# Liquidity Constraint Tightness and Consumer Responses to Fiscal Stimulus Policy*

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**Abstract**

The marginal interest rate is the rate of interest at which a household can access additional liquidity. Consumption theory posits that variation in marginal interest rates across consumers predicts differences in the propensity to spend a stimulus payment. We test this hypothesis directly in the context of a Danish 2009 stimulus policy that transformed illiquid pension wealth into liquid wealth. We use administrative records with account level information about loans and deposits to derive a household level measure of the marginal interest rate and merge this with survey data collected specifically to measure the spending response to the stimulus policy. The data reveal substantial variation in marginal interest rates across consumers, and these interest rates predict spending responses.

# 1 Introduction

Across the world, governments reacted to the large negative shock that hit the global economy in 2008 by adopting unprecedented fiscal stimulus policies, in many cases with the explicit aim of increasing household consumption to boost aggregate spending. Many empirical studies have documented that consumers do raise spending in response to stimulus policy, including recent studies by Shapiro and Slemrod (2009), Sahm, Shapiro, and Slemrod (2010), Parker et al. (2013), Broda and Parker (2014), and Agarwal and Qian (2014), who find spending propensities in the range 0.3-0.9.

These results are in contrast to the prediction of the Permanent Income Hypothesis/canonical Life-Cycle model with perfect capital markets where tax rebates just raise household savings, without having any stimulus effect on the economy. A standard explanation for this prediction failure is the prevalence of liquidity constraints (Zeldes, 1989). If some households are constrained by lack of access to liquidity then a stimulus payment reduces the tightness of the constraints and boosts the spending of these households.[1]

In this paper we employ a unique data set with information about all household borrowing and saving at the account level to provide a direct test of the importance of liquidity constraint tightness. A challenge is that the difference in access to liquidity is one of degree and not of kind in that the tightness of liquidity constraints is a continuous variable reflecting how costly additional liquidity is to the consumer and it is this shadow value of liquidity that theoretically determines the propensity to consume (Browning and Lusardi, 1996). For example, one consumer may have collateral and borrow at a low interest rate, while another may have used up his collateral-backed line of credit and therefore pays a higher interest on the last dollar borrowed. The marginal interest rate is the rate of interest at which a household can access additional liquidity. We demonstrate in a basic consumption model how variation across consumers in the marginal interest rate observed

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[1] A related explanation is that risk can drive consumers with a precautionary motive to have a marginal propensity to consume that is higher when available resources are scarce (Carroll, 1997; Carroll and Kimball 1996). This means that uncertainty about, say, future income or access to credit can be associated with a higher propensity to spend out of a stimulus.

prior to the stimulus policy—measuring liquidity constraint tightness—predicts variation in spending responses to stimulus policy.

We test this liquidity constraint hypothesis directly using a novel Danish data set containing third-party reported administrative records of all individual-level loan and deposit accounts that enables us to compute consumer level marginal interest rates based on information for the year before the stimulus was announced and released. The data reveal substantial variation in the marginal interest rates paid by consumers, varying from close to 0 to more than 20 percent across people in our sample in 2008. We employ this data in an analysis of a Danish fiscal stimulus policy that allowed consumers to take out wealth from otherwise inaccessible pension accounts within a seven month window during 2009, thereby transforming illiquid pension wealth into liquid wealth available for spending. The policy changed the timing of access to wealth without affecting the level of wealth, making it ideal for testing the importance of liquidity constraints for spending responses to stimuli.

We measure the spending effect of the reform through a survey conducted in January 2010, immediately after the pay-out window had closed, resulting in about 5,000 completed interviews with information about spending behavior related to the pension payout. Our survey method follows previous studies (Shapiro and Slemrod, 1995, 2003; Graziani, van der Klaauw, and Zafar, 2013; Japelli and Pistaferri, 2014) and asks respondents directly about the *change* in their total spending, net saving and pension saving in 2009 due to the stimulus payment.

We match the survey data at the individual level to the loan and deposit accounts data as well as to other administrative registers containing information about demographics, incomes and wealth. By comparing answers from the survey about the allocation of the payout on spending, net savings, and pension savings to corresponding measures constructed from the register data across several years surrounding the time of the stimulus reform, we show that there is a correspondence between the answers to survey questions about the allocation of the stimulus and the savings decision recorded in administrative registers. We interpret this as evidence that respondents understand the counterfactual

nature of the survey questions.

We find that the variation in marginal interest rates across consumers, observed prior to the stimulus reform, is strongly significant in predicting the variation in spending responses, with a 1 percentage point difference in the interest rate between consumers being associated with a 0.5 percentage point difference in the propensity to spend. This finding is in line with the theory and suggests that liquidity constraints are important for explaining spending responses to stimulus policies, even though other factors, e.g. size effects, also turn out to be important for explaining the total response to the stimulus policy.

Our results contribute in different ways to the literature measuring the effects of stimulus policies and the role of liquidity constraints. It is the first study that directly examines the role of variation in the cost of liquidity across consumers for the propensity to spend out of a stimulus. Previous studies have used various proxy variables to capture constraints. Following the seminal paper by Zeldes (1989), a number of studies have used low liquid asset holdings as a proxy for constraints. Johnson et al. (2006) estimate the change in consumption expenditures caused by the 2001 federal income tax rebates and show that people with little liquid wealth are likely to spend more and point to liquidity constraints as a likely driver of spending responses. Souleles (1999) examines the effects of tax refunds and reaches similar findings. Broda and Parker (2014) measure the effect of the 2008 tax rebate using scanner data and find that low liquid wealth households account for the majority of the spending response. Leth-Petersen (2010) analyzes a mortgage reform implemented to boost household spending and finds that increasing the supply of credit increases spending for those with limited liquid assets. A recent study by Johnson and Li (2010) adds to this by showing that the debt service to income ratio predicts whether households are turned down for credit and that it predicts which households have consumption growth that is excessively sensitive to past income.

Other measures are also potentially informative about the importance of liquidity constraints for spending behavior. For example, Sahm, Shapiro, and Slemrod (2010) collect information about income expectations and find that those expecting their income to grow

are more likely to spend, which is consistent with the notion that liquidity constraints matter. In earlier studies Shapiro and Slemrod (1995, 2003) find that the level of income does not predict the spending response.

In our study we include a range of proxies for liquidity constraints. Alongside the marginal interest rate we include the ratio of liquid assets to income and debt service to income. We also ask respondents whether their income actually developed better than anticipated, how they expect their income to develop next year, and finally about how they expect their access to credit to develop. We find that the liquid asset to income and the debt service to income ratios do not capture the full underlying heterogeneity in liquidity constraint tightness and that studies using these proxies are likely to underestimate the role of liquidty constraints in explaining consumption responses to stimuli. Having controlled for the marginal interest rate and liquid assets, we find no evidence that surprise income realizations or expectations to future income or credit play any role.

In another line of research, Agarwal et al. (2007) show, using credit card data, that consumers initially increased payments on credit card debt but soon after increased spending following the 2001 US income tax rebate. Similarly, Agarwal and Qian (2014) use credit and debit card data and find that those with low bank balances and credit card limits respond more strongly to a Singaporean stimulus policy. The focus on credit card use is interesting because credit cards are likely to be the source of credit that carries the highest marginal cost of liquidity. The high frequency of the credit card data makes it possible to follow the short term dynamics of spending, but the Agarwal et al. and Agarwal and Qian studies do not have data on other household assets and spending and do not measure the cost of liquidity directly.

The next section presents details of the Danish fiscal stimulus reform. Section 3 shows why liquidity constraint tightness may vary across households and how this leads to heterogeneity in consumption responses. The following sections introduce the data and present the results. The final section concludes.

# 2 The Danish fiscal stimulus policy

On March 1, 2009, the centre-right Danish government announced a major fiscal stimulus policy initiative, aimed at stabilizing the Danish economy in the midst of the financial and economic crisis: The Special Pension (SP) payout. The SP scheme was introduced in 1998 as a compulsory individual pension account, into which everyone earning income in Denmark deposited one percent of their gross earnings. The scheme was administered by the largest Danish public pension fund ATP, everyone earned the same rate of interest on funds in the scheme, and individuals would receive their pension at age 65.[2] Payments into the scheme were suspended in 2004 and from this point no more money was paid in to the accounts. However, all individuals with an account continued to receive a personal annual statement informing about the size of the balance. The stimulus policy gave individuals the possibility of having the balance on their SP account paid out in the period from June 1 to December 31 in 2009, and the payout was to be taxed at 35 percent for the first 15,000 DKK (approximately 3,000 USD) and at 50 percent beyond 15,000 DKK, reflecting that all pension benefits are taxable in Denmark.

The stimulus policy was noteworthy for several reasons: First, by allowing individuals to withdraw a part of their own pension funds that would otherwise be unattainable until age 65, the stimulus payment received by an individual would be financed by a corresponding reduction in the person's pension wealth rather than government borrowing and future tax increases. The stimulus policy therefore preserved Ricardian equivalence at the individual level: Having the money paid out and used for present spending would restrict future spending possibilities of the individual with certainty.[3]

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[2]If the balance was less than 15,000 DKK it would be paid out as a lump-sum and taxed at 40 percent. If the balance was bigger than 15,000 DKK it was to be paid out in rates over ten years and taxed as income. In 2009 the marginal income tax rate for people earning less than 377,000 DKK was 43.5 and it was 62.8 for people with incomes above this level. For more details about the income tax system in Denmark, see Kreiner, Leth-Petersen, Skov (2016). The SP balance was a supplement to other types of retirement income/savings. Generally, the Danish pension system consists of three components: a state-provided defined benefit (DB) plan (corresponding to Social Security in the United States), employer-provided defined contribution accounts (corresponding to 401(k)s in the United States), and individual retirement accounts (corresponding to IRAs in the United States). For more details, see Chetty et al. (2014).

[3]For most people the taxation of the SP payout was slightly more favorable than the original taxation

Second, the stimulus policy initiative was unanticipated. This can be seen from Figure 1, which shows the number of mentions of the words "SP" and "pension" in all Danish media, electronic and print, from October 2008 to June 2009. The early spikes are due to reports that the government first proposed and then abandoned plans to reinstate payments into the SP accounts as part of the 2009 government budget proposal, and the small blip in early February concerned media reports on capital losses on accumulated SP savings following the financial crisis, after which there was no mention of the SP scheme until March 1, 2009. Because the policy was unanticipated, variation in marginal interest rates across consumers prior to the announcement is not influenced by the change in liquidity due to the payout.

Third, the policy was transparent. All account holders received a personal letter, shown in Figure A1 in the appendix, from ATP with a pre-filled form including the account balance on May 1, 2009. To have the balance paid out, account holders should sign a slip and return it in an enclosed, stamped envelope. The money would then be transferred directly to the holder's main bank account, already on file. Out of the 2,603,565 individuals with an SP account, corresponding to 70 percent of the adult population ($\geq 25$ years), 94 percent chose to have their funds paid out. Almost 85 percent of account holders had their funds paid out within the first month after the release date.

Fourth, the stimulus was large. The average account balance was 14,924 DKK (approximately 3,000 USD). The average gross payout was 15,447 DKK and the corresponding average payout net of taxes was 9,536 DKK (approximately 1,900 USD). In comparison, the 2008 US tax rebates were between \$300 and \$600 per adult and \$300 per dependent child (Parker et al., 2013). The total sum paid out was 23.3 billion DKK net of taxes, equal to 1.4 percent of GDP.

< Figure 1 >

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of the SP funds, and it was most favorable to people with large balances combined with high income.

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# 3 A simple theory of liquidity constraint tightness and consumer responses to stimulus policy

This section illustrates within a basic two-period model why consumers may face different marginal interest rates prior to a stimulus reform and how such variation in liquidity constraint tightness may generate differences in spending responses to a stimulus policy.

