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Liquidity Effects and Precautionary Saving in The Czech Republic

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The views expressed in this paper are the personal responsibility of the author and are not necessarily held either by the Central Bank of Ireland or by the ESCB. All errors and omissions are the authors'. Comments are welcome. The paper is forthcoming in *Applied Financial Economics*.

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Abstract

An aggregate consumption function for the Czech Republic since its transition to market status is estimated. Economic theory and the ‘general to specific’ methodology are used to guide the choice of dynamic equation. Previous empirical evidence on the consumption function in Eastern Europe focused on the centrally planned period and so faced the ‘ liquidity overhang ‘ principle. We examine a number of different variants including alternative income variables and the rate of unemployment which would proxy income constrained consumers and precautionary saving. Our results indicate that the size of the long-run income elasticity is affected by the inclusion of the unemployment variable which may reflect liquidity constraints and precautionary saving.

1. Introduction

Since the break up of the Czech-Slovak Federation on 31 December 1992, the Czech Republic has been at the forefront of the transition to a market economy. Key aims of the Czech Republic, and many other former centrally planned economies (FCPE), are low inflation and a stable exchange rate, particularly for those who ultimately wish to enter the European Union (EU).

The aggregate consumption function has been a key component of macro-models since Keynes (1936) and is especially important for growth in a transitional economy. In the long-run we take the consumption function to be of the following form;

$$[1] \qquad c_t = \beta_0 + \beta_1 yh_t + \beta_2 R_t + \beta_3 inf_t + \beta_4 w_t$$

where c_t = the logarithm of real consumption, y = logarithm of real household income, R = the interest rate on credit, inf_t = logarithm of (p_t/p_{t-1}), where p is the price level, and w = logarithm of real wealth. We expect a positive relationship between real consumption and the level of real income and wealth, with a negative relationship between the consumption and the rate of interest and inflation[1]. The life cycle hypothesis (LCH) would suggest the inclusion of a wealth variable, for example Molana (1991) found a long-run relationship between consumption and wealth. In this paper we estimate a dynamic error correction model for private consumption in the Czech Republic since 1992.

The rest of the paper is organised as follows, section 2 gives a brief description of the performance of the Czech Republic since transition. An account of consumption models is given in section 3. Section 4 outlines the methodological approach adopted. Data and empirical results are discussed in section 5. Finally conclusions and policy implications are given in section 6.

2. Review of the Czech Economy and the Process of Reform

The Czech Republic suffered a downturn in growth in the early years of transition, following internal and external shocks. The shocks to hit the Czech economy as a result of the split with the Slovak Republic include: monetary dissolution, banking and financial separation and separation of the Central Bank. Transitional shocks include; VAT reform and

[1] The real rate of interest, (R - inf), is implicitly included in equation [1].

large scale privatisation (Smidkova, 1996). Since then GDP has grown by 2.6% in 1994 and 4.8% in 1995 (OECD, 1996).

Price stability should be an extremely important objective for any central bank, especially in a transition economy. Although the rate of inflation hit a high in 1991, due to domestic price liberalisation, and in 1993, due to the introduction of VAT, it has declined and remained at an annual rate of 10% (OECD, 1996). While fiscal deficits have persisted in other Eastern European economies (Calvo and Kumar, 1994), the Czech Republic has adopted a conservative stance and up to mid 1995 a budget surplus was recorded (CNB, 1996). Since then a budget deficit has been recorded and in the last year there has been increases in health expenditure and generous pay increases. The combination of a fairly stable nominal exchange rate and inflation of around 10% per annum has meant that the real exchange rate has appreciated significantly. The effect on competitiveness led to low export demand in 1994, although it has since began to rise again (OECD, 1996). The stagnating exports and high growth in imports has led a large increase in the balance of payments deficit. The trade deficit for 1995 was $3.9 billion, more than four times the 1994 level and twice as much as was forecast by the government at the beginning of the year (OECD, 1996).

