Interest Rate Pass-Through and Consumption Response: the Deposit Channel[1]

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ABSTRACT

This study assesses a new mechanism – the deposit channel – in the transmission of interest rate shock to household consumption using an administrative panel dataset of financial transactions for Turkey. Our empirical strategy exploits variation in consumer's adherence to the Muslim laws that forbid earning interest and employs a standard difference-in-difference design. Following an unanticipated announcement of interest rate hike, rate-sensitive consumers significantly reduce their overall spending and the response persists throughout the post-announcement period. The response of debt payment, disparate exposure to inflation, and exchange rate, the demographic difference can hardly fully account for the documented consumption response heterogeneity.

Keywords: Interest Rate Shock, Consumption, Big Data, Household Finance, Banking.

JEL Classification Codes: D12, D14, E52

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1. Introduction

Starting with Friedman and Schwartz (1963), it has been long agreed among economists that monetary policy can significantly impact the real economy at least in the short run (Romer and Romer, 1989; Bernanke and Gertler, 1995). Regarding the monetary transmission mechanism, the conventional view holds that monetary policy can shape firms' investment and households' consumption by reducing the cost of capital. Subsequent studies mainly focuse on two perspectives to evaluate monetary policy, namely transmission through the banking system or impact on real economic activities, in particular household consumption. For example, the literature has proposed various channels to explain its effect on the credit supply by highlighting the role of reserve requirement, bank's balance sheet, risk-taking and depositors' response[6]. Regarding the influence on household behavior, a significant part of the literature has focused on the household indebtedness and highlight the impact on borrower's consumption through the interest payment cash flow channel (i.e. Di Maggio et al. 2017; Cloyne, Ferreira, and Surico 2018). However, there has been much less study of the implications with the emphasis on the saver/depositor's point of view.

In this study, we use detailed financial transaction data and provide empirical evidence that supports the role of deposit channel for the effect of interest rate shocks on household consumption. When the central bank raises the policy rate, rate-sensitive households respond by reducing their highly liquid asset (cash or checking account balance) and switching for higher-yield products, which leads to postponement in current consumption. Looking at an unanticipated interest rate increase announcement by the Turkish Central Bank, we study how household consumption

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[6]For a review of the literature, please see Clarida, Gali, and Gertler (1999), Drechsler, Savov, and Schnabl (2018)

responds following the policy shock. On January 29 of 2014, the Central Bank of Turkey, following an emergency midnight policy meeting, hiked all of its major interest rates. Specifically, the overnight lending rate jumped from 7.75 to 12 percent, the one-week repo rate from 4.5 to 10 percent and the overnight borrowing rate from 3.5 to 8 percent. Such a bold and unanticipated policy action, rarely observed in other markets, led to an immediate increase in both the overall borrowing cost of the market and the deposit interest rate. This dramatic, sudden, and unanticipated jump in market interest rates provides a natural experiment to study the extent to which households adjust their consumption behavior accordingly[7]. While anticipated and unanticipated shocks bear different implications for the consumption response (Jappelli and Pistaferri, 2010), the announcement effect of monetary policy can be best identified off shocks to interest rate.

We use an administrative panel dataset of customers' financial transactions from one of the leading banks in Turkey. Specifically, we have a representative sample of more than 190,000 customers and rely on a comprehensive set of demographics and financial transactions from their bank checking accounts to examine how customers respond to such policy shock. Compared to other empirical studies that use annual/bi-annual survey data, high-frequency microdata on financial transactions allows us to perform a more robust test of consumers' consumption, and as a result, obtain estimates with fewer measurement errors.

Our analysis is based on a difference-in-difference identification that exploits cross-sectional variation in a customer's adherence to a particular Muslim rule to identify the rate-sensitive(treatment) and rate-nonsensitive (control) group. Given that all forms of interest are riba

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[7] Monetary policy typically takes the form of gradualism (or interest rate smoothing)(Coibion and Gorodnichenko, 2012). More importantly, there is no follow-up or other relevant and concurrent policy changes in Turkey during the sample period.

(excess or addition) and hence prohibited according to the Muslim rules, customers with strong adherence to the Muslim religion are expected to exhibit a lower level of sensitivity to the unanticipated positive interest rate shock, and as a result, they constitute a valid control group. On the other hand, customers with weak adherence to the Muslim religion are expected to exhibit a larger sensitivity to the interest rate shock, so they serve as a proper treatment group.

To identify the heterogeneity in customer's adherence to the Muslims rule, we rely on the specific timing of the fasting in observation of the Islamic holy month of Ramadan (i.e., one of the Five Pillars of Islam), in which Muslims shall abstain from eating, drinking, smoking, and engaging in sexual activities (or other behaviors deemed sinful) from dawn to sunset. If a consumer adheres to the prohibition rule on specific spending during the fasting hours in the month of Ramadan (i.e., exhibits strong adherence to the Muslim rule), then s/he is categorized as rate-nonsensitive (control) customer. Otherwise, s/he belongs to the rate-sensitive group. To ensure that all analyses are done across consumers with observationally equivalent characteristics except for sensitivity to the interest rate shock, we use the propensity score matching approach to construct a matched sample of the treatment and control group. We empirically test for the parallel trends in consumption before the policy announcement to validate our research design.

Using the difference-in-difference (DID) methodology, we find that the rate-sensitive (treatment) customers respond more strongly to the interest rate shock by significantly reducing their consumption relative to the rate-nonsensitive group. Specifically, the treatment group decreases their monthly spending amount by 159 lira on average during the six-month period after the shock. Prior to the announcement, there is no divergence in consumption between the treatment and the control group. We further investigate the dynamics of the response and find that the differential effect in the consumption between the rate-sensitive and rate-nonsensitive customers

persists throughout post-announcement months. Moreover, the consumption response exists in both cash and card spending.

We continue to provide evidence to further support the deposit channel by examining the response of account balance to the interest rate shock. Specifically, we gauge the impact on aggregate monetary terms by inferring the total amount that the customer moves out of the account in pursuit of higher-yield product. Combining the response estimates of cash, card spending and change in account balance indicates that consumers are moving around 10.2 to 11.5 percent of the account balance out in response to the interest rate shock.

Furthermore, we assess alternative mechanisms that may drive the heterogeneous consumption response we document. First, exploring the heterogeneity regarding customer's liquidity asset and age assures us that the documented spending response is not purely driven by disparate leverage position and thus disproves the interest payment cash flow channel. Second, we show that heterogeneous exposure to macroeconomic environment (i.e. inflation or exchange rate) can hardly account for the main result. Last, our main finding is unlikely due to an imbalance in demographics that lead to heterogeneous movement in earnings. While we do not rule out the possibility that any of the above channel might play a role here, they cannot reconcile all the patterns we document on their own.

Last, we perform additional tests to explore the spending response and check the robustness. First, we explore the heterogeneity in the consumption response and find that the consumption primarily responds in non-durable and discretionary spending items. Second, we confirm that our approach to classify rate-sensitive/-nonsensitive consumers is not purely picking up variations in consumer's other spending attributes. Third, to test the external validity of our identification, we analyze the full sample and an alternative credit card spending sample and obtain similar results.

Fourth, we conduct checks to verify the robustness of our results, including addressing "infra-maginality" concern, using alternative specification and measure, checking consistency of standard errors and doing a falsification test. Last, we attempt to estimate the elasticity of intertemporal substitution (EIS) via a difference-in-difference specification and find the estimate is economically small and statistically insignificant.

Our study advances the literature in the following three dimensions. First, we uncover the evidence to characterize how monetary policy changes can be transmitted to the real economy and impact household consumption through the deposit channel. When the policy rate rises, households move the deposits out of the banking system in pursuit of high-yield product. Our results indicate that the reach-for-yield trend during monetary tightening, as documented in Drechsler, Savov and Schnabl(2017) and Xiao(2017), not only leads to the outflow of bank's funding source and causes the contraction of credit supply but also matters for household's consumption decision.

Second, household consumption in concurrent studies typically is obtained either through survey questions or credit card transactions. However, both methods may have limitations: the former has low-frequency observations and suffers from more measurement errors; the latter can only capture the non-cash part of one's overall consumption. We try to circumvent such drawbacks by adopting a relatively advantageous approach to include both cash and card spending of the household based on daily financial transactions, which is in particularly suitable in an emerging and cash-oriented country. Third, the methodogical innovation we use in this paper, exploiting the Muslim rule to differentiate yield-sensitive and yield-not-sensitive households, enables us to employ a standard difference-in-difference design and estimate the casual effect of interest rate shock on consumption response.

