# Frisch Demand Functions and Intertemporal Behaviour in Consumption: The Turkish Case

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This paper examines the intertemporal behaviour in consumption for Turkey which has been experiencing high and chronic inflation since the late 1970s. The Frisch demand system is used to estimate three separate but inextricably intertemporal elasticities: intertemporal price elasticities of demand, commodity-specific intertemporal elasticities, and the intertemporal substitution elasticity of consumption. Our main result is that the Turkish households are reluctant to move their expenditures on non-durable goods from the current period to the next period, regardless of how high nominal interest rates are. This interesting result shows that the consumption behaviour in Turkey has been mainly shaped by uncertainty created by inflationary process and the tendency towards hedging against inflation.

## INTRODUCTION

There is extensive literature on the ways in which intertemporal behaviour in consumption complicates the conduct of macroeconomic policy. An understanding of the intertemporal behaviour in consumption is crucially important for the design of macroeconomic policy. One potentially important channel of influence concerns the effect of interest rates or prices on economic agent's intertemporal substitution for consumption. It is argued that if the intertemporal substitution elasticity of consumption is high**,** then the rational agents will wish to move their expenditures from the current period to the following period depending upon changes in interest rates or prices.[1]

[1]As pointed out by Boskin (1978), Summers (1981), and Browning (1989), in this case one might expect to observe an improvement in welfare as a result of the reduction of taxes on the magnitude of savings.

The nature of the intertemporal substitution in consumption through an estimation of the consumption functions has been investigated in a rich body of empirical literature [for example, Hall (1988); Mankiw (1981); Muellbauer (1983) and Lawrence (1991)]. In these studies, the intertemporal substitution effect of changes in interest rates on consumption has been examined, assuming that relative prices are constant across time, based on aggregate consumption data.[2]   On the other hand, Attfield and Browning (1985); Browning, Deaton, and Irish (1985) and Kim (1993) analysed the intertemporal elasticity of substitution in consumption by using the Frisch demand system through its component commodity demands. It is advantageous to work with the Frisch demand system because it allows the measurement of the effects of changes in relative prices on the intertemporal substitution in consumption. In addition, the Frisch demand function method is used by Kim (1993) to identify three separate but inextricably related intertemporal elasticities: intertemporal price elasticities of demand, commodity-specific intertemporal elasticities, and the intertemporal substitution elasticity of consumption.

All of the studies cited above analyse the intertemporal behaviour in consumption using data from major industrial countries. To the best of our knowledge, virtually no work has been done in analysing these elasticities with recent data from relatively small open economies. The objective of this paper is to narrow the existing gap in the empirical literature.

In this study, we examine the nature of intertemporal behaviour in consumption for Turkey. Turkey has been known as a high inflation country since the late 1970s. Inflation in Turkey started after the first oil shock, and the following political instability then gave it a persistent position with an average of 60 percent a year. In 1980, Turkey embarked on a major set of economic reforms which marked a radical departure away from the previous import substitution strategy to an export-oriented policy. During the first half of the 1980s, the Turkish economy started to experience, on average, 6 percent annual growth. The performance of the Turkish economy was chosen as a model case for structural change by the International Monetary Fund and major donor agencies.  However, by the end of the 1980s, the situation began to change. Deterioration of growth performance and acceleration of inflation pushed the Turkish economy once more into macroeconomic instability in the first half of 1994. Once the instability had been dealt with, the growth rate recovered, continuing to fluctuate around 6 percent, on average.  Inflation was around 60 percent in the last part of the 1980s.  After 1994, it increased rapidly to 85 percent and stayed at about that level thereafter. Turkish economic data give us an opportunity to analyse the effects of both real factors and substantial monetary growth on the intertemporal behaviour of consumption.

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[2]Anderson (1979) suggests that the assumption of constant relative prices may cause some serious misleading results.

In Section II we briefly explain the characterisation of consumer preferences by the profit function [see, for example, Attfield and Browning (1985)]. Section III presents the results obtained from applying the Frisch demand system, using a time series with Turkish economic data based on consumption expenditures. Finally, in Section IV, the conclusions of the paper are summarised.

