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Status and the Current Account in Canada

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Abstract

This paper investigates the role of wealth in the behavior of the current account. To do so, I include direct preferences for status in a small open economy real business cycle model. Status can take two forms: absolute status or relative status. Absolute status is nonhuman wealth in levels and relative status is the ratio of nonhuman wealth to the aggregate. The absolute status model can match several of the business cycle moments when status plays a large role. Also, total wealth and the current account have a positive relation in the long run. Finally, unanticipated innovations to income and total wealth produce current account surpluses.

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1 Introduction

The analysis of wealth and the current account in an open economy is important. From a policy makers point of view, the current account provides information about the amount of foreign assets that are borrowed to fund domestic investment. The amount of foreign borrowing determines the degree of indebtedness to foreign economies. Wealth is important because foreign assets may be a large portion of the consumer portfolio.

Interestingly, there is a small literature devoted to the study of wealth and the current account. The studies that do include wealth refer solely to nonhuman wealth in levels. The construction of the human wealth variable requires sophisticated econometric techniques, and the series does not exist for many countries. Fortunately, Macklem (1994, 1997) constructs the series for Canadian wealth.

This paper adds wealth to a small open model of production economies. It attempts to quantify two bodies of literature devoted to wealth.

First, a number of papers define wealth as status. It affects economic growth, the stock market, and the current account. In Cole, Mailath, and Postelwaite (1992, 1995), Corneo and Jeanne (1998, 2001), and Futagami and Shibata (1998), status impacts individual savings behavior and economic growth rates. In Abel (1990), Galí (1994), Bakshi and Chen (1996), Gong and Zou (2002), and Boileau and Brown (2004), status helps to solve the equity premium puzzle, predicts the volatility of stock prices, and generates a countercyclical risk premium. In Fisher (1999, 2004, 2005), status gives the small open economy model a well-behaved steady state. Further, the current account dynamics are non-monotonic. These papers share the idea that individuals have a motive for wealth accumulation that exceeds consumption needs.

Second, a number of papers study the empirical significance of wealth for the current account. Closely related to this paper is the work following Feldstein and Horioka (1980). They find that capital is sufficiently immobile and savings cannot explain movements in the current account. Kraay and Ventura (2000) and Ventura (2002) argue that countries smooth income shocks by purchasing foreign assets proportional to their share of net foreign assets to nonhuman wealth. They show that nonhuman wealth is an important factor in determining the movement of the current account.

This paper embodies both facets of the literature on wealth. I extend the model of Boileau and Brown (2004) to a small open economy. I extract the nonstationary series from the business cycle model to analyze the current account in the long run. The series are used to test for cointegrating relations in a multivariate vector autoregression (VAR). Finally, I monitor the responses of the current account to income and total wealth innovations.

The paper proceeds as follows. Section 2 presents the characteristics of the data. I use a sample of real quarterly Canadian data spanning the years 1976:I to 2001:IV. The business cycle statistics are presented first. The statistics are the volatilities, the correlations, and the persistences of several macroeconomic variables. The cointegration test follows. I use the Johansen Procedure to determine the number of cointegrating relations in the unrestricted VAR. The variables of the VAR are: the current account, output, the real interest rate, total wealth, and investment. There is evidence of one cointegrating relation, which is the current account equation. The innovation analysis is presented last. I show the responses of the current account to unanticipated shocks to income and total wealth. Both shocks induce a current account surplus.

Section 3 presents a standard real business cycle model (RBC). This serves as a benchmark for the models with status. The model is like those in Nason and Rogers (2003) and Letendre (2004) and does not include status. It fails to predict the business cycle moments in the data. However, the cointegrating equation is similar to that produced by the data. It matches the signs on income and total wealth. The responses of the current account to income and total wealth innovations match those in the data. The income shock, however, is too transitory, and the total wealth shock is too permanent.

Sections 4 and 5 present the models including status. Section 4 outlines the absolute status model. Consistent with Bakshi and Chen (1996) and Boileau and Brown (2004), status is nonhuman wealth in levels. The model can better predict the business cycle moments when status plays a large role in consumer preferences. The cointegrating relation can match the signs on income and total wealth, but does no better than the baseline model. The responses of the current account to income and total wealth innovations are different when status plays a large role. Following an unanticipated shock to total wealth, the current account slowly returns to its steady state. The shock is more temporary and matches the data well.

Section 5 outlines the relative status model. Consistent with Bakshi and Chen (1996) and Fisher (1999, 2004, 2005), status is individual nonhuman wealth relative to the aggregate. This model fails to match the business cycle statistics. The cointegrating relation produced by the model is similar to those produced in both the baseline model and the absolute status model. It matches the signs on income and total wealth. The response of the current account to an income innovation is too transitory and to a total wealth innovation is too permanent. The model does quantify the result from Fisher (1999, 2004, 2005). The current account exhibits non-monotonic dynamics following an innovation to income.

Section 6 concludes.

2 Data

This section presents the characteristics of the data in three forms: the business cycle moments, the cointegration analysis, and the innovation analysis. Together, I can extract information on the short run and the long run behavior of an open economy. I compare the characteristics of the data to the same characteristics extracted from the business cycle models.

2.1 The Business Cycle

The data are seasonally adjusted real quarterly Canadian data spanning the years 1976:I to 2001:IV. The data come from two sources: International Monetary Fund financial statistics and Statistics Canada. Consumption is real consumption of non-durables and services. Labor is average weekly hours worked. Output is real gross domestic product. Investment is fixed capital formations plus changes in inventories.

Macklem (1994, 1997) constructs the wealth series. Total wealth is the sum of human wealth and nonhuman wealth:

$$TW_t = HW_t + NHW_t.$$

Human wealth, HW, is the current plus present value of the net of tax labor income:

$$HW_t = X_t \left[1 + E_t \left(\sum_{i=1}^{\infty} \prod_{j=1}^{i} \left(\frac{1 + x_{t+j}}{1 + r_{t+j}} \right) \right) \right] \equiv X_t \left(1 + \Delta_t \right)$$

where X is after tax labor income, r is the real interest rate, and Δ is the expectation of the term in parenthesis. Measuring the cumulative growth factor, Δ, is not trivial. It depends on expectations and is not directly observed. Macklem measures Δ by estimating a bivariate vector autoregression of after tax labor income growth and the real interest rate. The expected value of the vector autoregression is approximated as a discrete-valued finite-state Markov chain. Using the approximated system, the cumulative growth factor, Δ, can be calculated for every state of the system. Nonhuman wealth, NHW, is

$$NHW_t = A_t + D_t^d,$$

where A is domestic and foreign assets net of liabilities and D^d is domestic holdings of government debt. Measuring nonhuman wealth is straightforward. Macklem consolidates assets and liabilities of different sectors in the economy to obtain the net worth of private-sector wealth.

The trade balance is real exports minus real imports. The current account is changes in the net foreign asset position. The real interest rate is the Canadian real interest rate. I construct the real interest rate using the following measure:

$$(1 + r_t) = \frac{1 + i_t^{can}}{1 + \pi_t^{can}},$$

where i^{can} is the Canadian 3-month treasury bill rate and π^{can} is the Canadian CPI inflation rate.

The business cycle moments are the volatilities, the correlations, and the persistences of several variables. In most cases, the statistics are computed using the logarithm of each variable. For the trade balance and the current account, the statistics are computed by dividing by output. The variables are Hodrick-Prescott filtered using a smoothing parameter equal to 1600.

Table 1 lists the business cycle moments. The volatilities are the ratios of the standard deviations for consumption, labor, investment, nonhuman wealth, total wealth, the trade balance over output, and the current account over output to the standard deviation of output: $\sigma_c/\sigma_y = 0.61$, $\sigma_l/\sigma_y = 0.84$, $\sigma_x/\sigma_y = 3.37$, $\sigma_{nhw}/\sigma_y = 2.14$, $\sigma_{tw}/\sigma_y = 1.85$, $\sigma_{tb}/\sigma_y = 1.85$, and $\sigma_{ca}/\sigma_y = 0.20$. The correlations are the contemporaneous correlations of consumption, labor, investment, nonhuman wealth, total wealth, the trade balance over output, and the current account over output with output: $\rho(c, y) = 0.60$, $\rho(l, y) = 0.86$, $\rho(x, y) = 0.88$, $\rho(nhw, y) = 0.59$, $\rho(tw, y) = 0.27$, $\rho(tb, y) = -0.10$, and $\rho(ca, y) = -0.23$. The persistences are the first autocorrelations of consumption, labor, output, investment, nonhuman wealth, total wealth, the trade balance over output, and the current account over output: $\rho(c', c) = 0.81$, $\rho(l', l) = 0.85$, $\rho(y', y) = 0.87$, $\rho(x', x) = 0.82$, $\rho(nhw', nhw) = 0.79$, $\rho(tw', tw) = 0.62$, $\rho(tb', tb) = 0.71$, and $\rho(ca', ca) = 0.37$.