Related Literature Our paper makes contributions to three main strands of the literature. First, we add to existing studies on the pass-through of monetary policy to impact household consumption. Within this literature, a large body of studies focus on the role of household balance sheet and particularly highlight the interaction of house price, mortgage market and real economy (e.g., Baker 2013; Mian, Rao, and Sufi, 2013; Aladangady 2014; Mian and Sufi 2014; Agarwal et al, 2015; Justiniano Primiceri and Tambalotti 2015; Cloyne and Surico 2016; Guerrieri and Iacoviello 2017; Cloyne, Ferreira, and Surico 2018; Auclert, 2019). For example, Di Maggio et al. (2017) exploit the expected resets of adjusted-rate mortgage and study how the reduction in mortgage payment affect car purchase decision. In an international setting, Calza, Monacelli, and Stracca (2013) document that consumption response to monetary policy shocks are stronger in countries with prevalence of mortgage equity release and higher share of adjustable rate mortgages. On the theoretical side, most studies in this line of work draws from the life-cycle features of a representative borrower (i.e. Garriga, Kydland and Sustek 2017; Greenwald 2017; Garriga and Hedlund 2017). Alternatively, Wong (2018) formulates the heterogeneity of monetary policy shocks with an emphasis on demographics. In this paper, we show evidence of the deposit channel as one alternative mechanism to explain the impact of interest rate shocks on household consumption.

We also contribute to the vast literature on consumption response to income shocks induced by policies and programs. According to the Permanent Income Hypothesis (PIH), anticipated and unanticipated shocks bear different implications and consumption should only respond to the unexpected one(Jappelli and Pistaferri 2010). On the empirical front, scholars have explored various settings as the identification of incomes shocks, including tax rebate (Souleles 1999; Johnson, Parker, and Souleles 2006; Agarwal, Liu, and Souleles 2007; Shapiro and Slemrod 2009;

Agarwal, Marvell, and McGranahan, 2017), minimum wage hikes (Aaronson, Agarwal, and French 2012), government stimulus campaign (Mian and Sufi 2012; Agarwal and Qian 2014), shocks to the employer (Gruber 1997; Jappelli and Padula 2015), liquidity shocks(Baker 2018; Agarwal and Qian, 2017; Agarwal et al., 2018), medical expenditure (Gertler and Gruber 2002) and credit card limit increase (Gross and Souleles 2002; Aydin, 2018). This paper takes advantage of the announcement of an unexpected interest rate hike policy and examines how consumers' behavior responds.

The third strand of studies to which this paper contributes concerns monetary policy transmission in the banking system. Traditional views by and large focus on constraints imposed by regulation, such as deposi trate ceilings (Tobin and Brainard 1963) and reserve requirements(Bernanke 1983, Bernanke and Blinder 1988, Kashyap and Stein 1994), and argue that central bank controls the size of bank lending through supply of required reserve. Recent literature begins to question whether these mechanisms are large enough to exert a meaningful influence on the bank's balance sheet and propose alternative channels (Romer and Romer,1990, Bernanke and Gertler 1995, Woodford 2010). The monetary policy can work through the balance sheet channel, under which a surprise increase in interest rates can causes banks' assets to decline by more than their liabilities, depressing net worth and forcing banks to shrink their balance sheets (Bernanke and Gertler 1989; Gertler and Kiyotaki 2010; Brunnermeier and Sannikov2014; Brunnermeier and Koby 2018). The transmission may also take place under *the deposit channel*: a rise in the Fed fund rate leads to large outflows of deposits from the banking system and causes banks to contract credit supply (Drechsler, Savov and Schnabl 2017,2018). Following this line of research, this study explores how such transmission can explain the effect of interest rate shock on household behavior.

The rest of the paper is organized as follows. Section 2 describes the institutional background and Section 3 presents the data and our empirical methodology. Sections 4, 5 and 6 provide the results and robustness check. Section 7 concludes.

2. Institutional Background

A. Identifying the Policy Shock

A large body of literature seeks to identify and analyze the effect of monetary policy shock (see Christinano, Eichenbaum and Evans,1999 and Ramey, 2016 for a review). The most classical approach devoted attention to the issue of correct specification of monetary policy function employing various methods, including standard VAR (i.e. Sims,1980), regime-switching models (Owyan and Ramey,2004; Primicerri,2005; Sims and Zha,2006) and Factor-Augmented Vector Autoregressive approach (Boivin et al,2010). The method that has become popular in recent decades is to construct shock series based on target rate change and information set available to the policymaker (Romer and Romer, 2004)[8]. Though Friedman and Schwartz's (1963) examination of monetary policy during the Great Depression has great impact on the relevant literature, it is surprising to see few studies take their event-study approach, perhaps due to circumstances of radical monetary policy rarely being observed. One of the few exceptions is Velde(2009), which present evidence of monetary nonneutrality based on a historical episode when the French government cut the money supply three times, leading to a total drop of 45%. Hence, in this study,

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[8] A few other studies also falls into this line of work: Coibion (2012) studies difference in the estimated effects of monetary policy shocks across the different methods. Cloyne and Huertegen (2016) apply this methodology in the U.K. and Cloyne and Ferreira and Surico (2018) use two comparable series in the U.S. and U.K. derive a new monetary policy shock indicator by using a series on intended funds rate changes around FOMC meetings.

we complement these papers by employing detailed micro-level data and an event-study approach utilizing the massive unanticipated interest rate shock in January 2014, Turkey.

As stated in the official webpage of the Central Bank of the Republic of Turkey (CBRT), the CBRT is delegated to use interest rates and other monetary policy instruments to achieve the overriding goal of inflation targeting and maintaining the stability of the financial system. Historically, the CBRT has had a relatively unstable framework in setting its recent interest rate policy. From February 2002 to May 2010, the CBRT used the overnight repo rate as its policy instrument with a symmetric corridor around the instrument. Immediately in the subsequent two months (June to July 2010), the CRBT adopted the weekly repo rate as the policy rate. Shortly after that, the CBRT developed a new monetary policy framework and relied on a combination of policy instruments with the weekly repo being the central rate, which is surrounded by the corridor between the overnight lending and borrowing rates at the Interbank Money Market and the İstanbul Stock Exchange Repo-Reverse Repo Market. The scheme was aimed at attaining instrument diversity in order to achieve multiple objective functions faced by the central bank.

In this paper, we study an aggressively tight monetary policy by the CBRT in 2014. The domestic unemployment condition and external developments in late 2013 had an adverse impact on the local currency, leading to a significant depreciation in the Turkish lira. After burning through forex reserves to defend the country's crumbling lira currency, at an emergency midnight policy meeting held on January 28, 2014, the CBRT unexpectedly hiked all of its major interest rates in a dramatic way by raising its overnight lending rate from 7.75 to 12 percent, its one-week repo rate from 4.5 to 10 percent, and its overnight borrowing rate from 3.5 to 8 percent. Panel A of Figure 1

presents the evolution of the three key interest rates overtime and displays a sudden and simultaneous jump after the announcement in January 2014.[9]

The decision to hike all its key interest rates was made at an emergency midnight policy meeting rather than the regular rate-setting meeting (like FOMC), and thus highly unanticipated. Before that, the Turkish central bank had been slow to act amid fears that a rate rise could hurt the economy. The decision dramatic fashion is also not anticipated by the markets or even the long-standing view expressed by CBRT. We perform a thorough search of the relevant media coverage and all major TV and newspapers highlighted the unanticipated nature of the announcement. For example, BBC reported on January 27 before the emergency meeting was just called:

"*Just last week, the central bank decided to hold rates steady at its rate-setting meeting. Analysts say the central bank is reluctant to raise rates for fear of slowing economic growth ahead of local elections due in March.*"

Raising borrowing costs also faces opposition from the political regime. Prime Minister, Erdogan has been a vociferous opponent of higher borrowing costs and keen to maintain economic growth ahead of an election cycle. He publicly announced his standview, "*I would like you to know that as always, I am against a hike in interest rates today*", before the emergency meeting[10]. We

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[9] Our transaction data is only available for a two-year period of 2013 and 2014. The overnight borrowing/lending rate is also observed to experience some fluctuations around mid-year of 2011, which we use to perform the external validity check using another credit spending sample in Section 6.C.

