# Understanding Consumption in Open Economies: Argentina 1927-2003

***Alejandro Gay***
(Universidad Nacional de Córdoba y CONICET)

Instituto de Economía y Finanzas, UNC
4 de octubre 2005

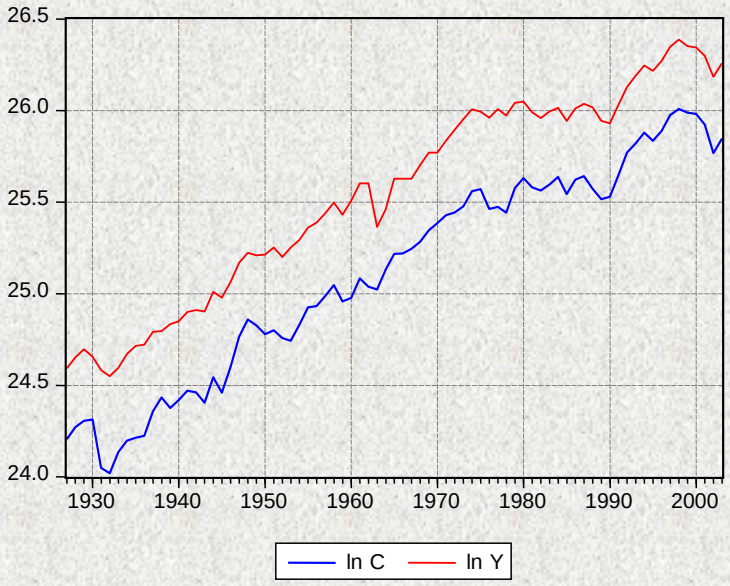
*La apariencia de un comportamiento cambiante del consumidor puede sencillamente ser un reflejo disfrazado del hecho de una estructura cambiante del ingreso.*

***Milton Friedman (1957)***,
*A Theory of the Consumption Function.*

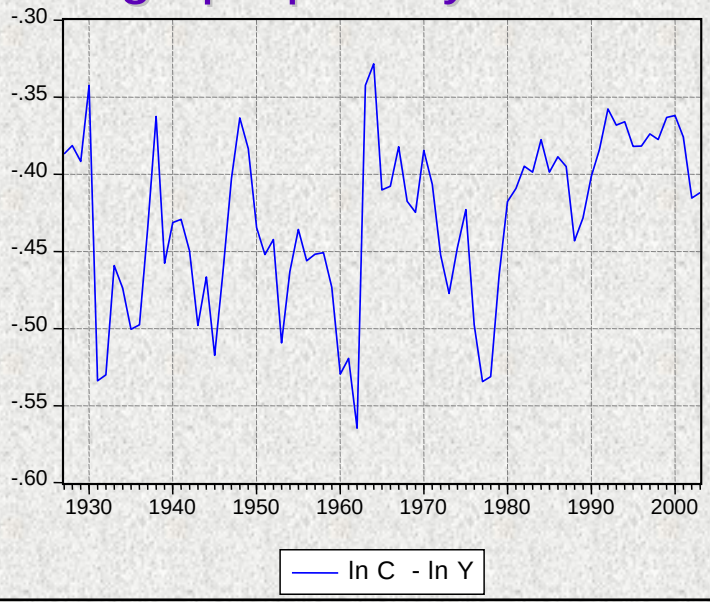
# Plan de la Presentación

- Introducción
- Modelo del Consumo en Economía Abierta
  - Condiciones de Primer Orden
  - Equilibrio de Estado Estacionario
  - Función Consumo en Economía Abierta
- Estimación y Resultados
  - Test de Raíz Unitaria y Test de Cointegración
  - Estimador de máxima verosimilitud (VECM)
  - Estimador de mínimos cuadrados dinámicos (DOLS)
  - Estimador de mínimos cuadrados no lineales (NLLS)
  - Consumo y Ciclo Económico
- Conclusión

# Real Consumption and GDP



# Average propensity to consume




# Objetivos

- Encontrar los determinantes del consumo en una economía abierta.
- Estimar la función consumo en Argentina.
- Evaluar las elasticidades del consumo respecto a los diferentes tipos de ingreso.
- Analizar las fluctuaciones económicas a partir de cambios en la demanda de consumo.