The intertemporal budget constraint of a consumer is illustrated by the solid piecewise linear budget line in Panel A of Figure 2, where $c_1$ and $c_2$ are the consumption levels in the two periods. The consumption level in period one is given by

$$c_1 = y_1 + d, \tag{1}$$

where $y_1$ denotes cash-on-hand equal to current income and liquid wealth, while $d$ is consumer debt at the end of period one (or savings if $d < 0$). We assume for simplicity that the rate of return on all types of savings is constant and equal to $\tilde{r}$, implying that the intertemporal consumption trade-off faced by the consumer is $-(1 + \tilde{r})$ when $d < 0$, as illustrated by the first part of the budget line in Panel A. We assume that loans carry a higher interest rate and that the interest rate on a new loan $r(d)$ is (weakly) increasing in the existing level of consumer debt $d$, reflecting a higher risk of default and a lower level of collateral at higher debt levels. This implies that the intertemporal trade-off faced by the consumer increases as he raises his consumption level in period one, illustrated in the figure by the slope of the budget line changing from $-(1 + r_1)$ to $-(1 + r_2)$ and to $-(1 + r_3)$ as $c_1$ increases.

< Figure 2 >

The consumer also owns illiquid wealth in period one, which is not accessible before period two, e.g. a positive balance on pension accounts that cannot be withdrawn or used as collateral for loans. The consumption level in the second period then becomes

$$c_2 = y_2 + (1 + \tilde{r}) a_1 - (1 + \bar{r}) d, \tag{2}$$

where $y_2$ is earnings and other non-capital income, the second term is the value of illiquid wealth carried over from period one, and the third term reflects the value of debt/savings from period one where

$$\bar{r} \equiv \begin{cases} \left( \int_0^d r(h)\,dh \right)/d & d \geq 0 \\ \tilde{r} & d < 0 \end{cases}, \tag{3}$$

is the *average* interest rate on consumer debt/savings. Note that it is important to distinguish between the *average* interest rate $\bar{r}$ and the *marginal* interest rate $r(d) \gtreqless \bar{r}$, defined as the interest rate on marginal liquidity and determining the slope of the budget line in Figure 2.

We assume consumer behavior is governed by a standard homothetic utility function $u(c_1, c_2)$.[4] In an interior optimum, illustrated in Panel A for different types of preferences by the points **X**, **Y** and **Z**, the choice of the consumer is characterized by a standard tangency condition derived from equations (1)-(3):

$$\text{MRS}\,(c_1/c_2) \equiv \frac{u_1\,(c_1, c_2)}{u_2\,(c_1, c_2)} = 1 + r(d), \tag{4}$$

where the marginal interest rate $r(d)$ depends on the consumption choice (through $d$), and where the marginal rate of substitution (MRS) is a function only of relative consumption levels $c_2/c_1$ because of the assumption of homothetic preferences. Note that the optimum condition (4) may be rewritten as

$$\text{MRS}\,(c_1/c_2) = (1 + \tilde{r})\,(1 + \psi), \quad \psi(d) \equiv \frac{r(d) - \tilde{r}}{1 + \tilde{r}},$$

where $\psi$ is the shadow price of liquidity linked to the interest rate wedge between borrowing and lending rates (Browning and Lusardi, 1996). It shows that a high marginal interest rate of the consumer is equivalent to a tight liquidity constraint reflected by a high shadow price of liquidity.

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[4]Within the class of homothetic utility functions the specification $u(c_1, c_2) = c_1^{1-\theta}/(1-\theta) + \beta c_2^{1-\theta}/(1-\theta)$ is commonly used in consumption theory and macro economics, where $\beta$ is the subjective discount factor while $\theta > 0$ is the coefficient of relative risk aversion. In addition, note that since our focus is on predicting consumer behavior, this utility function may be different from the utility metric determining the well-being of the consumer, due to present bias or other types of behavioral effects, without affecting the results.

The optimum of the consumer may also be at one of the kinks at the budget line such as **Q** without any tangency of an indifference curve. In this case, we define the marginal interest rate as the interest rate on the marginal existing loan of the consumer (captured by the slope of the budget line to the left of the kink point), corresponding to what we may observe empirically. Note that a kink exists only because of an interest wedge implying a positive shadow price on liquidity.

Now consider a fiscal stimulus policy that allows the consumer to transfer a certain amount of illiquid wealth $a_1$ to cash-on-hand wealth $y_1$. We assume that the permitted transfer amount is small compared to total wealth, allowing us to approximate the effect of the reform by a marginal change $dx$. This gives the consumer the opportunity to change the allocation of wealth between liquid and illiquid wealth according to

$$dy_1 = -da_1 = dx. \tag{5}$$

The welfare gain of the consumer from doing this, measured in period-two consumption units, is equal to the interest wedge $r(d) - \tilde{r} \geq 0$, and the gain is therefore increasing in the liquidity constraint tightness faced by the consumer.[5]

The consumption response to the reform is found by differentiating equations (1)–(4) with respect to $x$ and using the relationship (5), which gives

$$\frac{dc_1}{dx} = \begin{cases} \frac{r(d) - \tilde{r}}{1 + r(d) + c_2/c_1} & tangency \\ 1 & kink \end{cases}. \tag{6}$$

This result is illustrated in Panel A of Figure 2. The reform expands the budget set of the consumer as illustrated by the gray curve. From expressions (1)–(3), it follows that the horizontal movement equals $dc_1/dx|_{dc_2=0} = (r(d) - \tilde{r})/(1 + r(d))$, showing that the budget set is expanded only at points where the consumer is liquidity constrained, $r(d) > \tilde{r}$, and that the expansion is larger, the higher the marginal interest rate. The consumption response to the stimulus policy is illustrated for different types of consumer preferences. Consider first a person with indifference curves represented by $I_1$ and $I_2$,

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[5]This is based on an interior solution and is derived by differentiating utility and using the first order condition (4). For individuals at a kink point, the incentive is larger because MRS$>1+r(d)$.

where the optimum before the reform is point **Y**. With homothetic preferences, MRS is constant along a ray from the origin, implying that the new optimum is at **Y'**. A more impatient person is at **Z**, with a higher marginal interest rate before the reform, and moves to **Z'**, which gives a larger immediate consumption response to the stimulus policy. On the other hand, a person at point **X** where $r(d) = \tilde{r}$ does not respond at all to the reform. This illustrates why variation in marginal interest rates may predict consumption responses to stimulus reforms.

Next, consider the consumers who are initially at one of the kinks such as point **Q**. In this case, the stimulus policy moves the consumer to point **Q'** and the propensity to spend is 1. While such kinks exist only if there is an interest wedge, and therefore when liquidity constraints are present, they do not necessarily imply a positive association between the propensity to spend and the marginal interest rate. For example, we may observe a high propensity to consume for individuals with a low interest rate if many of them are at a kink. However, if the share of individuals at kinks is larger among individuals with higher marginal interest rates, then this implies that the average propensity to spend is increasing in the marginal interest rate across households.[6]

In Panel A differences across consumers in marginal interest rates arise because of preference heterogeneity. Differences in marginal interest rates may also arise because of heterogeneity in the budget set. For example, one consumer may receive the main part of life time income in period one and save funds for period two consumption, while another consumer may receive the main part of life time income in period two and borrow money in period one. This is illustrated in Panel B of Figure 2 where household **A** has all life time income in period one while household **B** has a large part of life time income in period two. This implies that household **A** faces the intertemporal trade-off $1+\tilde{r}$ everywhere, while the trade-off is larger for household **B** when borrowing money. With identical preferences and

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[6]The evidence indicates that there is a negative association between the size of loans and the interest rate paid on them in people's loan portfolio (see electronic appendix EA.1). When the loan size is small then few of the individuals observed at this loan segment will, ceteris paribus, be at an interior tangency point. This observation suggests that individuals with high interest rates are more likely to be at a kink point.

no credit market imperfections both households would attain the consumption levels at **X**, but because **B** faces a higher marginal interest, she obtains only the consumption level at **Y**. The stimulus policy does not have any impact on the budget set of household **A** but expands the budget set of household **B** and moves the optimum from **Y** to **Y'**, thereby increasing current consumption. In this case, we therefore also get a positive relationship across households between liquidity constraint tightness and consumption responses to the stimulus policy.

To conclude, heterogeneity in preferences (patience and risk aversion) and in timing of income may generate variation in marginal interest rates across consumers, and this variation in liquidity constraint tightness can predict differences in consumption responses to fiscal stimulus policy. The model studied is very simple. For example, it does not include uncertainty. It is also unable to explain why some people have money on a low-interest rate deposit account and at the same time a loan carrying a high interest rate (the credit card puzzle). In this case, we assume in the empirical application that the marginal interest rate of the consumer is the interest rate on the loan, but we also provide different types of sensitivity analyzes in this regard.

# 4   Data

The measurement of consumer spending responses to the stimulus policy is based on survey data collected in January 2010 for a random sample of persons with SP savings. For that purpose, we commissioned a survey company (Epinion A/S) that asked individuals about their response to the SP release. The survey data are joined at the individual level with third-party reported administrative register data from the Danish Tax Agency (SKAT) containing information about loans, deposits and interest payments, used to compute marginal interest rates, as well as a host of background information from other administrative registers.

## 4.1 Survey data and the spending response to the stimulus policy

The window of the SP release ended on the 31st of December 2009. Shortly thereafter, in weeks 4-7 in 2010, we issued a telephone administered survey where we asked about the use of the SP funds. Each interview lasted 10-12 minutes and covered 40 questions about the SP policy and a range of other topics. The questions about the SP policy were placed in the beginning of the interview and were followed by questions about the respondents' financial situation and expectations regarding the future. In the survey we asked respondents about their SP account balance, whether the money was withdrawn and finally the following question:[7]

> The sum of money that you have at your disposal is the sum of money that you have available for spending, saving, and reducing your debt. The SP payout increased the amount that you have at your disposal in 2009. Considering this increase, how did you allocate it:
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> - to increase spending (for example on food, traveling, clothes, televisions, cars, home appliances, computers, restaurants, maintaining the house, or other types of spending);
>
> - to increase your free savings (i.e. putting money in the bank, buying shares, bonds, or other securities);
>
> - to reduce your debt;
>
> - to increase your pension savings?

Respondents were sampled randomly from the entire set of SP account holders. The response rate in the survey is 50 percent when including item-nonresponses among nonrespondents, resulting in 5,038 completed interviews where the respondent decided to take out the SP balance.[8] 173 respondents did not take out the SP funds. We know the

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[7]The question is inspired by Shapiro and Slemrod (1995, 2003). In section 5.1 we validate the survey answers against register data.

[8]Two data sources that have been used extensively for measuring the effect of stimulus policies in the US are the CEX and the Michigan Survey of Consumers. The response rate in the CEX is 70-75 percent

identity of non-respondents and we are therefore able to characterize differences between respondents and nonrespondents in terms of the variables available in the population-wide administrative registers. In Appendix Table A1 we show that nonrespondents are on average slightly younger, slightly more likely to be single, renters, have lower income, and smaller SP accounts. These differences are statistically significant but quantitatively small.[9] Based on the 2008 characteristics observed in the administrative registers, we have estimated the propensity to participate in the survey and recalculated our estimates weighting with the inverse of the probability that the observation is included. If the participation decision is adequately captured by these characteristics used for estimating the propensity score then this would give a consistent estimate of the effect in the population. The results from this exercise (not reported) did not deviate in any important way from the results presented in the paper.