2.2 Cointegration Analysis

This section lists the results from the unrestricted VAR for the current account, output, the real interest rate, total wealth, and investment. Brown (2004) derives the long-run current account equation for a simple present value model:

$$CA_t = Y_t + rB_t - \frac{r+\theta}{1+r}(TW_t) - I_t, \tag{1}$$

where CA is the current account, Y is output, r is the real world interest rate, TW is total wealth, and I is investment. This is a useful benchmark to understand the empirical analysis. Income and the real interest rate have a positive relation with the current account, while investment has a negative relation with the current account. The effect of total wealth on the current account is ambiguous and depends on the tilting parameter, θ. The parameter $\theta = 1 - \beta^{\sigma}(1+r)^{\sigma}$ is the consumer tilting factor. If $\beta > 1/1+r$, then the consumer tilts toward the future. If $\beta < 1/1+r$, then the consumer tilts toward the present. If $(r+\theta) > 0$, then total wealth and the current account have a negative relationship and consumers tilt toward the present. If $(r+\theta) < 0$, then total wealth and the current account have a positive relationship and consumers tilt toward the future. I test for a cointegrating relation among the variables in the VAR.

The empirical analysis begins with tests for nonstationarity. Table 2 shows the results of the augmented Dickey-Fuller test. I include a trend term for output, total wealth, and investment. The results suggest that all series are nonstationary at the 5% level.[1]

I use the Johansen Procedure to test for a cointegrating relation. The procedure uses the following vector error correction model (VECM):

$$\Delta Z_t = \Pi Z_{t-1} + \sum_{i=1}^{k-1} \Gamma_i \Delta Z_{t-i} + \mu + \Phi D_t + V_t. \tag{2}$$

Equation 2 is the VECM, where $\Pi = \alpha\prime\beta$ contains information regarding the long-run relation among the variables of $Z_t = [CA_t \;\; Y_t \; r_t \; TW_t \; I_t]\prime$. The Johansen procedure

[1] Taylor (2002) rejects the null of a unit root for CA/Y in the Canadian data at the 10% level for the annual series. This series is current account in levels, which possesses a unit root.

requires the specification of equation 2; I must identify the lag length of the differenced terms, ΔZ_{t-i}, the system dummy variables, ΦD_t, and the system drift term, μ. I choose a lag length of two for the differenced terms. The series appear to possess a deterministic trend, so I include μ. Table 3 presents the results of the Johansen Procedure. It gives the eigenvalues, $\widehat{\lambda}$, and associated trace test statistics for the number of cointegrating relations. There is one cointegrating relation among the variables of Z_t:

$$CA = -0.18Y + 687.48r + 0.000125TW - 0.29I. \tag{3}$$

Equation 3 is the long-run normalized current account equation. Table 4 lists the 90% confidence intervals for the coefficient estimates in equation 3. Several signs on the estimates of the coefficients match the theoretical prior beliefs from equation 1. The sign on the real interest rate is positive and sign on investment is negative. The sign on output, however, is negative. Empirically, agents hold long-run deficits following rises in permanent income. The sign on total wealth is positive. Higher total wealth produces a current account surplus; agents accumulate foreign assets to tilt consumption toward the future.

2.3 Innovation Analysis

The innovation analysis includes the responses of the current account to income (output) and total wealth innovations. I construct the impulse-response functions using the Cholesky decomposition method. This method is a simple way to orthogonalize the shocks in the VAR. The ordering of the VAR variables is important when using the Cholesky decomposition. Using economic intuition, I give the variables the following order: TW, r, CA, I, Y.[2] I use the same ordering to study the models in sections 3-5.

Figure 1 shows the responses of the current account following two real macroeconomic shocks. The upper panel shows the response of the current account to an unanticipated positive income shock. The lower panel shows the response of the current account to an unanticipated positive total wealth shock. The income shock causes a current account surplus; agents save the extra income for future consumption through asset accumulation. Following the initial shock, the current account slowly drifts to a new, higher steady state. The total wealth shock causes an immediate current account surplus, but deficits quickly follow. Consumers tilt consumption toward the future by accumulating foreign assets. Asset accumulation decreases after the initial rise in total wealth because the shock is temporary. The current account returns to its steady state.

3 Baseline Model

The baseline model is a standard small open economy real business cycle model. The model is similar to those in Letendre (2004) and Nason and Rogers (2003). The

[2] The impulse responses are not sensitive to the ordering of the variables.

baseline model does not include status.

3.1 The Economic Environment

The planner chooses consumption, employment, investment, and bond holdings to maximize the expected lifetime utility

$$\max E_0 \left\{ \sum_{t=0}^{\infty} \beta^t U\left(C_{it}, 1 - N_{it}\right) \right\}, \tag{4}$$

subject to

$$C_{it} + I_{it} + B_{it+1} = Y_{it} + \left(1 + r_t\right) B_{it}, \tag{5}$$

$$r_t = q_t - \varphi B_t / Y_t, \tag{6}$$

$$Y_{it} = K_{it}^{\alpha} \left(\Gamma_t N_{it}\right)^{1-\alpha}, \tag{7}$$

and

$$K_{it+1} = \left(1 - \delta\right) K_{it} + \left(\frac{K_{it}}{I_{it}}\right)^{\theta} I_{it}, \tag{8}$$

where E is the expectations operator, β is the subjective discount factor, C_i is consumption, and $1 - N_i$ is leisure. The momentary utility function is

$$U\left(C_{it}, 1 - N_{it}\right) = \ln\left(C_{it}\right) + \psi \ln\left(1 - N_{it}\right).$$

Equation 5 is the aggregate resource constraint, where I_i is investment, B_i is the stock of foreign assets, and r is a country-specific real interest rate. Equation 6 describes the country-specific real interest rate; it depends on the world rate, q, and the country-specific risk premium, $\varphi B/Y$. Countries that are net creditors, $B > 0$, enjoy a premium below q, while net debtors, $B < 0$, must pay a premium above q. Equation 6 guarantees a well-behaved steady state.[3] Consumers take the real interest rate as given. Equation 7 describes the firm's constant returns to scale production technology, where K_i is the capital stock, Γ is the stochastic level of technology, and α is the capital share. Equation 8 describes capital accumulation, where δ is the depreciation rate. Capital adjustment costs are as in Baxter and Crucini (1993).

The economy grows with the stochastic level of technology. Technology and the world interest rate evolve according to

$$z_t = z + \epsilon_{zt} \tag{9}$$

and

$$q_t = (1 - \rho)\, q + \rho q_{t-1} + \epsilon_{qt}, \tag{10}$$

where $z_t \equiv \ln(\Gamma_t / \Gamma_{t-1})$, z and q are the mean levels of the growth rate of technology and the world interest rate, and ϵ_{zt} and ϵ_{qt} are uncorrelated random variables with means zero and variances σ_z^2 and σ_q^2. Equation 9 is the process of the permanent

[3] See Schmitt-Grohé and Uribe (2003).

technology shock, and equation 10 is the process of the transitory world interest rate shock.

