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Deciphering Consumption Pattern in Turkey: Testing an Euler Equation

Türkiye'de Tüketim Modelinin Deşifre Edilmesi: Bir Euler Denkleminin İncelenmesi

Zeynep Kantur [a] & Gülserim Özcan [b,*]

[a] Asst. Prof. Dr., Department of Economics, Başkent University, 06790, Ankara/Turkey
ORCID: 0000-0002-5756-6457
[b] Asst. Prof. Dr., Department of Economics, Atılım University, 06830, Ankara/Turkey
ORCID: 0000-0002-8207-8930

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ÖZ

Politika yapıcıların ekonomik modellerinde tüketim için yapısal bir biçim varsaymaları nedeniyle tüketim dinamiklerini anlamak çok önemlidir. Bu çalışma, kredi ve banka kartı harcama verilerini kullanarak bir Euler denklemi tahmin etmekte ve Türkiye'deki tüketim dinamiklerini ayrıştırmaya çalışmaktadır. Standart Euler denkleminden farklı olarak, döviz kuru dinamiklerinin tüketim üzerindeki etkisini anlamak için bir modelleme şeması kullanılmaktadır. Bulgularımıza göre Türk Lirası değer kaybettikçe tüketim artmaktadır. Ayrıca, tüketim davranışında önemli bir alışkanlık oluşumu olduğunu gösteriyoruz. Bununla birlikte, geriye dönük harcama davranışı, gelecekteki tüketime ilişkin beklentiler tarafından domine edilmektedir.

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ABSTRACT

Understanding the consumption dynamics is crucial as policymakers assume a structural form for consumption in their economic models. This paper attempts to decipher the consumption dynamics in Turkey by estimating an Euler equation using credit and debit card spending data. Unlike the standard Euler equation, we use a modeling scheme to figure out the impact of exchange rate dynamics on consumption. According to our findings, as the Turkish Lira depreciates, consumption increases. We also show that there is significant habit formation in consumption behavior. However, the backwardness is dominated by the expectations regarding future consumption.

1. Introduction

The success of monetary policy transmission mainly depends on understanding the determinants of individuals' consumption dynamics. Central banks implicitly assume that consumers' expectations of inflation and interest rates will affect their consumption and savings decisions. Therefore, it is crucial for policymakers to understand the determinants of consumption dynamics.

In the theoretical economic literature, the Euler equation characterizes the consumption dynamics, which characterizes the intertemporal decision showing an optimal choice as equating marginal costs and marginal benefits of consuming today. This paper attempts to explain the underlying factors of consumption dynamics in the Turkish

* *Sorumlu yazar/Corresponding author*.
e-posta: *gulserim.ozcan@atilim.edu.tr*

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economy by empirically testing a dynamic Euler equation. To do so, we derive an Euler equation with key ingredients by considering the economic narrative background of the Turkish economy. We use credit and debit card spending data to decipher the factors affecting the consumption behavior of households. Our specification of the Euler equation includes an expectation of future consumption of households, real interest rate, and the effect of the exchange rate channel. Since the Euler equation is forward-looking in nature, it is estimated by the Generalized Method of Moments (GMM) procedure.

The Euler equation is used in two strands of the economics literature. In monetary economics, the Euler equation characterizes the intertemporal distribution of consumption to examine the effect of change in nominal interest rate. (Galí, 2015) In finance, the Euler equation is used to determine asset price returns. (Mehra and Prescott, 1985). Our interest falls in the first category. Since Hall (1978), the monetary economics literature uses either macro or micro-level data to estimate different specifications of the Euler equation. The low-frequency nature of the macro-level data, such as quarterly consumption or GDP, extenuate the impact of change in interest rate. For this reason, the studies using micro-level data constitute most of the literature. Among others, Attanasio and Weber (1995), Attanasio et al. (1999), and Alan et al. (2019) investigate consumption dynamics with micro-level data. On the other hand, studies with macro-level data usually estimate the Euler equation within the large dynamic stochastic general equilibrium framework (Fernández-Villaverde et al., 2015). The relatively high-frequency credit card data enables us to estimate a single equation Euler equation at macro-level data. To the best of our knowledge, this is the first paper studying consumption dynamics in Turkey using credit and debit card spending data, taking the decision interval as a month. The monthly frequency of data is consistent with the fact that the majority of the employees in Turkey are salaried workers, and wages are usually paid monthly.