The survey question allows respondents to distribute the stimulus freely across all alternatives and in any portion they wish. We use this information to calculate a marginal propensity to spend by putting the amount spent in proportion to the total payout. Figure 3 shows the distribution of the net-of-tax payout (Panel A), the distribution of the propensity to spend (Panel B), and the relationship between the propensity to spend and the size of the payout (Panel C). The mean payout in our sample is 11.200 DKK.[10] The average propensity to spend out of the SP payout is 65 percent. However, the respondents mainly give extreme answers to the question about spending, with 63 percent indicating that they spent everything and 33 percent indicating that they spent nothing, leaving only 4 percent who spent a fraction of the payout. The smoothed regression in Panel C shows that the propensity to spend is higher among respondents with small SP accounts

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(http://www.bls.gov/cex/2012/csxintvw.pdf) and it is 40 percent in the Michigan Survey of Consumers (personal communication with the staff).

[9]The fact that we have more owners among respondents could suggest that we have more wealthy hand-to-mouth consumers, cf. Kaplan and Violante (2014), with high spending rates. However, we note that the differences are small, and that participants do not have less financial assets suggesting that they are not likely to be more prone to behave as if they are liquidity constrained.

[10]The average pay-out is slightly bigger in our sample than in the population. In appendix table A1 we compare our sample to the random sample from the population to which we sent out invitations to participate in the survey.

balances and that it declines monotonically as the payout amount becomes larger. It is, however, noticeable that the propensity to spend is significant across all levels of payout.

< Figure 3 >

## 4.2 Third party reported register data and computation of household interest rates

The register data are of three types, covering different periods and providing different amounts of detail. First, we have the register with information about SP accounts from the government pension fund, ATP. The data includes information about all SP accounts and the value of these on the 1st of May 2009. These data were used to draw the random sample of persons who were interviewed.

The second type of register data includes standard demographic information from several public administrative registers as well as information from the income-tax register for the period 1998-2009. The income tax register holds detailed information about incomes and values of assets and liabilities measured at the last day of the year. The asset and liability information that we have access to from these registers is aggregated into broad classes such as bonds, stocks, cash in banks, mortgage loans and the sum of other loans. A feature of these data is that they are organized longitudinally, enabling us to track incomesback in time for the persons in our survey. Another attractive feature is that the data are third party reported: Information about earnings is collected directly from employers and information about transfer income from government institutions, while information about the value of assets and liabilities by the end of the year is reported directly from banks and other financial institutions. The tax authorities use the income information to calculate tax liabilities and the wealth data to cross check if reported income is consistent with the level of asset accumulation from one year to the next. A recent study by Kleven et al. (2011) conducted a large scale randomized tax auditing experiment in collaboration with the Danish tax authorities and documents that tax evasion in Denmark is very limited, in particular among wage earners. This indicates that the third party reported

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information about income collected by the tax authorities is of a very high quality; see also Chetty et al. (2011) for more detailed information on the Danish income-tax data, and Leth-Petersen (2010) for a detailed description of the wealth data.

The third type of register data is obtained from the raw data files of the tax authorities and provides information about every individual deposit and loan account held by the persons included in our sample in the period 2007 to 2009. These data provide information about the value of deposits and loans at the individual account level at the last day of the year as well as interest payments over the past year.[11] We use the information from these files to calculate the realized marginal interest rate in 2008, i.e. before the SP payout was announced, for each person in our survey.

To do this, we link the interview persons to any spouses or partners and calculate an interest rate for each and every account held by the household. One may argue that mortgage loan interest rates reflect little about the marginal cost of obtaining further credits since it depends mainly on the collateral and income at the time when the loan was established. It turns out that the results are practically identical whether we include mortgage loans or not in the calculation of the marginal interest rate. The reported results are without mortgage loans. We perform the calculation at the household level to allow for the possibility that members of the household can shift funds within the household to obtain the lowest possible marginal interest rate.[12] Account specific interest rates are calculated as interest payments on loan $l$ relative to average debt on loan $l$ over the year: $r_{h,l} = \frac{R_{h,l}^{08}}{\frac{1}{2}\left[D_{h,l}^{07}+D_{h,l}^{08}\right]}$ where $R_{h,l}^{08}$ are interest payments from account $l$ for household $h$ during 2008, $D_{h,l}^{07}$ is the value of the account by the end of 2007 and $D_{h,l}^{08}$ is the value of the account by the end of 2008. We only include loans with a balance of at least 1,000 DKK. For people with loan accounts, we pick the highest calculated account-specific interest rate from a loan account if the household has at least one loan account. If the household only has deposit accounts, we pick the smallest account-specific interest rate among the calculated

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[11] We have received separate files for mortgage loans and other loans, but have otherwise no information about the types of loans that people hold. Thus, we cannot distinguish between for example credit cards, consumer loans, car loans and regular bank loans.

[12] We also performed all calculations at the individual level. This does not affect the results.

account-specific interest rates for that household. The idea is that if a household has loan accounts then the cost of liquidity is determined by the highest interest rate, whereas the cost of liquidity is given by the account where the lowest return is earned when the household has only deposit accounts.[13]

The high level of detail in these data generates significant dispersion in marginal interest rates across persons. Figure 4 plots the distribution for our sample.

< Figure 4 >

The distribution is bimodal with the area around the lower modal point dominated by households that have only deposit accounts, and the area around the upper modal point dominated by households that have loan accounts. The distribution shows that there is significant heterogeneity in marginal interest rates in our sample.

By calculating the interest rates, we potentially introduce a measurement error. However, our detailed account data includes a subset of accounts with information regarding the actual interest rates and this enables us to directly compare the calculated interest rates with the actual interest rates to get an impression of the accuracy of our imputation. Figure 5 plots the calculated interest rates against the actual interest rates for the 1,425 observations where we have an actual interest rate to match the computed marginal interest rate. The figure shows that the estimated interest rates match the actual interest rates quite well.[14]

< Figure 5 >

Many previous studies have used low levels of liquid assets as a fraction of income as an indicator for being affected by credit constraints, including Zeldes (1989), Johnson et al. (2006) and Leth-Petersen (2010). Such a measure is obviously not perfect, since people

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[13]People may be discouraged from borrowing and therefore effectively face a higher interest rate than we calculate. To check for the importance of this, we included a question in the survey, where we ask whether the respondent has had a loan application rejected. Including this in the analysis did not change the results and it was in itself insignificant.

[14]We have reproduced the entire analysis on this subsample using the actual interest rates. Estimates were practically similar, but standard errors were obviously much larger.

may have access to credit even when their financial asset holdings are low. Recently, Johnson and Li (2010) have suggested to complement this measure with the ratio of debt-service to disposable income. They show that people with a high debt-service to income ratio are more likely to be denied credit and that their consumption growth is excessively sensitive to income. In Figure 6, Panel A, we plot local polynomial regression curves of the liquid asset ratio and the debt service to income ratio on the marginal interest rate. The picture shows a clear negative relationship between the realized marginal interest rate and liquid asset holdings, and a clear positive relationship between the marginal interest rate and the debt service ratio. The three measures are thus clearly related.

According to the theory the incentive to take out the money following the release of the funds is increasing in liquidity constraint tightness. Panel B of Figure 6 shows local polynomial regressions of the three indicators of liquidity constraints on the number of days between the release date (1st of June) and the point in time where the money are paid out. It reveals that people with a high marginal interest rate, a high debt service ratio and a low liquid asset ratio on average take their funds out sooner than others.

< Figure 6 >

# 5    Empirical results

## 5.1    Comparing survey answers to third-party reports from administrative registers

A standard concern with survey questions is whether they are able to capture the variation intended. When analyzing the effects of stimulus policies, it is particularly important that the respondents understand the counterfactual nature of the questions, so that the answers reflect the causal effects of the policy. We therefore start by comparing the survey responses to net savings (comprising both savings and debt reduction), contributions to private pension savings accounts and imputed spending constructed from the administrative registers. The idea is that register data and survey data provide two potentially

noisy measures of the same object. If the noise in the two data sources is orthogonal then comparing the two measures should reveal if there is a signal.[15]

The administrative data contain information about bank deposits and bank debt (including credit card debt) recorded at the last day of the year. Net savings is hence measured as the difference in net bank assets, i.e. bank deposits minus bank debt, between time $t$ and $t-1$, and denoted $\Delta W_{it}$ for individual $i$. Pension contributions are measured directly and we denote pension contributions by $p_{it}$. Spending is not recorded in administrative data, but we construct a measure of spending, $c_{it}$, by subtracting from disposable income, $y_{it}$, the value of net savings and pension contributions, i.e. $c_{it} = y_{it} - \Delta W_{it} - p_{it}$. This imputation was proposed by Browning and Leth-Petersen (2003) who showed that it, while noisy, performs well in terms of matching the individual level expenditures in the Danish Expenditure Survey. To compare survey answers with the register based measures, we estimate equations of the following form:

$$z_{it}^R = \beta_{0t} + \beta_{1t} z_{i2009}^S + u_{it} \tag{7}$$

where $i$ is a person-identifier and $t$ indicates the year running from 2005 to 2011. $z_{it}^R$ is the measure constructed from information in the administrative registers, $z_{i2009}^S$ is the corresponding measure collected from the survey about the response to the SP payout in 2009, and $u_{it}$ is an error term. If both $z_{it}^R$ and $z_{i2009}^S$ were measured without error then regressing $z_{i2009}^R$ on $z_{i2009}^S$ should yield $\hat{\beta}_{1,2009} = 1$. A characteristic of the register based measures of net savings and imputed spending is, however, that they are quite noisy. The noise appears, for example, because the timing of spending in general is to some extent random, and this creates random variation in bank assets and debt. The survey data also contains noise, but of a different type that relates to recollection and rounding error. In practice the noise is substantial and a challenge to the exercise. We do two things to reduce the impact of these noise components. First, we normalize $z_{it}^R$ and $z_{it}^S$ on the level of the SP payout to make the scale more compact. Second, we apply a threshold approach as in

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[15]Kreiner et al. (2015) show the precise conditions under which register data can be combined with survey data at the individual level and used to validate information collected in the survey.

Chetty et al. (2014), where the dependent variable is transformed into a dummy variable $1[z_{it}^R > m(z_{it}^R)]$ where $m(z_{it}^R)$ is the mean of $z_{it}^R$. The pattern of estimates of $\beta_{1t}$ will reveal if the survey answers contain signals about actual spending/savings responses. If the answers to the survey merely reflect selection, i.e. that individuals who always have high spending/saving are the respondents who indicate spending/saving in the survey without having spent/saved any more than they always do, then estimates of $\beta_{1t}$ should be at a constant level across all the years for which equation (7) is estimated, i.e. $\beta_{1t} = \beta_{1t-1} > 0$ for all $t$. If, on the other hand, there is no selection and all respondents are of the same type then estimates of $\beta_{1t}$ should be close to zero in all years except 2009 where it should be positive, i.e. $\beta_{1,2009} > \beta_{1t} = 0$ for $t \neq 2009$. If $z_{i2009}^S$ is measured with noise, then $\hat{\beta}_{1,2009}$ will be attenuated. Hence, finding that $\hat{\beta}_{1,2009} > \hat{\beta}_{1,t}$ for $t \neq 2009$ is a strong indication that the survey measure actually carries a signal. Panel B of Figure 2 in the theory section illustrates the case where those spending/saving the most out of the stimulus are also types who generally have a higher level of spending/saving. In this case, the pattern of estimated parameters will be such that the estimated $\beta_{1t}$ parameters are positive in all years, but bigger in 2009, i.e. $\beta_{1,2009} > \beta_{1t} > 0$ for $t \neq 2009$. Estimates of $\beta_{1t}$ are presented in Figure 7.