[10] The Reuters reported the news with the title "Turkey's midnight surprise: The Turkey central bank defies the government with a huge hike in interest rate at an emergency midnight policy meeting" on January 29, 2014. While it is not surprising for the central bank to take action to stabilize the lira, such a sharp move went well beyond what economists and investors were expecting. According to a Reuters's poll of 31 economists one day before the substantial rate hike, the consensus was a 2.25-percentage-point rise in the lending rate.

check and confirm that there were no follow-up relevant policy changes in Turkey following this policy action.

The CBRT's surprise rate hike took place after the Turkish lira had sunk to record lows against the US dollars and had weakened sharply against the euro over the past month. Many viewed this as the CBRT's effort to short-circuit a vicious cycle of sweeping sell-off and also to raise investor confidence. We plot the time series of deposit interest rate across different terms in Panel B of Figure 1. The effectiveness of interest rate pass-through is evidenced by the sharp rise of all deposit interest rates. The pattern in Figure 1 reveals a similar fact as documented in (Drechsler, Savov, and Schnabl, 2017) that banks raise deposit rates less than one-for-one with the Fed funds rate.

B. Constructing Counterfactual using Interest Prohibition in Islamic Law

The main empirical challenge in quantifying the monetary policy's impact on household consumption is getting an estimate of the counterfactual level of spending in the absence of the policy. Studies on the debt channel of monetary policy transmission usually exploit a household's housing tenure status(renter vs owner with/without mortgage) or debt position to construct the treatment and control group. These groups can exhibit marked heterogeneity in their demographic characteristics and balance sheet composition, as shown in Cloyne, Ferreira and Surico (2018). Our methodological innovation is to rely on one Muslim rule – specifically all forms of interest is strictly prohibited – to identify the group with /without sensitivity to the interest rate shock via the deposit channel.

In Islam, there is no separation between mosque and state and the *Shariah* (Islamic law) governs every aspect of a Muslim's religious practices, everyday life, and economic activities. As

a vital part of Islam's general vision of a moral economy, Muslims are prohibited from taking

interest or any pre-determined return on a loan, called *riba*, which are viewed as a major sin[11]. The

basis for the prohibition of riba in Islam may be traced to the common medieval Arabic practice of

doubling the debt if the loan has not been repaid when due. There are stern warnings concerning

the riba and committing the sin can lead to extreme consequences, according to the *al-Baqarah*[12].

Therefore, consumers with strong adherence to the Muslim religion are expected to exhibit little

sensitivity to the unanticipated positive interest rate shock, which allows us to construct the control

group.

However, the act of lending money is not forbidden in Shariah, and only *riba* is prohibited.

There are different forms of contracts. For example, *Musharakah* is a partnership where profits are

shared based on an agreed ratio, while losses are shared in proportion to the capital invested by

each partner, and diminishing *Musharakah* is commonly used for housing finance. Borrowers

purchase the shares by making periodic mortgage payments and gradually purchase all the shares

and finally become the sole owner of the property. Other forms of contract for housing finance

include *Ijarah* (i.e., an Islamic leasing agreement), *Murabaha* (i.e., the purchase and resale of an

asset with a predetermined price over a time period), and *Mudarabah* (i.e., an investment

partnership)[13].

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[11] In addition the prohibition of riba, there are three additional general principles of a moral financing: (1) the prohibition of *Gharar*, removing any asymmetric information in a contract; (2) the prohibition of sinful activities such as gambling and the production of alcohol; (3) risk-sharing.

[12] "O you who believe! Fear Allaah and give up what remains (due to you) from Ribaa (from now onward) if you are (really) believers. And if you do not do it, then take a notice of war from Allaah and His Messenger " - [al-Baqarah 2:278-279].

[13] *Mudarabah*-based contract formulates the roles of the bank (or the owner of the capital – the investor) and the borrower (the entrepreneur - the client) to finance a particular project. A *Mudarabah* involves the issuer (as the investor) appointing the mudarib (investment manager) to

The retail customers at an Islamic bank (i.e., also called Participation bank in Turkey) can open a *Current Account* that offers free ways to access one's money (i.e., deposit, withdrawal and card spending) at any time. It just operates like checking account in non-Islamic banks and is the focus of our analysis in this paper. Alternative types of accounts pay profit shares, but they typically do not provide such flexibility, and the client can't withdraw the money until the predetermined day. For instance, the customer can have a *Participation Account,* which is usually the *Mudarabah-*based investment accounts similar to saving accounts without a predetermined rate. Other options are *Precious Metal Accounts*, including *Gold Account,* which is an indefinite term account opened to valorize accumulated savings as gold, and *Silver and Platinum Account*.

3. Data and Methodology

A. Data

The dataset we use in this paper comes from one of the leading Turkish banks headquartered in Istanbul that operates out of more than 300 branches in Turkey. Our original sample is a random and representative sample of the bank's customers and contains financial transaction data for more than 190,000 individuals of their checking accounts from January 2013 to December 2014. The data has a relatively complete coverage geographical and includes customers from all 81 provinces in Turkey. The representativeness is important to guarantee the generalization and external validity of the findings. To evaluate the general banked population, we plot the geographical distribution of the sample in Figure A1 Panel A and compare it with the province-level population distribution as of 2014 shown in Panel B. These plots visually present the evidence of comparability with the general population and support the representativeness of our data. At the disaggregated level, we

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invest its funds in particular assets. Profits are shared according to a previously agreed formula, but the investor bears all financial losses in respect of the assets.

observe the transaction-level financial records for each customer's withdrawal and point-of-sale

(POS) consumption, including the transaction amount, transaction time, automated teller machine

(ATM) location, and merchant category for POS spending. For each consumer, the dataset also

contains a comprehensive set of demographics including age, gender, marital status, nationality

(foreigner or not), location of living (domestic or not) and education.

The data provides several advantages. First, the transaction-level financial records enable

us to conduct a high-frequency test, which in itself is an advancement of the current empirical

studies relying on annual or bi-annual survey data, such as the Survey of Household Income and

Wealth in Italy or the Survey of Consumer Finances in US. Second, the administrative nature and

large size of the sample ensure reasonable statistical power and few measurement errors. Third, we

can observe the cash withdrawal transactions in addition to card spending, which allows us to

construct a more complete of the consumer's total consumption, particularly in such a cash-

oriented country[14].

We aggregate the daily financial transactions to filter out any seasonal pattern of spending

behavior within the month. Specifically, each consumer's total consumption is computed by

summing up his/her total daily withdrawal amount (proxy for cash spending) and point-of-sale

(POS) transaction amount (proxy for card spending) within a month. To alleviate the potential

concern of confounding effects due to other monetary policy announcements, we limit our sample

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[14] Despite the growing tendency to use alternative instruments in recent years all over the world, cash is still the dominant retail payment medium in Turkey. According to the estimate by the local news agency, *Anadolu Agency*, payment via cash constitutes more than 60 percent of all transactions in 2016. Another evidence that illustrates the dominance of cash is the share of cash in M1 as reported by the BIS report on payment in Turkey. Moreover, such cash payment habits tend to persist even when a Turkish migrate to less cash-oriented country. Using a unique diary survey, Kosse and Jansen (2013) shows that migrants with Turkish background are 13% more likely to use cash than the Dutch after migration to the Netherlands.

to the period of May 2013 to June 2014. Following Agarwal and Qian (2014), we exclude accounts that are closed or inactive (i.e., with no transactions) throughout the five months before the announcement of interest rate spike from our sample. For the purpose of conducting the subsequent difference-in-difference analysis and heterogeneity test, we utilize the first three months (May 2013 to July 2013) in our data to identify consumer's pre-treatment demographic and credit characteristics. We also use the observed card spending during the Ramadan month in 2013 to identify our treatment and control group for our difference-in-difference regression analysis. To achieve a cleaner identification, we remove these three months from our sample. Therefore, the final sample in our analysis ranges from August 2013 to June 2014.