# Model:The Optimization Problem

Maximize $$U_j = \sum_{s=t}^{\infty} \beta^{s-t} \left[ \frac{\sigma}{\sigma - 1} C_s^{\frac{\sigma-1}{\sigma}} + \frac{\chi}{1-\varepsilon} \left( \frac{M_s}{P_s} \right)^{1-\varepsilon} - \frac{\kappa}{2} y_{Ns}^2 \right]$$

where $$C = \left[ \gamma^{\frac{1}{\theta}} C_T^{\frac{\theta-1}{\theta}} + (1-\gamma)^{\frac{1}{\theta}} C_N^{\frac{\theta-1}{\theta}} \right]^{\frac{\theta}{\theta-1}}$$

Subjected to the budget constraint $$C_N = \left[ \int_0^1 c_N(z)^{\frac{\theta-1}{\theta}} dz \right]^{\frac{\theta}{\theta-1}}$$

$$P_{Tt} F_{t+1} + M_t = P_{Tt}(1+r_t) F_t + M_{t-1} + p_{Nt}(j) y_{Nt}(j) + P_{Tt} y_{Tt} - P_t C_t - P_t \tau_t$$

where $$P = \left[ \gamma P_T^{1-\theta} + (1-\gamma) P_N^{1-\theta} \right]^{\frac{1}{1-\theta}}$$

The producer also faces the demand of the non-tradable good:

$$y_{N,t}^d = \left[ \frac{p(j)_{N,t}}{P_{N,t}} \right]^{-\theta} C_{N,t}$$

# First Order Conditions

$$\frac{C_{Tt+1}}{C_{Tt}} = \left[ \beta(1+r_t) \right]^{\sigma} \left[ \frac{\left( \frac{P_t}{P_{Tt}} \right)}{\left( \frac{P_{t+1}}{P_{Tt+1}} \right)} \right]^{\sigma-\theta}$$

Optimal Consumption Path

$$\frac{C_{Nt}}{C_{Tt}} = \frac{(1-\gamma)}{\gamma} \left( \frac{P_{Nt}}{P_{Tt}} \right)^{-\theta}$$

Substitution of T and NT Consumption

$$\frac{M_t}{P_t} = \left[ \chi C_t^{\frac{1}{\sigma}} \frac{1+i_t}{i_t} \right]^{\frac{1}{\varepsilon}}$$

Monetary Market Equilibrium

$$y_{Nt}^{\frac{\theta+1}{\theta}} = \left( \frac{\theta - 1}{\theta \kappa} \right) C_t^{-\frac{1}{\sigma}} \left( C_{Nt}^A \right)^{\frac{1}{\theta}} \left( \frac{P_{Nt}}{P_t} \right)$$

Equilibrium Supply of NT goods

# Steady State Equilibrium

$$y_N = C_N = \left[\frac{\theta - 1}{\theta\,\kappa}\right]^{\frac{\sigma}{\sigma+1}} (1-\gamma)^{\frac{1}{\sigma+1}} \qquad y_T = C_T = \frac{\gamma}{1-\gamma} y_N$$

Aproximating around the Steady State $\qquad \hat{x} = \frac{dx}{x_0}$

$$\theta \hat{y}_N = -\frac{\theta}{\sigma}\hat{C} + \theta\left(\hat{P}_N - \hat{P}\right) - \theta\hat{\kappa}$$

$$\hat{C} = \sigma\hat{y} + \sigma\gamma\left(\hat{P}_N - \hat{P}_T\right)$$

$$\hat{P}_N - \hat{P}_T = \frac{1+\sigma}{\theta(1+\sigma) + \gamma(\sigma-\theta)}\left[r\hat{F} + \hat{A}_T - \frac{2\sigma}{\sigma+1}\hat{A}_N + \hat{P}_T^X - \hat{P}_T^M\right]$$

# Consumption Function

Main equation of the model:

$$\hat{C} = \sigma\hat{y} + \sigma\frac{\gamma(1+\sigma)}{\theta(1+\sigma) + \gamma(\sigma-\theta)}\left[r\hat{F} + \hat{A}_T - \frac{2\sigma}{\sigma+1}\hat{A}_N + \hat{P}_T^x - \hat{P}_T^M\right]$$

Equation to be estimated:

$$\ln C_t = \eta + \beta_2 \ln y_t + \beta_3 \frac{r_t F_t}{y_t} + \beta_4 \ln A_{Tt} + \beta_5 \ln A_{Nt} + \beta_6 \ln \frac{P_{Tt}^x}{P_{Tt}^M} + u_t$$

$$\beta_2 = \sigma > 0; \qquad \beta_3 = \sigma\frac{\varphi}{\gamma} > 0; \quad \beta_4 = \beta_6 = \sigma\varphi > 0; \quad \beta_5 = -\frac{2\sigma^2\varphi}{(\sigma+1)} < 0$$

$$\varphi = \frac{\gamma(1+\sigma)}{\theta(1+\sigma) + \gamma(\sigma-\theta)}$$

# Metodology: VECM

$$z_t = \left( \ln C_t,\ \ln Y_t,\ \frac{rF_t}{Y_t},\ \ln A_{Tt}, \ln A_{Nt}\ \ln \frac{P_T^X}{P_T^M} \right)'$$

$$\Delta z_t = \mu + \alpha\beta' z_{t-1} + \sum_{i=1}^{k} \pi_i \Delta z_{t-i} + \varepsilon_t$$