< Figure 7 >

Panel A shows that survey responses regarding how much of the SP payout that is allocated to net savings are strongly correlated with actual net saving in the register data in 2009 but not in the other years. Panel B shows the corresponding picture for pension saving. Survey answers about the allocation of the SP payout to pension saving are clearly correlated with actual pension saving in 2009, but less so in the other years. The fact that there is still a moderate correlation between pension savings as measured in the survey in 2009 and pension savings in other years reflects that individuals who decide to allocate their payout to pension savings are types who are more likely to save in such schemes in the first place.

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Panel C shows the corresponding picture for spending. Imputed spending inherits noise from all the components entering the imputation and the estimates are therefore less precise than for net saving and pension saving. Nevertheless, the survey answers about the allocation of the SP payout to spending exhibits a stronger correlation with the imputed spending in 2009 than in the other years. As in the case of pension savings, the fact that the survey answers about spending are moderately correlated with the imputed spending in other years likely reflects that the individuals who decide to allocate their SP payout to spending are types who generally spend more than the average person in the population. This is consistent with the illustration of the theory in Figure 2, Panel B, where those spending the most out of the stimulus are also types who generally have a higher level of spending.

Overall, the conclusion is that increases in spending/saving measured in the survey correlate with increases in spending/saving in the third party reported register data, suggesting that respondents understand the counterfactual nature of the survey questions.

## 5.2   Cost of liquidity and the propensity to spend

The theory in Section 3 shows that the propensity to spend the stimulus should be correlated with the observed marginal interest rate. Figure 8 plots a local polynomial regression curve of the propensity to spend against the marginal interest rate measured in 2008. Consistent with the predictions of the theory, the figure shows a significant positive and almost linear relationship between the propensity to spend and the marginal interest rate, with a 1 percentage point difference in the marginal interest rates between individuals being associated with a 0.5 percentage point increase in the propensity to spend.

< Figure 8 >

In Table 1 we run corresponding OLS regressions and include more covariates. Column 1 reports the bivariate relationship corresponding to Figure 8. It shows that a 1 percentage point increase in the marginal interest rate is associated with an increase in the propensity to spend of 0.5 percentage points. In column 2, we include the liquid asset to disposable

income ratio and the ratio of debt service to disposable income. The parameter on the liquid asset ratio is negative and highly significant. It shows that the propensity to spend decreases by 0.06 percentage points when the liquid asset holdings are increased by an amount corresponding to 1 percent of a full year of disposable income. The parameter on the debt service ratio shows that the propensity to spend increases by 0.1 percentage points when the debt service increases by an amount corresponding to 1 percent of the annual disposable income. This parameter is, however, not significant. After including these two measures of liquidity constraints, the coefficient on the marginal interest rate decreases only slightly, to 0.4, and is still strongly significant.

< Table 1 >

In column 3 we include the size of the SP payout, the income level in 2008 and a measure of permanent income calculated as the average of incomes over the period 1998-2008. Consistent with Figure 3, Panel C, we find that the propensity to spend is decreasing in the size of the SP payout. This "size effect" is consistent with previous studies also finding that the propensity to spend is high for small payout amounts and considerably smaller for large payout amounts.[16] The parameter estimate indicates that an increase of 1 percent in the size of the payout measured relative to the annual disposable income is associated with a 1.35 percentage point lower propensity to spend. The 2008 income level does not predict spending significantly, but the measure of permanent income is significant and shows that a 1 percent difference in permanent income is associated with a 10 percentage points difference in the propensity to spend. The past variability of income and the subjective variables capturing whether people thought that their income developed better or worse than expected in 2009 do not explain the propensity to spend. Overall, the inclusion of these extra covariates affects the parameter estimate of the marginal interest rate only slightly.

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[16]For example, Hsieh (2003) finds that the propensity to consume out of (large and anticipated) payments from Alaska's Permanent Fund is smaller than the same individuals' propensity to consumer out of (small and irregular) income tax refunds.

In column 4 we include a standard set of demographic covariates. Only age of the account holder and the number of children are clearly important for explaining the propensity to spend. Older account holders have a lower propensity to spend, and account holders with children are more likely to spend, but these effects are not large. Adding ten years to the age of the account holder is associated with a two percentage points lower propensity to spend, and adding a child to the family is associated with a two percentage points higher propensity to spend. A dummy variable for having a long education is significant at the ten percent level and shows that people with a long education have a five percentage points lower propensity to spend. Adding the demographic covariates has a negligible effect on the parameter of interest.

According to the life cycle framework, agents that have a precautionary motive also adjust their behavior if they expect to be affected by constraints in the future. In column 5 we introduce a set of indicators for expected constraints. Specifically, in the survey we asked people whether they expected their chances of obtaining credit the next year to be better or worse than in the previous year. Similarly, we asked respondents about whether they expected their income to develop better or worse in the next year than in the previous year. Neither of these indicators turn out to be significant, even when testing for their joint significance. Finally, the SP release was announced at the same time as a tax reform to be implemented from January 2010 aiming at increasing incentives to work. The tax reform was fully financed and lowered the highest marginal tax rate on wage income from 63 percent to 56 percent. In the survey we asked about subjective expectations regarding the permanent effects of the tax reform on the respondent's own income, and we include two variables for this in the regression presented in column 5, but neither of these indicators are significant.[17]

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[17]Browning and Crossley (2009) find evidence that when people face liquidity constraints they cut back on durable spending. In a follow-up question we asked: *Concerning the part of the increase [in the sum of money that you have at your disposal] that you allocated for spending, did you mainly spend it on:* 1) *large items (for example televisions, cars, white goods, computers, maintaining/improving the house) or unusual items (for example travels, nice clothes, eating at restaurants)* 2) *everyday spending (for example food).* 3) *do not know.* 67 percent of the spenders indicated that they had spent the money on large or unusual items. In a set of regressions (not reported), similar to the regressions presented in Table 1 but using an indicator for having spent the money on large or unusual items as the dependent variable, we

Across the regressions in Table 1, we find that the marginal interest rate is significant, both statistically and economically, in explaining the propensity to spend the stimulus.

## 5.3   Robustness and sensitivity analyzes

This section provides additional robustness analyzes with respect to our computation of the interest rate on marginal liquidity, the specification of the empirical model and the importance of the size effect.

In constructing our measure of the marginal interest rate we assume in accordance with the theory that people always access liquidity from the account that has the lowest opportunity cost. The closest proxy to the actual marginal interest rate for borrowers is then the highest interest rate among loan accounts, and it is the lowest interest rate among deposit accounts for people who only have deposit accounts. This might not be how people actually structure their thinking about accessing liquidity. To address this concern, we have conducted a number of robustness checks. The results are shown in Table 2.

First, our approach may not describe appropriately the behavior of people with both deposit and loan accounts. It is a well-known observation that some people hold expensive debt and at the same time have cash on a low-return deposit account, the so-called credit card puzzle, which is difficult to rationalize within a standard economic model and is not captured by our simple theory. However, we are able to verify in the data whether such types exist and whether they appear to behave differently in terms of their responses to the stimulus policy. To do this, we define a group in our sample who holds both assets and debt. One practical challenge is that everyone has a salary/transfer income account to which income is transferred a day or two before the account is summarized for the tax register by December 31. We therefore label people who have a total balance on their deposit accounts corresponding to more than one month's worth of disposable income as "having a balance" on their deposit accounts. There are 1,689 individuals corresponding to 34 percent of the number of observations in this category. In Table 2, column 1 we have reproduced column 5 from Table 1. In column 2 we have estimated the same specification

confirm the results from Table 1.

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for the subsample of respondents who hold both deposit accounts and loans. Because of the smaller sample the standard errors are now larger, and the parameter estimate on the marginal interest rate is insignificant. However, it is also never significantly different from the reference case presented in column 1. In other words, there is not sufficiently statistical power to tell whether people holding both deposit and loan accounts behave differently than other people. Another way to approach the same issue is to assume that persons who have a deposit account faces a low marginal interest rate. In column 3 we therefore assume that anyone who does not have loan accounts or have both loan accounts and deposit accounts with a total balance corresponding to at least one month's worth of disposable income faces a marginal interest rate of zero. This approach does not drop any observations and is hence not subject to loss of statistical power. The results show that the marginal interest rate in this case clearly predicts the propensity to spend, and that the parameter estimates are always within two (even one) standard deviations from the reference model in column 1.

It may also be that people have a range of accounts and that they do not order the accounts based on their liquidity costs in the way we assume. This could be behaviorally motivated or motivated by differences in convenience or transaction costs associated with accessing different accounts. In column 4 we have included a measure of the range of interest rates calculated across all the accounts, including mortgage loans, held by each individual in our sample. We calculated an interest range measure for all and allocated a range equal to zero for the 6 percent of the respondents with no spread or who are only recorded with one account. The interest rate range turns out to be almost linearly related to the marginal interest rate, i.e. that individuals with a large range of interest rates are also the individuals who have high marginal interest rates according to our definition of the marginal interest rate. When including the interest rate range as an additional regressor, column 5, we find that the parameter on the marginal interest rate is not significantly different from the original estimate.

According to the theory, the marginal interest rate should be better at predicting the

stimulus response than the average interest rate. In Table 2, columns 6-7, we compare the ability of the average and the marginal interest rate to predict the spending response. To do this, we calculate a balance-weighted average interest rate by calculating account specific interest rates and averaging across all accounts while weighting with the account balance. Column 6 reproduces column 1 using the balance-weighted average interest rate instead of the marginal interest rate. The average interest rate turns out to be significant and it attains an order of magnitude similar to the reference estimate using the marginal interest rate, cf. column 1. However, this may just reflect the strong correlation between the average and the marginal interest rates. In column 7 we include both the average and the marginal interest rate. In this case, the marginal interest rate is significant and the average interest rate is insignificant.

Estimations are based on OLS, and this can potentially lead to biased estimates as most responses are either 0 or 1. To make sure that potential misspecification is not driving the results, we have also reproduced the results using probit and tobit estimators, which did not affect results (reported in Table EA.2 in the electronic appendix). Furthermore, the specification presented in Table 1 includes linear terms only. Figure 3 suggests that the propensity to spend may be nonlinearly related to the size of the SP payout. Another concern might be that the realized marginal interest rate is just picking up variations in income across the persons/households in our sample. To address these concerns we repeated the estimations including up to 4th order polynomials in the size of the SP payout, in all the income variables, and in age. The inclusion of the polynomials affects the results only marginally. Results are reported in Table EA.3 in the electronic appendix. We also did an analysis where the sample was split into four groups according to the income quartiles in 2008 and carried out regressions corresponding to column 5 in Table 1 separately for each of these four sub-groups. The estimated effect of the interest gradient is almost identical across the four subsamples confirming the observation that income is not a strong proxy for liquidity constraints; these results are not reported but available upon request. As an additional robustness check, we included respondents who did not

take out the SP funds as non-spenders. This did not affect the results either (cf. Table EA4 in the electronic appendix).

The average propensity to spend out of the stimulus was 65 percent according to our survey, consistent with recent stimulus studies by Parker et al. (2013), Broda and Parker (2014), and Agarwal and Qian (2014).[18] Figure 8 suggests that the propensity to spend is relatively high among individuals observed to have a low realized marginal interest rate in 2008, even though the theory predicts low responses in this case.[19] This suggests that while liquidity constraints may be important in explaining the response, there are arguably other factors that are also important for explaining the response. The evidence in Sections 4.1 and 5.2 indicates that the size effect is important, i.e. the propensity to spend is decreasing in the size of the SP payout.

