open Economy". *American Economic Review*, vol. 81, n° 4, September, pp. 797-818.

Quiroz, J.; Bernasconi, F.; Chumacero, R. and C. Revoredo (1991). "Modelos y Realidad: Enseñando Macroeconomía En Los Noventa". *Revista de Análisis Económico*, volume 6, n° 2, November, pp. 79-103.

Table 1.
Cyclical Behaviour of the Chilean Economy, Quarterly Data Q1:1986-Q1:2000.

Variable	Volatility %	Relative Volatility (a)	Cross Correlation of Real GDP with:										
			x(t-5)	x(t-4)	x(t-3)	x(t-2)	x(t-1)	x(t)	x(t+1)	x(t+2)	x(t+3)	x(t+4)	x(t+5)
Real Gross Domestic Product	2.21	1.00	-0.41	-0.15	0.18	0.45	0.73	1.00	0.73	0.45	0.18	-0.15	-0.41
NATIONAL ACCOUNTS													
Private Consumption*	3.09	1.40	-0.44	-0.20	0.11	0.34	0.59	0.82	0.37	0.29	0.13	-0.32	-0.50
Government Purchases*	11.07	5.01	0.03	0.27	0.47	0.11	0.16	0.09	-0.02	-0.22	-0.22	-0.31	-0.24
Investment	7.39	3.34	-0.49	-0.35	-0.12	0.16	0.45	0.75	0.80	0.76	0.51	0.18	-0.15
Exports of Goods and Services	3.32	1.50	-0.09	-0.05	0.14	0.24	0.21	0.49	0.30	0.05	-0.10	-0.13	-0.29
Imports of Goods and Services	6.97	3.15	-0.48	-0.25	0.06	0.35	0.59	0.85	0.76	0.58	0.29	-0.09	-0.33
Net Exports (Balance of Trade/GDP ratio)	2.77	1.25	0.46	0.25	0.00	-0.28	-0.56	-0.71	-0.68	-0.60	-0.35	0.03	0.20
MONETARY AGGREGATES													
M1	5.83	2.64	-0.08	0.19	0.47	0.65	0.70	0.63	0.37	0.06	-0.21	-0.31	-0.40
M2A	3.20	1.45	-0.30	-0.16	0.08	0.29	0.48	0.62	0.67	0.55	0.42	0.22	-0.12
M2A - M1	3.50	1.58	-0.32	-0.32	-0.18	-0.03	0.17	0.39	0.62	0.65	0.65	0.47	0.09
INTEREST RATES													
Short Term Interest Rate	1.60	0.73	-0.23	-0.43	-0.62	-0.63	-0.44	-0.15	0.20	0.45	0.60	0.55	0.36
Long Term Interest Rate	1.61	0.73	-0.30	-0.47	-0.62	-0.59	-0.38	-0.08	0.25	0.49	0.62	0.56	0.35
PRICES													
Consumer Price Index	2.28	1.03	0.30	0.18	0.02	-0.05	-0.11	-0.18	-0.16	-0.11	-0.06	-0.07	-0.10
Inflation (CPI)	1.10	0.50	-0.16	-0.28	-0.32	-0.15	-0.20	-0.15	0.08	0.12	0.19	0.11	0.06
Producer Price Index	3.38	1.53	0.36	0.28	0.14	0.04	0.00	-0.12	-0.24	-0.30	-0.28	-0.29	-0.26
Inflation (PPI)	2.15	0.97	-0.12	-0.11	-0.20	-0.11	-0.05	-0.21	-0.22	-0.10	0.00	-0.08	-0.03
OTHERS													
Unemployment	0.86	0.39	0.51	0.38	0.17	-0.12	-0.41	-0.69	-0.79	-0.65	-0.48	-0.22	0.10
Productivity (GDP/Hours)	2.10	0.95	-0.09	0.16	0.41	0.58	0.71	0.82	0.47	0.17	-0.11	-0.38	-0.52
Average Weekly Hours	0.93	0.42	-0.51	-0.38	-0.17	0.12	0.41	0.68	0.79	0.65	0.48	0.22	-0.10
Capital Stock*	0.75	0.34	-0.20	-0.44	-0.57	-0.65	-0.60	-0.48	-0.20	0.07	0.37	0.54	0.61

Sources: Bergoing and Suárez (1998) and Central Bank of Chile.