# Dickey-Fuller Test (ADF)

| Variable | | Structure | Lags | t-statistics |
|---|---|---|---|---|
| ln C | Level | Intercept + Trend | 0 | -2.650792 |
| | 1 diff | Intercept | 1 | -8.16572** |
| ln Y | Level | | 0 | 3.217916 |
| | 1 diff | Intercept | 1 | -8.12144** |
| rF / Y | Level | | 1 | -1.537054 |
| | 1 diff | | 0 | -6.61051** |
| Ln $A_T$ | Level | | 0 | 1.249014 |
| | 1 diff | | 0 | -7.65664** |
| Ln $A_N$ | Level | | 2 | -2.235809 |
| | 1diff | | 1 | -7.04226** |
| Ln $P^X_T/P^M_T$ | Level | | 0 | -2.79803** |
| | 1 diff | | 0 | -9.75582** |

* denotes significance at 5%

** denotes significance at 1%

# Johansen Test

| Number of coint. eq. | Eigen-value | λ trace Statistics | Critical Values 5% | 1% | Signif | λ max Statistics | Critical Values 5% | 1% | Signif |
|---|---|---|---|---|---|---|---|---|---|
| None | 0.371702 | 59.95775 | 47.21 | 54.46 | ** | 35.78509 | 27.07 | 32.24 | ** |
| At most 1 | 0.186886 | 24.17266 | 29.68 | 35.65 | | 15.93009 | 20.97 | 25.52 | |
| At most 2 | 0.101282 | 8.242569 | 15.41 | 20.04 | | 8.222526 | 14.07 | 18.63 | |
| At most 3 | 0.000260 | 0.020043 | 3.76 | 6.65 | | 0.020043 | 3.76 | 6.65 | |

*(**) denotes significance at 5%(1%)

# VECM Maximum Likelihood Estimator

## Johansen (1988)

**Table 3: Coefficients of the cointegrating vector β**

| Variable | Coefficient | Standard error | Significance |
|---|---|---|---|
| ln C | -1.000000 | | |
| ln Y | 1.019689 | 0.02071 | ** |
| ln $A_T$ | 0.089483 | 0.03330 | ** |
| ln $A_N$ | -0.311100 | 0.05701 | ** |
| | 1.310173 | | |

*(**) denotes significance at 5%(1%)

$$\ln C_t = 1.31 + 1.02 \ln y_t + 0.09 \ln A_{Tt} - 0.31 \ln A_{Nt} + u_t$$

# Dynamic OLS Estimator (DOLS)

## Stock and Watson (1993)

**Table 4**

| Variable | Coefficient | Standard error | Significance |
|---|---|---|---|
| ln C | -1.000000 | | |
| ln Y | 1.047963 | 0.033583 | ** |
| rF / Y | 9.154300 | 3.523191 | ** |
| ln $A_T$ | 0.167203 | 0.031736 | ** |
| ln $A_N$ | -0.652654 | 0.125802 | ** |
| ln $P^X_T/P^M_T$ | 0.161102 | 0.050976 | ** |
| | 3.188709 | 0.636327 | ** |

*(**) denotes significance at 5%(1%)

$$\ln C_t = 3.19 + 1.05 \ln y_t + 9.15 \frac{r_t F_t}{y_t} + 0.17 \ln A_{Tt} - 0.65 \ln A_{Nt} + 0.16 \ln \frac{P^x_{Tt}}{P^M_{Tt}} + u_t$$

# Nonlinear Least Squares Estimator

## Baba, Hendry, and Starr (1992)

**Table 5: NLLS**

| Variable | Coefficient |
|---|---|
| ln C | -1.0000 |
| ln Y | 1.0690 |
| rF / Y | 6.3067 |
| ln $A_T$ | 0.0819 |
| ln $A_N$ | -0.5299 |
| ln $P^X_T/P^M_T$ | 0.1588 |