## MODEL

Consider a widely used model of consumer choice with additive preferences over time**,** given by the utility function:[3]

$$U(x^1,...,x^T) = \sum_{t=1}^{T} v^t(x^t) \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad (1)$$

where $x^t$ is a vector of goods available in the period $t$. The sub-utility functions $v^t(.)$ represent changing preferences over time. Gorman (1976) gives an alternative representation of the preferences by the consumer's profit function:

$$\pi^t(r_t, p^t) = \{ r_t \cdot v^t(x^t) - p^t x^t \} \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad (2)$$

where $p^t$ is a vector of current prices and $r_t$ is the current price of utility.[4] It is assumed that the sub-utility functions are continuous, increasing, and strictly concave in their arguments. Cornes (1992) and Chambers (1989) show that this profit function satisfies all of the properties of the multi-output firm's profit function: it is convex and non-decreasing in $p^t$ and linear homogeneous in $(p^t, r^t)$. Applying the envelope theorem to the consumer's profit function, we obtain

$$x_i^t = -f_i^t(p^t, r_t) , \, i = 1,\ldots,n , \, t = 1,\ldots,T \qquad \ldots \qquad \ldots \qquad \ldots \qquad (3)$$

where $f_i^t$ is the partial derivative of $\pi^t(.)$ with respect to the price of good $i$. Browning, Deaton, and Irish (1985) describe these functions as Frisch demand functions. A Frisch demand function possesses all of the properties of a traditional demand function, so it is downward-sloping, symmetric in the price derivatives, and homogeneous of degree zero in $(p^t, r_t)$.

In Equation (3), both current prices and current quantities are directly observable, but the current price of utility is not an observable variable. Therefore, in modelling the Frisch system demands for an empirical investigation**,** the definition of the current price of utility becomes an important issue.[5] Under the assumption that

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[3]To derive the Frisch demand system, we closely follow Attfield and Browning (1985).

[4]It could also be thought of as the inverse of the marginal utility of expenditure.

[5]Browning, Deaton and Irish (1985) and Browning (1991) discuss different identification schemes of $r_t$.

purchases are made at the beginning of the period $t$ and any remaining debts or savings are carried forward at the interest rate, $i_t$, the standard (stochastic) Euler equation for an expected utility-maximising consumer (who reviews his plans each period using newly available information efficiently) is:[6]

$$E_t\{(1+i_t)r_t / r_{t+1}\} = 1 \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad (4)$$

where $r_t$ is the inverse of the marginal utility of expenditure and $E_t(.)$ is the expectations operator, conditional on the information set available at time $(t–1)$. Note that the variable $r_t$ provides a link between the current and the next period decisions, and captures the expectations for evolution of the future variables. Under perfect certainty, Equation (4) reduces to the proposition that rational consumers allocate their expenditures in such a way as to keep the discounted cost of utility $(=r_t/(1+i_1)\ldots(1+i_{t-1}))$ constant.

Following Browning, Deaton, and Irish (1985) and Attfield and Browning (1985), our approach is to approximate this relationship between $r_t$ and $r_{t-1}$ in a way that allows us to directly estimate the parameters of a demand system. Specifically, we write Equation (4) as

$$r_t(1-\varepsilon_t) = (1+i_{t-1})r_{t-1} \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad (5)$$

where

$$E_{t-1}(\varepsilon_t) = 0 \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad (6)$$

By taking natural logs and assuming that $i_{t-1}$ is known in period $(t–1)$ and setting $dlnr_t = (lnr_t – ln\ r_{t-1})$, $ln(1+i_{t-1}) \cong i_{t-1}$, $ln(1-\varepsilon_t) \cong -\varepsilon_t$, we can rewrite Equation (5) in the form,

$$d\ ln\ r_t = (i_{t-1} + \varepsilon_t) \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad (7)$$

We assume that the consumers know the nominal interest rate at which they can borrow and lend when they make their purchases, so that $\varepsilon_t$ and $i_{t-1}$ are independent.[7] Thus, our specific assumption is that the nominal rate of interest is known but the real interest rates for each good are unknown because absolute price changes are unknown. In Equation (7), $dlnr_t$ is defined as the growth rate of the price of utility from period $t–1$ to period $t$. Thus, we can think of $\varepsilon_t$ as the stochastic part of it.