To get further insight into the importance of a size effect, we repeated the survey in January 2012 and asked hypothetical questions about what the spending response would have been if the SP payout had been 1,000 DKK, 10,000 DKK or 100,000 DKK (in random order). The follow-up survey included 3,118 persons from the original survey and was supplemented with randomly selected new respondents to reach a total of 5,866 respondents. We then matched these responses with the marginal interest rates from 2008 that we used in Figure 8. The results are presented in Figure 9. They show that the intercept, i.e. the spending response at a zero interest rate, varies considerably with the size of the hypothetical payout. Changing the size of the hypothetical pay-out from 1,000 to 10,000 to 100,000 changes the intercept from 60 percent to 40 percent to 25 percent. While we do not claim that this exhausts the list of explanations, these findings suggest that the level of the response is clearly affected by the size of the payout. This analysis is not conclusive. The 100,000 DKK question may be considered so different from the

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[18]In a supplementary analysis we investigate whether the infusion of liquidity is associated with a reduction of the marginal interest rate among people with loans. The results indicate that the payout is not associated with a change in the marginal interest rate. In the survey, 10 percent indicate that they allocate the payout to reduce their debt. We do not find any effect for this group either. These results are available upon request.

[19]As noted earlier, 67 percent of the spenders indicate that their spending is mainly on large or unusual items. To the extent that such items are durable goods, actual consumption in 2009 will be lower.

actual payout that it is not comparable. Also, the level of stated spending does not match the level of spending in Figure 8. This could be related to the hypothetical nature of the question or to the fact that the hypothetical questions were asked two years later than the original questions. However, the 2008 marginal interest rate gradient that we observe for the actual outcome in Figure 8 appears in all panels of Figure 9 as well.[20] It is also interesting to note, that the rate of extreme responses (i.e. a spending share equal to either 0 or 1) declines with the size of the amount: the fraction of extreme responses is 0.95, 0.83 and 0.49 for the 1,000, 10,000, and 100,000 hypothetical pay-out questions. This suggests that at least part of the reason for the high rate of extreme responses in the survey, cf. Figure 3, is related to the size of the pay-out.

< Figure 9 >

# 6  Conclusion

Liquidity constraints have been the leading explanation for the observation of positive spending responses in the literature studying the effects of fiscal stimulus policies. This paper studies the effects of a Danish 2009 stimulus policy that transformed illiquid pension wealth into liquid wealth, available for spending. The overall spending effect of this policy of "giving people their own money" is significant: 65 percent of the respondents in our survey indicate that they spent the money. Aggregating the survey responses suggests that the stimulus policy had an aggregate spending effect of about 1.8 percent of total private spending equal to 0.9 percent of GDP. In interpreting these numbers, it should be noted that the stimulus policy was introduced during a credit crunch. The results may therefore be specific to this particular environment, and the spending effect of the policy might be smaller in a normal business cycle situation where people are less credit constrained.

We examine the payout in the context of basic consumption theory where variation across consumers in preferences and budget sets creates variation in the interest rates that

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[20]We also performed the exercise for the subsample of 3,118 persons who participated in the original survey and found the same results.

consumers face on marginal liquidity. The theory predicts that this variation in liquidity constraint tightness predicts consumption responses to stimulus policy. We test this proposition directly by merging, at the individual level, survey data concerning consumption responses to a stimulus policy with third-party reported information from income-tax registers about all individual deposit and loan accounts held by our survey respondents before the reform. We find that marginal interest rates vary a lot across people, and consistent with the theory we find that the marginal interest rate is a robust predictor of the propensity to spend out of the stimulus: a 1 percentage point difference in the interest rate between consumers is associated with a 0.3-0.5 percentage point difference in the propensity to spend. Our results suggest it is possible to measure spending responses using survey techniques and that future studies will be able to quantify the effect of liquidity constraints better by including information about the marginal interest rate that people face. If not available through administrative data such information can be collected in surveys by including questions about the interest rates that people pay on their loan and deposit accounts. We also find large spending responses for people who are unlikely to be affected by liquidity constraints, which suggests that other factors, including size effects, are arguably also important drivers of spending responses. Learning more about other factors driving spending responses is an important objective for future research.

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# Figure 1: Newspaper coverage of the SP scheme
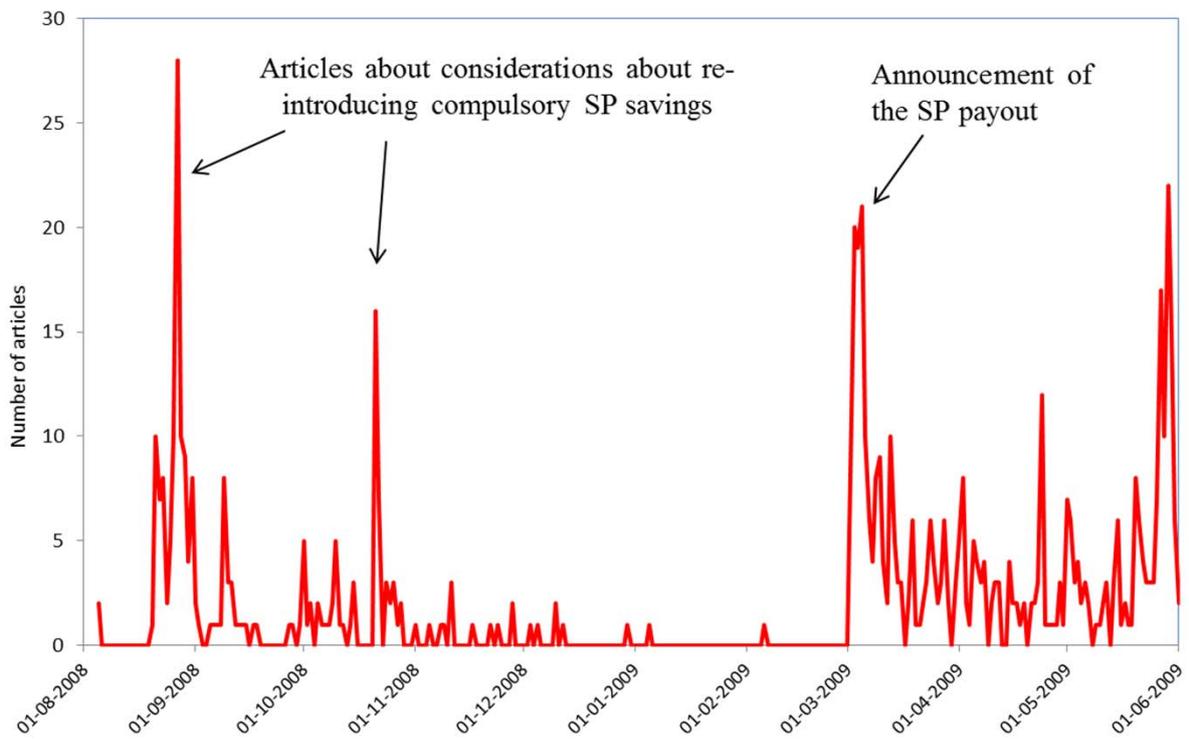


Notes: The graph displays number of articles about the SP savings scheme in national newspapers over time. Data is obtained from Infomedia.

# Figure 2: Marginal interest rates and the response to stimulus policy

**A. Preference heterogeneity**



**B. Budget set heterogeneity**
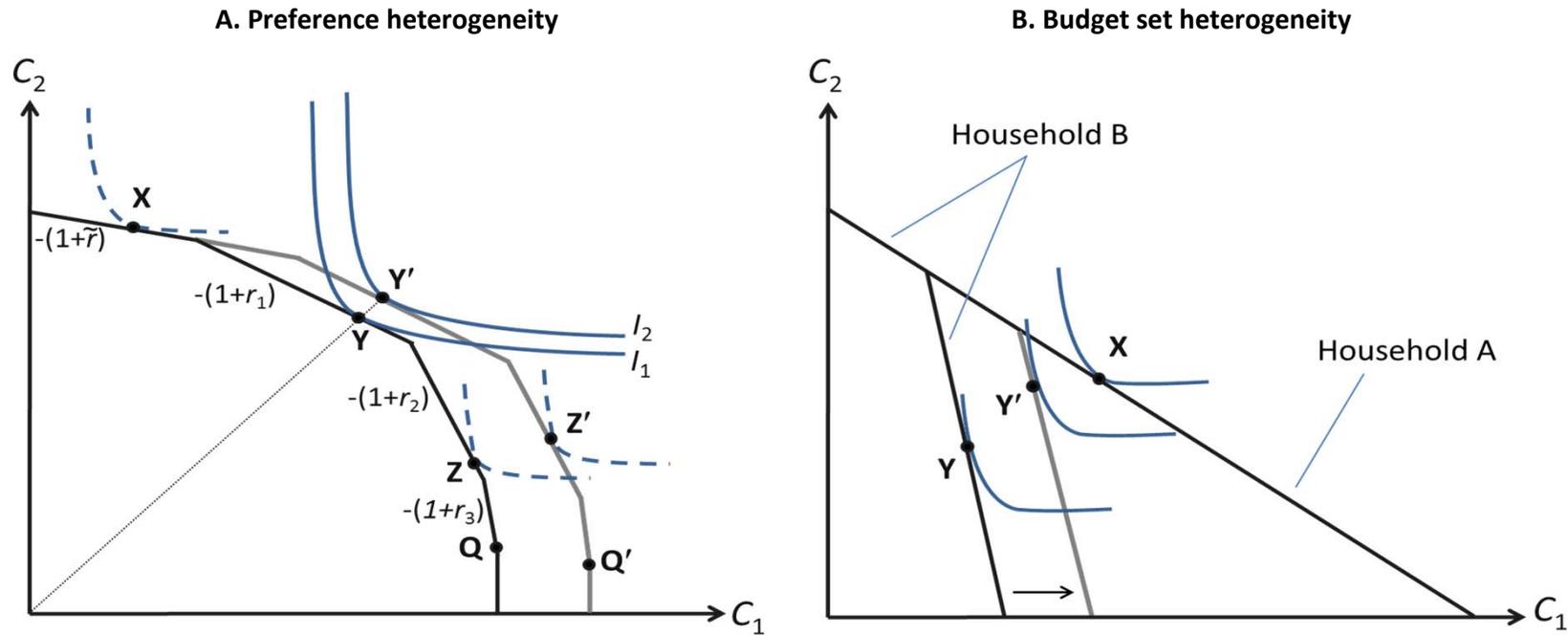


Notes: The figure illustrates how the marginal interest rate and the consumption trade-off faced by the consumer may change with the consumption level in period 1. The figure also shows how heterogeneity in preferences (Panel A) and in budget sets (Panel B) across consumers may lead to variation in marginal interest rates, which predicts consumption responses to stimulus policy. Panel A illustrates the choices of three types of consumers with different indifference curves. Panel B illustrates the choices of two types of consumers where household A receives all lifetime income in period one, while household B only receives a small fraction of lifetime income in period one. The budget lines prior to the stimulus policy are black, while the budget lines following the stimulus policy are gray.