(a) The Relative Volatility is defined as variable std. dev. / GDP std. dev. ratio.

* Statistics taken from Bergoing and Suárez (1998).

Table 2.
Comparing the Chilean Business Cycle.

Variable	Country					
	Chile		U.S.A. (a)		Canada (b)	
	Volatility %	Contemporaneous Correlation	Volatility %	Contemporaneous Correlation	Volatility %	Contemporaneous Correlation
Real Gross Domestic Product	2.21	1.00	1.72	1.00	2.81	1.00
Consumption of Non Durables	1.60	0.82	0.86	0.77	2.46	0.59
Investment	7.39	0.75	8.24	0.91	9.82	0.64
Exports of Goods and Services	3.32	0.49	5.53	0.37	-	-
Imports of Goods and Services	6.97	0.85	4.88	0.72	-	-
Net Exports	2.77	-0.71	-	-	1.87	-0.13
Capital Stock	0.75	-0.48	0.38	0.28	1.38	-0.38
Hours	0.93	0.68	1.59	0.86	2.02	0.80
Productivity	2.10	0.82	0.90	0.41	1.71	0.70
Consumer Price Index	2.28	-0.18	1.43	-0.52	-	-
Inflation (CPI)	1.10	-0.15	0.57	0.34	-	-
M1	5.83	0.63	1.52	0.33	-	-
M2A	3.20	0.62	1.46	0.33	-	-
Interest Rate	1.60	-0.15	1.29	0.40	-	-

(a) Cooley and Hansen (1989, 1995); Cooley and Prescott (1995).

(b) Mendoza (1991).

Table 3.
Parameter Values.

Preferences			Technology				Money		
β	A	h_0	θ	γ	σ_ε	δ	\hat{g}	α	σ_ξ
0.9859	1.563	0.43	0.40	0.99	0.017872	0.025	1.01924	0.1491	0.044268

Table 4.
Cyclical Behaviour Model 1.