To estimate the parameters, we have to combine Frisch demand functions with the approximation of Equation (7). For this purpose, we should rewrite Equation (3) in terms of growth rates. Differentiating Equation (3) we have,

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[6]See, for example, Deaton (1992) or (1997).

[7]The same assumption is made by Attfield and Browning (1985) and also by Kim (1993).

$$dx_{it} = -\sum_{j=1}^{n} f_{ij}^{t} dp_{jt} - f_{ir}^{t} d_{r_t}, \ i = 1,...,n \quad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad (8)$$

Now if we rewrite Equation (8), multiplying all of its terms by the expenditure share of good $i$ in the total expenditures, $w_{it} = p_{it}x_{it} / \sum_{k=1}^{n} p_{kt}x_{kt}$, then we have

$$w_{it}d \ ln \ x_{it} = \sum_{j=1}^{n} \gamma_{ij}d \ ln \ p_{jt} + \alpha_{i}d \ ln \ r_{t}, i = 1,...,n \qquad \ldots \qquad \ldots \qquad (9)$$

where $\gamma_{ij} = -f_{ij}^{t}(p_{it}x_{it} / \sum_{k=1}^{n} p_{kt}x_{kt})$ and $\alpha_{i} = -f_{ir}^{t}(p_{it}x_{it} / \sum_{k=1}^{n} p_{kt}x_{kt})$.

The parameters $\gamma_{ij}$ and $\alpha_i$ in Equation (9) give the effects of the growth rate of prices of the other goods and the growth rate of the price of utility on the weighted value of the growth rate of the quantity demanded of good $i$, respectively. Rewrite the model in Equation (9) to estimate the parameters as

$$w_{it}d \ln x_{it} = \sum_{j=1}^{n} \gamma_{ij}d \ln p_{jt} + \alpha_{i}d \ln r_{t} + u_{it}, i = 1,...,n \qquad \ldots \qquad \ldots \qquad (10)$$

where $\sum_{j=1}^{n} \gamma_{ij} + \alpha_{i} = 0$ , $i = 1,...,n$ and $\gamma_{ij} = \gamma_{ji}$, $i \neq j = 1,...,n$ due to the homogeneity and symmetry conditions.[8]

## PARAMETER ESTIMATES

To estimate the parameters in the Frisch demand system in Equation (10), for Turkey, we use quarterly, disaggregated data on five non-durable goods[9] (food-beverages, energy-transportation-communication, semi-durable-non-durable goods, services, and ownership of dwelling) from 1988:I to 1999:II. The data are seasonally adjusted and taken from the 1988 to the 1999 editions of the Quarterly Gross National Product by State Institute of Statistics (SIS). The interest rate series used is the nominal interest rates on time deposits for three months, taken from Central Bank Statistics. To form the growth rate series of the price of utility in the Frisch demand system, we apply the Hodrick-Presscott filtre method to the nominal interest rate series for period $t$, decomposing it into permanent and transitory components. The growth rate of the price of utility for period $t$, *dlnr$_t$*, is then defined by $\varepsilon_t + i_{t-1}$, where $\varepsilon_t$ denotes the transitory component of the interest rate. Table 1 gives the parameter estimates, using the Seemingly Unrelated Regression Equations (SURE) method.

Table 1

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[8]Attfield and Browning (1985) shows that homogeneity and symmetry restrictions together are sufficient to identify the parameters of the model.

[9]The level of disaggregation across goods is chosen according to the availability of data.

*Parameter Estimates*

|       | F-B [1]            | SD-ND [2]           | E-T-C [3]          | S [4]               | OD [5]              | $\alpha_i$           |
|-------|--------------------|---------------------|--------------------|---------------------|---------------------|----------------------|
| F-B   | –0,135             | –0,029              | –0,026             | 0,010               | 0,007               | 0,027                |
|       | (–2,363)**         | (–0,625)            | (–1,086)           | (0,357)             | (4,346)*            | (1,540)              |
| SD-ND |                    | –0,151              | 0,017              | –0,012              | –0,002              | 0,005                |
|       |                    | (–1,978)***         | (0,607)            | (–0,433)            | (–1,460)            | (0,278)              |
| E-T-C |                    |                     | –0,014             | 0,036               | 0,003               | 0,003                |
|       |                    |                     | (–0,452)           | (1,333)             | (1,293)             | (0,418)              |
| S     |                    |                     |                    | –0,095              | 0,002               | 0,012                |
|       |                    |                     |                    | (–2,155)**          | (0,868)             | (1,704)***           |
| OD    |                    |                     |                    |                     | –0,011              | 0,001                |
|       |                    |                     |                    |                     | (–3,202)*           | (3,074)*             |