**Figure 3: SP payout and the propensity to spend: distributions and correlation**

A. SP payout

Fraction (%)

SP payout (1000 DKK)

B. Spending

Fraction (%)

Propensity to spend (%)

C. Correlation

Propensity to Spend (%)

SP payout (1000 DKK)
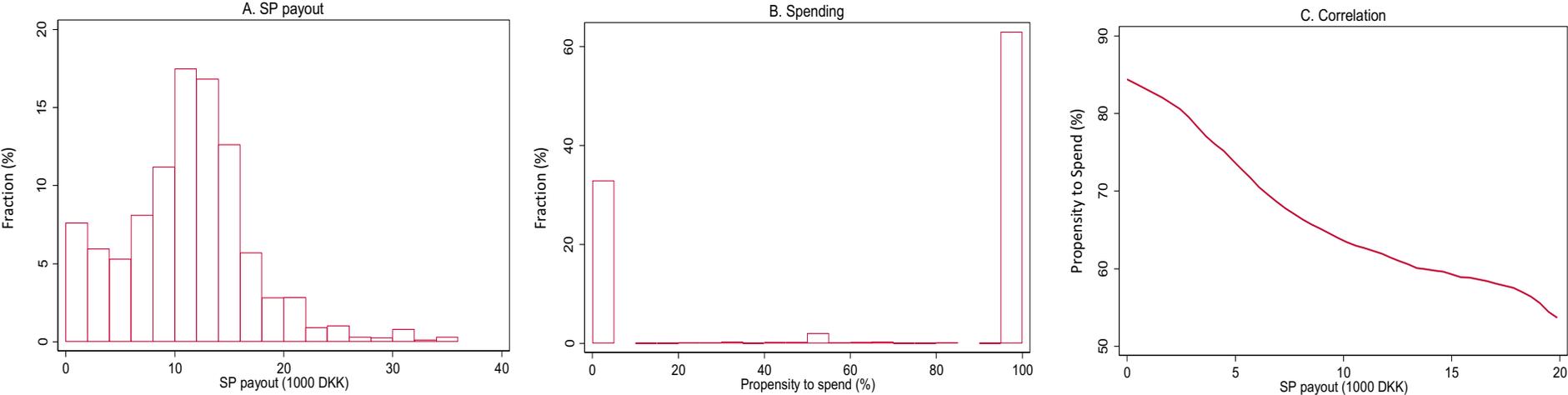
Notes: Panel A shows the distribution of SP payout after taxes. Panel B shows the distribution of the spending share of the SP payout. Panel C draws a local polynomial regression of the propensity to spend on the SP payout. Observations: 5038.

# Figure 4: Distribution of marginal interest rates across households
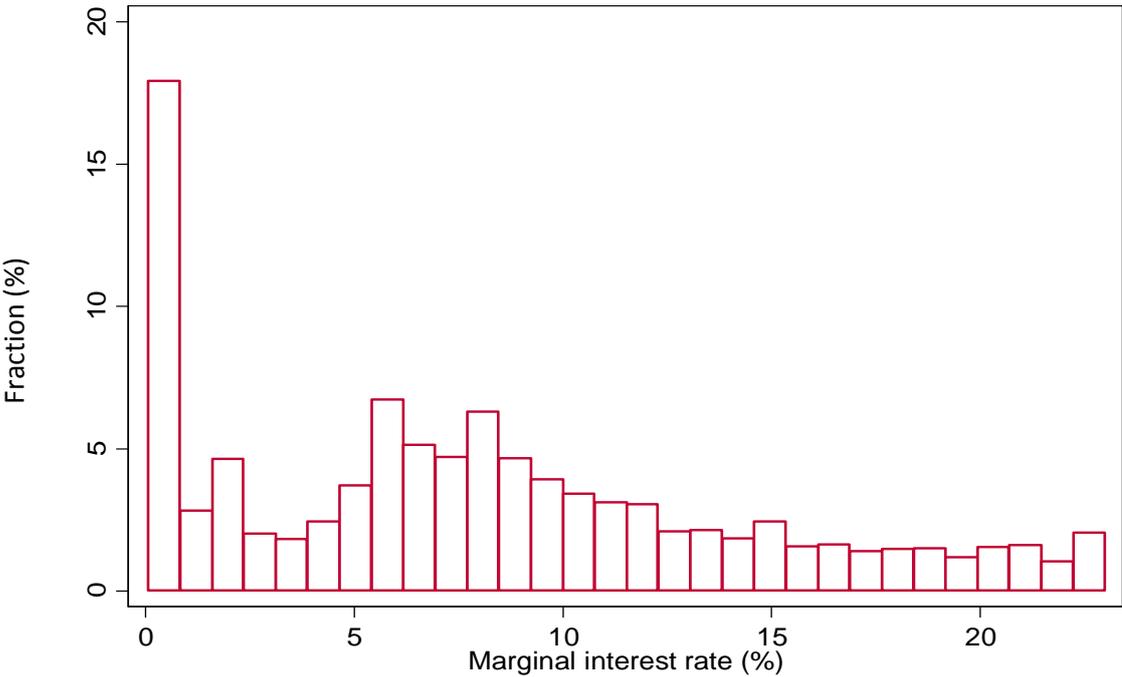


Notes: The figure shows the distribution of the marginal interest rates across households. The marginal interest rate denotes the interest on marginal liquidity and is computed from register data on all loan and deposit accounts of the household. The details of the computation are described in the text. Observations: 5038.

**Figure 5: Calculated interest rate and corresponding reported interest rate**
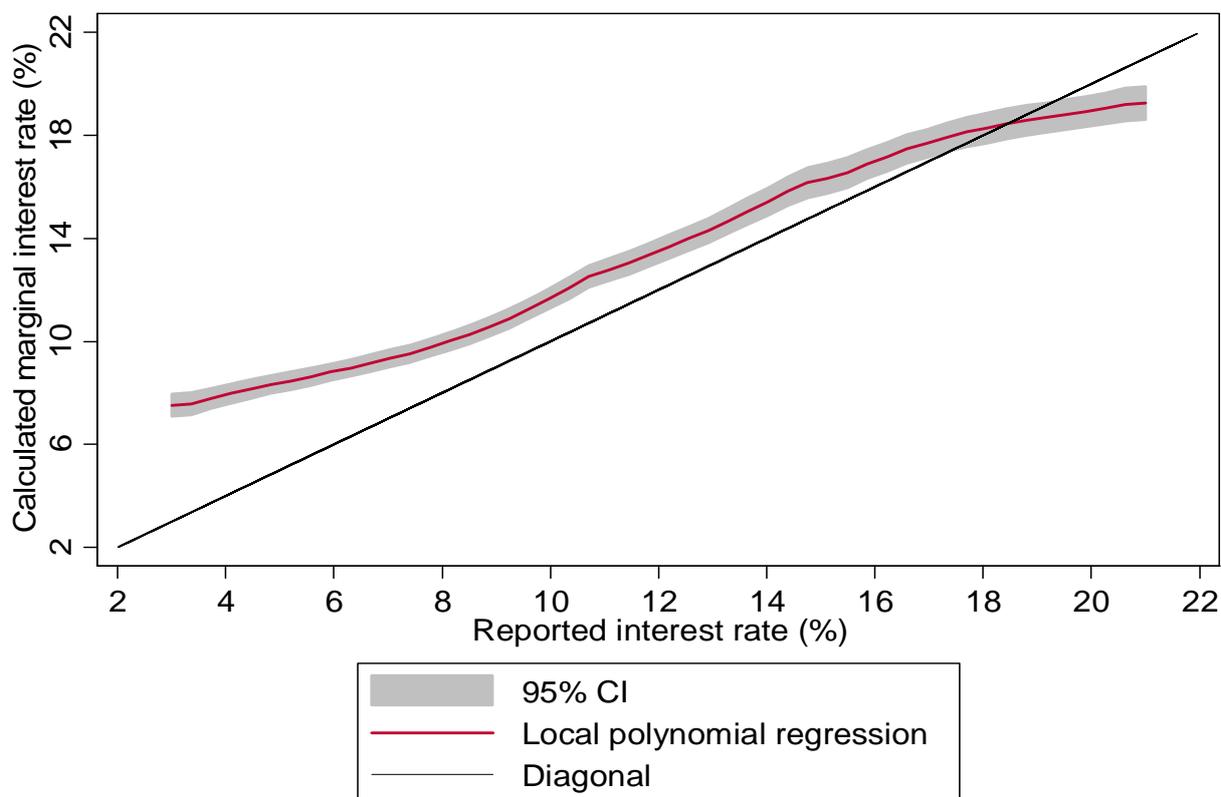


Notes: The figure shows the result from a local polynomial regression of the computed marginal interest rate on the interest rate reported on the loan by financial institutions for a subsample where this information exists. The marginal interest rate denotes the interest on marginal liquidity and is computed from register data on all loan and deposit accounts of the household. The details of the computation are described in the text. Observations: 1425.

# Figure 6: The relationship between different indicators of liquidity constraints
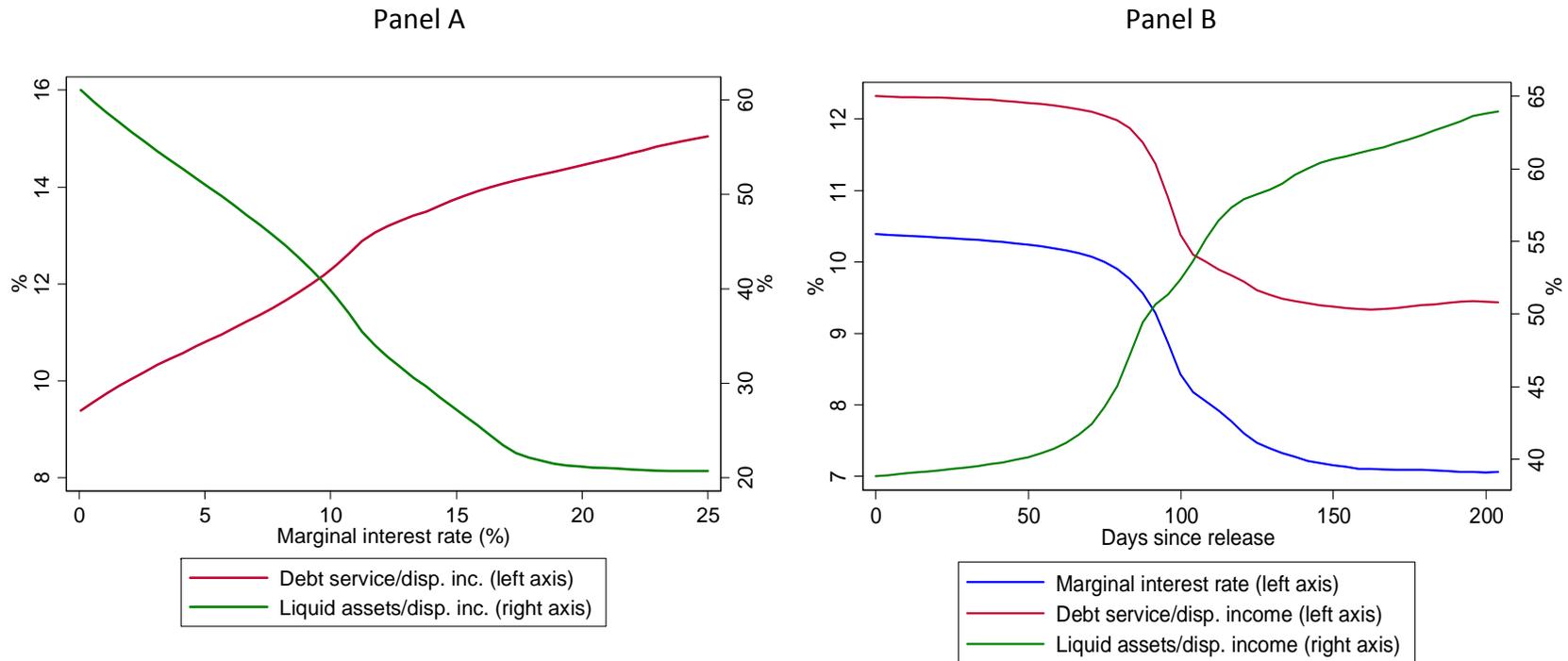
Panel A

Panel B



Notes: Panel A shows local polynomial regression curves of the liquid asset ratio and the debt service to income ratio on the marginal interest rate. All three variables are measured in 2008. Panel B shows local polynomial regression curves of the three indicators of liquidity constraints on the number of days between the SP release date (1st of June) and the date where the money was paid out. The marginal interest rate denotes the interest on marginal liquidity and is computed from register data on all loan and deposit accounts of the household. Debt service denotes total interest payments on loans. Liquid assets include deposits, shares and bonds. Observations: Panel A: 5038. Panel B: 4899.