3.2 Optimality and Stationarity Conditions

Along the balanced growth path, variables except N_i and r grow at rate $\widetilde{Z}_t = \Gamma_t/\Gamma_{t-1}$. All stationary variables are represented as $\widetilde{X}_{it}$, where $\widetilde{X}_{it} = X_{it}/\Gamma_t$ for $X_{it} = \{C_{it}, I_{it}, Y_{it}\}$. The stationary transformations for the state variables, B_i and K_i, are B_{it+1}/Γ_t and K_{it+1}/Γ_t. I focus on a symmetric equilibrium, where $\widetilde{X}_{it} = \widetilde{X}_t$, $\widetilde{N}_{it} = \widetilde{N}_t$, $\widetilde{B}_{it} = \widetilde{B}_t$, and $\widetilde{K}_{it} = \widetilde{K}_t$. The planner's problem yields the following stationary first-order conditions:

$$-\frac{\widetilde{U}_{N_t}}{\widetilde{U}_{C_t}} = \frac{(1-\alpha)\widetilde{Y}_t}{N_t} \tag{11}$$

$$1 = \beta E_t \left[(1 + r_{t+1}) \frac{\widetilde{U}_{C_{t+1}}}{\widetilde{U}_{C_t} \widetilde{Z}_{t+1}} \right] \tag{12}$$

$$\frac{1}{1-\theta} \left(\frac{\widetilde{I}_t \widetilde{Z}_t}{\widetilde{K}_t} \right)^{\theta} = \beta E_t \left\{ \left[\alpha \frac{\widetilde{Y}_{t+1} \widetilde{Z}_{t+1}}{\widetilde{K}_{t+1}} + \Delta_\theta \right] \frac{\widetilde{U}_{C_{t+1}}}{\widetilde{U}_{C_t} \widetilde{Z}_{t+1}} \right\}, \tag{13}$$

where $\Delta_\theta = \frac{(1-\delta)+\theta\left(\widetilde{K}_{t+1}/\left(\widetilde{I}_{t+1}\widetilde{Z}_{t+1}\right)\right)^{\theta-1}}{(1-\theta)\left(\widetilde{K}_{t+1}/\left(\widetilde{I}_{t+1}\widetilde{Z}_{t+1}\right)\right)^{\theta}}$. The stationary marginal utilities of work effort and consumption are $\widetilde{U}_{N_t}$ and $\widetilde{U}_{C_t}$. Equation 11 equates the marginal rate of substitution between consumption and leisure to the real wage rate. Equation 12 is the Euler equation for the bond market. Equation 13 is the Euler equation for capital.

3.3 Calibration and Numerical Method

The baseline model does not have an analytical solution for general values of the economy's parameters. I obtain a solution using the method of King, Plosser, and Rebelo (1987, 1988). This method requires that the model be stationary and parameters be set.

Following Brown (2004), $\alpha = 0.344$ and $\delta = 0.021$. I set $\psi = 2.070$ to ensure that hours worked forms 30 percent of the time endowment. I set the Canadian real interest rate to its mean rate, $r = 0.0097$. Following Nason and Rogers (2003), I use a risk premium of 50 basis points to get the real world interest rate. This implies $q = 0.0471$ and $\beta = 0.9935$. I fix $\varphi = 0.0141$ according to the mean Canadian bond-output ratio $(\overline{B}/\overline{Y})$. I set the capital adjustment cost parameter, $\theta = 0.177$, so that the relative volatility of investment to output is 3.37.

Using the sample of Canadian data, I set the steady state growth rate of technology at $z = 1.003$ and the bond-output ratio at $\overline{B}/\overline{Y} = -0.3551$. The ordinary least squares regression of equations 9 and 10 yield $\sigma_z^2 = 0.00042$ and $\sigma_q^2 = 0.000021$.

3.4 Results: The Business Cycle

Table 1 lists business cycle moments produced by the data and by the baseline model. All moments produced by the model are the mean values of 1000 simulations.

The baseline model does not replicate most business cycle moments. The current account is too volatile, while labor is not volatile enough. The trade balance has too low a correlation with output. Consumption, output, and investment are not persistent enough. The model predicts negative persistence for the current account when it should be positive. The model correctly predicts the volatility and persistence of the trade balance.

The baseline model produces too small a volatility for nonhuman wealth and total wealth, too small a correlation for nonhuman wealth, and both nonhuman wealth and total wealth have negative persistence. The model correctly predicts the correlation for total wealth.

3.5 Results: Cointegration Analysis

I extract the long-run series to investigate the cointegrating relations in the unrestricted baseline VAR. I compare the results of the baseline model to those produced by the data. The series for the current account, output, the real interest rate, and investment are the nonstationary series extracted from the baseline model. To get the total wealth series, I construct the human wealth variable as in the data, but using the model. Nonhuman wealth is the asset holdings, which is foreign assets plus capital. Total wealth is simply the sum of human wealth and nonhuman wealth.[4]

I compare the cointegration results produced by the baseline model to the cointegration results produced by the data. Table 5 lists the results of the Johansen Procedure. The trace test indicates that the model produces 3 cointegrating rela-

[4] The logarithm of total wealth is linearized around the steady state.

tions. I show only the first cointegrating vector, as the data predicts one cointegrating relation. The cointegrating relation is:

$$CA = -0.14Y - 4.25r + 0.00048TW + 0.52I. \tag{14}$$

Equation 14 is the long-run normalized current account equation produced by the baseline model. The signs on income and total wealth match those in equation 3. A country with higher income can sustain current account deficits in the long run. An increase in total wealth produces a long-run current account surplus; agents save their new wealth and buy foreign bonds. Table 4 shows that all estimates of the coefficients in equation 14, except that on income, fall outside their 90% confidence intervals.

3.6 Results: Innovation Analysis

I perform innovation analysis on the unrestricted VAR in the baseline model. As in the data, the VAR ordering is: TW, r, CA, I, Y.

Figure 2 shows the responses of the current account to income and total wealth innovations. The upper panel shows the response of the current account to an unanticipated positive income shock. The shock to income produces an immediate current account surplus. The current account returns to its steady state, as the shock is only temporary. The lower panel shows the response of the current account to an unanticipated positive total wealth shock. The shock to total wealth produces an immediate and permanent current account surplus.

Comparing to Figure 1, an income shock produces a current account surplus in the model and in the data. The income shock produced by the model is temporary and the current account returns to its steady state, but the data suggests that the current account rises steadily to a higher steady state. A total wealth shock produces a current account surplus in the model and in the data. The total wealth shock produced by the model is permanent and the current account rises to a higher steady state, but the data suggests that the shock is temporary and the current account falls back to its original steady state.

4 Absolute Status

This section shows a model with direct preferences for absolute status. Status is nonhuman wealth in levels.

4.1 The Economic Environment

I present the model beyond the baseline specifications. The planner's problem is:

$$\max E_0 \left\{ \sum_{t=0}^{\infty} \beta^t U\left(C_{it}, S_{it}, 1 - N_{it}\right) \right\}, \tag{15}$$

subject to

$$S_{it} = B_{it} + K_{it}, \tag{16}$$

where S_i is status. Equation 16 defines status as individual nonhuman wealth. Nonhuman wealth is the sum of foreign assets, B_i, plus the capital stock, K_i. The momentary utility function is

$$U\left(C_{it}, S_{it}, 1-N_{it}\right) = \ln\left[\left(\gamma C_{it}^{\frac{\eta-1}{\eta}} + (1-\gamma) S_{it}^{\frac{\eta-1}{\eta}}\right)^{\frac{\eta}{\eta-1}}\right] + \psi \ln\left(1-N_{it}\right),$$

where η is the elasticity of substitution between consumption and status and γ is the status share.

4.2 Optimality and Stationarity Conditions

New to the model is the variable for status, S_i, that grows with technology. The stationary transformation for status is $\widetilde{S}_{it} = S_{it}/\Gamma_t$ and $\widetilde{S}_{it} = \widetilde{S}_t$ in the symmetric equilibrium. The planner's problem yields the following stationary first-order conditions:

$$-\frac{\widetilde{U}_{N_t}}{\widetilde{U}_{C_t}} = \frac{(1-\alpha)\widetilde{Y}_t}{N_t} \tag{17}$$

$$1 = \beta E_t\left\{(1+r_{t+1})\frac{\widetilde{U}_{C_{t+1}}}{\widetilde{U}_{C_t}\widetilde{Z}_{t+1}} + \frac{\widetilde{U}_{S_{t+1}}}{\widetilde{U}_{C_t}\widetilde{Z}_{t+1}}\right\} \tag{18}$$

$$\frac{1}{1-\theta}\left(\frac{\widetilde{I}_t\widetilde{Z}_t}{\widetilde{K}_t}\right)^{\theta} = \beta E_t\left\{\left[\alpha\frac{\widetilde{Y}_{t+1}\widetilde{Z}_{t+1}}{\widetilde{K}_{t+1}} + \Delta_\theta\right]\frac{\widetilde{U}_{C_{t+1}}}{\widetilde{U}_{C_t}\widetilde{Z}_{t+1}} + \frac{\widetilde{U}_{S_{t+1}}}{\widetilde{U}_{C_t}\widetilde{Z}_{t+1}}\right\}, \tag{19}$$

where $\Delta_\theta = \frac{(1-\delta)+\theta\left(\widetilde{K}_{t+1}/\left(\widetilde{I}_{t+1}\widetilde{Z}_{t+1}\right)\right)^{\theta-1}}{(1-\theta)\left(\widetilde{K}_{t+1}/\left(\widetilde{I}_{t+1}\widetilde{Z}_{t+1}\right)\right)^{\theta}}$. The stationary marginal utilities of work effort, consumption, and status are $\widetilde{U}_{N_t}$, $\widetilde{U}_{C_t}$, and $\widetilde{U}_{S_t}$. Equation 17 equates the marginal rate of substitution between consumption and leisure to the real wage rate. Equation

18 is the Euler equation for the bond market. Equation 19 is the Euler equation for capital. Marginal utility of status enters equations 18 and 19, and I expect status to affect holdings of foreign assets and the stock of capital.

