# The Effect of Interest Rate on Household Consumption: Evidence from a Natural Experiment in India

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**The Effect of Interest Rate on Household Consumption: Evidence from a Natural Experiment in India**

*This paper estimates the effect of interest rate on household consumption. We exploit a change in Indian banking legislation, which encouraged banks to offer higher interest rate on deposits to citizens above sixty years. We use consumption data from the Indian National Sample Survey to calculate regression discontinuity estimates, based on age cut-offs. We find that a 50 basis point increase in interest rate on deposits leads to an immediate decline of consumption expenditure by 12 percent. This decline is primarily in non-food, non-essential items. Estimates prior to the banking legislation show no significant difference in the consumption expenditure.* (*JEL* E21, E62, H31, D91)

The effect of interest rate on consumption is a central concern in macroeconomics. Among many issues that are related to inter-temporal substitution, one of the most relevant from today's perspective is whether consumers can be induced to increase consumption by a reduction in interest rate paid on deposits. In this paper we measure the causal effect of interest rate on consumption. This has crucial implications for understanding the timing and effectiveness of the interest rate as a policy instrument that affects consumption, savings and ultimately the growth rate of an economy.

Our paper estimates the causal effect of a higher interest rate on household consumption expenditure by exploiting a unique Indian banking legislation and using detailed household consumption expenditure data from the National Sample Survey (NSS). As of April 2001, the Reserve Bank of India permitted and actively encouraged banks to offer higher interest rates on deposits of any size to senior citizens, defined as people over 60 years of age. The Government of India too launched a Senior Citizens Savings Scheme (SCSS) with higher interest rates exclusively for the benefit of senior citizens. Today all private and public sector banks in India offer higher interest rate to senior citizens amounting to 50 basis points on average.

The banking legislation for senior citizens provides a neat identification strategy. We use the regression discontinuity approach to estimate the precise causal effect that the interest rate has on consumption of households. We estimate the change in household

consumption expenditure to a higher interest rate by comparing the expenditures of households that are eligible for higher interest earnings on their deposits to households that are not eligible. The eligibility criterion is the age of household members where a household is eligible for the higher interest rate if there is at least one member who is of 60 years or above. A natural experiment setting is provided by this legislation allowing us to identify directly the causal effect of interest rate on consumption. This is in contrast to research relying on the time series properties of the consumption Euler equation to test the null hypothesis of the permanent income hypothesis (PIH). Such tests cannot estimate causal effects outside of the null hypothesis.

We use data from the 61st round (2005-06) and the 56th round (2000-01) of Indian National Sample Survey (NSS). This is an unusually good disaggregated dataset of household consumption expenditure for representative sample of households across India and is a commonly used dataset in the economics literature.[1] We first do the analysis with the 2005-06 data which was collected four years after the legislation was passed. Then, in order to compare results prior to the banking legislation, we also analyze the 2000-01 data which was collected before the legislation was passed.

The main results suggest that households do change their consumption expenditure significantly in response to the predictable change in interest rate on deposits. More specifically, when we compare 59 year old households with 60 year old households, we find that an increase of 50 basis points in the interest rate leads to a decline in consumption expenditure of 12 percent. Analysis of the disaggregated monthly consumption expenditure reveals that the decline is primarily in non-food, non-essential items. Next, we compare the change in consumption expenditure prior to the banking legislation and find no significant difference in consumption expenditure between the two age groups.

These findings do not depend on any particular theoretical model of consumer behavior, however, they constitute a rejection of the benchmark rational expectations Permanent Income - Life Cycle Hypothesis which implies that consumption response to a predictable permanent change in interest rate should be uncorrelated with the age of the

[1] Deaton (1992, 1996, 2000, 2003, ); Banerjee and Iyer (2005)

household, that is the precise time when the legislation becomes effective for a household.

Most previous studies have found small effects of interest rates on consumption and saving (Hall 1988). However, it remains unclear whether interest rate elasticities are truly small or these findings are spurious due to endogeneity of interest rate (Summers 1982, Hall 1988 and Balassa 1989) or measurement problems like the difficulty of observing household specific interest rate (Browning and Lusardi 1996; Mishkin 1995). This paper uses a methodology and data that allows us to precisely estimate the causal effect of interest rate on consumption and is a significant improvement on previous findings which were biased due to a combination of endogeneity problems and measurement errors.

The paper proceeds as follows. The next section discusses the related literature. Section II discusses the interest rate policies for senior citizens. Section III describes the household consumer expenditure survey data. Section IV lays out the empirical strategy. Section V presents the main results for different groups of consumption expenditure and has two sub sections. The first subsection, Va., has results from post banking legislation data and the second subsection, Vb., describes results prior to the banking legislation. Section VI concludes with a discussion and policy implications. The appendix in section VII lays out the theoretical wealth based consumption function that forms the base of the empirical analysis.

## I. The Literature

It is difficult to measure the precise causal impact of interest rates on consumption. In order to determine whether consumption responds to a predictable change in interest rate, we must identify clean measures of a predictable interest change and isolate its effect from other confounding factors that affect consumption decision. Most previous studies have found small effects of interest rates on consumption and saving (e.g. Hall 1988). However, it remains unclear whether interest rate elasticity are truly small or these findings are spurious due to endogeneity of interest rate as argued by Summers (1982), Hall (1988) and Balassa (1989) or due to measurement problems like the difficulty of observing a household specific interest rate (Browning and Lusardi 1996; Mishkin 1995).

A key advantage of this paper is that the banking legislation provides us with a natural experiment that allows us to identify directly the causal effect of interest rate on consumption.