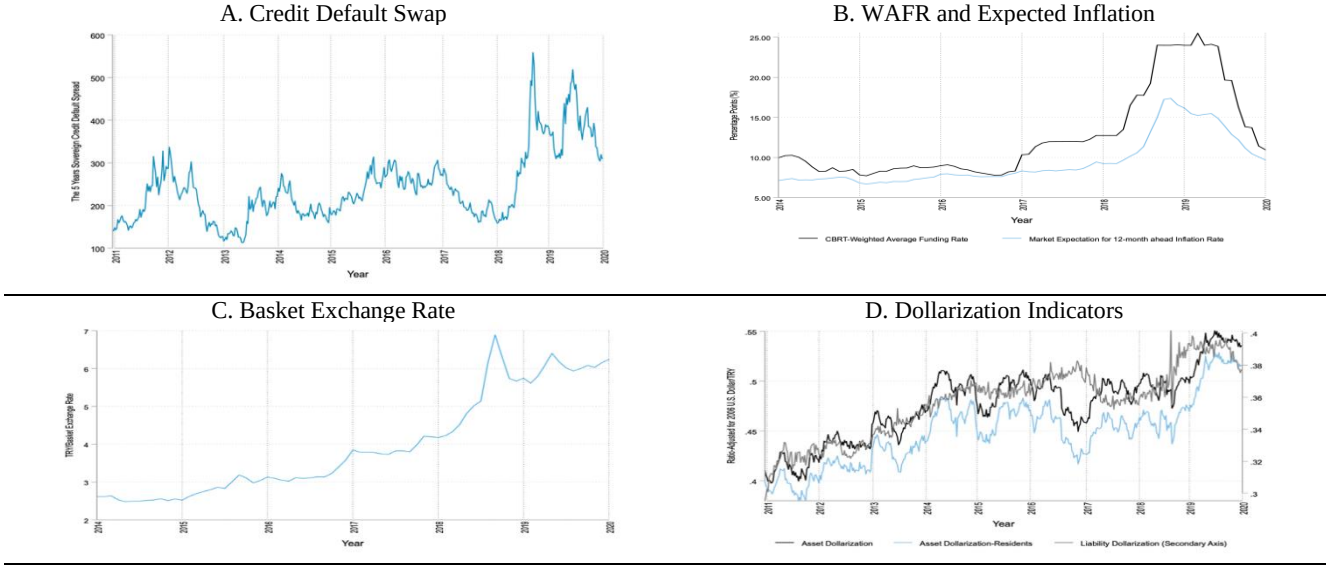
Our findings can be summarized as follows: (1) the estimate of the intertemporal elasticity of substitution is close to zero and negative, suggesting a change in the real interest rate has a small impact on the consumption level of households; (2) there is significant habit formation observed in Turkey; (3) the exchange rate channel is positive and significant.

Our paper is organized as follows. Section 2 summarizes the narrative background of the Turkish economy. In Section 3, we characterize the model for the specific Euler equation used in the empirical analysis. Section 4 introduces data and briefly explains the empirical methodology. In Section 5, we discuss our results. Section 6 concludes.

2. Recent Background of Turkish Economy

Over the last decade, the Turkish economy has been experiencing an unstable economic environment. The deteriorating economic indicators proliferated the uncertainties faced by the economic agents and thus the riskiness of the country. In Panel A of Figure 1, we demonstrate the Turkey's risk premium—measured by the five-years sovereign credit default swap—which follows a volatile and elevated path. The Credit Default Swap (CDS) provides an economically important distinct insight by reflecting the market's sentiment or view about a country's solvency.