4.3 Calibration and Numerical Method

The parameters α, δ, r, q, and φ are set as in the baseline model. I set $\psi = 2.003$ to ensure that hours worked forms 30 percent of the time endowment. The domestic rate r, and world rate q, imply $\beta = 0.992$. I set $\theta = 0.156$ so that the standard deviation of investment to output is 3.37. Additionally, the parameters for the elasticity of substitution between consumption and status, η, and the status share, γ, must be set. The relationship between consumption and status changes for different values of η and γ. There are three relevant values for the elasticity of substitution between consumption and status: $\eta = 1$, $\eta \to 0$, and $\eta \to \infty$. Preferences are Cobb-Douglas when $\eta = 1$. Consumption and status approach perfect compliments as $\eta \to 0$. Consumption and status approach perfect substitutes as $\eta \to \infty$. As a benchmark, the status1 model sets $\eta = 0.9999$ and $\gamma = 0.95$, so preferences are Cobb-Douglas and status has a small share.

4.4 Results: The Business Cycle

Table 1 lists the business cycle moments produced by the data and by the status1 model. The model cannot reproduce the business cycle moments from the data.

The statistics are as in the baseline model. The current account is too volatile, while labor is not volatile enough. The trade balance has too low a correlation with output. Consumption, output, and investment are not persistent enough. The model predicts negative persistence for the current account when it should be positive. The status1 model correctly predicts the volatility and the persistence of the trade balance. The volatility of nonhuman wealth and total wealth are lowered further, the correlation for nonhuman wealth is too low, and both nonhuman wealth and total wealth are negatively autocorrelated. The status1 model correctly predicts the correlation for total wealth.

To further understand the model, I present the business cycle statistics for different values of the status parameters. Table 6 lists the business cycle results from the sensitivity analysis. The status2 model sets $\eta = 0.9999$ and $\gamma = 0.75$, so status has a larger share. This further lowers the volatilities of nonhuman wealth and total wealth. The status3 model sets $\eta = 0.1$ and $\gamma = 0.95$, so consumption and status are compliments. The business cycle moments produced by this model are similar to those from the status1 model. The status4 model sets $\eta = 0.1$ and $\gamma = 0.75$, so consumption and status are compliments and status has a larger share. Again, the business cycle moments are similar to those from the status1 model.

The status5 model sets $\eta = 5$ and $\gamma = 0.95$, so consumption and status are strong substitutes.[5] This model gives a large role to status in consumer preferences.

[5] I do not present results for high η and low γ because steady state consumption falls to zero. Agents choose to sacrifice all consumption for wealth.

The model closely matches the volatility of labor, matches the correlation of the trade balance, closely matches the persistence of consumption, and closely matches the persistence of the current account. The volatilities of nonhuman wealth and total wealth are very low in the status5 model; status plays a large role in consumer preferences and consumers are risk-averse in their wealth holdings. Adding two state variables, B and K, to agent preferences does change the business cycle moments.

4.5 Results: Cointegration Analysis

I test for cointegrating relations in the absolute status model. I extract the long-run series from the absolute status model as was done in the baseline model. Table 5 lists the results from the Johansen Procedure. The cointegrating relations are:

$$CA = -0.15Y - 2.72r + 0.0013TW + 0.58I \tag{20}$$

and

$$CA = -2.79Y - 43.84r + 0.29TW - 7.69I. \tag{21}$$

Equations 20 and 21 are the long-run normalized current account equations produced by the status1 and status5 models. The status1 model can match the signs on both income and total wealth to those in equation 3, however, the estimate on total wealth falls outside the 90% confidence interval. The status5 model can match the signs on income, total wealth, and investment, but all estimates fall far outside their 90%

confidence intervals. The absolute status model does not have an advantage over the baseline model in the cointegration analysis.

4.6 Results: Innovation Analysis

I perform innovation analysis on the unrestricted VAR in the absolute status model. The ordering of the VAR is: TW, r, CA, I, Y.

Figure 3 shows the responses of the current account to income and total wealth innovations in the status1 model. The upper panel shows the response of the current account to an unanticipated positive income shock. The income shock produces a temporary current account surplus. The current account quickly returns to its original steady state. The lower panel shows the response of the current account to an unanticipated positive total wealth shock. The total wealth shock produces an immediate and permanent current account surplus. Comparing to Figure 1, the income shock is too temporary and the total wealth shock is too permanent.

Figure 4 shows the responses of the current account to income and total wealth innovations in the status5 model. The upper panel shows the response of the current account to an unanticipated positive income shock. The shock induces a current account surplus, and the current account rises to a new steady state. The lower panel shows the response of the current account to an unanticipated positive total wealth shock. The shock induces a current account surplus, and the current account falls back to its steady state. Comparing to Figure 1, the current account responses produced by the status5 model match the data well. The income shock produces a permanent response and the total wealth shock produces a temporary response.

5 Relative Status

This section shows a model with relative status. The model includes direct preferences for relative nonhuman wealth.

5.1 The Economic Environment

The relative status model is similar to the absolute status model, but it includes direct preferences for relative wealth. The planner's problem is:

$$\max E_0 \left\{ \sum_{t=0}^{\infty} \beta^t U \left(C_{it}, S_{it}, 1 - N_{it} \right) \right\}, \tag{22}$$

subject to

$$S_{it} = \frac{B_{it} + K_{it}}{B_t + K_t}. \tag{23}$$

The momentary utility function is:

$$U \left(C_{it}, S_{it}, 1 - N_{it} \right) = \ln \left[\left(\gamma C_{it}^{\frac{\eta - 1}{\eta}} + (1 - \gamma) \left(\Gamma_t S_{it} \right)^{\frac{\eta - 1}{\eta}} \right)^{\frac{\eta}{\eta - 1}} \right] + \psi \ln \left(1 - N_{it} \right).$$

Consumption is growing and status is stationary. To ensure a balanced growth path, I premultiply status by the level of technology.[6] Equation 23 defines status. It is the ratio of individual nonhuman wealth to the aggregate wealth index, $B+K$.

5.2 Optimality and Stationarity Conditions

Status is bounded and does not grow with technology, so $\widetilde{S}_{it} = S_{it}$. The new stationary first-order conditions are:

$$1 = \beta E_t \left\{ (1 + r_{t+1}) \frac{\widetilde{U}_{C_{t+1}}}{\widetilde{U}_{C_t} \widetilde{Z}_{t+1}} + \frac{\widetilde{U}_{S_{t+1}}}{\widetilde{U}_{C_t} \widetilde{Z}_{t+1}} \frac{1}{\left(\widetilde{B}_{t+1} + \widetilde{K}_{t+1}\right)} \right\} \tag{24}$$

$$\frac{1}{1-\theta} \left(\frac{\widetilde{I}_t \widetilde{Z}_t}{\widetilde{K}_t} \right)^{\theta} = \beta E_t \left\{ \left[\alpha \frac{\widetilde{Y}_{t+1} \widetilde{Z}_{t+1}}{\widetilde{K}_{t+1}} + \Delta_\theta \right] \frac{\widetilde{U}_{C_{t+1}}}{\widetilde{U}_{C_t} \widetilde{Z}_{t+1}} + \frac{\widetilde{U}_{S_{t+1}}}{\widetilde{U}_{C_t} \widetilde{Z}_{t+1}} \frac{1}{\left(\widetilde{B}_{t+1} + \widetilde{K}_{t+1}\right)} \right\}, \tag{25}$$

where $\Delta_\theta = \frac{(1-\delta)+\theta\left(\widetilde{K}_{t+1}/\left(\widetilde{I}_{t+1}\widetilde{Z}_{t+1}\right)\right)^{\theta-1}}{(1-\theta)\left(\widetilde{K}_{t+1}/\left(\widetilde{I}_{t+1}\widetilde{Z}_{t+1}\right)\right)^{\theta}}$. The new term, $1/\left(\widetilde{B}_{t+1} + \widetilde{K}_{t+1}\right)$, in equations 24 and 25 should affect the optimal decision paths for bond holdings and capital.