Variable	Volatility %	Relative Volatility	Cross Correlation of Output with:										
			x(t-5)	x(t-4)	x(t-3)	x(t-2)	x(t-1)	x(t)	x(t+1)	x(t+2)	x(t+3)	x(t+4)	x(t+5)
Output	3.44	1.00	-0.10	0.01	0.16	0.37	0.64	1.00	0.64	0.37	0.16	0.01	-0.10
Standard Deviation	0.6435		0.158	0.163	0.165	0.149	0.102	0.000	0.102	0.149	0.165	0.163	0.158
Consumption	1.44	0.42	-0.23	-0.12	0.04	0.26	0.56	0.94	0.70	0.50	0.32	0.17	0.06
Standard Deviation	0.3280		0.138	0.141	0.145	0.135	0.095	0.017	0.097	0.151	0.179	0.188	0.187
Investment	10.49	3.05	-0.05	0.06	0.21	0.40	0.66	0.97	0.59	0.30	0.08	-0.07	-0.17
Standard Deviation	3.5348		0.170	0.175	0.175	0.154	0.103	0.012	0.100	0.143	0.154	0.148	0.143
Capital Stock	0.81	0.23	-0.45	-0.45	-0.41	-0.33	-0.18	0.05	0.36	0.54	0.62	0.62	0.57
Standard Deviation	0.2521		0.158	0.145	0.140	0.139	0.136	0.124	0.090	0.081	0.091	0.116	0.143
Hours	2.18	0.63	-0.02	0.09	0.24	0.43	0.67	0.96	0.57	0.26	0.04	-0.11	-0.21
Standard Deviation	0.5668		0.177	0.180	0.179	0.156	0.103	0.015	0.100	0.141	0.150	0.144	0.140
Money	0.00	0.00	-0.01	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01
Standard Deviation	0.0000		0.271	0.264	0.252	0.235	0.217	0.200	0.193	0.198	0.211	0.230	0.248
Price Level	1.44	0.42	0.23	0.12	-0.04	-0.26	-0.56	-0.94	-0.70	-0.50	-0.32	-0.17	-0.06
Standard Deviation	0.3280		0.138	0.141	0.145	0.135	0.095	0.017	0.097	0.151	0.179	0.188	0.187
Unemployment	1.93	0.56	0.02	-0.09	-0.24	-0.43	-0.67	-0.96	-0.57	-0.26	-0.04	0.11	0.21
Standard Deviation	0.4698		0.177	0.180	0.178	0.156	0.103	0.014	0.100	0.141	0.150	0.144	0.139
Inflation	1.06	0.31	-0.09	-0.14	-0.21	-0.29	-0.38	-0.49	0.31	0.27	0.23	0.19	0.16
Standard Deviation	0.1620		0.127	0.127	0.122	0.107	0.089	0.050	0.082	0.092	0.101	0.114	0.122
Productivity	1.41	0.41	-0.24	-0.14	0.02	0.24	0.53	0.91	0.70	0.50	0.33	0.19	0.08
Standard Deviation	0.2972		0.151	0.156	0.159	0.151	0.114	0.058	0.096	0.153	0.185	0.199	0.201

Table 5.
Cyclical Behaviour Model 2.

Variable	Volatility %	Relative Volatility	Cross Correlation of Output with:										
			x(t-5)	x(t-4)	x(t-3)	x(t-2)	x(t-1)	x(t)	x(t+1)	x(t+2)	x(t+3)	x(t+4)	x(t+5)
Output	3.49	1.00	-0.09	0.02	0.17	0.38	0.64	1.00	0.64	0.38	0.17	0.02	-0.09
Standard Deviation	0.6790		0.167	0.168	0.169	0.156	0.108	0.000	0.108	0.156	0.169	0.168	0.167
Consumption	1.56	0.45	-0.20	-0.10	0.05	0.25	0.52	0.87	0.65	0.46	0.30	0.17	0.07
Standard Deviation	0.3458		0.143	0.142	0.146	0.145	0.115	0.039	0.117	0.163	0.184	0.189	0.192
Investment	10.78	3.09	-0.04	0.07	0.21	0.40	0.65	0.95	0.58	0.30	0.09	-0.06	-0.16
Standard Deviation	3.5078		0.178	0.180	0.178	0.160	0.112	0.014	0.109	0.149	0.156	0.152	0.151
Capital Stock	0.83	0.24	-0.44	-0.44	-0.41	-0.32	-0.17	0.05	0.36	0.54	0.62	0.62	0.57
Standard Deviation	0.2718		0.162	0.149	0.141	0.140	0.141	0.127	0.087	0.075	0.086	0.112	0.143
Hours	2.23	0.64	0.00	0.10	0.24	0.43	0.66	0.96	0.56	0.27	0.05	-0.10	-0.20
Standard Deviation	0.5807		0.189	0.188	0.183	0.163	0.111	0.016	0.108	0.146	0.151	0.145	0.144
Money	5.98	1.71	0.01	0.01	0.00	0.00	0.00	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Standard Deviation	1.1256		0.247	0.246	0.246	0.247	0.243	0.242	0.244	0.248	0.254	0.255	0.250
Price Level	6.37	1.83	0.05	0.03	-0.01	-0.06	-0.12	-0.22	-0.17	-0.12	-0.08	-0.05	-0.03
Standard Deviation	1.1592		0.237	0.237	0.237	0.238	0.232	0.228	0.232	0.238	0.246	0.244	0.239
Unemployment	1.97	0.56	0.00	-0.10	-0.25	-0.43	-0.67	-0.96	-0.56	-0.27	-0.05	0.10	0.21
Standard Deviation	0.4836		0.189	0.188	0.183	0.163	0.111	0.015	0.107	0.146	0.151	0.144	0.144
Inflation	5.02	1.44	-0.02	-0.03	-0.05	-0.06	-0.08	-0.11	0.06	0.05	0.05	0.04	0.03
Standard Deviation	0.5128		0.131	0.128	0.131	0.131	0.130	0.129	0.129	0.125	0.124	0.124	0.128
Productivity	1.43	0.41	-0.23	-0.13	0.02	0.24	0.53	0.91	0.70	0.51	0.35	0.21	0.10
Standard Deviation	0.3170		0.152	0.155	0.160	0.155	0.120	0.058	0.099	0.158	0.190	0.206	0.212