Besides price stability, a second major role for the CNB is to direct the reform of the banking system, which began in 1990 (Corbett and Mayer, 1991). In the early years the banking sector expanded rapidly due to liberal licensing policy, gradual opening of domestic financial markets, and the voucher privatisation programme[2]. The initial number of banks in the transformed banking sector was 7, this increased to 32 by 1991, and by 1995 there were 59 (including the state and central bank). In order to solve the problem of bad debts on banks balance sheets, the Consolidation Bank (state owned and non-profit making) was set up in 1991 (Smidkova, 1996).

The second major development in the Czech Republic was the emergence of new financial assets. The money market, bond market, short term securities market and the equity market began functioning around 1995. Some of these assets provide substitutes for money balances and provide new sources of marketable financial wealth.

[2] The national property fund (NPF), set up by the government to oversee the privatisation process, has retained a majority share in the major banks that have been privatised

3. Literature Review

The theoretical and empirical limitations of the absolute income hypothesis (AIH) (Keynes, 1936) led to the development of the LCH (Modigliani and Ando, 1957) and the permanent income hypothesis (PIH) (Freidman, 1957). Both of the later theories were based on strong micro foundations of utility maximisation behaviour. In recent years the main empirical approach to modelling consumption functions has been the error correction model (ECM) based on Davidson et al (1978) and the random walk model by Hall (1978).

Hall (1978) took the permanent income approach and included rational expectations, rational expectations permanent income hypothesis (REPIH)[3]. Although this approach has strong theoretical appeal (Speight, 1989), empirical evidence has not been favourable (Wilcox, 1991). In the context of a transition economy, with extra constraints on private consumption and a high degree of uncertainty, it is unlikely that the REPIH will hold. A number of researchers have explained the excess sensitivity of consumption to current income through liquidity constraints, e.g. Flavin (1985). Such constraints will be even more important in a transition economy. As has been mentioned in section 2 the transition of financial markets and institutions is still developing and needs to be widened and deepened. The need for well developed financial markets that allow consumers to borrow against future income in order to maintain a regular consumption path is a key assumption of Hall's model. It would therefore not be an appropriate approach to model consumption in the Czech Republic.

The second approach mentioned is the ECM (Davidson et al , 1978). This approach is based on the dynamic modelling framework developed by Sargan (1964). The authors take the view that the long run relationship during any point in time between income and consumption may be out of equilibrium. In other words it takes time for private consumers to adjust to changes in income. If such a time allowance did not take place, the adjustment would take place immediately. The model would take the form of the growth in consumption being determined by the growth in income plus a long-run relationship between consumption and income. Early empirical evidence on Davidson et al (1978) model was favourable, e.g. Davis (1984). However recent evidence would suggest the inclusion of additional regressors (Speight, 1989 and Molana, 1991).

Given the nature of the Czech financial markets and institutions (discussed in section 2) it is likely that consumption will not immediately reach the long-run equilibrium. Therefore the long-run relationship and short-run interactions which is the basis of the ECM approach would appear to be the appropriate choice for an emerging economy. Studies of consumption

[3]The rational expectations assumption implies that current consumption would be the best predictor of future consumption and only surprise components would influence consumption.

in Eastern Europe used a Keynesian type model (Green, 1978 and Portes and Winter, 1978). Portes and Winter (1978) estimated the consumption function for the Czechoslovakia between 1955 and 1973. The authors found income elasticity's that ranged from 0.89 to 0.93. The estimates were slightly lower for the other countries, GDR, Hungary, and Poland. The results may be influenced by the ' liquidity overhang ' principle where people are forced to hold money because of the lack of financial assets (Cottarelli and Blejer, 1992). However Oles et al (1987) argues that there are many more alternative assets than the liquidity overhang implies. Weitzman (1991) states that goods may be purchased to act as a store of value and so forced spending may also result. In a transitional economy, such as the Czech Republic, with fewer quantity constraints and growing financial markets and institutions, we would expect to find lower income elasticity's.

4. Econometric Methodology

The econometric methodology adopted is Hendry's general to specific methodology which results in a dynamic error correction model (Hendry, 1987). Using non-linear least squares (NLLS) in error correction form allows a clear analysis of long-run and short-run effects. Given the small post reform data set it allows some variants without loosing too many degrees of freedom. Because of the small sample the Johansen cointegration approach is not adopted[4].

