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Liquidity Constraint Tightness and Consumer Responses to Fiscal Stimulus Policy[†]

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The marginal interest rate is the price 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. This hypothesis is tested in the context of a Danish 2009 stimulus policy that transformed illiquid pension wealth into liquid wealth. Marginal interest rates are constructed from administrative records with account level information and merged with survey data measuring 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. (*JEL* D14, D15, E21, E43, E62)

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

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

We test this hypothesis directly using a novel Danish dataset 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 constraint tightness for spending responses to stimuli.

We measure the spending effect of the reform through a survey conducted in January 2010, immediately after the payout 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 2016; and Jappelli 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

[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.

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 constraint tightness is 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, Parker, and Souleles (2006) estimates the change in consumption expenditures caused by the 2001 federal income tax rebates and shows 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) measures 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) collects information about income expectations and finds 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) finds that the level of income does not predict the spending response.

In our study, we include a range of proxies for liquidity constraint tightness. 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 the marginal cost of liquidity

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, Liu, and Souleles (2007) shows, 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) uses credit and debit card data and finds 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 II 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.

I. The Danish Fiscal Stimulus Policy

On March 1, 2009, the center-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 1 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 Danish krone (DKK) (approximately US$3,000) 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

[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 10 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, and Skov (2016). The SP balance was a supplement to other types of retirement income/savings. Generally, the Danish pension system consists of 3 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).

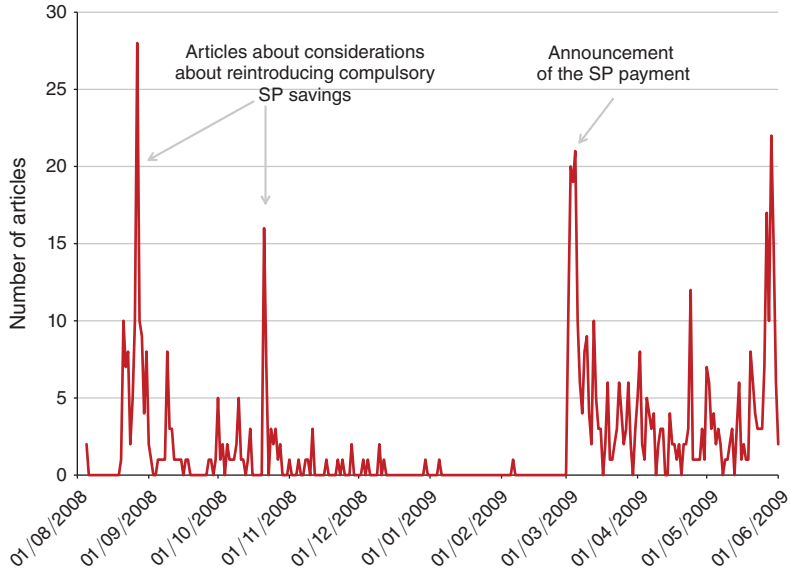

FIGURE 1. NEWSPAPER COVERAGE OF THE SP SCHEME

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

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]

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 from ATP with a prefilled 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

[3] For most people, the taxation of the SP payout was slightly more favorable than the original taxation of the SP funds, and it was most favorable to people with large balances combined with high income.

($\geq$ 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 US$3,000). The average gross payout was 15,447 DKK and the corresponding average payout net of taxes was 9,536 DKK (approximately US$1,900). 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.

II. 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 can 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 1 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 1 (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 1, 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.

The consumer also owns illiquid wealth in period 1, a_1, which is not accessible before period 2, 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

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

where y_2 is earnings and other noncapital income and $\overline{r}$ is the average interest rate on consumer debt/savings defined as