Table 6.
Data and Model Comparison.

Variable	Data		Model 1		Model 2	
	Volatility %	Contemporaneous Correlation	Volatility %	Contemporaneous Correlation	Volatility %	Contemporaneous Correlation
Output	2.21	1.00	3.44	1.00	3.49	1.00
Consumption	1.60	0.63	1.44	0.94	1.56	0.87
Investment	7.39	0.75	10.49	0.97	10.78	0.95
Capital Stock	0.75	-0.48	0.81	0.05	0.83	0.05
Hours	0.93	0.68	2.18	0.96	2.23	0.96
Money (M1)	5.83	0.63	0.00	0.00	5.98	-0.01
Price Level	2.28	-0.18	1.44	-0.94	6.37	-0.22
Unemployment	0.86	-0.69	1.93	-0.96	1.97	-0.96
Inflation (CPI)	1.10	-0.15	1.06	-0.49	5.02	-0.11
Productivity	2.10	0.82	1.41	0.91	1.43	0.91

Table 7.
Co-movement and Phase Shift of Simulated Variables.

Variable	Data		Model 1		Model 2	
	Degree of Comovement	Phase Shift	Degree of Comovement	Phase Shift	Degree of Comovement	Phase Shift
Consumption	Procyclical	Coincides	Procyclical	Coincides	Procyclical	Coincides
Investment	Procyclical	Lags 1 period	Procyclical	Coincides	Procyclical	Coincides
Capital Stock	Countercyclical	Leads 2 periods	Uncorrelated	Lags 4 periods	Uncorrelated	Lags 4 periods
Hours	Procyclical	Lags 1 period	Procyclical	Coincides	Procyclical	Coincides
Money (M1)	Procyclical	Leads 1 period	Uncorrelated	Coincides	Uncorrelated	Coincides
Price Level	Countercyclical	Coincides	Countercyclical	Coincides	Countercyclical	Coincides
Unemployment	Countercyclical	Lags 1 period	Countercyclical	Coincides	Countercyclical	Coincides
Inflation (CPI.)	Countercyclical	Leads 1 period	Countercyclical	Coincides	Countercyclical	Coincides
Productivity	Procyclical	Coincides	Procyclical	Coincides	Procyclical	Coincides

Table 8.
Confidence Interval and Statistics Summary for Model 1.

Variable	Data		Model 1			
	Volatility %	Mean	Median	P-value	Confidence Interval	
					Lower Limit	Upper Limit
Output	2.21	3.44	3.38	0.992	2.38	4.83
Consumption	1.60	1.44	1.41	0.280	0.91	2.18
Investment	7.39	10.49	9.78	0.853	5.88	18.06
Capital Stock	0.75	0.81	0.79	0.544	0.40	1.37
Hours	0.93	2.18	2.10	1.000	1.31	3.43
Money (M1)	5.83	0.00	0.00	0.000	0.00	0.00
Price Level	2.28	1.44	1.41	0.016	0.91	2.18
Unemployment	0.86	1.93	1.86	1.000	1.20	2.98
Inflation (CPI.)	1.10	1.06	1.04	0.367	0.79	1.42
Productivity	2.10	1.41	1.38	0.015	0.90	2.01

Table 9.
Confidence Interval and Statistics Summary for Model 2.