We began by estimating a very general model which includes several lagged differences and the level variables lagged once. The general-to-specific regression strategy is then used to reach a robust preferred model. At each step in the testing down procedure diagnostic tests are used (e.g. serial correlation, heteroscedasticity, normality etc.). Finally the robustness of the model is tested by checking for parameter stability. The final preferred equation is of the following form;

[2] $$\Delta c_t = \beta_0 + \beta_1 \Delta c_{t-n} + \beta_2 \Delta yh_{t-n} + \beta_3 \Delta R_{t-n} + \Delta\beta_4 \Delta inf_{t-n} + \Delta\beta_5 w_{t-n}$$

$$+ \alpha [(c_{t-1} - \lambda_1 yh_{t-1} - \lambda_2 R_{t-1} - \lambda_3 inf_{t-1} - \lambda_4 w_{t-1}].$$

where c_t is the logarithm of real consumption on goods and services, y_t is the logarithm of real household income. The interest rate, R_t, is the percentage per annum rate on credit, $inf_t = \ln(p_t/p_{t-1})$ and finally w_t is the logarithm of real wealth.

[4] The principle problem associated with cointegration is the potential sample bias in a system approach due to the possibility that the other equations (non money demand) in the system may be misspecified.

5. Data and Empirical Results

Our data are monthly 1993(1)-1995(4)[5]. All the required data are taken from the CNB, *Financial Statistics Report*[6].

Table 1

	% Real Growth in Consumption	*% Real Growth in Wage Income*
1993	5	5
1994	5	3
1995	7	10

Our empirical work will focus on real private consumption. As can be seen from table 1, private consumption growth was strong for the post transition period and this has been attributed to high real wage growth and some increase in employment (OECD, 1996). The effects of both real wages and employment will both be investigated. A second point is that the Czech Republic has been hit by a number of different shocks over the relatively short transition period. Most notable is the dissolution of the monetary union with the Czech-Slovak Republics and the introduction of the new tax system. As a result we will estimate the empirically based consumption functions starting from 1993. Because of the paucity of data we initially include only standard variables associated with the consumption function; real disposable income, interest rates and inflation. We will however test a number of variants, including using an alternative measure of income, namely real wage income. We also include the unemployment rate which would proxy liquidity constraints, e.g. Bean (1986). Also if there is an increase in the probability of unemployment current liquidity, future liquidity or uncertainty - or all three - may lead to a reduction in current consumption. Cuddington (1982), Flavin (1985) and Carroll and Summers (1987) have all argued for the inclusion of the unemployment rate to proxy liquidity constraints in the consumption function.

[5] The data is seasonally adjusted but seasonal dummies are not reported.
[6] A full list of the data is given in the appendix.

After testing down our preferred equation, we estimated the model using nonlinear least squares in the error correction form (Phillips, 1991). They are shown with standard errors in parenthesis and the results of the diagnostic tests[7].

[3] $$\Delta c_t = 0.95 + 0.09\Delta yh_t + 0.01\Delta R_{t-1} + 0.76\Delta inf_{t-1}$$
$$(0.33) \quad (0.06) \quad (0.01) \quad (0.27)$$

$$- 0.48 [c_{t-1} - 0.51 yh_{t-1} + 0.01 R_{t-1}]$$
$$(0.12) \quad (0.11) \quad (0.01)$$

NLLS: Sample 1993M1-1995M12, $R^2 = 0.98$, SEE = 0.02,
F(3,20) = 0.25[0.86], ARCH(3,17) = 1.13[0.36],
B-J(2) = 0.79[0.67], SK = 0.29, EK = -0.13.
D-F(4) = -1.98*, P-P(4) = -4.33*.

As can be seen from the error correction coefficient term (in square brackets) there is a long-run relationship between real consumption and real disposable income[8]. The equation implies a long-run income elasticity of 0.51. The income elasticity would appear to be relatively small, however the income elasticity's for developed economies are low (Molana, 1991). Portes and Winter (1978) found an income elasticity of around 0.9. This may be due to the ' liquidity overhang ' where goods are purchased as a store of value (Weitzman, 1991), and so may result in a near unit elasticity. The error correction coefficient indicates a relatively slow adjustment to equilibrium in the long-run and this may be due to informational problems and general uncertainty which occurs in a transitional economy.