Fig. 1. Turkish Data



Sources. Thomson Reuters Datastream Database, Central Bank of the Republic of Turkey, and Authors' Own Calculations

As suggested by the macroeconomic theory, these unfavorable economic conditions can be attenuated by the anchoring and managing inflation expectations of individuals —through tight and coordinated policies of

monetary and fiscal authorities. Panel B of Figure 1 shows the market expectation for 12-month ahead annual inflation together with the Central Bank of the Republic of Turkey's weighted average funding rate (WAFR). Especially after 2015, there is a deterioration in inflation expectations in Turkey. Although the policy rate has been moving in accordance with the inflation expectations, and the ex-ante real rate is positive for most of the time, it was not enough to suppress the macroeconomic riskiness of the country. The insufficient real interest rate to hedge the country's risk causes economic agents to turn to foreign currency denominated assets with the motive of protection of financial wealth. The depreciation of the Turkish lira against foreign currencies (shown in Panel C of Figure 1[1]) results in an upward pressure in inflation owing to the import-oriented production scheme of Turkey (Kantur and Özcan, 2021). Hence, the real interest rate falls, even more, putting the economy in a vicious cycle dominated by uncertainty.

Panel D of Figure 1 demonstrates that the undertaken policy measures could not prevent the soaring behavior of both asset and liability dollarization. To measure the currency preference in deposits and credit in Turkey, we use foreign exchange deposit to total deposit ratio and foreign exchange credit to total credit ratio.[2]

3. Economic Foundations of the Model

Following the contribution of the seminal paper by Friedman (1957), the optimal intertemporal decision of consumption allocation in life-cycle models suggests that households' smooth consumption considering their lifetime permanent income by equating marginal benefit and the marginal cost of consuming today—real interest rate.

The Euler equation in this paper represents households' optimal consumption decision that aims to maximize expected utility from consumption and leisure subject to period budget constraints. In addition to the conventional framework, we use a modeling setup that allows for wealth effects upon consumption. Our framework integrates the closed economy setup with wealth effects of Nistico (2012) and the small open economy DSGE model of Galí and Monacelli (2005).

Following Blanchard (1985), we assume a perpetual youth model where the economy is populated by an indefinite number of households who face a constant γ probability of death. The effective decision horizon of consumers is 1-γ. Households consume final goods and supply labor. The representative household j chooses its optimal amount of consumption, labor supply, and holdings of financial assets to maximize its lifetime utility function:

$$E_0\left[\sum_{t=0}^{\infty}\beta^t(1-\gamma)^t\left[\ln\left(\boldsymbol{C_t(j)}\right)+\ln\left(1-N_t(j)\right)\right]\right] \quad (1)$$

where $\boldsymbol{C_t(j)} = C_t(j) - hC_{t-1}(j)$. Including habit behavior (h) in consumption in the baseline model matches some characteristics of the data, as the hump-shaped pattern of consumption in response to shocks. Moreover, as studied in Campbell and Cochrane (1999) the presence of habits enhances the explanatory power of the consumption-capital asset pricing model (see also Campbell and Cochrane (2000)).

The household j faces the following period-budget constraint at time t:

$$\begin{aligned} C_t(j) + \frac{1}{P_t}E_t\{F_{t,t+1}B_{t+1}(j)\} &+ \int_0^1 \frac{\Theta_t^i}{P_t}E_t\{F_{t,t+1}B_{t+1}^i(j)\}di \\ &+ \frac{1}{P_t}\int_0^1 Q_t^k Z_{t+1}(k,j)dk \\ &= \frac{W_t}{P_t}N_t(j) - T_t(j) + \frac{\Omega_t(j)}{P_t} \end{aligned} \quad (2)$$

Each household can save in two types of financial assets: domestic and foreign state-contingent bonds and equity shares of domestic intermediate firms. $B_t(j)$ refers to the domestic bond-holdings of cohort j and $B_t^i(j)$ represents the foreign-bond holdings of cohort j from country i. $Z_{t+1}(k, j)$ denotes the number of equity shares held by cohort j of firm k. Q_t^k is the nominal price of shares of a firm k.