There are endogeneity concerns when one uses aggregate level data to measure how interest rates affect consumption expenditures. This is because it is difficult to separate out the effects of interest rate from the economic factors that led to the interest rate changes themselves, including other macroeconomic variables. This paper uses household level data to test the impact of a change in the interest rate on consumption expenditure and therefore builds more directly on the literature that test implications of Permanent Income Hypothesis (PIH) using household level consumption data such as Deaton (1992) and Browning and Lusardi (1996).

There is recent literature that uses household consumption data to test implications of PIH by exploiting changes such as social security tax withholding (Parker, 1999) and random timing of income tax rebate (Johnson et. al. 2006 and Agarwal et.al. 2007). Parker (1999) uses household level consumption data to test whether expenditures on nondurable goods increase contemporaneously with predictable changes in social security tax withholding. He finds that a predictable one percent increase in after-tax income in a three month interval contemporaneously increases expenditures on nondurable consumption by around 0.5 percent. In the study by Johnson, Parker and Souleles (2006), they use a unique experiment to measure the change in consumption expenditures caused by receipt of the 2002 income tax rebate which were randomly mailed to recipients. They find that households spent 20-40 percent of their rebate on nondurable goods during the three month period of receiving the rebate and roughly two-thirds of their rebate cumulatively during the quarter of receipt and the subsequent quarter. Another paper that exploits the random timing of this 2001 tax rebate mailing is Agarwal, Liu and Souleles (2007) which uses credit card data to identify the dynamic response of credit card payments, spending and debt to the rebates.

A study that comes closest to ours in that it studies effect of interest rate is Gross and Souleles (2002) which analyzes the response of debt to changes in credit limits and the annual percentage rate (APR). Their main finding is that increases in credit limits generate an immediate and significant rise in debt with an average marginal propensity to

consume (MPC) out of liquidity between 10-14 percent. They also find strong effects from changes in interest rates with the average elasticity of debt to interest rate of approximately -1.3. In contrast to Gross and Souleles (2002), we study the effect of the interest rates on deposits on household consumption expenditure.

A recent study by Card, Dobkin and Maestas (2008) also exploits an age based policy change. They look at the threshold for Medicare coverage eligibility which occurs at age 65 and using a regression discontinuity framework their study compares health related outcomes among people just before and just after the age of 65.

## II. Interest Rate Polices for Senior Citizens

Prior to April 2001, Reserve Bank of India (RBI) prohibited discrimination of interest rate paid on deposits by commercial banks, based on age of a depositor. This was, however, changed on April 19, 2001 with the introduction and immediate effect of a new Interest Rate Policy under the Monetary and Credit Policy for the year 2001-02. Under this new policy, a Deposit Scheme for Senior Citizens was introduced where banks were permitted and advised to offer higher rates of interest to senior citizens as compared to normal deposits of any size.

The Senior Citizens Deposit Scheme of 2001 was strengthened further by Government of India through the Senior Citizens Savings Scheme Rules (SCSS) that were enforced in August 2004, through section 15 of the Government Savings Banks Act. The SCSS is meant to benefit all deposits made by senior citizens in post office savings accounts, in banking companies and in any other company or institution which is authorized by the Government of India to receive subscriptions under the Public Provident Fund Scheme.

As a result of the above policies, banks in India have offered higher interest rates on deposits held by senior citizens since 2004. For data on interest rates, we have looked at all private banks, nationalized (public) banks, foreign banks and other scheduled commercial banks in India. The Reserve Bank of India publishes profile of all banks for every financial year. For our analysis, we are interested in the exact interest rates that were offered to senior citizens compared to other depositors by a bank in the year 2005-06. This data was collected from archives of the Reserve Bank of India and through

individual phone calls to customer service for each bank. Several banks have information on differential interest rates displayed on their websites as well. The data reveals that for the year 2005-06, banks on average offered 50 basis points higher interest rates to senior citizens compared to other deposits.

## III. The Household Consumer Expenditure Survey Data

We use a nationwide sample data from India collected by the National Sample Survey Organization (NSSO) as a part of its 62nd round (July 2005 - June 2006) and 56th round (July 2000 - June 2001). The NSSO conducts regular consumer expenditure surveys through household interviews, using a random sample of households covering practically the entire geographical area of India. The total sample size is 39436 households of which 18992 are rural households and 20444 are urban. The household consumer expenditure survey collected information on quantity and value of household consumption with a reference period of "last 30 days" for some items of consumption and "last 365 days" for some less frequently purchased items. To minimize recall errors, a very detailed disaggregated classification of household consumption items was adopted to collect information. This included classifications such as food (148 items), fuel (13 items), clothing, bedding and footwear (28 items), educational and medical expenses (18 items), durable goods (52 items) and 85 other items.

In our analysis we only consider households that are self-employed and fall within the three age groups, 59, 60 and 61 years. We study self-employed households in order to minimize the impact of retirement on consumption expenditure as there is no clear retirement age for a self–employed household. The age group of a household is determined by the age of the oldest living member within a household. For the banking policy of higher interest earnings to have an impact on household consumption level, it would require that at least one person within the household is of 60 years of age. This is why we restrict our sample to households which have oldest living members who are 59, 60 and 61 years of age. Identification of interest rate effect on consumption is based on comparing the consumption expenditure of "treated" households, whose oldest living member is 60 years and above with consumption expenditure of households in the control

group which are just below the cutoff age. Table 1 highlights the summary statistics for an average household in our sample. The data defines 'occupation' of a household based on source of income. There are several households that are engaged in more than one form of occupation and therefore the 'occupation' definition is based on the majority source of income. Nearly 60 percent of households in our data are self-employed and this includes households that are engaged in agriculture, non-agriculture and urban self employed households. An average household has six members and it includes four adults and two children defined as members below 18 years of age. Average age of a household head is less than 54 years and that is because for nearly 20 percent of the sample households, the head is different from the oldest living member.