# Figure 7: Comparing survey and register data measures of net savings, pension saving and spending



Notes: The sample used for generating these figures omits self-employed persons as well as persons with a SP payment smaller than 1,000 DKK or under 25 years of age.  The panels show estimates of the slope parameter $b_{1t}$ from equation (7) $z^R_{it} = b_{0t} + b_{1t}\, z^S_{i\,2009} + u_{it}$ for t=2005,…,2011, estimated separately for each $t$ . $z^R_{it}$ is net savings, pension savings, and imputed spending derived from register data, $z^S_{i\,2009}$ is the corresponding measure collected by survey for 2009, and $u_{it}$ is an error term. The dependent variable $z^R_{it}$ is transformed into a dummy variable $1[z^R_{it} > m(z^R_{it})]$, where $m(z^R_{it})$ is the mean of $z^R_{it}$ . Observations: 4353.

**Figure 8: Household propensity to spend and the marginal interest rate**
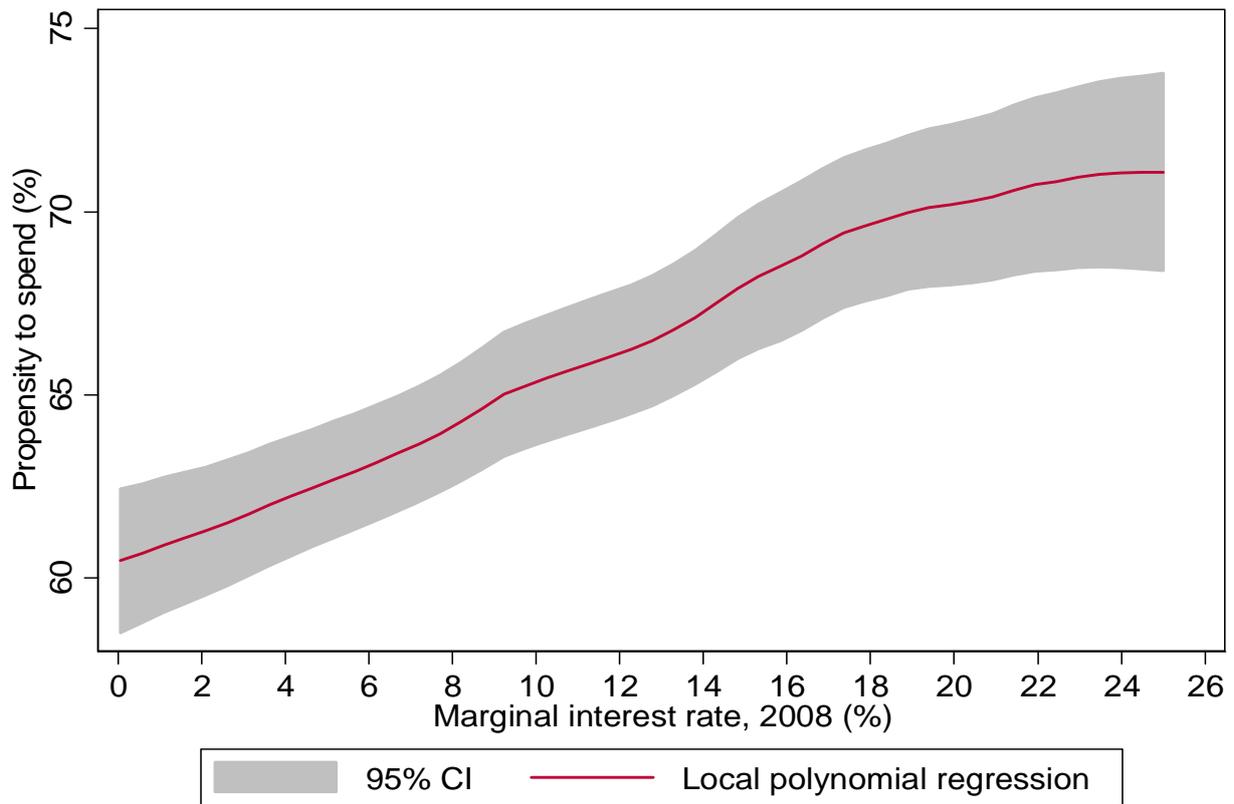


Notes: The figure shows the result from a local polynomial regression of the spending share of the SP payout on the marginal interest rate. The spending share is obtained from survey questions. The marginal interest rate denotes the interest on marginal liquidity and is computed from register data on all loan and deposit accounts of the household obtained from the Danish Tax Agency. The details of the computation are described in the text. Observations: 5038.

**Figure 9: Households' propensity to spend and the marginal interest rate for hypothetical SP-payouts**
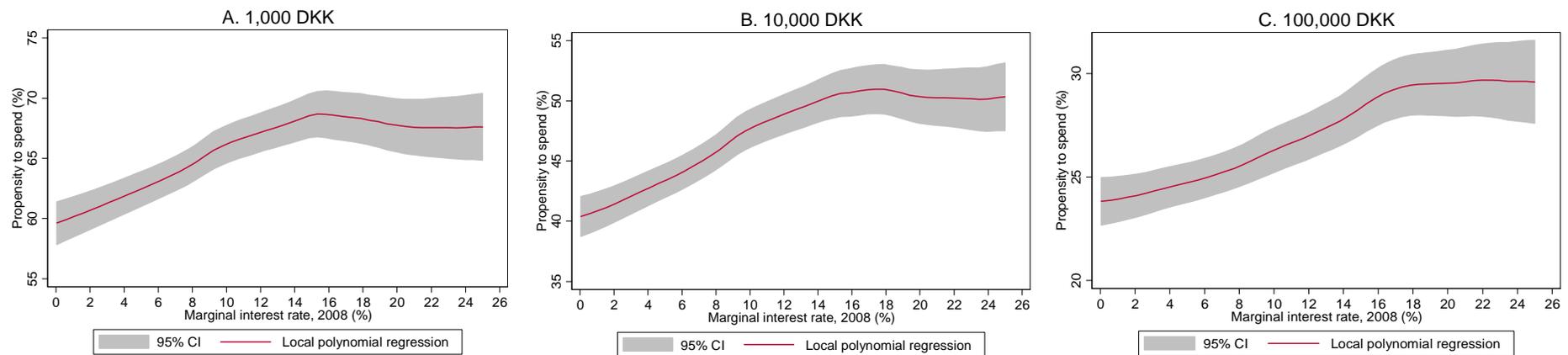


Notes: The figure shows the result from local polynomial regressions of the spending share out of a hypothetical SP payout on the marginal interest rate. The hypothetical SP payout is 1,000 DKK, 10,000 DKK and 100,000 DKK in panels A, B and C, respectively. The information on spending shares is obtained by asking respondents how much they would have increased spending if they had received a given amount in the SP payout. The marginal interest rate denotes the interest on marginal liquidity and is computed from register data on all loan and deposit accounts of the household obtained from the Danish Tax Agency. The details of the computation are described in the text. Observations: 5920.

**Table 1: Spending share in percent of SP payout regressed on covariates (OLS)**

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| **Liquidity** | | | | | |
| Marginal interest rate, 2008 (%) | 0.5388 *** | 0.3621 *** | 0.3134 *** | 0.2977 *** | 0.2961 *** |
| | (0.0810) | (0.0874) | (0.0865) | (0.0879) | (0.0879) |
| Liquid assets / disp. income, 2008 (%) | | -0.0608 *** | -0.0443 *** | -0.0320 ** | -0.0321 ** |
| | | (0.0126) | (0.0128) | (0.0132) | (0.0132) |
| Debt service / disp. income, 2008 (%) | | 0.0999 | 0.1790 *** | 0.1344 * | 0.1385 * |
| | | (0.0654) | (0.0658) | (0.0752) | (0.0756) |
| **Size effect** | | | | | |
| SP payout / disp. income, 2008 (%) | | | -1.3512 *** | -1.1905 *** | -1.1820 *** |
| | | | (0.2821) | (0.2865) | (0.2868) |
| **Income controls** | | | | | |
| Ln(income), register | | | -2.8267 | -3.2618 * | -3.1575 |
| | | | (1.9309) | (1.9704) | (1.9667) |
| Ln(permanent income) | | | -10.5039 *** | -8.1205 *** | -8.2750 *** |
| | | | (2.2886) | (2.5283) | (2.5260) |
| sd[ln(income)] | | | 0.4747 | 0.2395 | 0.2424 |
| | | | (1.7318) | (1.8547) | (1.8546) |
| Income developed better, 2009 | | | 2.0538 | 1.4139 | 2.1155 |
| | | | (1.9665) | (1.9641) | (2.0215) |
| Income developed worse, 2009 | | | -0.3434 | -0.5667 | -0.5205 |
| | | | (1.9794) | (1.9969) | (2.0965) |
| **Demographic controls** | | | | | |
| Age | | | | -0.1851 ** | -0.1742 ** |
| | | | | (0.0815) | (0.0838) |
| Woman (d) | | | | 2.1759 | 2.1612 |
| | | | | (1.3762) | (1.3784) |
| Single (d) | | | | 0.8691 | 0.8002 |
| | | | | (1.6978) | (1.6981) |
| Number of children | | | | 2.0997 *** | 2.0472 *** |
| | | | | (0.6765) | (0.6774) |
| Education, short (d) | | | | -0.5880 | -0.5498 |
| | | | | (1.6532) | (1.6535) |
| Education, medium (d) | | | | -2.2356 | -2.2316 |
| | | | | (1.9676) | (1.9670) |
| Education, long (d) | | | | -4.3433 * | -4.4116 * |
| | | | | (2.5566) | (2.5621) |
| Home owner (d) | | | | 0.2161 | 0.0456 |
| | | | | (1.8855) | (1.8884) |
| **Expected constraints** | | | | | |
| Change E[credit possibility 2010]<0, 2009 (d) | | | | | 1.0494 |
| | | | | | (1.9387) |
| Change E[credit possibility 2010]>0, 2009 (d) | | | | | -0.4980 |
| | | | | | (2.3517) |
| Change E[income 2010]>0, 2009 (d) | | | | | -1.9482 |
| | | | | | (1.7125) |
| Change E[income 2010]<0, 2009 (d) | | | | | -0.0014 |
| | | | | | (2.0672) |
| Taxreform => permanent income increase (d) | | | | | -0.9581 |
| | | | | | (1.4280) |
| Taxreform => permanent income decrease (d) | | | | | -4.1263 * |
| | | | | | (2.2021) |
| Constant | 59.6651 *** | 62.7911 *** | 235.6151 *** | 216.9308 *** | 218.2017 *** |
| | (1.0750) | (1.4730) | (18.3237) | (20.8679) | (20.8948) |
| | | | | | |
| Observations | 5,038 | 5,038 | 5,038 | 5,038 | 5,038 |
| R-squared | 0.0085 | 0.0141 | 0.0444 | 0.0493 | 0.0504 |
| RMSE | 46.47 | 46.35 | 45.66 | 45.58 | 45.58 |

Notes: The table shows the results from regressing the spending share of the SP payout on covariates. A dummy variable is indicated by (d). Robust standard errors reported in parentheses. Level of significance denoted by: *** p<0.01, ** p<0.05, * p<0.1. The spending share is obtained from survey questions. The marginal interest rate denotes the interest on marginal liquidity and is computed from register data on all loan and deposit accounts of the household obtained from the Danish Tax Agency. Liquid assets, debt service, income variables and all demographic controls are obtained from administrative registers at Statistics Denmark. Permanent income is calculated as the average of incomes over the period 1998-2008. Debt service denotes total interest payments on loans. Liquid assets include deposits, shares and bonds. Short, medium and long education correspond to vocational training, college BA level, College Master and PhD level, respectively. Individuals not in these categories have high school or less education. Information about whether income has developed better/worse than expected and about expected constraints are obtained from survey questions.