*Notes:* 1. (1) F-B food-beverages (2) SD-ND semi-durable-non-durable goods, (3) E-T-C energy-transportation-communication, (4) S services, (5) OD ownership of dwelling.

2. The values in parentheses indicate *t*-statistics, and *, ** and *** show the significant level for 1 percent, 5 percent, and 10 percent, respectively.

3. The average share values calculated are 0.44 for F-B, 0.20 for SD-ND, 0.16 for E-T-C, 0.11 for S, and 0.10 for OD.

4. The correlation matrices and related five graphs are given at the end of the text.

Except the column $\alpha_i$, the diagonal elements in Table 1 describe own-price effects, $\gamma_{ii}$'s, while off-diagonal elements depict cross-price effects, $\gamma_{ij}$'s. The column $\alpha_i$ represents the effects of the interest rate on commodity demands.

All of the estimated own-price effects have negative signs. This provides evidence for the negativity property of the Frisch demands. All of the estimated coefficients $\gamma_{ij}$'s are statistically insignificant except that for the relationship between ownership of dwelling and food-beverages, which is very close to zero.

The elasticities of real expenditure, $\alpha_i^*$ for all commodities are calculated by

$$\alpha_i^* = \frac{\alpha_i}{\sum_{i=1}^{n} \alpha_i} \cdot \frac{1}{w_{it}}.$$ The estimated expenditure elasticities are 1,256 for food-beverages, 0,525 for semi-durable-non-durable goods, 0,360 for energy-transportation-communication, 2,261 for services, and 0,227 for ownership of dwelling.[10] Since all of the elasticities have a positive sign, all of the commodities are said to be normal, i.e., a rise in nominal interest rates leads to an increase in demands for all goods, holding the relative commodity prices constant. In addition, a normal good is theoretically defined as a luxury if $\alpha_i^* > 1$, and as a necessity if $0 \leq \alpha_i^* < 1$. In this sense, semi-durable-non-durable goods, energy-transportation-communication, and ownership of dwelling are found to be necessities for households in Turkey. According to our results, the expenditures on these three commodities are not very responsive to changes in nominal interest rates. The least sensitive good to changes in nominal interest rates is the ownership of dwelling. This interesting result needs to

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[10]Although estimated $\alpha_i$'s are statistically insignificant, we calculated the elasticities in order to give a general insight for understanding consumption behaviour in Turkey.

be explained by taking into account the specific features of the economic and cultural structure of Turkey. First of all, in Turkey, the fact that family supports in cash are generally used instead of borrowings from banks in purchasing dwellings shows how important a role traditions play in the consumption behaviour of the Turkish people. Another factor which might have contributed to obtain this result is the preferences and behaviour of the banking sector during the period considered. High real interest rates as a result of financing high budget deficits (by mainly domestic borrowing) made purchasing government securities an attractive investment opportunity for the banking sector. Thus, the banking sector moved away from its basic functions, such as lending with their deposits to private sector, and so became a 'last resort' for the governments. Annual real interest rate of approximately 30 percent might also have made the consumers reluctant to borrow from the banking sector particularly for purchasing semi-durable and non-durable goods and dwellings. The tendency toward hedging against high inflation is another factor to explain our interesting result for dwellings. High growth rate of population and migration from rural to urban areas created excess demand for housing in Turkey, and hence prices of housing have increased, being at least as high as the inflation rate. On the other hand, expected returns on the other investment alternatives have been subjected to the uncertainty created by the inflationary process. Consequently, ownership of dwelling has been a good investment alternative for the Turkish people, who are risk-averse and want to hedge against inflation.