The results for the diagnostic tests do not indicate any misspecification[9]. The F test (F) does not indicate any evidence of serial correlation, (p-value = 0.31)[10]. The ARCH statistic indicates that autoregressive conditional heteroscedasity is not a problem in the model. The

[7] Seasonal dummies are included in the estimation but are not reported.
[8] A positive relationship was found in the short-run dynamics for the inflation term. A plausible explanation is that private consumers will increase consumption in the short-run if they expect higher inflation.
[9] See Hendry (1989) for an account of these diagnostics which are now widely reported for time series models.
[10] The asymptotic F-test is reported for serial correlation due to its better finite sample properties (Davidson and MacKinnon, 1993).

Bera-Jaque (B-J), the skewness (SK), and the excess kurtosis (EK) statistics all indicate the errors are normally distributed. The Dickey-Fuller (Fuller, 1976 and Dickey and Fuller, 1979) and the Phillips-Perron (Phillips, 1987) and Phillips and Perron, 1988) test statistics indicate the error correction term (ECT) is stationary[11]. The test statistics do not point to any evidence of misspecification at the conventional level. The out of sample forecasts for model 3 are shown in Figure 1 and given the limited data set, our model forecasts quite well.

We also estimated the consumption function using an alternative measure of income, namely real wage income, *yw*. The results along with standard errors and diagnostic tests are shown below.

$$[4] \quad \Delta c_t = 1.95 + 0.49\Delta c_{t-1} + 0.24\Delta c_{t-2} + 0.60\Delta yw_t - 0.21\Delta yw_{t-1} - 0.01\Delta R_t + 0.06\Delta inf_{t-1}$$
$$(0.31) \quad (0.10) \quad (0.11) \quad (0.09) \quad (0.10) \quad (0.00) \quad (0.02)$$

$$- 1.19 \left[c_{t-1} - 0.65 yw_{t-1} + 0.09 inf_{t-1} \right]$$
$$(0.17) \quad (0.04) \quad (0.03)$$

NLLS: Sample 1993M1-1995M12, $R^2 = 0.99$, SEE = 0.01,
F(3,16) = 0.560.65 ARCH(3,13) = 0.25[0.86]
B-J(2) = 0.85[0.66], SK = -0.32, EK = -0.39,
D-F(4) = -3.03*, P-P(4) = 5.89*.

As can be seen a long-run relationship exists between consumption, real wages and inflation. An important distinction between equation 4 and equation 3 is that the ECT coefficient is much larger, 1.19 and that inflation is now included in the ECT. Again the diagnostic tests indicate no misspecification. The out of sample forecasts are shown in figure 2 and appear to forecast well.

Following the results of Molana (1991) we reestimate the model including a proxy for real wealth. We would expect to find a positive relationship between wealth and consumption. The test results along with standard errors and diagnostic tests when net wealth is included are shown below[12].

[11] The 95% critical value for the Dickey-Fuller and Phillips-Perron test is -1.95 (Hamilton, 1994, pp.763).

[12] We also included our net wealth variable with household income as the scale variable. The results were very similar to those of equation 5.

[5] $\Delta c_t = 0.87 + 0.22\Delta yw_t + 0.94\Delta inf_{t-1} - 0.88[\, c_{t-1} + 0.94 inf_{t-1} - 0.44 nw_{t-1}]$

(0.18) (0.05) (0.21) (0.11) (0.38) (0.03)

NLLS: Sample 1993M1-1995M12, $R^2 = 0.99$, SEE = 0.01,
F(3,16) = 0.26[0.86], ARCH(3,19) = 0..72[0.55],
B-J(2) = 3.20[0.20], SK = -0.56, EK = -0.37,
D-F(4) = -3.07*, P-P(4) = -4.68*.

Although our proxy for income is eliminated from the long-run relationship when we include wealth, it does appear in the short-run dynamics. As can be seen consumption, inflation and net wealth form a long-run relationship. Given that wage income and not wealth appear in the short-run, it may be an indication that individuals are liquidity constrained which is certainly plausible given that we are dealing with a transition economy. We will investigate this point below. Diagnostic tests show no sign of misspecification and the out of sample forecasts quite well, as shown in figure 3.