TABLE 1: SUMMARY STATISTICS

| Variable | Mean | Standard Deviation | Observations |
|---|---|---|---|
| Monthly household expenditure (in Rs.) | | | |
| Total | 3902.73 | 124.46 | 1482 |
| Food-group | 2019.25 | 58.26 | 1482 |
| Non-food group | 1883.53 | 77.36 | 1482 |
| Number of household members | 6 | 0.19 | 1482 |
| Adults (above 18 years) | 4.1 | 0.11 | 1482 |
| Children (below18 years) | 1.9 | 0.11 | 1482 |
| Age of household head (years) | 53.73 | 0.75 | 1482 |
| Covered area of dwelling unit (square meters) | 62.54 | 2.85 | 1473 |
| Incremental interest rate* (basis points) roi(60years) – roi (59years) | 49.16 | 25.23 | 96 |
| Self employed households (dummy variable) | .59 | | 2499 |

The sample is of all self employed households whose oldest living member is 59 years or 60 years of age. Data source: Household Consumer Expenditure in India, NSS 62nd Round (July 2005-June 2006); National Sample Survey Organization, Ministry of Statistics and Program Implementation, Government of India; * Reserve Bank of India

Apart from household consumption expenditure data, the NSS also collects qualitative information on some additional aspects to measure living condition of a household. This

includes, for example, the structure of a dwelling unit (thatched or concrete), energy used for cooking and lighting and the education level of a household. There are also some variables which are a good proxy for wealth level of a household. These include amount of land owned and the total covered area of dwelling unit in square meters. In addition, data is also available for occupation of a household, the social group to which a household belongs as well as occupancy status.

We provide a simple graphical representation of the per capita monthly household consumption expenditure for the two age groups, 59 and 60, in figures 1a and 1b. Figure 1a shows the kernel density graphs for the year 2005-06 which was after the banking legislation and figure 1b shows the kernel density graphs for the year 2000-01 which was before the legislation. It is evident from the two graphs that the household monthly consumption expenditure is lower for the 60 year group compared to the 59 year group in the year 2005-06. However there is no obvious difference in the year 2000-01 which was prior to the change in banking norm. We tested for the equality of distributions using Kolmogorov - Smirnov tests which confirm that the distributions are statistically different in 2005-06 and equal in 2000-01.

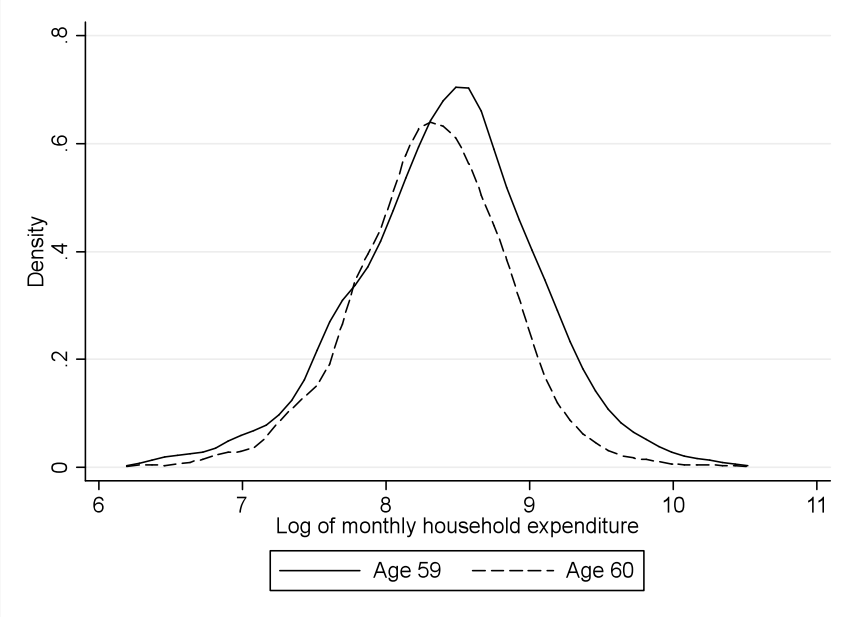


FIGURE 1A: KERNEL DENSITY GRAPHS OF MONTHLY HOUSEHOLD CONSUMPTION EXPENDITURE (2005-2006)