After solving the optimization problem, we aggregate first order conditions and log-linearize them to get the following Euler equation:

$$\begin{aligned} c_t = \frac{1}{1+h+\psi}E_t\{c_{t+1}\} &+ \frac{h}{1+h+\psi}c_{t-1} \\ &+ \frac{\psi}{1+h+\psi}q_t \\ &- \frac{1}{1+h+\psi}(i_t - E_t\{\pi_{t+1}\} - \rho) \end{aligned} \quad (3)$$

where $\psi = \gamma\frac{1-\beta(1-\gamma)}{1-\gamma}\frac{\Omega}{C}$ and $\rho = log(\beta)$.

From the theoretical Euler equation in (3), we hypothesize that current consumption is positively related to expected consumption, expected inflation, and wealth effect, and negatively to (expected) nominal interest rates. We also expect to find significant habit behavior of consumption.

4. Data and Methodology

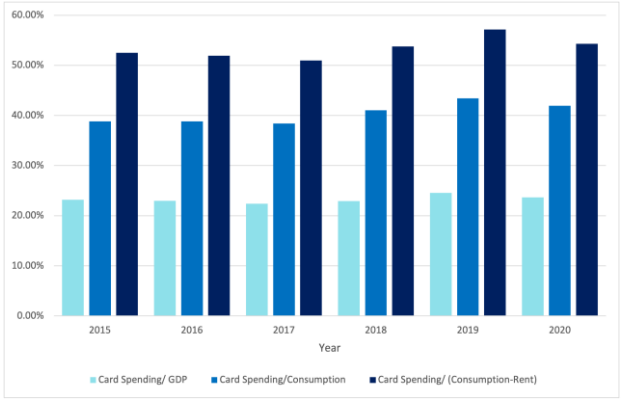
4.1. Card Spending Data

In this paper, we use monthly data for 2015M01-2019M12 to estimate the Euler equation for consumption in Turkey. We consider the decision interval as a month. This assumption is consistent with the fact that most of the employees in Turkey are salaried workers, and wages are usually paid monthly. Moreover, we particularly exclude the COVID-19 period considering that post-2019 data may contaminate the sample as the variation in macroeconomic data is essentially generated by large shocks during this

period. Among others, Lenza and Primiceri (2020), Schorfheide and Song (2020), Bobeica and Hartwig (2021) and Ng (2021) discusses the challenges COVID-19 pandemic poses for the empirical analysis of macroeconometric models.

We obtain monthly credit and debit card spending data from The Interbank Card Center (ICC) to characterize consumption patterns. As illustrated in Figure 2, total card transactions data capture a sizable amount of Turkish consumer spending.

Fig. 2. Total Card Spending as Percentages of Consumption, Consumption Excluding Rent and GDP



Sources. Interbank Card Center, Central Bank Republic of Turkey, Turkish Statistical Institute and Authors' Own Calculations.
Notes. Consumption excluding rent is calculated by using the ratio of housing from the Household Budget Survey provided by CBRT.

During the analyzed time span, the aggregate card expenditure constitutes approximately 23% of Gross Domestic Product, 40% percent of total private consumption spending, and 53% percent of total private consumption spending excluding rents. Household spending net of rent is especially pertinent because they are generally paid through direct debit transfers or cash. The pattern of card expenditure is a key indicator of aggregate economic activity.

Since we are particularly interested in the behavior of households, we use the real household card payment index (HCPI) from ICC, which is calculated based on only domestic retail transactions, i.e., card payment transactions with domestic cards net of Private Pensions payments and Government/Tax payments. Table 1 shows data sources and transformations.