5.3 Calibration and Numerical Method

The parameters α, δ, r, q, β, φ, ψ, and θ are set as in the status1 model. The status6 model is the benchmark relative status model. I set $\eta = 0.9999$ and $\gamma = 0.95$, so preferences are Cobb-Douglas and status has a small share.

[6] See Hercowitz and Sampson (1991).

5.4 Results: The Business Cycle

Table 1 lists the business cycle moments produced by the data and by the status6 model. The status6 model produces too high a volatility of the current account, too low a correlation of the trade balance, and negative persistence for the current account. The model correctly matches the volatility of the trade balance and the persistence of the trade balance. Nonhuman wealth and total wealth are not volatile enough, the correlation of nonhuman wealth is too low, and the persistence of nonhuman wealth and total wealth are negative. The status6 model matches the correlation of total wealth.

To better understand the model, I perform three simulations. The status7 model sets $\eta = 0.9999$ and $\gamma = 0.75$, so status has a larger share. The status8 model sets $\eta = 0.10$ and $\gamma = 0.95$, so consumption and status are compliments. The status9 model sets $\eta = 5$ and $\gamma = 0.95$, so consumption and status are strong substitutes. Table 6 lists the business cycle moments for the sensitivity analysis. The model is not sensitive to the parameters of status, as the moments produced by the models do not change. Unlike in the status5 model, assigning a large role to status in consumer preferences does not change the business cycle moments.

5.5 Results: Cointegration Analysis

I estimate the unrestricted VAR for the relative status model. I compare the results produced by the relative status model to those produced by the data.

I test for cointegrating relations in the relative status model. Table 5 lists the results from the Johansen Procedure for the status6 model. It indicates that there are up to 3 cointegrating relations, but I focus on the first relation. The cointegrating relation is:

$$CA = -0.19Y - 9.44r + 0.0016TW + 0.62I. \tag{26}$$

Equation 26 is the long-run normalized current account equation produced by the status6 model. I compare equation 26 to equation 3. Equation 26 matches the signs on income and total wealth. The estimate of the coefficient on total wealth falls far outside the 90% confidence interval. Both the absolute and the relative status models produce estimates on output that fall inside the 90% confidence interval. The relative status model has no advantage over the baseline model in the cointegration analysis.

5.6 Results: Innovation Analysis

I include innovation analysis for the unrestricted VAR produced by the relative status model. The ordering of the VAR is: TW, r, CA, I, Y.

Figure 5 shows the current account responses to income and total wealth innovations in the status6 model. The upper panel shows the response of the current account to an unanticipated positive income shock. The shock produces a current account surplus, but the current account returns to its original steady state. Consistent with Fisher (1999, 2004, 2005), current account dynamics are non-monotonic; the current account oscillates between deficits and surpluses as it transitions to the steady state. Agents have motive to hold current account surpluses to increase their status. Agents also face convex installation costs to investment, which gives them motive to hold current account deficits. The lower panel shows the response of the current account to an unanticipated positive total wealth shock. The shock produces a permanent current account surplus.

Comparing to figure 1, the model produces current account responses that do not match the data. The income shock is too transitory and the total wealth shock is too permanent.

6 Conclusion

This paper quantifies the value of wealth in open-economy real business cycle theory. I define status as either nonhuman wealth in levels or relative nonhuman wealth. The business cycle analysis evaluates the ability of the models to match business cycle moments. The cointegration analysis tests the ability of the models to produce a long-run current account equation. Finally, the innovation analysis shows the responses of the current account to real economic shocks.

The absolute status model can match several business cycle moments when status plays a large role in consumer preferences. That is, the model closely matches the volatility of labor, matches the correlation of the trade balance, closely matches the persistence of consumption, and closely matches the persistence of the current account. The relative status model, however, cannot match the business cycle moments.

I extend the standard business cycle analysis and extract the long-run nonstationary series from the models. I test for a cointegrating relation among the variables of a multivariate VAR. The models with status produce a long-run cointegrating relation similar to that in the data. It correctly matches the signs on income and total wealth. The estimate on total wealth, however, falls outside the 90% confidence interval from the data. I perform innovation analysis on the current account. The absolute status model closely matches the response of the current account to an unanticipated total wealth innovation. The shock is more transitory when status plays a large role in consumer preferences.

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Table 1. Business Cycle Moments				
	Canada	Baseline	Status1	Status6
Volatilities				
$\sigma_{\mathsf{c}}/\sigma_{\mathsf{y}}$	0.61	0.81	0.73	0.73
$\sigma_{\mathsf{l}}/\sigma_{\mathsf{y}}$	0.84	0.18	0.22	0.84
$\sigma_{\mathsf{x}}/\sigma_{\mathsf{y}}$	3.37	3.37	3.37	3.37
$\sigma_{\mathsf{nhw}}/\sigma_{\mathsf{y}}$	2.14	1.03	0.98	0.98
$\sigma_{\mathsf{tw}}/\sigma_{\mathsf{y}}$	1.85	1.01	0.97	0.96
$\sigma_{\mathsf{tb}}/\sigma_{\mathsf{y}}$	0.54	0.55	0.53	0.53
$\sigma_{\mathsf{ca}}/\sigma_{\mathsf{y}}$	0.20	0.65	0.64	0.63
Correlations				
$\rho\,(c, y)$	0.60	0.98	0.98	0.98
$\rho\,(l, y)$	0.86	0.81	0.91	0.91
$\rho\,(x, y)$	0.88	0.97	0.97	0.97
$\rho\,(nhw, y)$	0.59	0.27	0.26	0.27
$\rho\,(tw, y)$	0.27	0.29	0.29	0.29
$\rho\,(tb, y)$	-0.10	-0.80	-0.77	-0.77
$\rho\,(ca, y)$	-0.23	-0.16	-0.13	-0.14
Persitstences				
$\rho\,(c^{\theta}, c)$	0.81	0.68	0.68	0.73
$\rho\,(l^{\theta}, l)$	0.85	0.87	0.82	0.58
$\rho\,(y^{\theta}, y)$	0.87	0.71	0.71	0.71
$\rho\,(x^{\theta}, x)$	0.82	0.68	0.69	0.73
$\rho\,(nhw^{\theta}, nhw)$	0.79	-0.17	-0.17	-0.17
$\rho\,(tw^{\theta}, tw)$	0.62	-0.15	-0.15	-0.15
$\rho\,(tb^{\theta}, tb)$	0.71	0.70	0.70	0.70
$\rho\,(ca^{\theta}, ca)$	0.37	-0.07	-0.07	-0.07

This table gives simulation results for the sample of Canadian data, the baseline model, the status1 model, and the status6 model. The simulation results take different parameter values. Entries for Canadian data refer to seasonally adjusted quarterly data over the years 1976:I to 2001:IV. The model-generated variables and moments are the averages of 1000 simulations. All variables and the data are Hodrick-Prescott filtered with a smoothing parameter equal to 1600.

Table 2. Test for One Unit Root

Variable	ADF Lags ($\max p$)	ADF T-Value
CA	4	-2.3010319
Y^{t}	3	-2.1717776
r	0	-0.00000017
TW^{t}	7	-0.83929246
I^{t}	2	-2.8475471

Variables with a t include a trend term in the ADF test for a unit root. The critical values for the 5% and 10% ADF tests with trend are -3.45 and -3.15; for the ADF models without deterministic trend, the critical values are -2.89 and -2.58.

Table 3. Trace Test Statistics

Eigenvalues $\hat{\lambda}$

$(0.2664, 0.1565, 0.0727, 0.0614)$

Null hypothesis	Trace Test Statistic	10% Critical Value
ce6 0*	67.703897	65.01
ce6 1	27.361739	43.96
ce6 2	13.067682	26.79
ce6 3	4.8870426	13.34
ce6 4	0.89519534	2.82

The critical values are taken from Harris, 1995. The null hypothesis tests the number of cointegrating equation, ce.

Table 4. 90% Confidence Intervals

Variable	Estimate	Confidence Interval
CA	-0.18	$[1, 1]$
Y	-0.18	$[-0.26, -0.11]$
r^{w}	687.47	$[387.76, 987.200]$
TW	0.000125	$[0.0000076, 0.00017]$
I	-0.29	$[-0.34, -0.0244]$

This table gives the 90% confidence intervals for the coefficient estimates of equation 3.