*(**) denotes significance at 5%(1%)

$$\ln C_t = \eta + 1.07 \ln y_t + 6.31 \frac{r_t F_t}{y_t} + 0.08 \ln A_{Tt} - 0.53 \ln A_{Nt} + 0.16 \ln \frac{P^x_{Tt}}{P^M_{Tt}} + u_t$$

## Business Cycle of Argentina

"Perhaps what is remarkable is that the volatility of consumption is larger than that of output. Although theoretically the opposite should hold, this excess relative consumption volatility is within the ranges observed in Japan and some European countries. [According to the permanent income hypothesis, the series for consumption should be smoother than that for income (or GDP). However, this prediction is valid only for consumption of nondurable goods, and the series for consumption typically includes durable goods] More specifically, according to the new national account estimates in Table 1, Argentinean consumption is 19 percent more volatile than GDP. This is not uncommon by international standards."

(Kydland and Zarazaga ,1997, p.26).

## Business Cycle of Argentina (2)

"Some studies have attributed this excess volatility to the presence of credit constraints. However, there are reasons to be skeptical about this explanation because in models with credit constraints, consumption is not as smooth as it would be otherwise, but it is still typically smoother than income. [Intuitively, in an economy incapable of transferring wealth between periods, economic agents will use up all they produce in every period-that is, consumption will be exactly equal to income period after period. Although there is absolutely no credit in this economy, the volatility of consumption cannot exceed that of output (or income).]

(Kydland and Zarazaga ,1997, pp.26-27)

## Conclusion (1)

- We have developed a theoretic framework to estimate the Consumption Function in an Open-economy.
- The fundamentals of Consumption in this set up appear to be: domestic product (GDP), net foreign assets income, tradable productivity, non-tradable productivity and terms of trade.
- These findings are consistent with the results of other studies which consider that national disposable income is the only long-run determinant of private consumption.

## Conclusion (2)

- Our paper additionally disaggregates national income by its sources. This improves the estimates because consumption-income elasticities differ from source to source.
- The long-run GDP-consumption elasticity is found to be equal to 1.
- The ToT-consumption elasticity (0.16), give support to the Haberger-Laursen-Metlzer effect, which posits a positive relationship between (transitory) changes in the terms of trade and saving.

## Conclusions (3)

- The paper allows to explain the puzzle of excess volatility of consumption relative to that of output (GDP), present in some countries, particularly in Argentina.
- All in all, the paper makes a contribution for abandoning the traditional and limiting closed-economy specification of the Consumption Function.

## References


- Obstfeld Maurice and Kenneth Rogoff, ”Exchange Rate Dynamics Redux”, *Journal of Political Economy*, n.103, 1995
- Lane Philip R. y Milesi-Ferretti Gian Maria, "The Transfer Problem Revisited: Net Foreign Assets and Real Exchange Rates," *IMF Working Paper 123*, 2000.
- Lane Philip R., "Money Shocks and the Current Account", en *Money, Factor Mobility and Trade: Essays in Honor of Robert Mundell*, Calvo Guillermo A., Dornbusch Rudiger y Obstfeld Maurice (eds.), MIT Press, 2001.

# Model's Parameters

$\beta$: time discount rate of the utility, $\beta \in (0,1)$

$\sigma$: intertemporal substitution elasticity, $\sigma > 0$

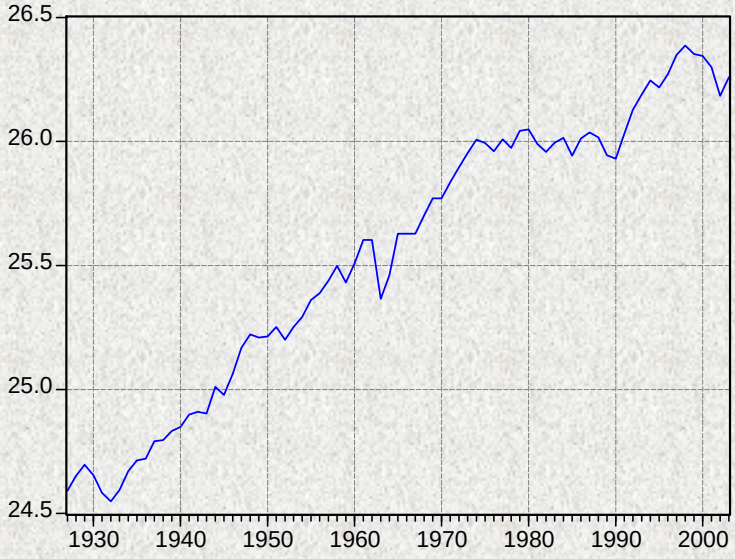
$\kappa$: labor disutility, $\kappa > 0$