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

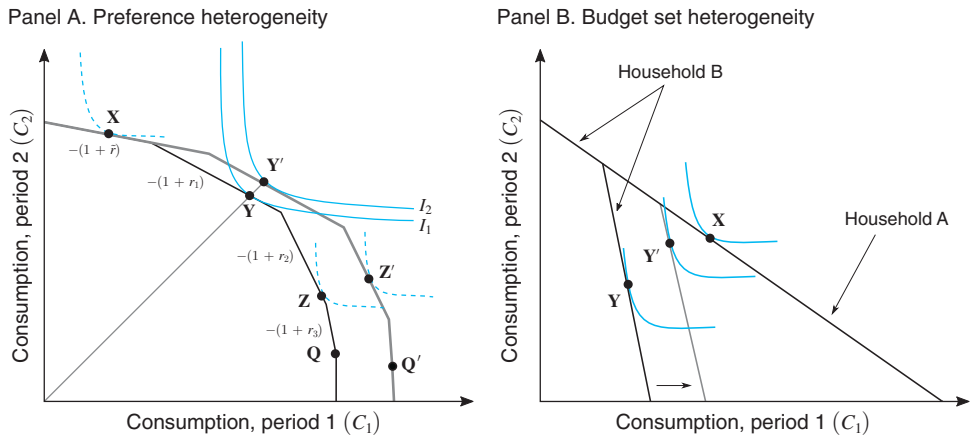

FIGURE 2. MARGINAL INTEREST RATES AND THE RESPONSE TO STIMULUS POLICY

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 one. 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 1, while household B only receives a small fraction of lifetime income in period 1. The budget lines prior to the stimulus policy are black, while the budget lines following the stimulus policy are gray.

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

Consumer behavior is governed by a standard homothetic utility function $u(c_1, c_2)$. In an interior optimum, illustrated in panel A of Figure 2 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.

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.

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 policy 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-2 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.[4] The consumption response to the policy is found by differentiating equations (1)–(4) with respect to x and using the relationship (5), which gives

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

This result is illustrated in panel A of Figure 2. The policy expands the budget set of the consumer as illustrated by the outer budget line. From expressions (1)–(3), it follows that the horizontal movement equals $dc_1/dx|_{dc_2=0} = \big(r(d) - \tilde{r}\big)/\big(1 + r(d)\big)$, 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, where the optimum before the policy 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 policy, and moves to **Z**′, which gives a larger immediate consumption response to the stimulus policy. However, a person at point **X** where $r(d) = \tilde{r}$ does not respond at all to the policy. This illustrates why variation in marginal interest rates may predict consumption responses to stimulus policies.

For consumers who are initially at a kink such as point **Q**, the stimulus policy moves their consumption to point **Q**′ and the propensity to spend is one. 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. However, if the share of individuals at kinks is larger among individuals with higher marginal interest rates, then the average propensity to spend is increasing in the marginal interest rate across households. In panel A of Figure 2, 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. This is illustrated in panel B of Figure 2 where household **A** has all lifetime income in period 1, while household **B** has a large part of lifetime income in period 2. Household **A** will never have to borrow and faces the intertemporal trade-off $1 + \tilde{r}$ everywhere. Household

[4] 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 $> 1 + r(d)$.

B will have to borrow at some point when increasing period 1 consumption and will then face a higher intertemporal trade-off. With identical preferences and 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.

III. 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.

A. *Survey Data and the Spending Response to the Stimulus Policy*

The window of the SP release ended on December 31, 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:[5]

> 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

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

at your disposal in 2009. Considering this increase, how did you allocate it:

- 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 5,037 completed interviews where the respondent decided to take out the SP balance.[6] Two-hundred-fifteen respondents did not take out the SP funds. We know the identity of nonrespondents 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 online Appendix Table EA.1, 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.[7] 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 did not deviate in any important way from the results presented in the paper and are relegated to the online Appendix (Table EA.2).

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. 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 of Figure 3 shows that the propensity

[6] Two data sources that have been used extensively for measuring the effect of stimulus policies in the United States are the CEX and the Michigan Survey of Consumers. The response rate in the CEX is 70-75 percent (http://www.bls.gov/cex/2012/csxintvw.pdf) and it is 40 percent in the Michigan Survey of Consumers (personal communication with the staff).

[7] 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.

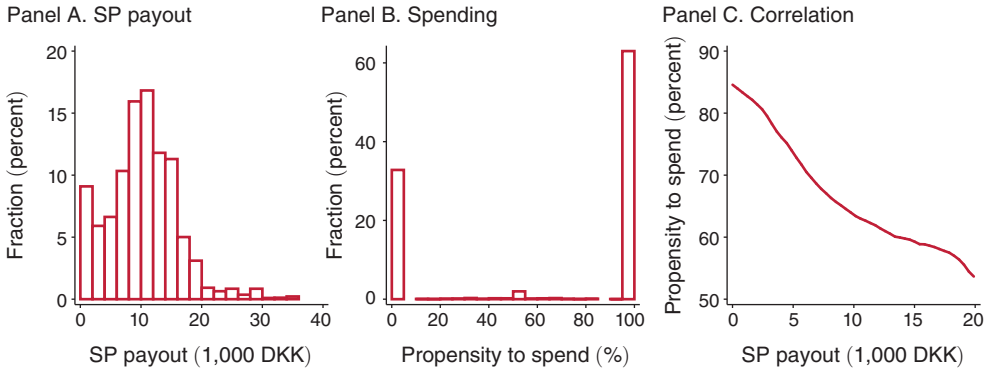

FIGURE 3. SP PAYOUT AND THE PROPENSITY TO SPEND: DISTRIBUTION AND CORRELATION

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 are 5,037.

to spend is higher among respondents with small SP account 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.