Services and food-beverages are found to be luxuries. This finding seems to be interesting especially for food-beverages because these goods are normally expected to be a necessity. However, a closer inspection justifies the robustness of this result in the Turkish case. As mentioned before, the import substitution strategy was abandoned for an export-oriented growth policy, changing dramatically the consumer behaviour and consumption pattern in Turkey. In this respect, the most important development is that big grocery store chains entered daily life during the second half of 1980s. With their many different brands and products, including imported ones, and with credit card acceptance for payments, these stores appealed to Turkish consumers especially for purchasing food and beverages.

We should also mention that low real income level has two implications for food and beverages. First, the expenditure share of food and beverages is very high, with approximately 44 percent as an average for the sample period. Second, people usually make the minimum payment required on their credit cards, which are mainly used for purchasing food and beverages, as mentioned above. Consequently, consumption of food and beverages is very responsive to interest rates in Turkey.

In Table 1, since the estimated values of $\gamma_{ii}$ are greater than $\alpha_i$ in absolute terms for all commodities, the demands for all goods are more sensitive to changes in their own-prices than to changes in nominal interest rates. However, the parameters

$\gamma_{ii}$'s and $\alpha_i$'s do not directly provide information about the current period elasticities, which are identified as the commodity-specific intertemporal elasticity of substitution and the intertemporal own-price elasticity for all commodities.

The commodity-specific intertemporal elasticity of substitution and the intertemporal own-price elasticity for a commodity are defined by $\alpha_i/w_{it}$ and $\gamma_{ii}/w_{it}$, respectively. The signs of these elasticities are determined by the signs of $\alpha_i$ and $\gamma_{ii}$ because $w_{it} > 0$. Since all of the estimated parameters for $\gamma_i$ in Table 1 are positive, the commodity-specific intertemporal elasticities of substitution for each commodity are also positive; and because all of the estimated parameters for $\gamma_{ii}$ in Table 1 are negative, the intertemporal own-price elasticities associated with each good are negative. The calculated commodity-specific intertemporal elasticities of substitution are 0,060 for food-beverages, 0,025 for semi-durable-non-durable goods, 0,017 for energy-transportation-communication, 0,109 for services, and 0,011 for ownership of dwelling. These estimates indicate that the current consumption of food-beverages and services are more responsive to the current changes in nominal interest rates than those of semi-durable-non-durable goods, energy-transportation-communication, and ownership of dwelling. Since the elasticity of real expenditure and commodity-specific intertemporal elasticity of substitution are closely related, the necessities have a smaller commodity-specific intertemporal elasticity of substitution than the luxuries. In other words, the expenditures on luxuries are more responsive to changes in nominal interest rates than those on luxuries for both over the sample period and within the periods.

The calculated intertemporal own-price elasticities of the commodities are –0,304 for food-beverages, –0,754 for semi-durable-non-durable goods, –0,086 for energy-transportation-communication, –0,843 for services, and –0,114 for ownership of dwelling. Thus, services and semi durable-non-durable goods are found to be the most sensitive goods to the temporary changes in their own prices in the current period.

Finally, we can calculate the intertemporal substitution elasticity of consumption that is the weighted sum of commodity-specific intertemporal elasticities of substitution. The calculated intertemporal substitution elasticity of consumption is 0,048. The positive sign of this elasticity indicates that a rise in nominal interest rates leads to a rise in the total consumption of all commodities, but its small value shows that responsiveness of the total consumption to changes in nominal interest rates is low. In other words, since the intertemporal substitution elasticity of consumption is small, it can be said that households in Turkey are not willing to move their expenditures from the current period to the future periods when nominal interest rates increase, and their willingness to save for a higher value of future consumption is not strong.

## CONCLUSION

In this paper, we have analysed the intertemporal behaviour in consumption, using quarterly and disaggregated data on five non-durable goods for Turkey. In

order to explain the nature of the intertemporal substitution in consumption, we used the Frisch demand function method. We estimated four separate but inextricably related elasticities: real expenditure elasticities, intertemporal price elasticities of demand, commodity-specific intertemporal elasticities, and the intertemporal substitution elasticity of consumption. Our important results are as follows: (i) semi-durable-non-durable goods, energy-transportation-communication, and ownership of dwelling are found to be necessities, while food-beverages and services are luxuries; (ii) the estimated value of the commodity-specific intertemporal substitution and intertemporal own-price elasticities are greater than the values of the current period elasticities; (iii) demands for all of the goods are more sensitive to changes in their own-price than to changes in nominal interest rates; and (iv) the calculated intertemporal substitution of consumption is positive, but its value is close to zero.