B. Empirical Methodology

Identifying the Treatment and Control. The main analysis in this paper studies the consumption response to the tight interest rate shock. To identify the treated/untreated consumers, we exploit the consumer's adherence to a particular Muslim rule - accruing interest is forbidden - to identify the rate-sensitive(treatment) and rate-nonsensitive(control) consumers. Consumers with strong adherence to the Muslim religion are expected to exhibit little sensitivity to the unanticipated positive interest rate shock; these consumers serve as a valid control group. On the other hand, consumers with weak adherence to the Muslim religion are expected to exhibit larger sensitivity to the interest rate shock; these consumers constitute the treatment group.

Religion adherence is not an observable characteristics in the data. Instead, we rely on the Islamic holy month of *Ramadan* and observe information about a consumer's adherence to the required fasting during specific times of the day. As one of the Five Pillars of Islam, *Ramadan* fasting is very prominent and its observance is understood to be obligated for all billion-plus Muslims. This religious practice has a well-defined rule, requiring that Muslims shall abstain from

food, drink, as well as smoking and sexual activities between dawn and sunset during the entire month. The daily routine of *Ramadan* involves a pre-dawn breakfast (*suhoor*), a fast-breaking meal at sunset (*iftar*), and a supererogatory late night prayer which is often performed with the congregation (*taraweeh*) (Demiroglu et al.,2018)[15].

To identify the sunrise and sunset time, we collect the data from the *Astronomical Applications Department of the U.S. Naval Observations*, which provides sunrise and sunset time for any geographic coordinate on earth at any given day in the Gregorian calendar.[16] Islamic Philosophy Online provides the data on the Islamic calendar, which enables us to map the Ramadan dates in 2013 to the Gregorian calendar. Therefore, we can determine whether or not each spending is transacted during the *Ramadan* fasting hours. If a consumer spends in the category of dining, bar and casino during the fasting hours in 2013, then s/he does not adhere to the prohibited spending during the fasting hours in Ramadan month (i.e., exhibits weak adherence of the Muslim rule) and s/he is in our treatment group. Otherwise, the consumer exhibits strong adherence of the Muslim rule and falls into our control group.

Propensity Score Matching To ensure that the control group constitutes a valid counterfactual in terms of their consumption behavior after the announcement, we rely on the propensity score matching approach to construct a matched sample of treated and control customers. Specifically, we first estimate a logistic regression using a set of demographic factors including consumer's wealth (proxied by his/her ex-ante account balance over May 2013 to July 2013), age, gender, marital status, nationality (foreigner or native), location of residence (domestic or not),

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[15] Ramadan observance and its effects on a wider set of individual and economic conditions are well documented in the literature (i.e. Campante and Yanagizawa-Drott, 2015)

[16] For simplicity, we use the capital of Turkey, Ankara, as the coordinates of interest. Results are similar if we instead use the capital of each province.

education and residing region (see Table A1 in the online Appendix for the logistic regression result). Based on the propensity scores computed in the logistic model, we select the matched control group using the nearest-neighbor algorithm without replacement. We conduct pairwise comparisons between the treatment and the control groups before and after the matching processes in Table 1 Panel A. As can be seen, differences in demographics between the treatment and control group is economically small and statistically insignificant in the post-matching sample.

The similarity in the two groups after matching is not only visible in means but also for the entire distribution. For instance, we plot the kernel density of age and wealth for the treated and control in the matched sample (Figure A2). As can be observed, there is no visible difference in the distribution of these two characteristics between the matched treatment and control groups. The matching approach allows us to exclude the potential confounding factors that could influence consumption decision. More importantly for our identification, as we will show in Section 4.B. , there are no visible pretrends in this difference. Thus, we have a sample of comparable treatment and control group to identify the consumption response to the unanticipated interest rate shock using our difference-in-difference regression analysis[17].

Table 1 Panel B shows the consumption behavior between rate-sensitive(treatment) and rate-nonsensitive(control) customers. On average, the total consumption of treatment and control group is comparable: the average monthly total spending is about 1,852 and 1,835 lira (equivalent to US$874 and US$865 using the exchange rate, USD/TRY = 2.12, reported as of the middle point of our sample period, December 31, 2013) for the matched sample of rate-sensitive(treatment) and

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[17] One might worry about the size of matched sample and thus the estimated effects may not be representative of a greater population. We conduct two externality validity tests using the full sample as well as an alternative credit card spending in Section 6.C.

rate-nonsensitive(control) customers. Decomposing the total spending based on payment instruments, we observe customers in treatment group are more likely to have card spending while rate-nonsensitive customers prefer cash payment.

Difference-in-Difference Design We analyze the consumption response using a difference-in-difference (DID) regression methodology. The treatment group is represented by consumers with low adherence to the Muslim religion and the control group is represented by consumers with strong adherence to the Muslim religion. The specification is as follows

$$Y_{i,t} = \beta_{post} * D(Treat) * D(Post) + \gamma_i + \mu_t + \varepsilon_{i,t} \qquad (1)$$

$$Y_{i,t} = \beta_{pre} * D(Treat) * D(Pre) + \beta_{post} * D(Treat) * D(Post) + \gamma_i + \mu_t + \varepsilon_{i,t} \qquad (2)$$

$D(Treat)$ is the indicator for the treatment group. $D(Pre)$ and $D(Post)$ are indicator variables equal to 1 for the pretreatment (2013:09-2013:12) and post-treatment (2014:01-2014:06) period, respectively. μ_t is the year-month dummy to control for the seasonal variation in the consumption or other time-varying aggregate factors. β_{post} captures the average monthly consumption response relative to the benchmark period (2013:08-2013:12 in Equation (1) and 2013:08 in Equation (2)) and relative to the post-policy change of the control group. β_{pre} reflects the difference in consumption between the treatment and control group during the four months before the announcement, relative to 2013:08. Equation (2) implements a test of the validity of our difference-in-difference design, which requires β_{pre} to be statistically and economically insignificant from zero.

Following Agarwal and Qian (2014), we run the following distributed lag model to study the dynamics of the response:

$$Y_{i,t} = \sum_{m=-4}^{5} \beta_m * D(Treat) * D(month\ m) + \gamma_i + \mu_t + \varepsilon_{i,t} \qquad (3)$$

The coefficient β_0 captures the immediate response during the announcement month. The

coefficients $\beta_1 ... \beta_5$ measure the additional response in the following one, two, three, four and five

months after the announcement, respectively. The coefficients $\beta_{-4}, ..., \beta_{-1}$ can be interpreted as the

difference in consumption response between the treatment and control group during the pre-

announcement period. Summing up the coefficients to month k can yield the cumulative response

from month -4 up to month k.

We also examine the heterogeneity response across different groups of consumers,

including liquidity constraint and age by estimating the following specification:

$$Y_{i,t} = \sum_{m=-4}^{5} \beta_m * D(Treat) * D(month\ m) + \sum_{m=-4}^{5} \beta_{c1,m} * D(Treat, c1) * D(month\ m) + \cdots$$

$$+ \sum_{m=-4}^{5} \beta_{c(N-1),m} * D(Treat, c(N-1)) * D(month\ m) + \gamma_i + \mu_t$$

$$+ \varepsilon_{i,t} \qquad (4)$$

where N is the number of subgroups of consumers, which include group 1 denoted by c1,…and

group N-1 denoted by c(N-1). The N-th group is absorbed in the regression.

4. Main Results

We start our formal analysis by first estimating the average response consumption response via a

difference-in-difference approach. To sharpen our analysis, we then nalyze the dynamics with a

distributed lag model and study response heterogeneity across different payment methods: cash vs

card. To ensure the comparability of the treatment and control group, we focus on behaviors of

consumers of the matched sample in the main analysis, and include the full sample analysis as the

external validity check.

A.The Average Consumption Response

Column (1) of Table 2 shows the average response after applying Equation (1) to total consumption.

The coefficients on the interaction term of *D(Post)* and *D(rate-sensitive)* indicates that rate-sensitive

customers (consumers in the treatment group who do not adhere to the Ramadan fasting) on

average reduced their monthly consumption by 159 lira during the six-month period after the policy

shock. The effect is both statistically and economically significant. Based on the average monthly

consumption for the treated group in the matched sample (1,852 lira as reported in Table 1 Panel

B), the response corresponds to a 8.58 percent decrease in consumption.

As a validation of our research design, we interact the pre-policy shock period dummy *D(Pre)*

with the treatment group indicator *D(rate-sensitive)* in Column (2) and find that the coefficients β_{pre}

is negative at -9 lira, which is small and statistically insignificant[18]. Collectively, this set of result

validate our empirical strategy : there are no significant differences in spending trends between the

matched treatment and control group during pre-policy period, and the consumption response for

the treatment group declined only after the announcement of unanticipated massive interest rate

hike.