Table 1. Variable Definitions and Data Sources

Variable	Definition	Source
HCPI (c_t)	Real household card payment index, logarithm, filtered	ICC
Ex-ante real interest ($i_t - E_t\pi_{t+1}$)	Personal-credit borrowing rate minus market expectation for the headline inflation rate, logarithm, filtered	CBRT
Exchange rate (q_t)	Basket Effective Nominal Interest Rate (50% USD Dollar/TRY,50% Euro/TRY), logarithm, filtered, percentage change	CBRT
Consumer inflation (π_t)	Core CPI (D-Index) rate of inflation, monthly, year-on-year	CBRT
Production index	Real Industrial production index, logarithm, filtered	TurkStat

Notes. CBRT and TurkStat denote for the Central Bank of the Republic of Turkey and Turkish Statistical Institute, respectively. Variables are de-trended with Hodrick-Prescott filter by taking 14400 as the smoothing parameter.

4.2. Empirical Methodology

We use the Generalized Method of Moments (GMM) technique to estimate a dynamic Euler equation for Turkish card spending empirically. Under the assumption of rational expectations, with no systematic errors in forecasting consumption, there is an expectational error in realized future consumption, i.e., $\vartheta_t = E_t c_{t+1} - c_{t+1}$. In Equation (3), we replace expectation about future consumption by its ex-post realization as follows:

$$c_t = \gamma_f c_{t+1} + \gamma_b c_{t-1} + \psi \hat{q}_t + \sigma r_t + \varepsilon_t \qquad (4)$$

where ε_t is the summation of the prediction error, $\gamma_f[c_{t+1} - E_t c_{t+1}] = \gamma_f \vartheta_t$, and a measurement error. As the forecast error ϑ_t is assumed to be uncorrelated with all variables in the information set available at the time expectations are formed, the following orthogonality conditions are used to estimate the Euler relation:

$$E_t\{(\pi_t - \gamma_f \pi_{t+1} - \gamma_b c_{t-1} - \psi \hat{q}_t - \sigma r_t) I_{t-1}\} = 0 \qquad (5)$$

where I_{t-1} is an instrument vector dated from period $t-1$ or earlier.

We utilize the continuously updated (CU)-GMM by Hansen et al. (1996), which is developed as a solution to the finite sample bias problems of the two-step GMM. CU-GMM estimator, where the weighting matrix and coefficients vector are evaluated simultaneously, performs better in the case of weak instruments.

5. Results and Discussion

Table 2 reports the Euler equation estimates as specified in Equation (3) from CU-GMM. To prevent possible correlation in moment conditions, the standard errors are corrected with Newey–West procedure with automatic plug-in lag length to ensure robustness to autocorrelation and heteroscedasticity. We employ a small number of instruments in the estimation. The instrument set consists of

a constant, five lags of card spending, four lags of ex-ante real interest rate, change in the basket exchange rate, and three lags of industrial production. The validity of the instrument set is acknowledged by the regression diagnostic statistics. We check for the weakness of instruments by first-stage F tests, Kleibergen-Paap LM statistics, and Cragg-Donald Wald F statistics. With weak identification, conventional strong instrument asymptotic theory provides a poor approximation to the sampling distribution of GMM estimators. First-stage F-test statistic is found to be larger than 10; the p-value for Kleibergen-Paap LM-statistics is over the 5% threshold; and Cragg-Donald Wald F-statistic is significant against Stock-Yogo weak ID-test critical values. Hence, we found no evidence for weak correlation between endogenous explanatory variables and instruments. Moreover, our instrument set provides p-values for Hansen J-statistics above the 5% threshold, indicating no evidence for overidentification. Hence, our instrument set is robust to underidentification and overidentification restrictions.