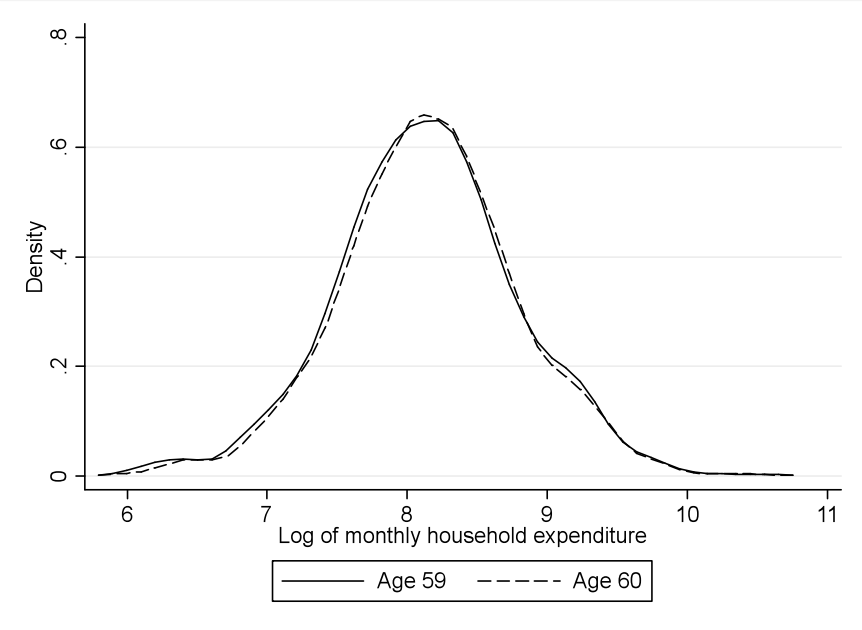


FIGURE 1B: KERNEL DENSITY GRAPHS OF MONTHLY HOUSEHOLD CONSUMPTION EXPENDITURE (2000-2001)

## IV. Empirical Strategy

We need to determine the absolute level of consumption given wealth and expected future interest rates. For this we cannot solely rely on an Euler equation implied by optimizing models of intertemporal choice. The Euler equation determines only the level of consumption today relative to the future level of consumption. We therefore need a traditional consumption function with a closed form solution for consumption given exogenous variables. Our empirical strategy is based on a consumption function that we derive in the appendix. This is based on the model in Campbell and Mankiw (1989). The consumption function relates consumption, wealth and expected future returns on wealth. For our empirical strategy, a simple linear model (see equation A9 in the appendix) provides a starting point:

$$(1) \qquad c_{it} = w_{it} + (1-\sigma)E_t \rho r_{t+1} + (1-\sigma)E_t \rho^2 r_{t+2} + (1-\sigma)E_t \rho^3 r_{t+3} \ldots + \phi + \varepsilon_{it},$$

where $c_{it}$ is the log of monthly consumption expenditure of individual $i$ in time $t$, $r_t$ is the rate of interest earned by this individual in time $t$, $w_{it}$ is the log of wealth of individual $i$ in time $t$ and the errors $\varepsilon_{it}$ are independently distributed. The parameter $\rho$ can be interpreted as the average ratio of invested wealth to the total wealth, $\sigma$ is the intertemporal elasticity of substitution and $\phi$ is a constant. This equation captures the effect of a change in interest rate on consumption, holding wealth constant. Our analysis is at the household level since the consumption expenditure data is at the household level. For the banking policy of higher interest earnings to have an impact on household consumption, it would require that at least one person within the household is 60 years or older. This is why we restrict our sample to households where the oldest living members are 59, 60 and 61 years of age.

Our main empirical approach exploits the discontinuity in interest rate at age 60 to estimate the causal effect of interest rate on consumption. To improve on equation (1), we exploit the exogenous variation on the interest rate earned by individual above 60 years of age. Identification of interest rate effect on consumption is based on comparing the outcomes of "treated" households consumption expenditure, whose oldest living member is 60 years and above with those of the control group - households which are just below the cutoff age. The causal interpretation of such comparisons hinges upon the assumption that birth dates are random near the cutoff. In our context this is a perfectly valid assumption. Consider the regression model:

$$C_{ia} = \alpha + \beta_1 D_a + \delta(a) + X_{ia}\beta_2 + \varepsilon_{ia} \tag{2}$$

where $C_{ia}$ is the log of monthly household consumption expenditure for a household $i$ with the oldest living member of age $a$, $\delta(a)$ is a smooth function representing the age profile, and $D_a$ is a treatment dummy that captures the higher interest rate on offer to households that have members who are 60 years or older. In equation (2), $\beta_1$ is the causal effect on consumption of a unit increase in interest rate. The identification assumption that underlies the regression discontinuity (RD) strategy is that $\delta(a)$ is a smooth function.

Under this assumption, the treatment effect $\beta_1$ is obtained by estimating the discontinuity in the empirical regression function at the point where the treatment variable switches from 0 to 1. We have a "sharp" RD design since the treatment variable is a deterministic function of the regression variable (age). The assumption that $\delta(a)$ is a continuous function means that differential interest rates are the only source of discontinuity in consumption level at age 60, after we control for household observables $X_{ia}$ which suggest wealth level of household and other socioeconomic characteristics. These include variables such as ownership of land, structure of dwelling unit, energy used for cooking and lighting, level of education, household size and if households are located in rural or urban areas.

We need to adapt the regression discontinuity (RD) approach to the limitations of the data. One problem is that we only observe the age in years of the individual at the census day. This means that the best we can do is to compare all individuals who are 60 at the census date. In other words, we cannot compare people who "just turned 60" to people "just about to turn 60". Because of this limitation, all the information available in the data can be summarized in the age specific means of the variables. The empirical model we work with is the age cell version of equation (2). Regression estimates of equation (2) based on micro data are identical to weighted estimates when the weight used is the number of observations by age group. The bandwidth in our analysis is a one year period. We have compared the consumption level of 59 year old households with the consumption level of 60 year old households to capture immediate impact of the higher interest rates. We have also compared the consumption level of the 59 year olds with the 61 year old households to capture any longer term effect.