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[18] To ensure the documented response reflects the shadow cost of deposit rather than some demographic factors, in Table 5 we also allows the impact of interest rate shock to vary with demographics by interacting the post-even dummy, *D(Post),* with demographical variables. The results are qualitatively and quantitatively similar as those reported in Table 2, which further corroborates our approach.

B. Dynamics of the Consumption Response

To obtain a better understanding of the evolution of the response, in this section we study the dynamic pattern before and after the CRBT announcement. Specifically, we estimating the distributed lag model in Equation (3) and present the regression result in Column (3) and (4) of Table 2. The regression includes a set of interaction terms between the dummy for the treatment group *D(rate-sensitive)* and the event month indicators *D (month s)*. The specification aims to contrast the differential total spending behavior between the treatment and control within a given month around the announcement.

Our finding are summarized as follows. First, we show no divergence in consumption between the treatment and control group during four months prior to the announcement: differences in consumption response are both economically and statistically insignificant. This lends further support to the parallel trend assumption required for the D-i-D approach to be valid. Second, we confirm the average effect in Section 4.A. and the differential response of consumption becomes significant following the onset of the announcement. As suggested by the estimate in Column (4), individuals in the treatment group reduce their total spending by 185 lira as compared to the control group in the first month after the shock. Third, the differential effect is persistent and there is no reverse of the trend. In the fourth month after the announcement month (May 2014), the decline in overall consumption remain significant at 167 lira (about 9.01 percent of the sample average)[19].

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[19] We also plot the entire path of cumulative estimated coefficients, for k = -4,…-1, 0, 1,…5 months away from the unanticipated interest rate policy shock, in Figure A3. The dotted line represents the corresponding 90 percent confidence intervals. Again, we observe a strong and consistent response of spending as reported in Table 2. Differences in the cumulative consumption response are insignificant prior to the announcement. However, differences in total consumption are substantially larger after the unanticipated interest rate shock announcement and persist further in the subsequent months..

C. Anatomy of the Consumption Response

While we sofar examine spending in the aggregate level, the consumption dynamics could exhibit heterogeneity when customers pay with different instruments (i.e. cash vs card). For example, experimental studies suggest that, compared to the usage of cash, card usually become spending facilitating stimuli. The role of boosting spending is likely due to the lower level of vividness which individuals can feel outflow of money. So in this section we decompose the documented consumption response into cash and card spending separately.

Panel A of Table 3 reports the estimated average consumption response when we decompose total consumption into cash and card spending. We observe evidence of strong response to the interest rate shock for both cash and card spending. The decrease in cash spending is higher than that for card spending in the magnitude: cash spending of the rate-sensitive customers decreases by 118 lira per month on average after announcement while the reduction of card spending is 40 lira per month. The conclusion is different when we interpret the response relative to the sample average: the treated custmers reduce their cash and card spending by 7.61% and 13.33 % in response to the announcement respectively. As indicated by the coefficients β_{pre}, there is no difference in the cash/card spending trend between the matched treatment and control group during pre-policy period.

5. Evaluting the Transmission Channels

We have documented that rate-sensitive and rate-nonsensitive customers exhibit significant heterogeneity in consumption response to the tight interest rate shock. In this section, we provide further evidence to support the deposit channel by formulating a estimation of total monetary amount that customers allocate out of the checking account in their "reach-for-yield" effort and

assess other channels that may drive the heterogeneous response we document. For instance, the stronger consumption response by rate-senstitive customers may be simply driven by their high level of debt service obligations, which is in support of the "debt service channel". Alternatively, the heterogenous response might reflect the difference in their exposure to macroeconomic environment. Tow notable examples are inflation and exchange rate. Last, the finding could also be due to differences in demographics that lead to heterogenous movement in earnings. Our evidence indicates that the heterogenous response we document in Part 4 is unlikely to be fully driven by any of these alternative mechanisms.

A. Deposit Channel: Estimating the Total Outflow

Our main analysis shows evidence of consumers' response to the unforetold interest rate policy shock by reducing their cash and card spending. In this section, we gauge the impact in aggregate monetary terms by inferring the total amount that the customer moves out of the account in pursuit of higher-yield product due to the massive increase in interest rate because the checking account does not accure interest rate return. The spirit of our estimation method is as follows.

Suppose for month t and consumer i, the begining and ending balance are denoted as $BB_{i,t}$ and $EB_{i,t}$, the withdrawal (cash spending) and point-of-sale (card spending) amount are $C_{i,t}$ and $POS_{i,t}$, the accounting identities related to (net) outward transfer amount, $OT_{i,t}$, can be expressed by

$$OT_{i,t} = BB_{i,t} - EB_{i,t} - C_{i,t} - POS_{i,t} = \Delta B_{i,t} - C_{i,t} - POS_{i,t} \quad (5)$$

As cash and card spending response is estimated in Panel A of Table 3, estimating the impact on $OT_{i,t}$ pins down to getting an estimate of average response of $\Delta B_{i,t}$. We cannot observe account balance on each day of month t but only on days when at least one transaction of withdrawal and

point-of-sale occurs. To obtain a reasonable estimate of $BB_{i,t}$ (and $EB_{i,t}$, which equals $BB_{i,t+1}$), we adopt two methods here: (1) *Simple Average*: We first obtain the balance on the last day we can observe at month t-1 ($B\_Last_{i,t-1}$) and the balance on the first day we can observe at month t($B\_First_{i,t}$) and then take a simple average of the two as $BB_{i,t}$; (2) *Linear Interpolating*: Instead of taking average, we assume rate of balance change per day between $B\_Last_{i,t-1}$ and $B\_First_{i,t}$ is constant and compute $BB_{i,t}$ as the linearly-interpolated value.

We follow the dif-in-dif approach in Equation(1) to estimate the response of account balance change constructed from the above two methods. As suggested in Panel B of Table 3, the response of $\Delta B_{i,t}$ by the treatment group are positive and significant (ranging from 102 to 136 lira) under both methods, relative to the control group during the post-announcement period. Summing up the estimates of cash spending, consumption and account balance change response using Equation (5), we can say that, in response to the massive interest rate increase, the amount of money flowing out of the account ranges from 260 to 294 lira. Given that the average balance is 2,553 lira., the treated consumers are moving around 10.2 to 11.5 percent of the account balance out in response to the monetary policy shock.

The amount of remittance (to alternative return-bearing accounts) is unlikely to be used for consumption because, as we discuss in Section 2.A., these investment-type accounts typically don't offer free access to one's money. In addition, we further attenuate the concern by providing a descriptive illustration of dynamics of market share for various financial instruments in Turkey. Figure A4 plots the pie chart breakdown of market share across financial instruments before and after the announcement. We can see a decrease in the market share of current account (non-interest-bearing): compared to the month right before the policy shock, the share drops by 1% (6% in relative terms) in the month afterwards. These observations here lend additional support to the

empirical finding we document at the account level in the paper.

B. Interest Payment Cash Flow Channel

The rise in interest rate can automatically increase the debt payment and lower the disposal income of households with loans linked with adjustable rate, thus leading to postponement in consumption. If rate-sensitive customers at the same time hold higher level of debt obligations on their balance sheet, the reduction in current spending might rationalize the heterogeneity we document in Part 4. While the dataset does not contain information on the consumer's leverage position, we argue the explanation is unlikely at least for the following two reasons. First, the validity of our empirical strategy to identify the rate-non-sensitive customers hinges on the assumption that consumers in our control group (those with strong adherence to Muslim rules) view the action of earning interest out of the money as sins. There is no compelling evidence to support that they are also doing so in term of taking out loans, as argued by the "*Interest Payment Cash Flow Channel*". Second, we conduct two tests to disprove the interest payment hypothesis. Specifically, we exploit the heterogeneity of consumption response across customers with two relevant characteristics, liquidity constraint, and age.