Table 5. Johansen Test					
Null		Trace Test Statistic			Critical Value
	Baseline	Status1	Status5	Status6	
ce6 0*	212.52	207.16	224.03	210.05	75.33
ce6 1*	96.35	98.84	96.59	95.21	53.35
ce6 2*	40.25	43.33	43.10	40.16	35.07
ce6 3	15.17	15.68	16.43	14.90	20.17
ce6 4	2.90	2.71	2.89	2.83	9.09
Eigenvalues λ Baseline Model					
(0.6499, 0.4234, 0.2203, 0.1151, 0.0283)					
Eigenvalues λ Status1 Model					
(0.6521, 0.4203, 0.2403, 0.1212, 0.0265)					
Eigenvalues λ Status5 Model					
(0.7064, 0.4104, 0.2334, 0.1266, 0.0283)					
Eigenvalues λ Status6 Model					
(0.6760, 0.4173, 0.2218, 0.1132, 0.0277)					

The critical values are taken from Harris, 1995. * indicates rejection of the null at the 5% level. Status1 is the benchmark absolute status model. Status5 is the high substitution absolute status model. Status6 is the benchmark relative status model. The results are the mean values of 1000 simulation.

Table 6. Sensitivity Analysis							
	Status2	Status3	Status4	Status5	Status7	Status8	Status9
Volatilities							
σ_{c}/σ_{y}	0.25	0.56	0.56	0.13	0.48	0.60	0.75
σ_{l}/σ_{y}	0.53	0.33	0.33	0.67	0.37	0.44	0.19
σ_{x}/σ_{y}	3.73	3.73	3.73	3.73	3.37	3.37	3.37
σ_{nhw}/σ_{y}	0.71	0.88	0.89	0.61	0.84	0.80	1.01
σ_{tw}/σ_{y}	0.69	0.86	0.86	0.58	0.82	0.77	0.98
σ_{tb}/σ_{y}	0.53	0.52	0.52	0.63	0.50	0.52	0.54
σ_{ca}/σ_{y}	0.68	0.62	0.62	0.53	0.62	0.95	0.64
Correlations							
$\rho(c, y)$	0.98	0.98	0.98	0.17	0.99	0.97	0.98
$\rho(l, y)$	1.00	0.97	0.97	1.00	0.99	0.98	0.87
$\rho(x, y)$	0.93	0.95	0.95	0.90	0.95	0.95	0.97
$\rho(nhw, y)$	0.29	0.27	0.27	0.33	0.28	0.26	0.27
$\rho(tw, y)$	0.33	0.30	0.30	0.37	0.31	0.30	0.29
$\rho(tb, y)$	-0.37	-0.63	-0.65	-0.09	-0.64	-0.55	-0.79
$\rho(ca, y)$	0.095	-0.06	-0.06	0.36	-0.05	-0.01	-0.16
Persistences							
$\rho(c^{0}, c)$	0.68	0.68	0.68	0.78	0.68	0.69	0.69
$\rho(l^{0}, l)$	0.74	0.78	0.79	0.73	0.74	0.76	0.84
$\rho(y^{0}, y)$	0.72	0.72	0.72	0.73	0.71	0.72	0.71
$\rho(x^{0}, x)$	0.67	0.68	0.68	0.66	0.67	0.68	0.68
$\rho(nhw^{0}, nhw)$	-0.14	-0.17	-0.16	-0.10	-0.17	-0.17	-0.17
$\rho(tw^{0}, tw)$	-0.12	-0.14	-0.15	-0.07	-0.15	-0.15	-0.15
$\rho(tb^{0}, tb)$	0.78	0.72	0.72	0.82	0.72	0.75	0.70
$\rho(ca^{0}, ca)$	-0.01	-0.05	-0.06	0.19	-0.06	-0.05	-0.075

This table gives simulation results for the status2, status3, status4, status5, status7, status8, and status9 models. The simulation results take different parameter values. The model-generated moments are the averages of 1000 simulations. All variables are Hodrick-Prescott filtered with a smoothing parameter equal to 1600.