**Table 2: Spending share in percent of SP payout regressed on covariates (OLS): Robustness analyses**

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| **Liquidity** | | | | | | | |
| Marginal interest rate, 2008 (%) | 0.2961 *** | 0.2036 | | | 0.4267 ** | | 0.3650 *** |
| | (0.0879) | (0.1777) | | | (0.2051) | | (0.1245) |
| Marginal interest, deposit account rates=0 (%) | | | 0.2317 *** | | | | |
| | | | (0.0822) | | | | |
| Interest range (%) | | | | 0.2603*** | -0.1551 | | |
| | | | | (0.0942) | (0.2201) | | |
| Average interest rate, account balance weighted (%) | | | | | | 0.2934 * | -0.1665 |
| | | | | | | (0.1543) | (0.2186) |
| Liquid assets / disp. income, 2008 (%) | -0.0321 ** | -0.0181 | -0.0332 ** | -0.0367 *** | -0.0310 ** | -0.0379 *** | -0.0324 ** |
| | (0.0132) | (0.0216) | (0.0133) | (0.0130) | (0.0133) | (0.0131) | (0.0132) |
| Debt service / disp. income, 2008 (%) | 0.1385 * | 0.1981 | 0.1602 ** | 0.1557 ** | 0.1377 * | 0.1791 ** | 0.1359 * |
| | (0.0756) | (0.1280) | (0.0747) | (0.0750) | (0.0756) | (0.0740) | (0.0757) |
| **Size effect** | | | | | | | |
| SP payout / disp. income, 2008 (%) | -1.1820 *** | -0.4334 | -1.2067 *** | -1.1845 *** | -1.1821 *** | -1.1875 *** | -1.1825 *** |
| | (0.2868) | (0.5032) | (0.2868) | (0.2870) | (0.2867) | (0.2872) | (0.2865) |
| **Income controls** | | | | | | | |
| Ln(income), register | -3.1575 | 0.9845 | -3.3800 * | -3.2732 * | -3.1104 | -3.1744 | -3.1952 |
| | (1.9667) | (2.8182) | (1.9465) | (1.9749) | (1.9620) | (1.9852) | (1.9472) |
| Ln(permanent income) | -8.2750 *** | -7.2169 * | -7.9168 *** | -8.2526 *** | -8.2704 *** | -8.2525 *** | -8.2491 *** |
| | (2.5260) | (4.0266) | (2.5140) | (2.5321) | (2.5214) | (2.5394) | (2.5137) |
| sd[ln(income)] | 0.2424 | 3.2195 | 0.2792 | 0.2376 | 0.2306 | 0.2906 | 0.1834 |
| | (1.8546) | (3.1941) | (1.8524) | (1.8559) | (1.8541) | (1.8652) | (1.8558) |
| Income developed better, 2009 | 2.1155 | 3.0979 | 2.1721 | 2.1416 | 2.1237 | 2.2533 | 2.0887 |
| | (2.0215) | (3.6884) | (2.0234) | (2.0229) | (2.0214) | (2.0224) | (2.0223) |
| Income developed worse, 2009 | -0.5205 | -2.2726 | -0.4809 | -0.4930 | -0.5078 | -0.3871 | -0.5334 |
| | (2.0965) | (3.6999) | (2.0939) | (2.0952) | (2.0971) | (2.0971) | (2.0957) |
| **Demographic controls** | | | | | | | |
| Age | -0.1742 ** | -0.2526 * | -0.1733 ** | -0.1726 ** | -0.1747 ** | -0.1751 ** | -0.1729 ** |
| | (0.0838) | (0.1474) | (0.0838) | (0.0838) | (0.0838) | (0.0839) | (0.0838) |
| Woman (d) | 2.1612 | 3.8804 | 2.2147 | 2.1550 | 2.1534 | 2.1658 | 2.1337 |
| | (1.3784) | (2.4837) | (1.3793) | (1.3788) | (1.3786) | (1.3790) | (1.3785) |
| Single (d) | 0.8002 | -1.5513 | 0.4170 | 1.0470 | 0.6044 | 0.4711 | 0.8817 |
| | (1.6981) | (3.1874) | (1.6988) | (1.7113) | (1.7289) | (1.7000) | (1.7040) |
| Number of children | 2.0472 *** | 1.2756 | 1.9428 *** | 2.1078 *** | 2.0218 *** | 2.0980 *** | 2.0415 *** |
| | (0.6774) | (1.2787) | (0.6813) | (0.6775) | (0.6795) | (0.6777) | (0.6773) |
| Education, short (d) | -0.5498 | -1.6294 | -0.5851 | -0.5916 | -0.5650 | -0.7067 | -0.5474 |
| | (1.6535) | (3.0274) | (1.6543) | (1.6533) | (1.6533) | (1.6531) | (1.6536) |
| Education, medium (d) | -2.2316 | -4.6180 | -2.2907 | -2.3434 | -2.2329 | -2.3919 | -2.2875 |
| | (1.9670) | (3.4798) | (1.9701) | (1.9679) | (1.9666) | (1.9701) | (1.9684) |
| Education, long (d) | -4.4116 * | -9.8286 ** | -4.4977 * | -4.6198 * | -4.3747 * | -4.6760 * | -4.4498 * |
| | (2.5621) | (4.4022) | (2.5628) | (2.5609) | (2.5639) | (2.5653) | (2.5629) |
| Owner (d) | 0.0456 | 1.7868 | -0.2456 | -0.0687 | -0.0271 | -0.4148 | 0.0028 |
| | (1.8884) | (3.4606) | (1.8806) | (1.8911) | (1.8929) | (1.8819) | (1.8891) |
| **Expected constraints** | | | | | | | |
| Change E[credit possibility 2010]<0, 2009 (d) | 1.0494 | 6.6920 * | 0.9973 | 1.0896 | 1.0565 | 1.2041 | 1.0287 |
| | (1.9387) | (3.5777) | (1.9429) | (1.9397) | (1.9383) | (1.9386) | (1.9391) |
| Change E[credit possibility 2010]>0, 2009 (d) | -0.4980 | -1.8958 | -0.3821 | -0.4394 | -0.5153 | -0.4133 | -0.5081 |
| | (2.3517) | (4.1933) | (2.3463) | (2.3500) | (2.3526) | (2.3490) | (2.3521) |
| Change E[income 2010]>0, 2009 (d) | -1.9482 | 1.3971 | -1.8728 | -1.9365 | -1.9309 | -1.8832 | -1.9327 |
| | (1.7125) | (2.9938) | (1.7130) | (1.7124) | (1.7132) | (1.7122) | (1.7135) |
| Change E[income 2010]<0, 2009 (d) | -0.0014 | 2.0778 | 0.1051 | 0.0528 | -0.0048 | 0.1176 | -0.0066 |
| | (2.0672) | (3.7207) | (2.0659) | (2.0674) | (2.0675) | (2.0684) | (2.0673) |
| Taxreform => permanent income increase (d) | -0.9581 | -0.6257 | -1.0308 | -0.9470 | -0.9754 | -0.9747 | -0.9719 |
| | (1.4280) | (2.5649) | (1.4285) | (1.4292) | (1.4287) | (1.4297) | (1.4281) |
| Taxreform => permanent income decrease (d) | -4.1263 * | -7.4454 ** | -4.1410 * | -4.1851 * | -4.1104 * | -4.1940 * | -4.1294 * |
| | (2.2021) | (3.7389) | (2.1998) | (2.2012) | (2.2020) | (2.1998) | (2.2023) |
| Constant | 218.2017 *** | 149.7353 *** | 218.2278 *** | 219.9097 *** | 217.7916 *** | 219.2766 *** | 218.9046 *** |
| | (20.8948) | (36.6019) | (20.9480) | (20.8825) | (20.9183) | (20.9191) | (20.8832) |
| Observations | 5,038 | 1,689 | 5,038 | 5,038 | 5,038 | 5,038 | 5,038 |
| R-squared | 0.0504 | 0.0417 | 0.0497 | 0.0497 | 0.0505 | 0.0490 | 0.0505 |
| RMSE | 45.58 | 46.51 | 45.60 | 45.60 | 45.58 | 45.61 | 45.58 |

Notes: The table corresponds to Table 1. Column 1 is identical to the baseline specification in column 5 of Table 1. It shows the results from regressing the spending share of the SP payout on covariates. Column 2 reports the results from restricting the sample to households who have debt and at the same time have a total balance on deposit accounts corresponding to more than one month of disposable income. Column 3 reports the results when we set the marginal interest to zero for all individuals who have funds in a deposit account. Columns 4 and 5 report the results from including the spread between the largest and smallest interest rate on the accounts of the household (=0 if only a single account) in the regression. Columns 6 and 7 report the results from including the balance-weighted average interest rate in the regression. A dummy variable is indicated by (d). Robust standard errors reported in parentheses. Level of significance denoted by: *** p<0.01, ** p<0.05, * p<0.1.

**Table A1: Means of selected characteristics across groups of respondents and non-respondents**

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| | | **Respondents** | **t-value** | **Non-** | **t-value** |
| | **Main sample** | **no payout** | **diff. (1)-(2)** | **respondents** | **diff. (1)-(4)** |
| **Liquidity** | | | | | |
| Marginal interest rate, 2008 (%) | 9,998 | 10,276 | -0,45 | 10,21 | -1,31 |
| Liquid assets / disp. income, 2008 (%) | 41,892 | 40,934 | 0,22 | 42,20 | -0,26 |
| Debt service / disp. income, 2008 (%) | 12,199 | 10,641 | 1,78 | 11,21 | 4,24 |
| **Size Effect** | | | | | |
| SP payout / disp. income, 2008 (%) | 4,123 | 3,701 | 2,48 | 4,14 | -0,33 |
| **Income controls** | | | | | |
| Ln(income), register | 12,712 | 12,618 | 1,87 | 12,55 | 11,24 |
| Ln(permanent income) | 12,583 | 12,478 | 2,54 | 12,44 | 12,21 |
| sd[ln(income)] | 0,349 | 0,426 | -2,26 | 0,42 | -7,45 |
| **Demographic controls** | | | | | |
| Age | 45,058 | 45,699 | -0,73 | 44,67 | 1,69 |
| Woman  (d) | 0,518 | 0,503 | -0,73 | 0,48 | 3,96 |
| Single (d) | 0,219 | 0,277 | -1,84 | 0,32 | -11,41 |
| Number of children | 0,900 | 0,636 | 3,17 | 0,73 | 8,02 |
| Education, short (d) | 0,446 | 0,422 | 0,64 | 0,45 | -0,35 |
| Education, medium (d) | 0,219 | 0,156 | 1,97 | 0,15 | 8,93 |
| Education, long (d) | 0,100 | 0,116 | -0,68 | 0,07 | 6,16 |
| Owner (d) | 0,751 | 0,694 | 1,70 | 0,55 | 22,07 |
| | | | | | |
| Observations | 5038 | 173 | | 5188 | |

Notes: The table shows the mean of selected characteristics for our main sample (column 1), for survey respondents who did not withdraw the SP funds (column 2) and for survey non-respondents (column 4). Columns 3 and 5 show the t-value from a test of whether the difference to main sample is significant. A dummy variable is indicated by (d). The marginal interest rate denotes the interest on marginal liquidity and is computed from register data on all loan and deposit accounts from the Danish Tax Agency. Remaining variables are obtained from administrative registers at Statistics Denmark. Permanent income is calculated as the average of incomes over the period 1998-2008.  Debt service denotes total interest payments on loans. Liquid assets include deposits, shares and bonds. Short, medium and long education correspond to vocational training, college BA level, College Master and PhD level, respectively. Individuals not in these categories have high school or less education.