Variable	Data		Model 2			
	Volatility %	Mean	Median	P-value	Confidence Interval	
					Lower Limit	Upper Limit
Output	2.21	3.49	3.40	0.986	2.35	4.98
Consumption	1.60	1.56	1.53	0.424	1.00	2.34
Investment	7.39	10.78	10.11	0.879	6.08	19.08
Capital Stock	0.75	0.83	0.80	0.580	0.40	1.43
Hours	0.93	2.23	2.14	1.000	1.33	3.55
Money (M1)	5.83	5.98	5.88	0.527	4.00	8.32
Price Level	2.28	6.37	6.28	1.000	4.37	8.97
Unemployment	0.86	1.97	1.90	0.999	1.22	3.05
Inflation (CPI.)	1.10	5.02	5.00	1.000	4.12	6.08
Productivity	2.10	1.43	1.41	0.027	0.88	2.11

Table 10.
Deep Parameters Confidence Intervals.

Parameter	Mean	Std. Deviation	Lower Limit *	Upper Limit *
β	0.9859	0.00676728 (a)	0.9724	0.9994
θ	0.40	0.07421637 (a)	0.25	0.55
δ (b)	0.025	-	0.0178	0.0322
A (c)	1.563	-	1.502	1.631
σ_{ε}	0.017872	0.00006036 (d)	0.014095	0.020979
σ_{ξ}	0.044268	0.00037369 (d)	0.034818	0.052029

* The confidence intervals are computed using the parameter mean \pm two times standard deviation.

(a) Standard deviation is computed using the regular formula: $\sigma^2 = \sum_{i=1}^N \frac{(X_i - \mu)^2}{N-1}$, where $\mu = \sum_{i=1}^N \frac{X_i}{N}$.

(b) The confidence interval for the depreciation rate is computed using a value taken from Bergoeing *et al.* (2000) as the upper limit. The lower limit is obtained by a difference.

(c) The confidence interval for the parameter A is obtained indirectly from the construction of a confidence interval for leisure share that is equal to (0.59001, 0.6226).

(d) The standard deviation for technology and monetary shocks is obtained using the variance-covariance matrix, which is computed using maximum likelihood method.

Table 11.
Simulation with Lower Limit in both Shocks Model 1.

Variable	Data		Model 1			
	Volatility %	Mean	Median	P-value	Confidence Interval	
					Lower Limit	Upper Limit
Output	2.21	2.73	2.69	0.856	1.83	3.86
Consumption	1.60	1.14	1.11	0.052	0.73	1.76
Investment	7.39	8.02	7.66	0.563	4.70	13.38
Capital Stock	0.75	0.66	0.63	0.285	0.32	1.16
Hours	0.93	1.72	1.67	0.993	1.02	2.69
Money (M1)	5.83	0.00	0.00	0.000	0.00	0.00
Price Level	2.28	1.14	1.11	0.000	0.73	1.76
Unemployment	0.86	1.52	1.48	0.994	0.94	2.34
Inflation (CPI.)	1.10	0.83	0.82	0.015	0.63	1.08
Productivity	2.10	1.13	1.12	0.002	0.74	1.65

Table 12.
Simulation with Lower Limit in both Shocks Model 2.