Liquidity Constraint - Customers with higher level of debt are more likely to hold relatively fewer liquidity assets because they would run down on their non-interest bearing liquid assets to pay off the expensive borrowing cost. If the "*Interest Payment Cash Flow Channel*" is driving our results, we would expect the spending response to be concentrated among low-balance (or highly-leveraged) customers. We use account balance to measure the extent to which customers face liquidity constraints since consumers with high account balance are more likely to be less liquidity constrained. Specifically, we classify each consumer into the group of having high (low) liquid assets if his/her average monthly checking account balance over the three months prior to our

sample period is above (below) the median of the empirical distribution. As reported in Table 4 Panel A, consumption response between the liquidity constrained and liquidity unconstrained consumers exhibit opposite patterns with what would be predicted by "Interest Payment Cash Flow Channel". High balance consumers (consumers that are unlikely to hold much debt) respond strongly to the unanticipated interest rate shock by reducing their cumulative spending by about 842 lira after two months and about 1,644 lira after five months following the unanticipated interest rate policy shock. This response is statistically an economically significant. In contrast, there is an economically small and statistically insignificant decrease in total consumption among low-balance consumers following the unanticipated interest rate shock.

Life Cycle The data also allows us to do an indirect test for "debt service channel" by comparing the young and older consumers given that youngesters are disproportionately likely to be leveraged with debt (Jappelli, 1990). Under "debt service channel", we expect young consumers would exhibit a much stronger spending response following the unanticipated interest rate shock. We define young (old) consumers as those whose age is below (above) than the median age of the sample. As shown in Table 4 Panel B, we find instead older consumers show stronger responses and reduce their cumulative spending by 683/1,218 lira during the subsequent two/five months after the unanticipated policy announcement. By contrast, for young consumers, the point estimates suggest a both economically and statistically smaller magnitude of decline in total spending. Overall, the results suggest that the heterogeneous response to the unanticipated interest shock documented in the main analysis is not primarily attributable to the "*Interest Payment Cash Flow Channel*".

C. Exposure to Inflation and Currency Rate

Another concern is that reduction in consumption is not driven by interest rate shock but changes in inflation (or expectation) (i.e. Coibion et al., 2019). We argue that increasing interest rate is to combat inflation rather than to create inflation. More importantly, the effect of inflation should affect both our treatment and control group and thus cannot explain the D-i-D result. We include a plot of monthly CPI inflation during our sample period in Figure A5 and do not observe a significant difference in the inflation level before and after the announcement.

Second, the sharp interest rate movement may be either the response or leading factor and thus associated with movement in other asset prices. The most obvious example would be exchange rate as the price levels in emerging market economics are more sensitive to fluctuations in the exchange rate (i.e. Calvo and Reinhart, 2002). Thus, an alternative story that may rationalize the difference-in-difference result is that individuals with lower level of adherence to the Muslim rule (the treatment group) are more likely to be employed in the tradable sector and might react differently to the interest shock, not because of the increased shadow cost but rather because of the movement in the exchange rate[20]. To ensure the change in consumption we document truly reflect the results of interest rate increase, we interact both the inflation rate and the exchange rate of Turkey lira to US dollars with the treatment indicator and re-estimate our main specifications. As shown in Column 1 of Table 5, the result are again both qualitatively and quantitatively unchanged[21].

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[20] Here we refer tradable sectors as industries whose output, in terms of goods and services, are internationally traded. Prior literature has shown that industries with substantial cross-border exposure are particularly sensitive to exchange rate regimes and currency volatility (Broz, Frieden and Weymouth, 2008).

[21] Results are similar when we include the interaction with inflation rate and the exchange rate separately.

D. Heterogeneity in Demographics

The finding could also be due to differences in demographics that lead to heterogeneous sensitivity of household income to macroeconomic conditions. The statistics in Table 1 and the density plot in Figure A2 assures us that the matched sample of rate-sensitive (treatment) and rate-nonsensitive (control) are observationally similar not only in means but also for the entire distribution. To further mitigate the concerns about demographic imbalance, we also allow the impact of interest rate shock to vary with demographics by interacting with the post-even dummy, *D(Post)*, with demographical variables in Column (2) of Table 5. The results are qualitatively and quantitatively similar as those reported in Table 2.

6. Robustness Tests and Further Results

A. Consumption Response and Spending Category

The extant literature has documented response heterogeneity in different spending categories to income shock (i.e. Johnson, Parker, and Souleles, 2006; Parker et al., 2013; Leininger, Levy, and Schanzenbach, 2010; Baker, 2018; Aydin,2018). We further investigate the nature of consumption response by decomposing the card spending into two categories: durable versus non-durable goods and service, as defined in the Consumer Expenditure Survey. Durable goods include apparel, electronics, computers, appliances, and home or office furnishing. The estimates are presented in Table A3 Panel A. We find that the non-durable category spending respond strongly to the unanticipated interest rate shock, while response in their spending on durable goods is relatively small.

We also decompose the card spending in discretionary versus non-discretionary categories following prior literature (i.e. Agarwal and Qian, 2017). The discretionary spending includes

spending on apparel, entertainment, travel, dining, automotive-related expenses, furnishing and appliances, and personal services, while non-discretionary spending comprises spending on groceries, utilities, insurance, and government-related expenses. Table A3 Panel B shows the results : treated consumers are more likely to cut spending on discretionary items, rather than non-discretionary goods, in response to the policy shock.

B. Alternative Control Sample

One concern with our transaction-based selection procedure of rate-sensitive and rate-nonsensitive consumers is that it may confound consumers who do not consume forbidden categories during Ramadan month with those who never use a debit card to pay for these products. While misidentifying rate-sensitive consumers as rate-insensitive tend to bias against finding significant estimates, we attempt to account for such error and try an alternative selective approach[22]. That is, we require the control group to be those consumers that do not spend on forbidden categories during daytime at Ramadan but do have at least one transaction during daytime in non-Ramadan months. Doing so can help ensure the selection procedure is making a cleaner comparison of treatment and control instead of picking up variations in consumer's other spending attributes. We re-estimate the average consumption response using this newly matched sample (The matched treatment and control groups are quite comparable as evidenced in Table A2). In Column 3 and 4 of Table 5, We observe that our baseline results are robust when we match with this alternative control group.

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[22] We thank two anonymous reviewers for this constructive suggestion.

C. Full Sample Analysis and External Validity

Full Sample Analysis - Our main analysis focus on the matched sample in which the treatment and control group are similar in terms of demographic variables. We now extend the same analysis to the full sample in order to ensure the generalizability of our findings. We repeat the analysis on the unmatched sample and report the baseline estimation of consumption response in Table A4. Here we find that the estimate of response to the unanticipated interest rate shock are qualitatively comparable. For example, column 3 indicates that cash spending response of the treatment group (non-adherent to the Muslim religion) reduce their cash spending by 138 lira per month (about 158 lira for the matched sample) during the six-month period after announcement, relative to the control group. The effect is both statistically and economically significant. Taken together, our main results are robust to the external validity, and can thus be generalized to a larger sample.

Estimate from an Alternative Credit Card Spending Sample - As an alternative validity check, we obtain a sample of monthly credit card spending for customers within the same bank from January 2010 to August 2012[23]. The dataset contains information on monthly credit card spending, and a rich set of consumer characteristics, including card limit, number of cards owned, initial credit card approval date and demographics (i.e. age, gender, education, marital status, address). We remove all inactive credit card users exclude accounts that were opened during our sample. The final sample includes more than 2 million observations.

We examine one monetary policy shock during the sample period, in which the central bank raises the policy rate dramatically in two consequent moves: the overnight borrowing rate from 1.5 to 5 percent on August 5th and lending rate from 9 to 12.5 percent on October 21st in 2011(Please

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[23] The anonymity nature of the data does not allow us to link with customers in our main analysis.

refer to Panel A of Figure A6). One caveat is that the setting is less ideal as one examined in the

main analysis as the interest rate increase comes with fewer magnitude and announced in two

consequent timepoints. To obtain a cleaner estimate and facilitate comparison with our main

finding, we attempt to integrate the two announcements as one shock by defining the *pre-period*

as six months before August 5th and *post-period* as six months after October 21st and excluding

months inbetween (August, September and October, 2011). The effectiveness of interest rate shock

is evidenced by the rise of deposit interest rate for all terms in Panel B of Table A5, in particular

when we compare the rates during *pre-* and *post-period*.