## V. Empirical Results

Before discussing the main results based on the empirical specification of the previous section, we begin by examining the change in consumption level between any two subsequent age groups from age 55 to 65. This is to identify any existing systematic relationship between age and consumption for this age group. We estimate and plot the coefficients, $\beta_1$ from equation (2) for every two consecutive age groups from 55 to 65

years. Figure 2 shows the distribution of coefficient $\beta_1$ for every consecutive age group pairs from 55 to 65 years. The figure indicates that the coefficients are distributed around zero. Interestingly, we find that other than the coefficient estimates on pair group 59-60 and pair group 60-61, all the other estimates are close to zero and statistically insignificant. The coefficient on age group 59-60 is negative and statistically significant indicating a fall in consumption expenditure at age 60 compared to 59. The coefficient on age group 60-61 is positive and statistically significant indicating a rise in consumption at age 61 compared to age 60.

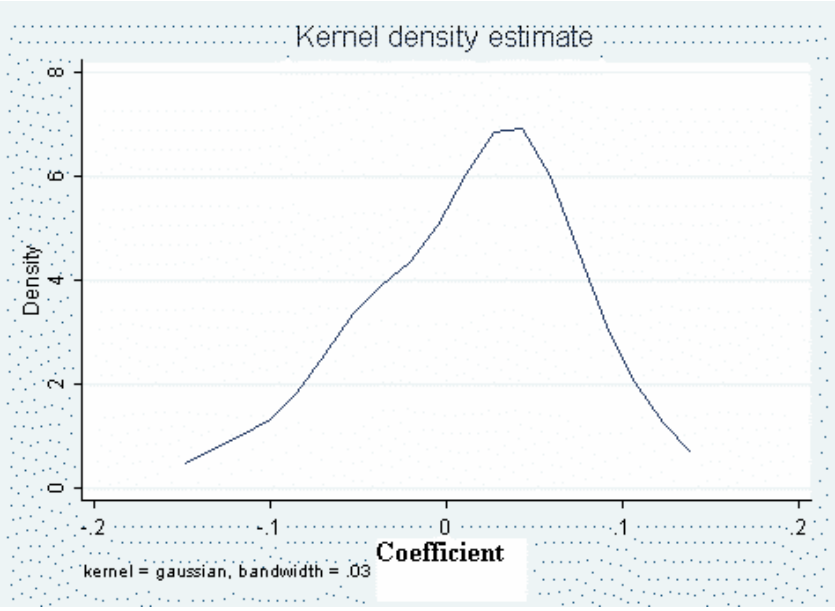


FIGURE 2: CHANGE IN MONTHLY CONSUMPTION EXPENDITURE BETWEEN EVERY TWO CONSECUTIVE AGE GROUPS FROM 55 TO 65 YEARS

To check for any systematic differences in household size by age, we plotted the distribution of number of household members by age group of households. Figure 3 displays the density plots of number of adult household members in each of the three age groups within our study. We test for the equality of the three distributions using Kolmogorov-Smirnov tests. We find no significant difference between the three distributions.

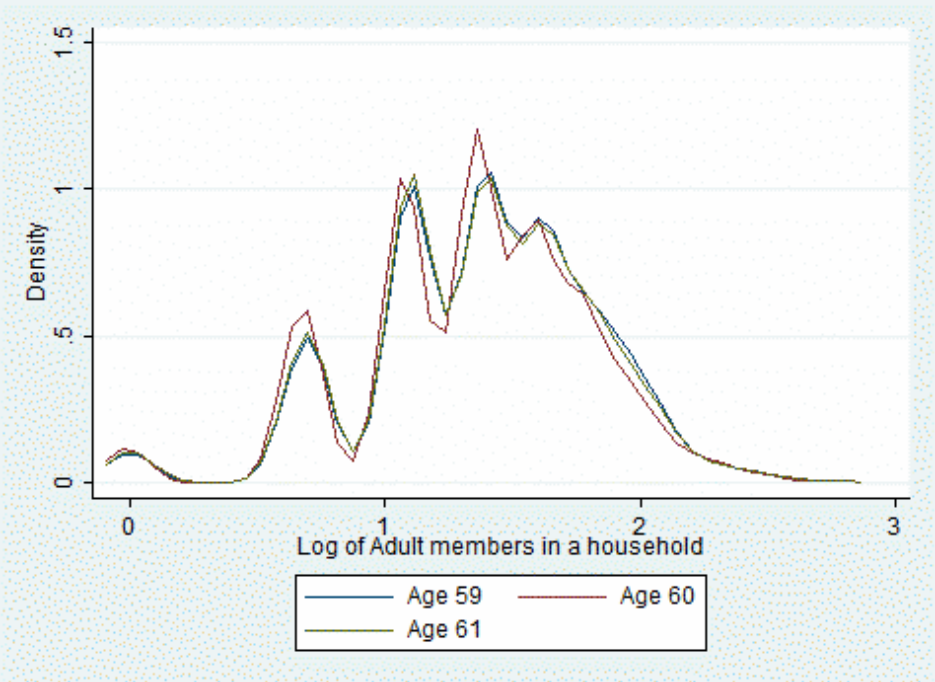


FIGURE 3: DISTRIBUTION OF NUMBER OF HOUSEHOLD MEMBERS FOR EACH AGE GROUP

The main results based on the empirical specification outlined in section IV are presented in tables 2 through 4. All the regressions are ordinary least squares (OLS) estimates of equation 2 with the logarithm of monthly household consumption expenditure as the dependent variable. The coefficients of interest are the ones against age dummies. There are some standard controls like the size of household which is number of members within the household, education level which is measured as the highest education level amongst all household members, amount of land owned, type of dwelling unit and energy used for cooking and lighting. There is significant variation in living standard across states and location within India. We, therefore, include additional controls to capture state level effects and urban-rural effect by adding state dummies and a dummy for urban.