Figure 1: Response of Current Account to Income Shock

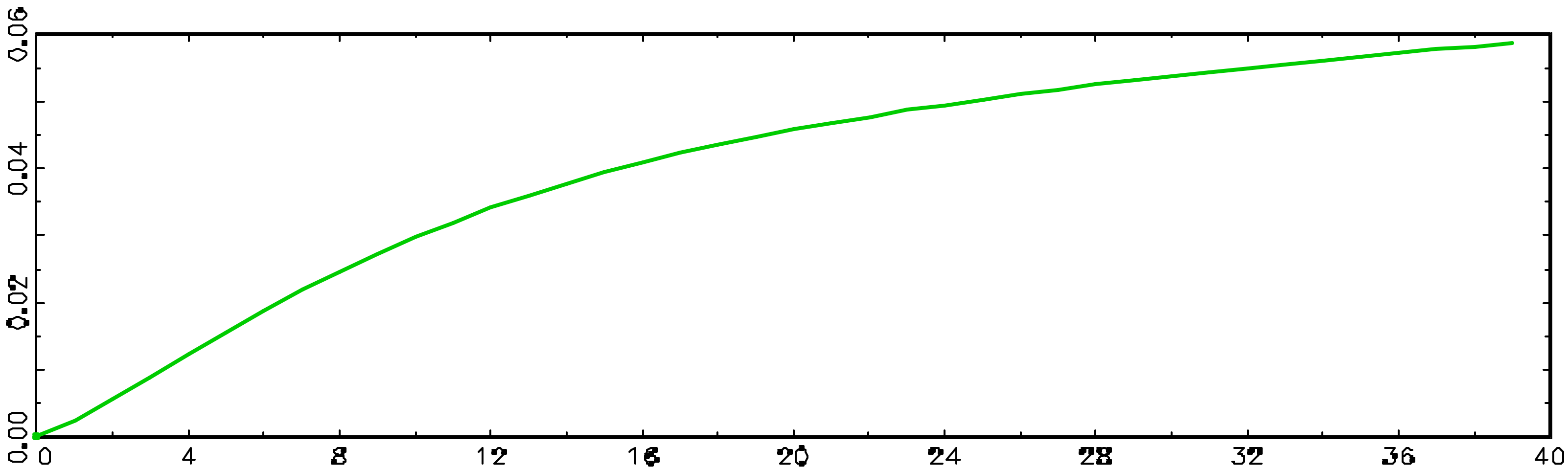

Figure 1: Response of Current Account to Total Wealth Shcok

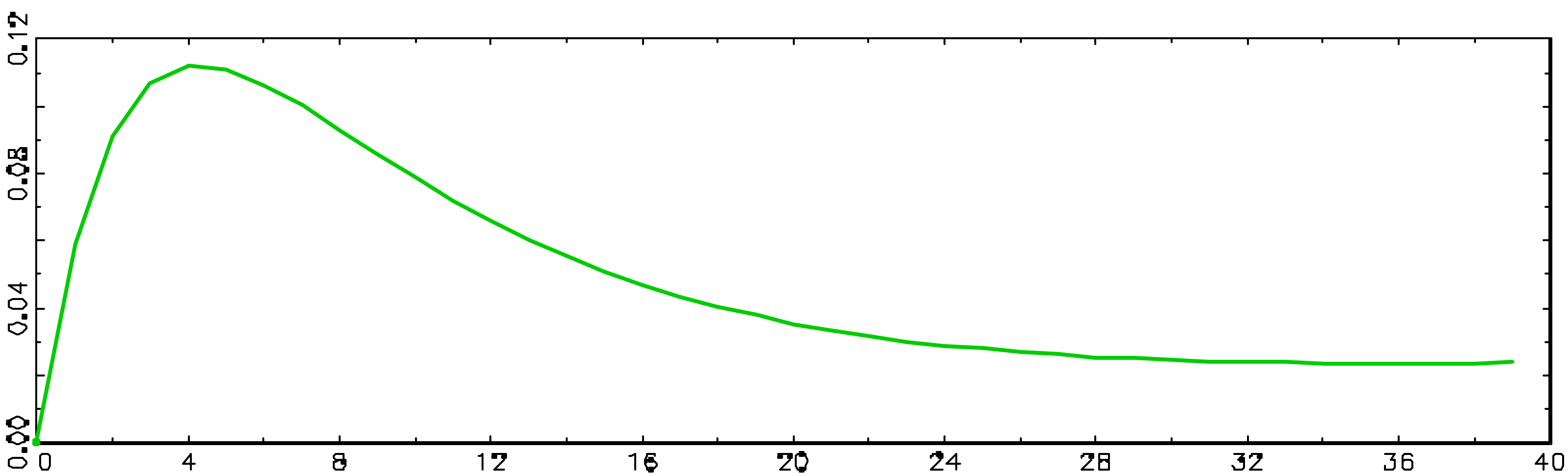

Figure 2: Response of Current Account to Income Shock

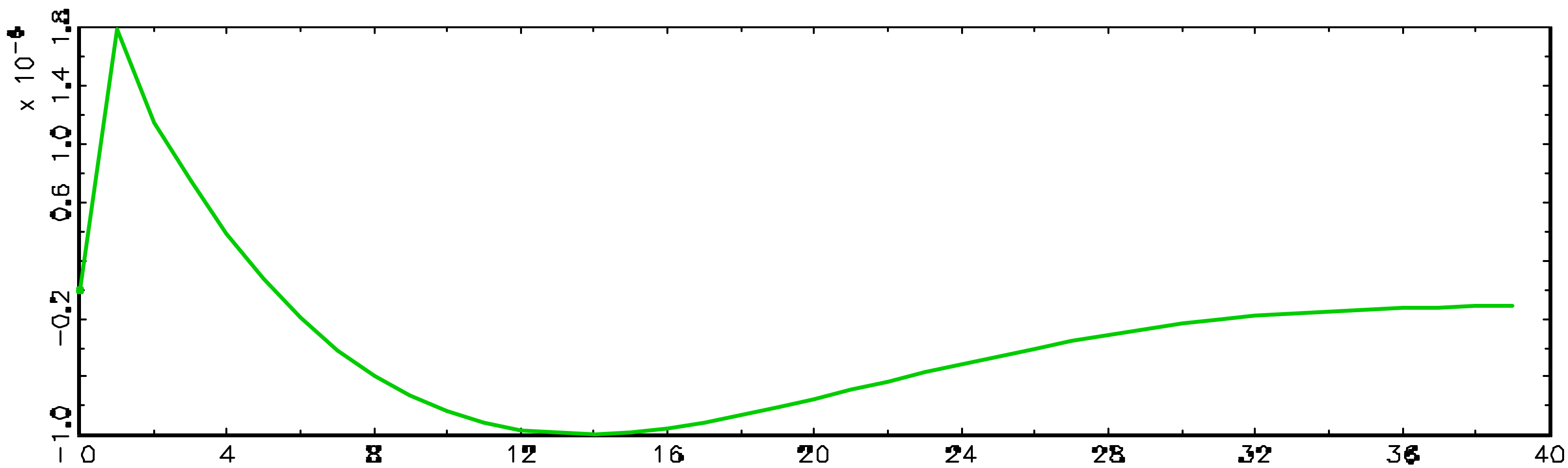

Figure 2: Response of Current Account to Total Wealth Shcok

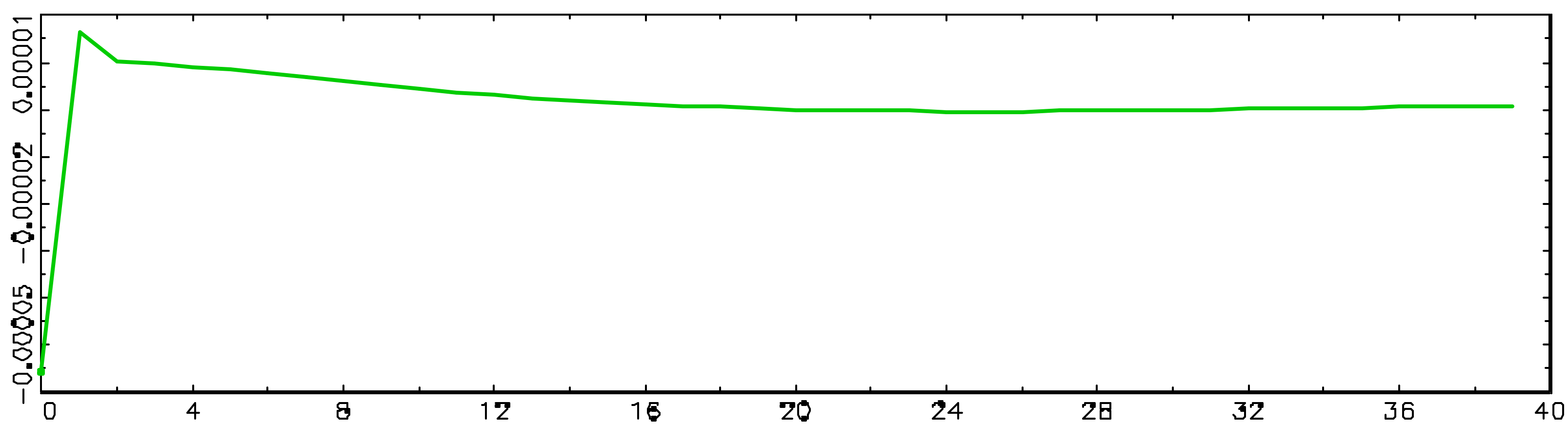

Figure 3: Response of Current Account to Income Shock

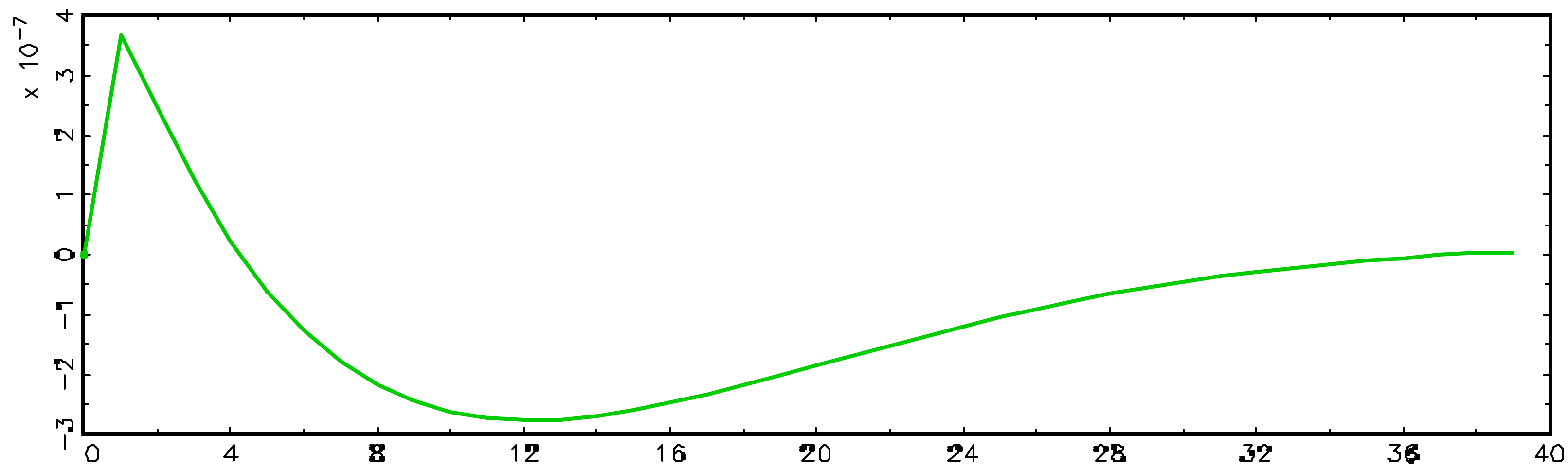