As has been mentioned earlier we estimate the consumption function using the unemployment rate to proxy liquidity constraints[13]. Our final model is reported below along with the standard errors and diagnostic tests.

[6] $\Delta c_t = 2.21 + 0.37\Delta yw_t - 0.13\Delta u_t + 0.06\Delta u_{t-1} - 0.01\Delta R_t - 0.11\Delta inf_{t-1}$

(0.33) (0.06) (0.03) (0.03) (0.01) (0.02)

$- 0.69\,[\, c_{t-1} - 0.35 yw_{t-1} + 0.02 R_{t-1} + 0.22 inft_{t-1} + 0.08 U_{t-1}]$

(0.07) (0.10) (0.01) (0.05) (0.02)

NLLS: Sample 1993M1-1995M12, $R^2 = 0.99$, SEE = 0.01,
F(3,15) = 1.69[0.21], ARCH(3,12) = 0.01[0.99],
B-J(2) = 5.31[0.07], SK = -0.11, EK = 0.97,
D-F(4) = -3.29*, P-P(4) = -4.60*.

We find a long-run relationship between real consumption and wages, interest rates, inflation and the rate of unemployment. Of particular importance is the negative coefficient on

[13] Flavin (1985) also uses the unemployment rate to proxy liquidity constraints.

the unemployment variable, both in the short and long run[14]. The *change* in the unemployment rate is likely to reflect changes in the purchasing power of liquidity constrained consumers, while the *level* of unemployment reflects the degree of precautionary saving. A high *level* of unemployment would imply an increased probability of future unemployment and hence greater uncertainty over *future* income. The above equation implies that both of these effects are present and statistically significant both in the short and long-run. When we include unemployment a long-run relationship remains between consumption and labour income, interest rates, and inflation. Of particular note is the fact that our coefficient on wage income drops from 0.65 (equation 4) to 0.35 (equation 6), in the long-run, when the unemployment rate is included, since the latter may reflect liquidity constraints and increased precautionary saving. All variables have the appropriate sign and the diagnostic test results show no sign of misspecification. Again we run the out of sample forecasts, as shown in figure 4, and find our model to forecast well.

Equation 6 is our preferred equation on the balance of a priori and empirical grounds. We take our preferred model and assess the impact of an increase in a key variable, e.g. wage income, rate of unemployment and interest rates, when consumption is at its long-run equilibrium level[15]. Of interest will be the path and the speed of the adjustment. Figure 5 shows the response of our preferred equation to a 1% increase in income. As can be seen the equation quickly and smoothly achieves it's new equilibrium; a 1% increase in income will result in a 0.35% increase in consumption. We also assess the impact of a 1% change in the unemployment rate, figure 6, and the interest rate, figure 7. Again our equation achieves its new equilibrium level with in about 5 months.

6. Conclusion

We have estimated the consumption function for the Czech Republic since its transition to a market economy. Although we are faced with a limited data set we do however find a number of interesting results. Of particular note for a transition economy, such as the Czech Republic, is the long-run relationship between real consumption and wage income, interest rates, inflation and the rate of unemployment. We take the change in unemployment to reflect changes in liquidity constraints and the level of unemployment to reflect precautionary saving. Equation 6 implies that these effects are present and statistically significant both in the short and long-run. Our results also indicate that the long-run income elasticity is affected by the inclusion of the unemployment term.

[14] Although a positive sign is found on the unemployment rate coefficient in the short-run lagged once, the dynamic step response (figure 6) remains monatomic.
[15] For our model consumption reached its long-run level by time period 35.

The main contribution of this paper is empirical. We have introduced dynamics in to the consumption function with plausible long-run effects, the diagnostic test results indicate no misspecification, and the preferred equation has reasonable step response. Given such momentous changes in the Czech Republic (see section 2) it is encouraging that the estimated consumption function performs reasonably well empirically. However any policy inferences must be treated with caution because of the limited data set.