Our total sample consists of self-employed households where the oldest living members are 59, 60 or 61 years of age. The first set of regression results in Tables 2 and 3 are for a sample of 1470 households from 2005-06 data which was collected after the banking legislation was enacted. The second set of regression results in Table 4 is from 2000-01 data which was collected prior to the banking legislation and the sample size is 2484 households.

The coefficients of interest are the ones against the dummy variables for age. We use two age dummy variables. The variable 'Dummy for Age 60' equals 1 if the oldest living member in the household is 60 years of age and it equals 0 if oldest member is 59 years old. This variable captures the immediate impact on consumption level from the treatment which is increased interest rate on deposits. The variable 'Dummy for Age 61' equals 1 if the oldest living member in the household is 61 years of age it equals 0 if oldest member is 59 years old. This variable captures a longer term impact on consumption from the treatment as households within this group have received higher interest earnings on deposits for at least a year now. Age group 59 is the benchmark or control group for both treatment age categories 60 and 61.

### Va. Results (2005-06): Post Banking Legislation

We start by looking at regression results from data collected in 2005-06 which is after the banking legislation. Tables 2 and 3 display the results of estimating equation (2) by ordinary least squares (OLS) with the monthly household consumption expenditure (MHCE) as the dependent variable and the age dummies as the key independent variables. In table 2, we see that the coefficient on variable 'Dummy for Age 60' is -0.12 and statistically significant. This means that compared to the control group households, the treatment group households are spending 12 percent less on monthly consumption. That is, on an average, a 60 year old household is spending 12 percent less on monthly consumption relative to a similar 59 year old household. The treatment in this natural experiment is higher interest rates on deposits of senior citizens or depositors above 60 years of age. The interest rate data from banks show that on an average, senior citizen deposits earn approximately 50 basis points higher interest rates. So the regression results in Table 2 show that for an average increase of 50 basis points in interest rate on savings, household reduce consumption expenditure by 12 percent.

To understand whether the effect of a predicted increase in interest rate on expenditure is sustained over a long period, we compare the 61 year age group with the control group of 59 year old households. The regression results show that the coefficient on variable 'Dummy for age 61' is small and statistically insignificant. This implies that although the

age group 61 earns higher interest rates on their deposits, their consumption expenditure is not significantly different from the 59 year age group.

These results reveal an interesting age-wise pattern to the effect of a higher interest rate on the consumption expenditure of households. There is an immediate reduction in consumption or an intertemporal substitution when a predictable increase on interest rate on savings actually becomes effective. However, over a longer period, the effect of interest rates on consumption expenditure is smaller. We do not have sufficient data to analyze why household consumption expenditure responds differently in the long run compared to the short run response. This might be because the total price effect of increased interest rate is distributed over time. The substitution effect of an increased interest rate on savings kicks in immediately and households redistribute by lowering consumption and raising savings level. The income effect, on the other hand, is felt only after the term of a deposit. The raised earning from higher interest rate on a deposit only accrues over the term of a deposit. Any increase in consumption expenditure in response to the raised earnings is then witnessed after the term of the deposit. There might be other behavioral explanations for this discrepancy between long run and short run responses.

The household consumption expenditure increases with household size which is defined as the number of members that eat from a common household kitchen for more than 6 months in a year. The variable 'log of covered area' for a household is a proxy for asset holding and the results show that a household's consumption expenditure increases significantly with asset holding. Education level of a household does not have any effect on the consumption expenditure. To account for variation in consumption across urban and rural locations, we included the 'urban' dummy but the results show that this does not have any effect either.

There is no redistribution of household members across different age groups to take advantage of the higher interest rate on savings. We rule this out based on Figure 3 which showed the distributions of number of members is similar across different age group households. In any case, if there was redistribution across age groups, and members moved in with their 60 year old relatives, this would have resulted in higher consumption expenditure for the 60 year age group which is contrary to our findings.

TABLE 2: RESPONSE OF CONSUMPTION EXPENDITURE TO INCREASED INTEREST RATE ON DEPOSITS

| | Dependent variable: Logarithm of monthly household consumption expenditure |
|---|---|
| Dummy for age 60 | -.12** |
| | (0.053) |
| Dummy for age 61 | -0.02 |
| | (.077) |
| Log of household size | .669*** |
| | (0.029) |
| Log of covered area | .12*** |
| | (.03) |
| Number of observations | 1470 |
| $R^2$ | 0.76 |

Note – Standard errors are in parenthesis; * significant at 10 % confidence; ** significant at 5 % confidence; *** significant at 1 % confidence. There are additional controls for education level, amount of land owned in hectares, dwelling unit, dwelling type, energy source used for cooking, lighting source, and dummies for urban and state. Source: National Sample Survey 62nd Round (July 2005 – June 2006): Household Consumption Expenditure in India

We need to probe deeper to understand the main result which is a 12 percent immediate reduction in the consumption expenditure when a predicted increase of 50 basis points in interest rate actually becomes effective. It is important to see the different components of consumption that are affected by the interest rate. We analyze the disaggregated monthly consumption expenditure data and look at food and non-food items separately. Table 3 displays results of estimating equation (2) by OLS with monthly household consumption expenditure on food as dependent variable in column 1 and monthly household consumption expenditure on non-food items as dependent variable in column 2.