We apply a similar difference-in-difference strategy to measure the impact on household

credit card spending. Again, we compare those who are affected by the policy (rate-sensitive) to

those who are not affected (rate-nonsensitive), before and after the policy change. Specifically, we

exploit the cross-sectional variation in customer's spending on dining and entertainment (i.e. club,

cinema, theatre, etc.) during the Ramadan month (August) of 2011[24]. We perform the propensity

score matching based on consumer's income (proxied by credit limit) as well as demographics

information including age, gender, education, marital status, address and construct a matched

sample of treated and control that are observationally similar.

Table A5 shows the average consumption response estimated based on Equations (1). The

coefficients on the interaction term of *D(Post)* and *D(rate-sensitive)* in Column 2 suggests that

treated consumers respond strongly to the policy by decreasing their consumption through credit

card spending. To alleviate the potential concern that our estimates are likely contaminated by

including spending on dining and entertainment into total spending, we focus on credit card

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[24] In 2011, Ramadan begins on Monday, the 1st of August and ends 30 days later on Tuesday, the
30th of August.

spending exclusive of dining, entertainment and find the effect is even stronger : relative to control group in the matched sample, rate-sensitive customers (consumers in the treatment group who do not adhere to the Ramadan fasting) on average reduced their monthly credit card spending by 49 lira during the six-month period after the policy shock. The response corresponds to a 7.11 percent decrease in consumption based on the sample average monthly credit card spending (689 lira). As in Section 5.B., to ensure our approach to define treated vs control does not pick up variation in other spending attributes, we restrict the control group to be those consumers that have at least one transaction on the designated categories at non-Ramadan month and re-construct matched sample for estimation. The result is presented in Panel B and we observe a qualitatively and quantitatively similar effect.

D. Robustness

We perform additional tests to verify the robustness of our results. First, to address the the "infra-marginality" problem that average consumption response may be driven by extreme values (Angew and Fang, 2006), we, for each consumer in the treatment group, adjust his/her consumption based on the matched peer and plot the distribution of the adjusted consumption response. Second, we conduct our tests using alternative specifications, including using the Ramadan month in both 2013 and 2014 to identify the treated/control and number of purchase to measure consumption. Third, we verify the robustness of our statistical inference, namely consistency of standard errors, and follow Bertrand, Duflo and Mullainathan (2004) to collapse the time series of outcome variables into "before the announcement" and "after the announcement" period. Fourth, we investigate whether our results are robust to the potential exposure of the religious (rate-insensitive) consumers to firm profits. Last, we perform a falsification test to further examine the robustness. We leave the detailed discussion to the online appendix and our main findings remain the same throughout

these robustness checks.

E. Estimating the Elasticity of Intertemporal Substitution

The elasticity of intertemporal substitution (EIS) is a parameter of central important in macroeconomics and a key input into theoretical models[25]. The EIS has been estimated by hundreds of researchers and the value is often found to be very small. For instance, using U.S. data on aggregate consumption and interest rates, Hall (1988) finds estimates of σ are close to zero and sometimes even negative. Researchers typically follow Hall(1988) (Equation (1)) and apply the log-linearized consumption Euler equation for the estimation of the EIS:

$$\Delta log c_{t+1} = k + \sigma log R_t \ (6)$$

Where $\Delta log c_{t+1}$ stands for expected change in log of consumption (or consumption growth) at time $t+1$, $log R_t$ is the expected real return (in our case is expected real interest rate) and k is assumed to a constant that does not change significantly over time.

One major empirical challenge is the endogeneity problem that the time-series movement in interest rates and consumption growth are jointly determined in the capital market equilibrium. The literature attempts to resolve the problem using lagged values of interest rates and consumption growth as instruments. We take a complementary perspective by looking at the cross-sectional variation in interest rates and adopt a difference-in-difference version, in a similar way to Table A7, to estimate σ. We follow Hall (1988) and Attanasio and Weber (1995) to focus on nondurable consumption, as the data allows us to precisely identify nondurable spending, and measure the expected real interest rate as deposit interest rate over different terms (1-month, 3-month, 6-month and 12-month) in Panel B of Figure 1, after adjusting for inflation. Specifically, we are relating

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[25] The EIS is a key parameter in the basic model of monetary policy (Woodford, 2003).

difference in average monthly changes in consumption(logarithm) between the pre- and post-

period on the change in the average real interest rate (logarithm) for the treated and control.

$$\Delta log c_{i,post} - \Delta log c_{i,pre} = \sigma \Delta log R_{i,post-pre} + \varepsilon_i \ (7)$$

In Table IA11, we present the estimates of σ from the above difference-in-difference specification

with interest rate for different horizons. The result indicates that the point estimate of the elasticity

is positive, ranging from 0.075 to 0.147. However, the estimate is statistically insinigicant because

of large standard errors and thus not rendering support for a conclusively positive value of σ. The

findings are in line with the conclusion in Hall (1988)[26].

7. Conclusions

In this paper, we examine the impact of interest rate shock on household consumption from

the saver/depositor's perspective and provide evidence for a new transmission channel: the deposit

channel. When the central bank raises interest rates, commercial bank deposits pay too little to

depositors due to their market power (Drechsler, Savov, and Schnabl 2017; Xiao 2018). This leads

rate-sensitive customers to switch from highly liquid asset (cash or checking account balance) to

higher-yield product and thus reduce current consumption. To identify the rate-sensitive (treatment)

and rate-nonsensitive (control) customers, we exploit cross-sectional variation in a consumer's

adherence to one Muslim rule that forbids accruing interest rate. Using an administrative panel

transaction-level dataset in Turkey, we document a negative consumption response to the policy

shock. Such difference in spending does not exist prior to the announcement and persists

throughout post-announcement months. The consumption response existis in both cash and card

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[26] The overall conclusion in Hall(1988) is "the value may even be zero and is probably not above
0.2".

spending, and is primarily driven by non-durable and discretionary spending. Our analysis indicates that consumers are moving around 10.2 to 11.5 percent of the account balance out (potentially in pursuit of high yield) in response to the interest rate shock.

We also assess alternative channels that may account for the above finding and show that the heterogeneous consumption response is not driven by the response of interest payment, exposure to inflation expectation and exchange rate, or demorgraphic imbalance. Building on recent literature showing market power of commercial banks in deposit markets leads to deposit outflow and credit supply reduction under monetary tightening, this paper focuses on the household perspective and highlights the role of depositor's "reaching-for-yield" behavior in influencing their day-to-day consumption decision. Our results of deposit channel have important implications for the role of monetary policy formulation: monetary policy-induced interest rate changes can have a larger magniutude of impact on real economic activity, in particular household consumption than conventional estimates.

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Table 1: Summary Statistics

This table presents the summary statistics of the matched treatment and control sample. The treatment group consists of rate-sensitive individuals (with low level of adherence to Muslim religion) while the control sample includes rate-non-sensitive individuals (with higher level of adherence of the Muslim religion). Panel A shows the comparison of demographics, including age, male, marital status, education, citizenship and wealth between the treatment and control groups. Panel B displays the comparison of total consumption, cash and card spending between the matched treatment and control groups in the full sample period (2013:08-2014:06). Cash spending is computed by summing up withdrawals for each customer in a given month. Card spending is the total point-of-sale spending for each customer in a given month. All the amounts are in the local currency (lira) and 1 lira = 0.45 USD as of January 2014.

	(1)	(2)	(3)	(4)	(5)
	Panel A Comparison of Demographics				
	Treatment group		Control Group		Difference
	Mean	SD	Mean	SD	(T - C)
Age	43.362	6.687	43.425	7.101	-0.063
Male	0.744	0.436	0.751	0.432	-0.007
Married	0.826	0.379	0.825	0.380	0.001
DomesticResidence	0.992	0.091	0.993	0.081	-0.001
Native	0.973	0.162	0.972	0.164	0.001
Education	0.239	0.427	0.255	0.436	-0.016*
Wealth	2906.77	6724.29	2810.27	6665.55	96.5
N	4422		4422		
	Panel B Comparison of Consumption				
	Treatment group		Control Group		Difference
	Mean	SD	Mean	SD	(T - C)
Total Consumption	1852.03	2237.15	1835.85	2263.33	16.18
Cash Spending	1551.67	2046.86	1775.90	2234.55	-224.23***
Card Spending	300.36	567.67	59.95	274.29	240.41***

Table 2: The Average Response of Consumption to Interest Rate Shock

Column 1 and 2 presents estimates of the average consumption response, based on Equation 3 and 4, to the unanticipated interest rate rise for the matched sample during the period of 2013:08-2014:06. Column 3 and 4 reports dynamics of consumption response based on Equation 5. The beginning month 2013:08 is absorbed. *D (pre)* is a dummy variable that equals to one for four months before the policy announcement (2013:09-2013:12). *D(post)* is a binary variable that equals to one for months after the announcement of the interest rate rise (2014:01-2014:06). *D(rate-sensitive)* represents the treatment group. Customer fixed effects are included for all specifications except for Column 3 and year-month fixed effects are included in all specifications. Standard errors are clustered at the customer-year-month level. T-statistics are reported in parentheses under the coefficient estimate. *, **, *** denotes significance at the 10%, 5%, and 1% levels, respectively.