Table 2. CU-GMM Results of the Hybrid Euler Equation

Reduced form parameters					Test			
γ_f	γ_b	ψ	σ	constant	J-Stat	KP-Stat	CD-Stat	F-Stat (1^{st} stage)
0.702[a]	0.350[a]	0.111[a]	-0.001[b]	0.005[a]	3.714	3.840	3.927	81.36
(0.052)	(0.037)	(0.027)	(.0004)	(0.001)	[0.988]	[0.993]		

Notes. The instrument set includes five lags of card spending; four lags of ex-ante real rate and change in exchange rate basket; three lags of industrial production. Newey-West-corrected HAC standard errors are shown in parenthesis. p-values are presented in brackets. J-Stat refers to Hansen's overidentification restrictions test. KP-Stat is Kleibergen-Paap rk LM statistic for the test of underidentifying restrictions. To test for weak identification, F-Stat reports Kleibergen-Paap rk Wald F statistic from the first-stage regression. CD-Stat shows Cragg-Donald Wald F statistic. A significance level of 1%, 5%, and 10% is indicated by [a], [b], and [c], respectively.

We report that the estimate for the responsiveness of spending to the real interest rate is negative and quite low, implying a very high degree of risk aversion (σ^{-1}) for the consumers. We further find that habit formation in preferences and expectation of future spending significantly determines current spending. The estimated future spending and backward spending coefficients are 0.7 (γ_f) and 0.35 (γ_b), respectively.

These findings are in line with the recent theoretical predictions by Del Negro et al. (2012) and McKay et al. (2016). They show that, for the agents facing uninsurable income risk, precautionary savings motive dampens their responses to changes in interest rates. Hence, real interest rate changes have a trivial impact on consumption. Moreover, the degree of forward-lookingness measured by γ_f is well below unity, implying a discounted-Euler equation. The presence of habit formation points out that past consumption choices affect current preferences. This implies that consumers dislike abrupt changes in consumption, thereby inducing a moderate degree of smoothness in consumption dynamics.

The main interest in this paper is whether and how exchange rate fluctuations affect Turkish spending patterns. Our GMM results show that exchange rate fluctuations positively affect consumption. This result has several interpretations and implications. For developed countries having deep financial markets, there is a wealth channel from financial instruments towards consumption. However, in emerging countries with low saving rates, we cannot discuss direct wealth effects on consumption. Instead, considering the narrative background of the Turkish economy with a high degree of instability, we interpret the sensitivity of current consumption to exchange rate movements as functions of risk preferences by advancing the consumption of durable goods. In other words, individuals choose to carry future consumption to the present in order to secure themselves against the future exchange rate attacks and by predicting the pass-through of the rising current exchange rate to inflation. Card spending data is particularly useful in the way that it represents the part of the consumption that can be compensated by borrowing.

6. Conclusion

Understanding the allocation of households' consumption over time allows us to answer how and by how much they will advance or delay their consumption in response to changes in interest rates. We estimate an augmented Euler equation with exchange rate channel using GMM methodology. We use monthly card spending data of Turkish households. The findings of our analysis show that the impact of interest rate is small on the level of spending. The presence of habit formation points out that past consumption choices affect current preferences, implying that consumers dislike abrupt changes in consumption, thereby inducing a moderate degree of smoothness in consumption dynamics. Finally, the exchange rate has a positive effect on card spending due to increasing inflation expectations of the individuals. In other words, households tend to increase their current spending to hedge against future inflation. Future work should investigate whether households are more likely to spend by reducing their savings or borrowing by using credit data. Therefore, policymakers should pay close attention to the exchange rate dynamics due to the pass-through effect on inflationary expectations. The results obtained using Turkish data emphasize that the central bank's anchoring of inflation expectations is necessary for the success of the inflation targeting regime and control abnormal fluctuations in consumption behavior.

Notes

[1] Currency Basket=0.5 * (USD/TRY)+0.5 * (EUR/TRY)

[2] In order to eliminate the effect of currency changes, we adjusted these ratios using local currency and a fixed exchange rate, i.e., 2006 U.S. Dollar per Turkish Lira.

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