Variable	Data		Model 2			
	Volatility %	Mean	Median	P-value	Confidence Interval	
					Lower Limit	Upper Limit
Output	2.21	2.74	2.68	0.851	1.92	3.86
Consumption	1.60	1.22	1.19	0.078	0.80	1.82
Investment	7.39	8.31	7.82	0.589	4.97	14.41
Capital Stock	0.75	0.66	0.63	0.293	0.33	1.13
Hours	0.93	1.75	1.68	0.996	1.08	2.79
Money (M1)	5.83	4.75	4.65	0.120	3.30	6.61
Price Level	2.28	5.04	4.94	1.000	3.56	7.00
Unemployment	0.86	1.55	1.49	0.997	0.99	2.46
Inflation (CPI.)	1.10	3.95	3.95	1.000	3.20	4.70
Productivity	2.10	1.12	1.10	0.002	0.73	1.66

Table 13.
Simulation with Upper Limit in both Shocks Model 1.

Variable	Data		Model 1			
	Volatility %	Mean	Median	P-value	Confidence Interval	
					Lower Limit	Upper Limit
Output	2.21	4.04	3.95	0.998	2.75	5.85
Consumption	1.60	1.69	1.65	0.546	1.03	2.63
Investment	7.39	12.93	11.74	0.961	7.05	27.07
Capital Stock	0.75	0.93	0.89	0.682	0.44	1.63
Hours	0.93	2.58	2.47	1.000	1.53	4.25
Money (M1)	5.83	0.00	0.00	0.000	0.00	0.00
Price Level	2.28	1.69	1.65	0.078	1.03	2.63
Unemployment	0.86	2.26	2.18	1.000	1.40	3.61
Inflation (CPI.)	1.10	1.25	1.25	0.767	0.92	1.66
Productivity	2.10	1.63	1.60	0.103	0.99	2.45

Table 14.
Simulation with Upper Limit in both Shocks Model 2.

Variable	Data		Model 2			
	Volatility %	Mean	Median	P-value	Confidence Interval	
					Lower Limit	Upper Limit
Output	2.21	4.04	3.96	0.998	2.66	5.27
Consumption	1.60	1.83	1.79	0.704	1.19	2.66
Investment	7.39	13.04	11.87	0.965	7.18	26.13
Capital Stock	0.75	0.94	0.90	0.719	0.46	1.64
Hours	0.93	2.59	2.48	1.000	1.54	4.27
Money (M1)	5.83	7.05	6.94	0.830	4.83	10.02
Price Level	2.28	7.48	7.38	1.000	5.25	10.39
Unemployment	0.86	2.27	2.18	1.000	1.39	3.56
Inflation (CPI.)	1.10	5.91	5.88	1.000	4.78	7.19
Productivity	2.10	1.64	1.61	0.094	1.01	2.37

Table 15.
Simulations Mixing* Parameters Values Model 1.

Variable	Data	Model 1							
	Volatility	Varying							
	%	1	5	6	8	11	31	40	41
Output	2.21	3.43	2.58	3.20	3.49	3.18	2.60	3.46	3.49
Consumption	1.60	1.54	1.32	1.17	1.45	1.33	1.33	1.48	1.45
Investment	7.39	14.06	14.30	7.82	10.75	8.91	14.45	18.61	23.42
Capital Stock	0.75	1.04	0.88	0.64	0.84	0.92	0.89	0.91	0.79
Hours	0.93	2.13	1.36	2.35	2.23	2.28	1.38	2.19	2.13
Money (M1)	5.83	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Price Level	2.28	1.54	1.32	1.17	1.45	1.33	1.33	1.48	1.45
Unemployment	0.86	1.74	1.30	1.78	1.90	1.55	1.32	1.72	1.99
Inflation (CPL)	1.10	1.08	1.02	0.84	1.06	0.89	1.02	1.06	1.21
Productivity	2.10	1.55	1.35	1.17	1.43	1.36	1.36	1.47	1.46

Table 16.
Simulations Mixing* Parameters Values Model 2.