Appendix: Definitions of Variables and Data Sources

c : Real Consumption

p : Consumer price index

yh : Real household income

yw : Real labour income

R : % per annum interest rate on credit

w : Real net wealth = (M2-BL) / P

M2 : Currency circulation + demand deposits + quasi money

BL : Bank loans

U : Unemployment rate

Source: Czech National Bank Financial Statistics Report

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Figure 1 Forecast Changes in Consumption
Equation 3

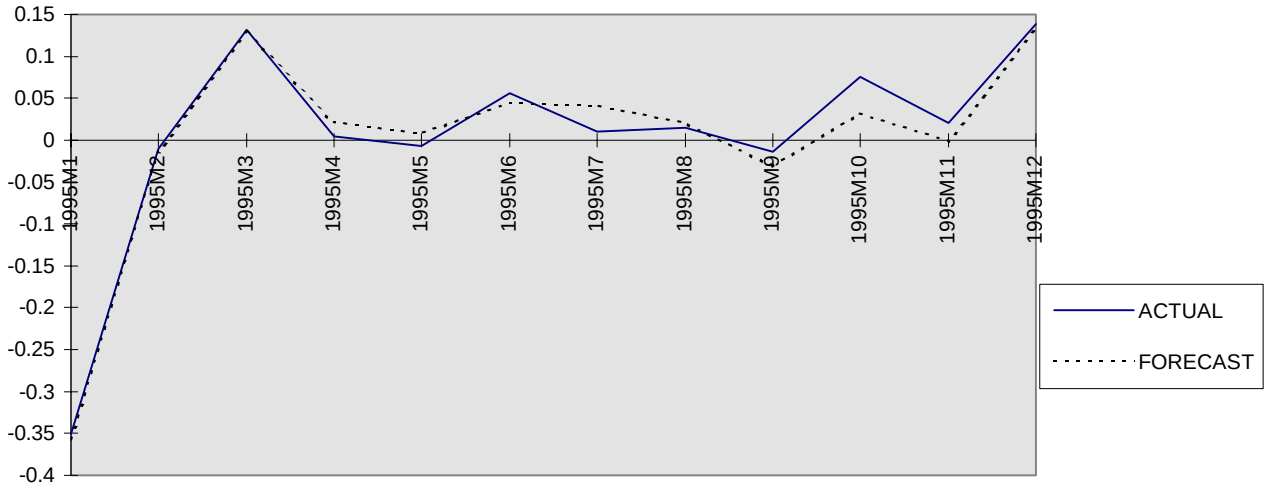

Figure 2 Forecast Changes in Consumption
Equation 4

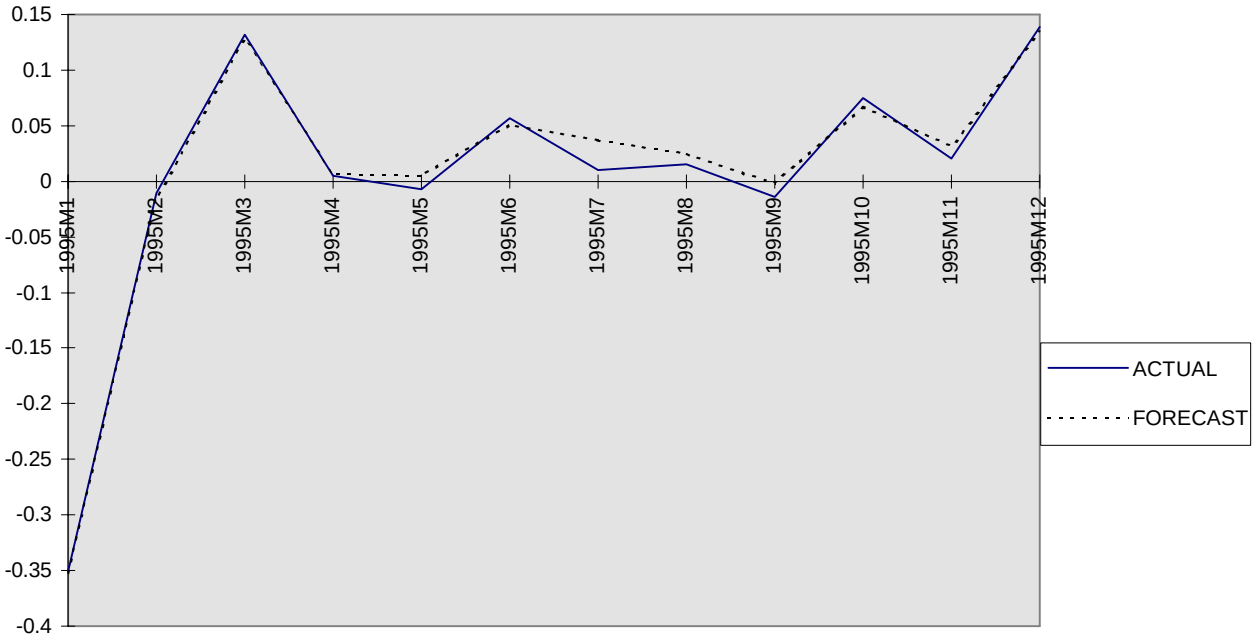

Figure 3 Forecast Changes in Consumption
Equation 5

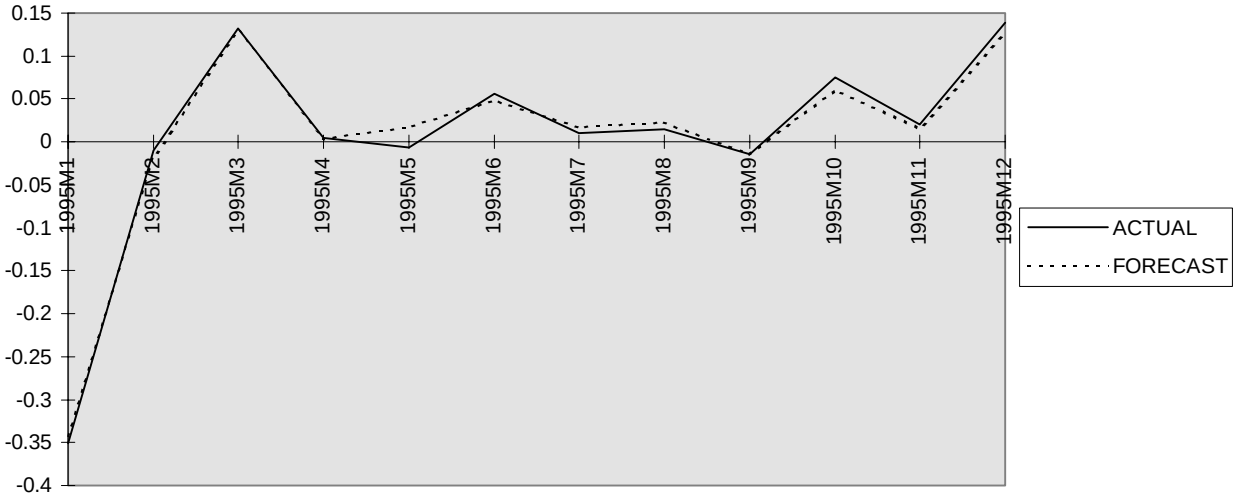