B. *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 May 1, 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 incomes back 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 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.[8] 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.[9] Account-specific interest rates are calculated as interest payments on loan l relative to average debt on loan l over the year: $r_{h,l} = R^{08}_{h,l} / \left(\frac{1}{2} \left[D^{07}_{h,l} + D^{08}_{h,l} \right] \right)$ where $R^{08}_{h,l}$ are interest payments from account l for household h during 2008, $D^{07}_{h,}$ is the value of the account by the end of 2007, and $D^{08}_{h,l}$ 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 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.[10]

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.

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.

[8] 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.

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

[10] 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.

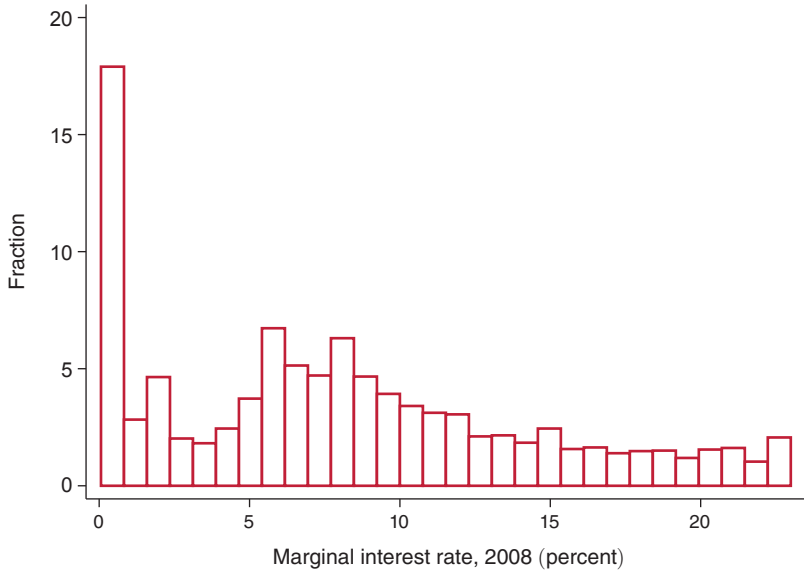

FIGURE 4. DISTRIBUTION OF MARGINAL INTEREST RATES ACROSS HOUSEHOLDS

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 are 5,037.

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.[11]

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, Parker, and Souleles (2006); and Leth-Petersen (2010). Such a measure is obviously not perfect, since people 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

[11] 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.

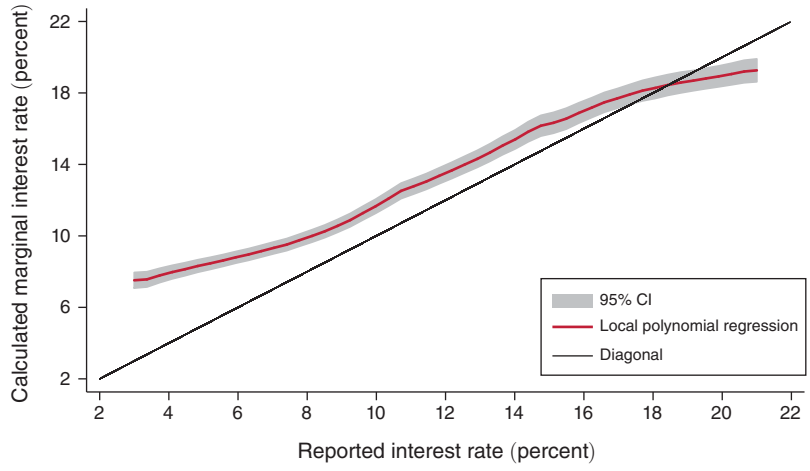

Figure 5. Calculated Interest Rate and Corresponding Reported Interest Rate

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 are 1,426.