Figure 3: Response of Current Account to Total Wealth Shcok

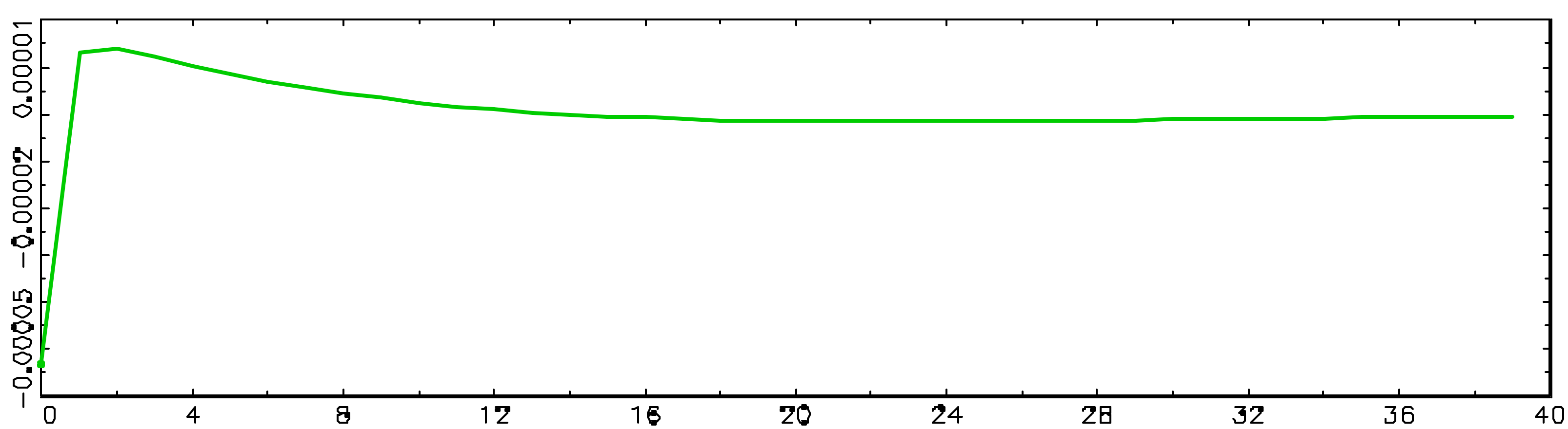

Figure 4: Response of Current Account to Income Shock

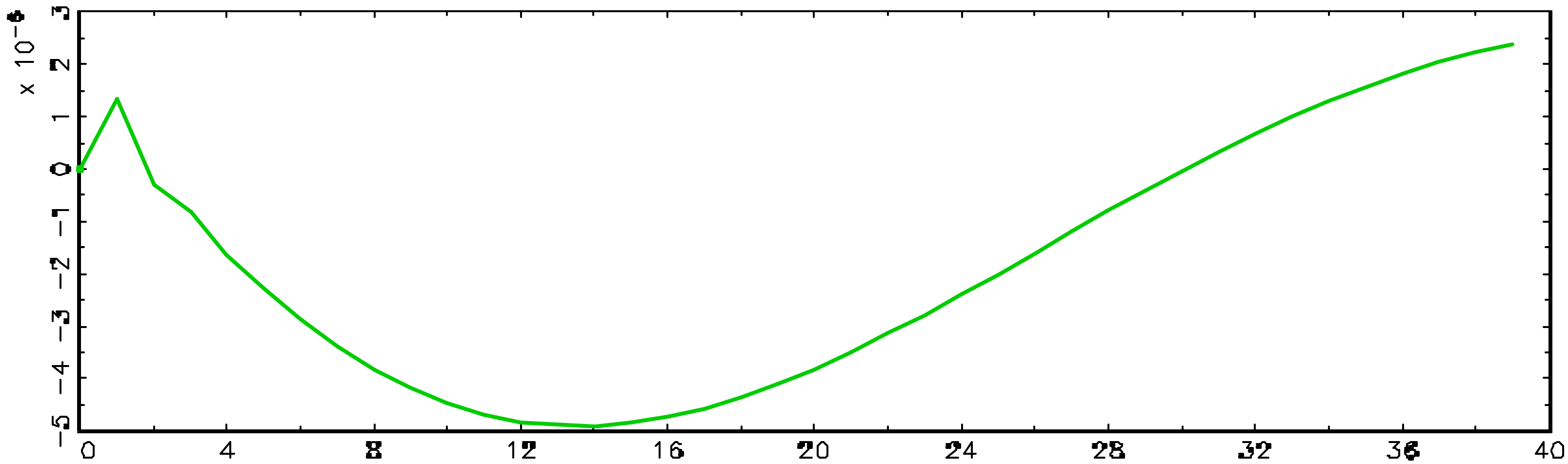

Figure 4: Response of Current Account to Total Wealth Shcok

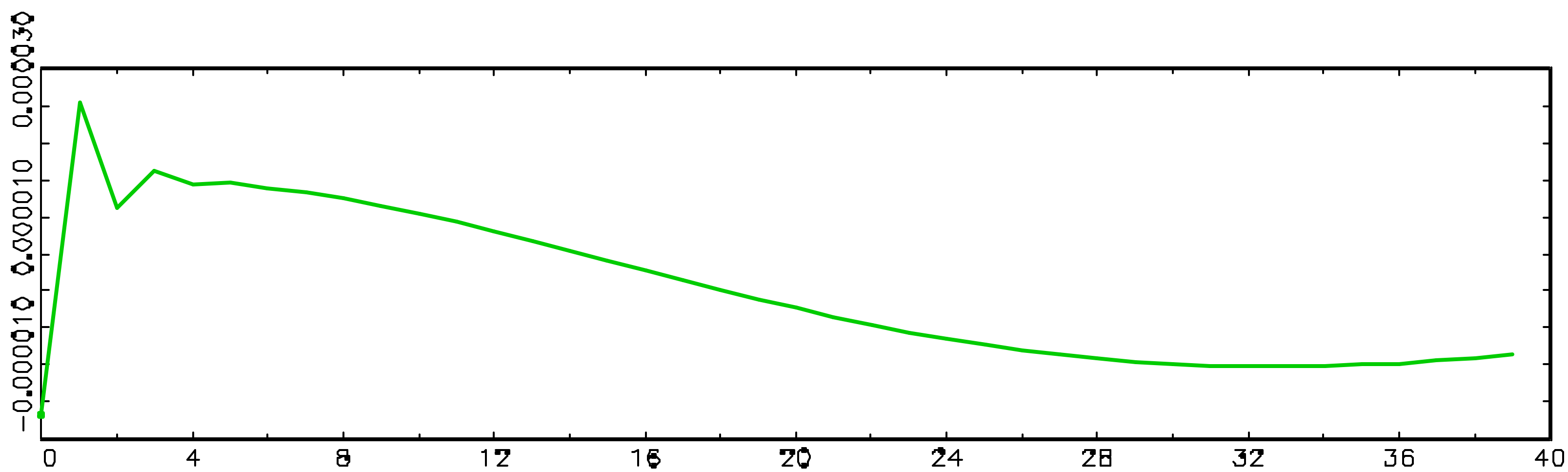

Figure 5: Response of Current Account to Income Shock

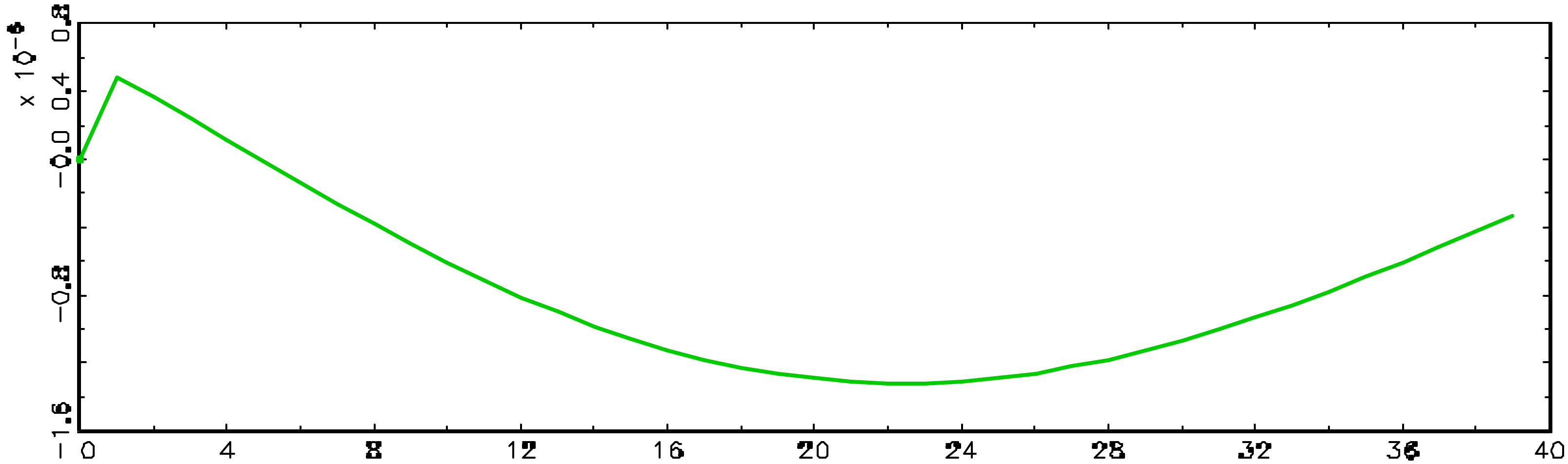

Figure 5: Response of Current Account to Total Wealth Shcok