Figure 4 Forecast Changes in Consumption
Equation 6

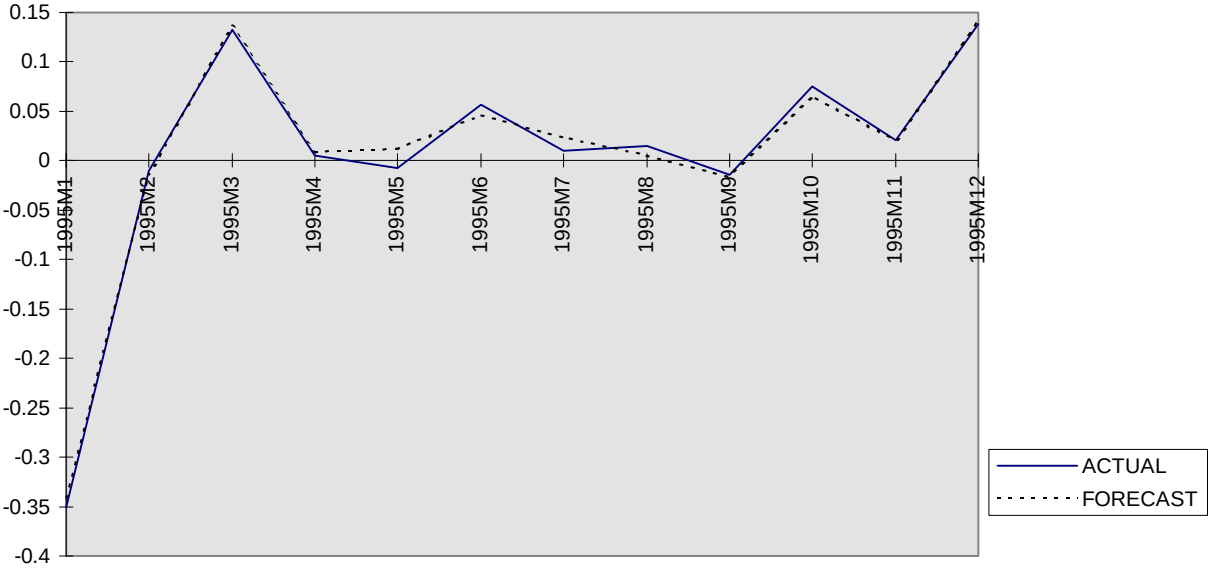

Figure 5 Step Response (Equation 6)
a 1% increase in wages

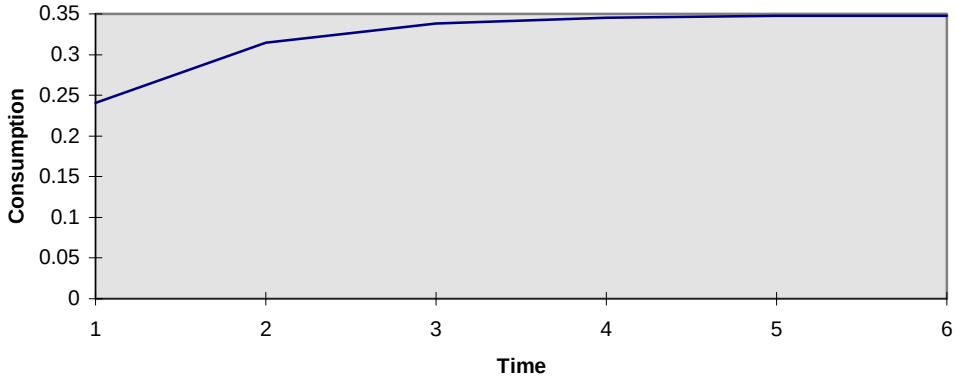

Figure 6 Step Response (Equation 6)
a 1% increase in the unemployment rate

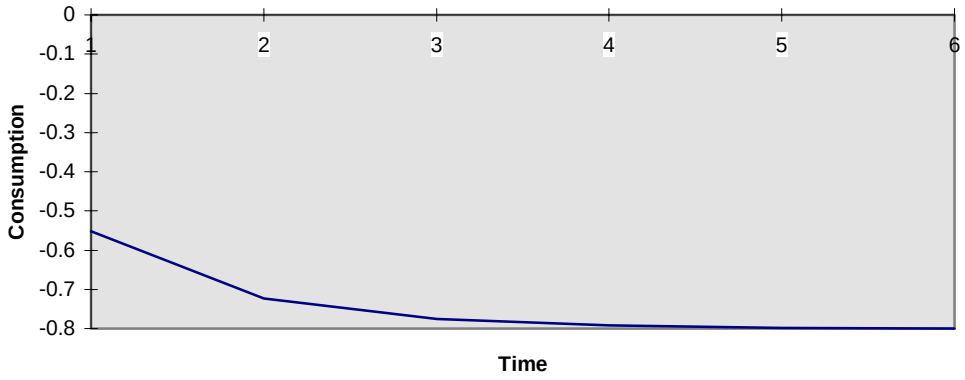

Figure 7 Step Response (Equation 6)
a 1% increase in interest rates