Our results need to be interpreted in light of the specific features of the Turkish economy. Our first finding seems to be very interesting especially for food-beverages. Wide usage of credit cards and low real income level might have played a significant role in bringing about this result. Ownership of dwellings is found to be a necessity, which is another surprising result. The fact that traditions play an important role in purchasing dwellings, and that high real interest rates prevailed during the sample period, might have contributed to causing this interesting result. The second result shows that the demands for all commodities are primarily affected by the current changes in nominal interest rates and commodity prices. Our findings in (i) and (iv), together, indicate that the households in Turkey exhibit a myopic behaviour in consumption in a life-cycle context. Myopia in consumption might be attributed to the existence of high and chronic inflation throughout the sample period. High inflation has created uncertain conditions which make the consumers reluctant to give up current consumption for the sake of consuming more in the future, regardless of how high the nominal interest rates are.

The main reason to be given for the third result is the fact that the real interest rates have been very high because of high borrowing requirements of the governments to finance the budget deficits. Since it is very costly, people might have been reluctant to borrow money to finance their expenditures. In addition, the banking sector has not been willing to lend money for consumption because of the high profits it can make by investing in government securities.

Consequently, we can conclude that the consumption behaviour of the Turkish people has been mainly shaped by traditional habits and the inflationary process. The driving force behind consumption behaviour has been the tendency towards hedging against inflation. Given the fact that they can not be certain about what the future holds under the uncertain conditions created by high inflation, it should not be surprising to find that the households are reluctant to move their expenditures from the current period to the next period.

**Graphs**

**Graphs**

## REFERENCES

Anderson, R. W. (1979) Perfect Price Aggregation and Empirical Demand Analysis. *Econometrica* 47:5 1209–1230.

Attfield, C. L. F., and M. J. Browning (1985) A Differential Demand System, Rational Expectations and the Life Cycle Hypothesis. *Econometrica* 53:1 31–48.

Boskin, M. J. (1978) Taxation, Saving, and the Rate of Interest. *Journal of Political Economy* 86:2 S3-S27.

Browning, M. (1989) The Intertemporal Allocation of Expenditure on Non-Durables, Services, and Durables. *Canadian Journal of Economics* 22:1 23–36.

Browning, M. (1991) A Simple Nonadditive Preference Structure for Models of Household Behaviour over Time. *Journal of Political Economy* 99:3 607–637.

Browning, M., A. Deaton, and M. Irish (1985) A Profitable Approach to Labour Supply and Commodity Demands over the Life-cycle. *Econometrica* 53:3 503–543.

Chambers, R. G. (1989) *Applied Production Analysis*. Cambridge: Cambridge University Press.

Cornes, R. (1992) *Duality and Modern Economics*. Cambridge: Cambridge University Press.

Deaton, A. (1992) *Understanding Consumption.* Oxford: Clarendon Press.

Deaton, A. (1997) *The Analysis of Household Surveys: A Microeconometric Approach to Development Policy.* Baltimore: John Hopkins University Press.

Gorman, W. M. (1976) Tricks with Utility Functions. In M. Artis and R. Nobay (eds) *Essays in Economic Analysis*. Cambridge: Cambridge University Press. 211–43.

Hall, R. E. (1988) Intertemporal Substitution in Consumption. *Journal of Political Economy* 96:2 339–357.

Kim, H. Y. (1993) Frisch Demand Functions and Intertemporal Substitution in Consumption. *Journal of Money, Credit, and Banking* 25:3 445–454.

Lawrence, E. C. (1991) Poverty and the Rate of Time Preference: Evidence from Panel Data. *Journal of Political Economy* 99:1 54–77.

Mankiw, N. G. (1981) The Permanent Income Hypothesis and the Real Interest Rate. *Economic Letters* 7:4 307–311.

Muellbauer, J. (1983) Surprises in the Consumption Function. *Economic Journal* 93: (Supplement) 34–50.

Summers, L. H. (1981) Capital Taxation and Accumulation in a Life Cycle Growth Model. *American Economic Review* 71:4 533–44.