VARIABLES	Dependent Variable = Total Consumption			
	(1)	(2)	(3)	(4)
	Difference-in-Difference		Dynamics	
D(rate-sensitive)*D(pre)		-9.985		
		(-0.20)		
D(rate-sensitive)*D(post)	-158.604***	-166.583***		
	(-5.39)	(-3.33)		
D(rate-sensitive)*D(month=-4)			-13.623	15.754
			(-0.18)	(0.25)
D(rate-sensitive)*D(month=-3)			-12.395	-9.677
			(-0.16)	(-0.15)
D(rate-sensitive)*D(month=-2)			-7.202	-29.322
			(-0.09)	(-0.49)
D(rate-sensitive)*D(month=-1)			-5.850	-20.382
			(-0.08)	(-0.34)
D(rate-sensitive)*D(month=0)			-184.998**	-173.636***
			(-2.34)	(-2.72)
D(rate-sensitive)*D(month=1)			-195.944**	-185.868***
			(-2.46)	(-2.85)
D(rate-sensitive)*D(month=2)			-171.571**	-160.023**
			(-2.13)	(-2.40)
D(rate-sensitive)*D(month=3)			-158.289*	-152.276**
			(-1.90)	(-2.22)
D(rate-sensitive)*D(month=4)			-149.413*	-167.414**
			(-1.78)	(-2.45)
D(rate-sensitive)*D(month=5)			-124.219	-159.968**
			(-1.44)	(-2.23)
Constant	1,945.314***	1,945.339***	1,643.128***	1,945.364***
	(87.17)	(87.16)	(8.93)	(87.15)
Year-month Fixed Effects	YES	YES	YES	YES
Customer Fixed-Effects	YES	YES	NO	YES
Demographics Controls	NO	NO	YES	NO
Observations	66,353	66,353	66,353	66,353
R-squared	0.47	0.47	0.02	0.47

Table 3: Response of Cash, Card Spending and Account Balance Change

Panel A of this table decompose the response of total consumption into cash and card spending and shows estimates of Equation 1 and 2. Cash spending is computed by summing up withdrawals for each customer in a given month, while Card spending is the total point-of-sale spending for each customer in a given month. Panel B present estimates of the account balance change response in each month t. The depdent variable, account balance change, is the difference between month-beginning and month-end balance (begning minus ending) during this month. To obtain a reasonable estimate of the month-beginning and month-end balance, both methods of linear interpolating and simple average are used. *D (pre)* is a dummy variable that equals to one for the four months before the announcement (2013:09-2013:12). *D(post)* is a binary variable that equals to one for the months after the announcement of the interest rate rise (2014:01-2014:06). *D(rate-sensitive)* represents the treatment group. Customer and year-month fixed effects are included for all specifications. Standard errors are clustered at the customer-year-month level. *T*-statistics are reported in parentheses under the coefficient estimate. *, **, *** denotes significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)
Panel A Response of Cash vs Card Spending				
	Cash Spending		*Card Spending*	
D(rate-sensitive)*D(post)	-118.620***	-116.471**	-39.984***	-50.112***
	(-4.16)	(-2.41)	(-7.31)	(-5.22)
D(rate-sensitive)*D(pre)		2.690		-12.675
		(0.06)		(-1.34)
Constant	1,739.145***	1,739.138***	206.169***	206.201***
	(81.16)	(81.17)	(45.25)	(45.15)
Year-month Fixed Effects	YES	YES	YES	YES
Customer Fixed-Effects	YES	YES	YES	YES
Observations	66,353	66,353	66,353	66,353
R-squared	0.46	0.46	0.54	0.54
Panel B Response of Account Balance Change				
	Linear Interpolate		*Simple Average*	
D(rate-sensitive)*D(post)	136.137***	148.351**	102.537***	140.056**
	(3.33)	(2.28)	(2.76)	(2.31)
D(rate-sensitive)*D(pre)		15.374		47.224
		(0.24)		(0.79)
Constant	-85.409***	-85.359***	-74.236***	-74.082***
	(-3.01)	(-3.01)	(-2.77)	(-2.77)
Year-month Fixed Effects	YES	YES	YES	YES
Customer Fixed-Effects	YES	YES	YES	YES
Observations	66,353	66,353	66,353	66,353
R-squared	0.08	0.08	0.08	0.08

Table 4: Heterogeneity in the Consumption Response

This table presents estimates of heterogeneity in the consumption response. Specifically, we show the long and short-run cumulative response upon announcement, , which represents 2 and 5 months after the announcement of interest rate policy shock, across the sample account holders with different account balance and age. The analysis is based on the matched sample of treatment and controls during the period of 2013:08-2014:06 and reported in this table are the estimated coefficients following the specification in Equation 4. Panel A compares consumption responses of consumers who have low account balance to those consumers with high bank account balance. High/low-balance consumer is defined based on the median account balance value of the sample. Panel B compares among younger versus older consumers based on the median age of the sample. Customer and year-month fixed effects are included. Standard errors are clustered at the customer-year-month level. *, **, *** denotes significance at the 10%, 5% , and 1% levels, respectively.

	(1)	(2)	(3)	(4)
	2 months		5 months	
	Coefficient	Standard Error	Coefficient	Standard Error
Panel A Balance				
High Balance	-842.482***	238.180	-1644.864***	462.131
Low Balance	-126.626	176.946	-200.353	343.615
Panel B Age				
Old	-683.755***	201.931	-1218.048***	393.489
Young	-314.588	232.223	-725.477	450.318

Table 5: Assessing Other Transmission Channels

Column 1 presents the estimate of consumption response when we consider the sharp interest rate is associated with movement in inflation/exchange rate. We interact both the inflation and exchange rate (Turkey lira to US dollars) with the treatment indicator and re-estimate our main specifications. In Column 2, we address the concerns about imbalance of demographics by adding the interaction term of demorgraphic controls with the post-policy indicator in the estimation. Column 3 and 4 reports the estimates when we match the treatment with refined control group: consumers that do not spend on forbidden categories during daytime at Ramadan but do have at least one transaction during daytime on non-Ramadan month. *D(post)* is a binary variable that equals to one for months after the announcement of the interest rate rise (2014:01-2014:06). Customer and year-month fixed effects are included for all specifications. Standard errors are clustered at the customer-year-month level. T-statistics are reported in parentheses under the coefficient estimate. *, **, *** denotes significance at the 10%, 5% and 1% levels, respectively.

	Dependent Variable = Total Consumption			
	(1)	(2)	(3)	(4)
	Interactions		*Alternative Control Sample*	
D(rate-sensitive)*D(post)	-148.470***	-158.538***	-115.999***	-136.652***
	(-3.42)	(-5.37)	(-4.25)	(-2.85)
D(rate-sensitive)*Inflation Rate	0.044			
	(0.20)			
D(rate-sensitive)*Exchange Rate	-0.890			
	(-0.38)			
D(rate-sensitive)*D(pre)				-25.772
				(-0.53)
Constant	2,046.656***	1,945.374***	1,938.554***	1,938.261***
	(7.68)	(87.17)	(88.62)	(88.53)
Demographics Controls*D(Post)	NO	YES	NO	NO
Year-month Fixed Effects	YES	YES	YES	YES
Customer Fixed-Effects	YES	YES	YES	YES
Observations	66,353	66,353	72,931	72,931
R-squared	0.47	0.47	0.46	0.46

Figure 1: Policy Rate and Deposit Interest Rate in Turkey

Panel A plots the policy rate, including the repo rate, overnight borrowing and lending rate, and panel B shows the deposit interest rate from one month to 12 months during our sample period.

Source: the Central Bank of Turkey

Source: the Central Bank of Turkey