Variable	Data	Model 2							
	Volatility	Varying							
	%	1	5	6	8	11	31	40	41
Output	2.21	3.47	2.59	3.25	3.53	3.22	2.59	3.49	3.51
Consumption	1.60	1.65	1.40	1.32	1.56	1.44	1.40	1.59	1.55
Investment	7.39	14.50	14.38	8.09	11.05	9.18	14.38	19.12	24.38
Capital Stock	0.75	1.07	0.88	0.66	0.86	0.95	0.88	0.94	0.80
Hours	0.93	2.18	1.42	2.43	2.28	2.37	1.42	2.24	2.15
Money (M1)	5.83	5.98	5.98	5.97	5.97	5.97	5.98	5.97	5.98
Price Level	2.28	6.37	6.25	6.31	6.34	6.31	6.25	6.35	6.33
Unemployment	0.86	1.78	1.36	1.85	1.94	1.62	1.36	1.76	2.01
Inflation (CPL)	1.10	5.00	4.92	5.01	4.99	4.97	4.92	5.01	5.03
Productivity	2.10	1.57	1.35	1.17	1.44	1.38	1.35	1.49	1.46

* The changing parameters are: 1: $\beta = 0.9724$; 5: $\beta = 0.9994$; 6: $\theta = 0.55$; 8: $A = 1.631$; 11: $\beta = 0.9724$, $\theta = 0.55$, $\delta = 0.0322$, $A = 1.631$; 31: $\beta = 0.9724$, $\theta = 0.25$, $A = 1.502$; 40: $\beta = 0.9724$, $\delta = 0.0178$; 41: $\theta = 0.25$, $\delta = 0.0178$.

Footnotes:

¹ The only papers that we know in this line are Chumacero (2000), Bergoing, Soto and Alós (2000) and Quiroz *et al.* (1991). Previous work suggests that there are some differences between the business cycles of the Chilean and USA economies (see Bergoing and Suárez (1998)).

² For a comparison of alternative filters, see Bergoing, R. and J. Suárez (1998).

³ For more details of the H-P filter see Cooley, T. F. and E. C. Prescott (1995).

⁴ Before data filtering, the series are expressed as natural logarithms in order to smooth the trend.

⁵ After performing Granger causality tests, we conclude that M1 does Granger cause GDP, and GDP does not Granger cause M1.

⁶ For details, see Hansen (1985).

⁷ This constraint is obtained from equation (5) using $\tilde{m}_t = m_t/M_t$ and $\tilde{p}_t = p_t/M_t$. Multiply both sides by M_t/M_t :

$$c_t + i_t + (m_t M_t / M_t p_t) \leq w_t h_t + r_t k_t + (M_t m_{t-1} + (g_t - 1) M_t M_{t-1}) / M_t p_t .$$

Next using a change of variables and equation (8):

$$c_t + i_t + \tilde{m}_t / \tilde{p}_t \leq w_t h_t + r_t k_t + (\tilde{m}_{t-1} + g_t - 1) / g_t \tilde{p}_t$$

⁸ This constraint is obtained from equation (6) using $\tilde{m}_t = m_t/M_t$ and $\tilde{p}_t = p_t/M_t$. Multiply both sides by $M_t/(p_t * M_t)$:

$$p_t c_t M_t / p_t M_t \leq m_{t-1} + (g_t - 1) M_{t-1} M_t / p_t M_t$$

Using a change of variables and equation (8):

$$c_t \leq (\tilde{m}_{t-1} + g_t - 1) / \tilde{p}_t g_t$$

⁹ Bravo and Oyarzún (2001) estimate preference parameters (discount factor and the risk aversion coefficient) for the Chilean economy applying the Generalized Method of Moments approach to financial market data. They obtained estimates for quarterly discount factor in the range (0.860, 0.985).

¹⁰ We solve and simulate the model using GAUSS software. The code is available for colleagues.

¹¹ The confidence intervals are constructed ordering the observations in ascendant order and eliminating the first thirty and the last thirty observations, thus giving 95% of the observations.

¹² For the other 36 combinations of parameter values the solution algorithm doesn't converge because the second order conditions are violated. For details see Hansen and Prescott (1995).