The findings reveal that consumption expenditure on food and essential items is unaffected but consumption expenditure on non-food items reduces significantly in response to a higher interest rate on savings. As column 2 of table 3 displays, households reduce consumption expenditure on non-food items by 17 percent immediately when the predicted increase in interest rate on deposits becomes effective. And according to column 1 of table 3, there is no significant difference in the consumption of food across the different age groups. This implies that the strongest violations of consumption smoothing occur in categories in which households can easily substitute purchases across time. This finding is consistent with earlier literature such as Parker [1999]. Non food

items in the data include durables, clothing, footwear, medical, educational and travel expenses.

Similar to the results in table 2 where we analyzed the aggregate consumption data, even with the disaggregated consumption data we find that the effect of higher interest rate does not persist over a long run. This is reflected by the coefficients on variable 'Dummy for age 61' in column 1 and 2 of table 3 which are insignificant. This means that the food and non-food expenditure of a 61 year old household which has earned higher interest rate on its deposits for at least a year is not significantly different from the food and non-food expenditure of a 59 year old household which is not eligible for higher interest rates. Combined with the earlier result of immediate reduction in non-food consumption in response to higher interest rates, we can conclude that households raise their expenditure on these items subsequently. Once again, we believe that this might be driven by the income effect which is only realized at the end of a term deposit. There might also be other behavioral explanations for this discrepancy between short run and long run responses. Other explanatory variables have similar effects on food and non-food consumption as in the analysis with aggregate consumption expenditure data.

TABLE 3: DISAGGREGATED RESPONSE OF CONSUMPTION EXPENDITURE

| | Dependent variable: Logarithm of monthly household consumption expenditure | |
|---|---|---|
| | Food | Non-food |
| Dummy for age 60 | -.07 | -.17** |
| | (0.05) | (.071) |
| Dummy for age 61 | .060 | -.14 |
| | (0.07) | (.10) |
| Log of household size | .699*** | .651*** |
| | (0.033) | (.037) |
| Log of covered area | .072*** | .16*** |
| | (0.027) | (.036) |
| Number of observations | 1470 | 1470 |
| $R^2$ | 0.77 | 0.70 |

Note – Standard errors are in parenthesis; * significant at 10 % confidence; ** significant at 5 % confidence; *** significant at 1 % confidence. There are additional controls for education level, amount of land owned in hectares, dwelling unit, dwelling type, energy source used for cooking, lighting source and dummies for urban and state. Source: National Sample Survey 62nd Round (July 2005 – June 2006): Household Consumption Expenditure in India

### Vb. Results (2000-01): Prior to Banking Legislation

Analysis of consumption expenditure data collected after the banking legislation reveals that households reduce consumption expenditure significantly when a predicted increase in interest rate on deposits actually becomes effective. This result, however, would also hold if there is a systematic difference in the consumption pattern of 60 year old households compared to 59 year old households and which is unrelated to the interest rate on deposits. In order to rule out this alternate hypothesis, we have analyzed the consumption expenditure data from 2000-01 which was collected prior to the banking legislation that led to higher interest rate for senior citizens. We run a regression with the same specification as before using the same control variables, that is, we estimate equation (2) by OLS, with the monthly household consumption expenditure as the dependent variable and the age dummies as key independent variables. The sample size, however, is now 2484 self employed households with oldest living members who are 59, 60 or 61 years of age.

The results from analysis of the data collected in 2000-01, prior to banking legislation is displayed in table 4. These results further confirm our main finding that the difference in consumption levels of the two age groups is significantly driven by the interest rates. The coefficient on the variable 'Dummy for age 60' is insignificant. This implies that when there was no difference in the interest rates on deposits of senior citizens, their consumption level was similar to that of a 59 year old household. This result rules out any systematic difference in consumption levels of 59 and 60 year old households as an alternate explanation to our main hypothesis.

Similar to results from post banking legislation data, the coefficient on the 61 year dummy is insignificant in table 4. This implies that when there was no difference in interest rates earned on savings, the three age groups had similar consumption expenditure levels. As before, the effects of asset holding and household size on consumption expenditure are positive and significant.

TABLE 4: CONSUMPTION EXPENDITURE PRIOR TO THE BANKING LEGISLATION (2000-01)

| | Dependent variable: Logarithm of monthly household consumption expenditure |
|---|---|
| Dummy for age 60 | -.03 |
| | (0.080) |
| Dummy for age 61 | .037 |
| | (0.098) |
| Log of household size | .672*** |
| | (0.036) |
| Log of covered area | .111*** |
| | (.080) |
| Number of observations | 2484 |
| $R^2$ | 0.71 |

Note – Standard errors are in parenthesis; * significant at 10 % confidence; ** significant at 5 % confidence; *** significant at 1 % confidence. There are additional controls for education level, amount of land owned in hectares, dwelling unit, dwelling type, energy source used for cooking, lighting source and dummies for urban and state. Source: National Sample Survey 56th Round (July 2000 – June 2001): Household Consumption Expenditure in India

## VI. Discussion and Conclusion

Earlier studies that have looked at the impact of interest rate on consumption have found small effects. The main concern, however, remained whether the effects are truly small or these findings are spurious due to measurement error problems or endogeneity of consumption and interest rate. A key advantage of this paper is that an age based banking legislation in India provides us with a natural experiment setting which allows us to identify directly the causal effect of interest rate on consumption. We use a regression discontinuity approach to estimate the precise causal effect that interest rate has on consumption level of a household.

Our main result is that an increase of 50 basis points in the interest rate on deposits leads to an immediate 12 percent decline in the consumption expenditure of a household. Analysis of the disaggregated monthly consumption expenditure data reveals that the decline is primarily in non-food, non-essential items and the magnitude of this decline is a significant 17 percent. The disaggregated data reveals that there is no significant change in the consumption expenditure of food and essential items.