$\theta$: intratemporal substitution elasticity, $\theta > 1$

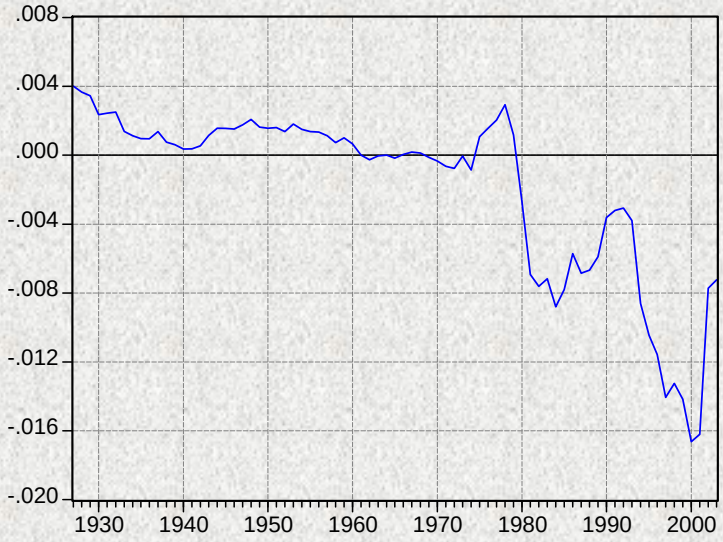
$\gamma$: tradable good share in consumption, $\gamma \in (0,1)$

r: international interest rate

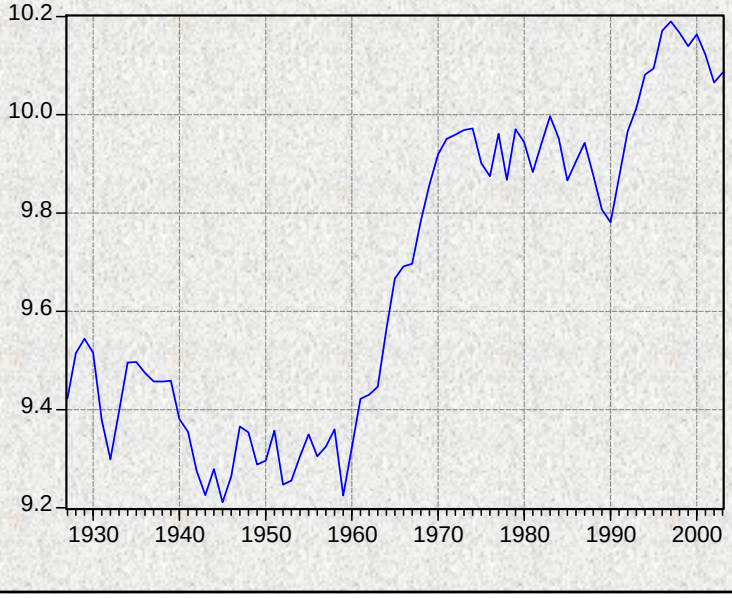
# Real Gross Domestic Product



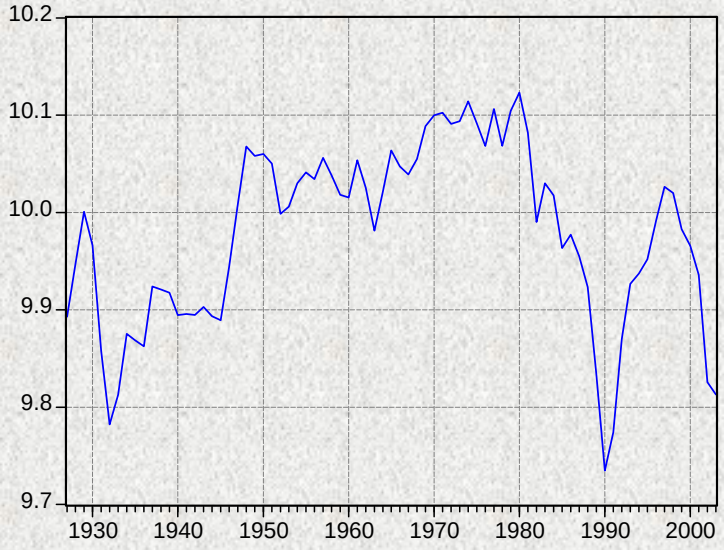
# Net Foreign Assets Revenues




# Tradable Productivity



## Non-tradable Productivity




## Terms of Trade