To rule out any general systematic difference in consumption levels of 59 and 60 year old households as an alternate explanation to our main hypothesis, we analyzed data

collected prior to the banking legislation that led to higher interest rate for senior citizens. We find that there is no significant difference in consumption levels of the age groups when there is no difference in the interest rate on deposits.

Our results reveal an interesting age-wise pattern to the effect of interest rate on consumption. We find that consumers do not perfectly smooth consumption across expected interest rate changes. We find that contrary to the Permanent Income Hypothesis, consumption responds significantly to predictable changes in interest rate. There is an immediate intertemporal substitution or a reduction in consumption expenditure when a predictable increase in interest rate on savings actually becomes effective. However, over a longer period, measured as at least one year, the effect of interest rate on consumption expenditure is significantly reduced. We find that one year after becoming eligible for higher interest rate on deposits, households increase their consumption expenditure to the prior level. We do not have sufficient data to analyze why households respond differently in the long run compared to the short run. One likely explanation might be that the total effect of increased interest rate is distributed over time such that the substitution effect kicks in immediately and households redistribute by lowering consumption and raising savings, while the income effect from raised interest earnings is only felt after the term of a deposit. We cannot rule out other behavioral explanations for this discrepancy between long run and short run responses. Based on this study, however, we can conclude that interest rate as a policy instrument has a strong and significant short run impact on consumption and savings of households.

## VII. APPENDIX: WEALTH BASED CONSUMPTION FUNCTION

To determine the absolute level of consumption, given wealth and expected future interest rates, we cannot solely rely on an Euler equation implied by optimizing models of intertemporal choice. The Euler equation determines only the level of consumption today relative to the level of consumption tomorrow. We therefore need a traditional consumption function with a closed form solution for consumption given exogenous variables. Based on the model of Campbell and Mankiw (1989), we explore a class of approximate consumption functions obtained by log linearizing the intertemporal budget constraint. These approximate consumption functions give considerable insight and an alternative way to test the models with data.

Consider the budget constraint of a consumer who invests his wealth in a single asset with a time varying risky turn $R_t$. If all the consumer's income flows are capitalized into marketable wealth then we do not have to explicitly model income. The budget constraint for a period is:

(A1) $$W_{t+1} = R_{t+1}(W_t - C_t)$$

Solving forward with an infinite horizon and imposing the transversality condition that the limit of discounted future wealth is zero, we get

(A2) $$W_t = C_t + \sum_{i=1}^{\infty} \frac{C_{t+i}}{(\prod_{j=1}^{i} R_{t+j})}$$

This means that the wealth today is the discounted value of all future consumption.

To get a linear relationship between log wealth, log consumption and log returns measured at different points of time, we first divide equation (A1) by $W_t$, take logs and rearrange to get:

(A3) $$w_{t+1} - w_t = r_{t+1} + \log(1 - \frac{C_t}{W_t}) = r_{t+1} + \log\{1 - \exp(c_t - w_t)\}.$$

The last term in (A3) is a non-linear function of the log consumption-wealth ratio, $c_t - w_t = x_t$. When we take a first order Taylor expansion of this function, $\log\{1 - \exp(c_t - w_t)\}$ around the point $x_t = x$, we get:

(A4) $$\log\{1-\exp(c_t - w_t)\} \cong k + (1-1/\rho)(c_t - w_t)$$

where the parameter $\rho$ can be interpreted as the average ratio of invested wealth $(W-C)$ to total wealth $W$. Substituting (A4) into (A3) will give the following growth rate of wealth equation:

$$\Delta w_{t+1} \cong k + r_{t+1} + (1-1/\rho)(c_t - w_t)$$

where the parameter $\rho$ is a number less than 1 and $k$ is a constant. The growth rate of wealth $\Delta w_{t+1}$ can also be re-written as:

(A6) $$\Delta w_{t+1} = \Delta c_{t+1} + (c_t - w_t) - (c_{t+1} - w_{t+1})$$

When we substitute (A6) into (A5), we get the following:

(A7) $$c_t - w_t = \sum_{j=1}^{\infty} \rho^j (r_{t+j} - \Delta c_{t+j}) + \frac{\rho k}{1-\rho}$$

This is the log linear version of the infinite horizon budget constraint (A2). It states that the log of consumption to wealth ratio today is positively correlated with future rates of return and negatively correlated with future consumption growth.

The next step is to derive a wealth based consumption function that relates consumption, wealth and expected future returns. For this we assume that the consumer satisfies the log linear Euler equation

(A8) $$E_t \Delta c_{t+1} = \mu + \sigma E_t r_{t+1},$$

where the coefficient on the real interest rate, $\sigma$, is the intertemporal elasticity of substitution. By taking the conditional expectations of (A7) and substituting for the expected consumption growth from (A8), we arrive at a consumption function relating consumption, wealth and expected future returns on wealth:

(A9) $$c_t - w_t = (1-\sigma) E_t \sum_{j=1}^{\infty} \rho^j r_{t+j} + \frac{\rho(k-\mu)}{1-\rho}$$

This result states that when $\sigma = 1$, then consumption is a constant fraction of wealth. When $\sigma > 1$, an increase in interest rates lowers the log consumption wealth ratio because substitution effect outweighs income effects and when $\sigma < 1$, income effect is stronger and high interest rates increase consumption. The interest rate in this equation captures the effects of changes in interest rates holding wealth constant.

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