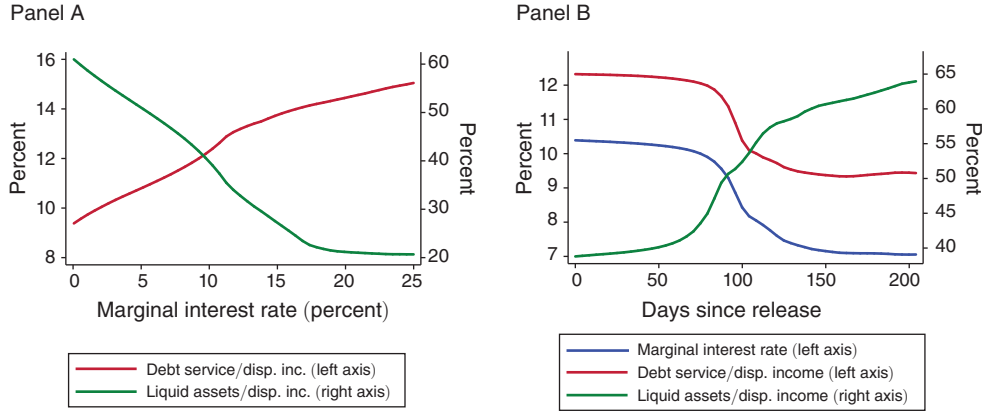

Figure 6. The Relationship between Different Indicators of Liquidity Constraints

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 elapsed from the SP release date (first of June) and to the date where the money was paid out. For example, day 0 is June 1, 2009 and day 100 after the release is September 9, 2009. 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 for panel A are 5,037 and 4,898 for panel B.

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 constraint tightness on the number of days elapsed since the release date (June 1) 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.

IV. Empirical Results

A. *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.[12]

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 ΔW_{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

[12] Kreiner, Lassen, and Leth-Petersen (2015) shows 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.

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 Chetty et al. (2014), where the dependent variable is transformed into a dummy variable $\mathbf{1}[z_{it}^R > m(z_{it}^R)]$ where $m(z_{it}^R)$ is the mean of z_{it}^R. The pattern of estimates of β_{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 β_{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 β_{1t} should be close to 0 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 β_{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 β_{1t} are presented in Figure 7.

Panel A of Figure 7 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.

Panel C of Figure 7 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

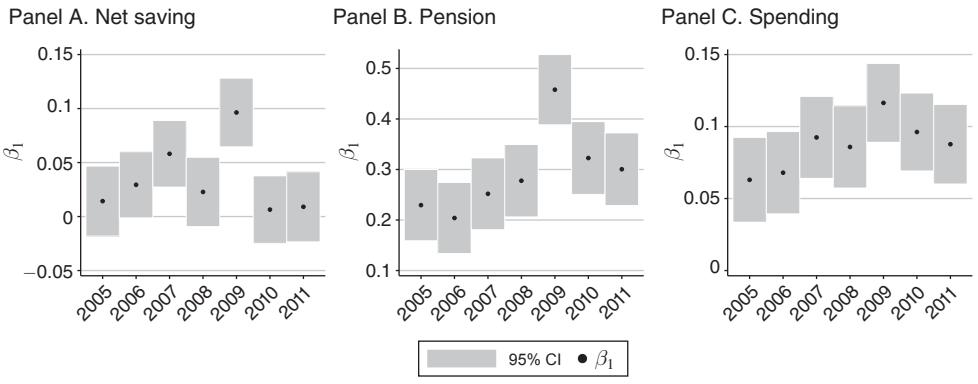

Figure 7. Comparing Survey and Register Data Measures of Net Savings, Pension Saving, and Spending

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 β_{1t} from equation (7) $z_{it}^R = \beta_{0t} + \beta_{1t} z_{i2009}^S + u_{it}$ for $t = 2005, \ldots, 2011$, estimated separately for each t. z_{it}^R is net savings, pension savings, and imputed spending derived from register data, z_{i2009}^S is the corresponding measure collected by survey for 2009, and u_{it} is an error term. The dependent variable z_{it}^R is transformed into a dummy variable $\mathbf{1}[z_{it}^R > m(z_{it}^R)]$, where $m(z_{it}^R)$ is the mean of z_{it}^R. Observations are 4,388.

data, suggesting that respondents understand the counterfactual nature of the survey questions.

B. *Cost of Liquidity and the Propensity to Spend*

The theory in Section III 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.

In Table 1, we report 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 precisely estimated. 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, imprecisely estimated and the confidence interval spans zero. After including these two measures of liquidity constraints, the coefficient on

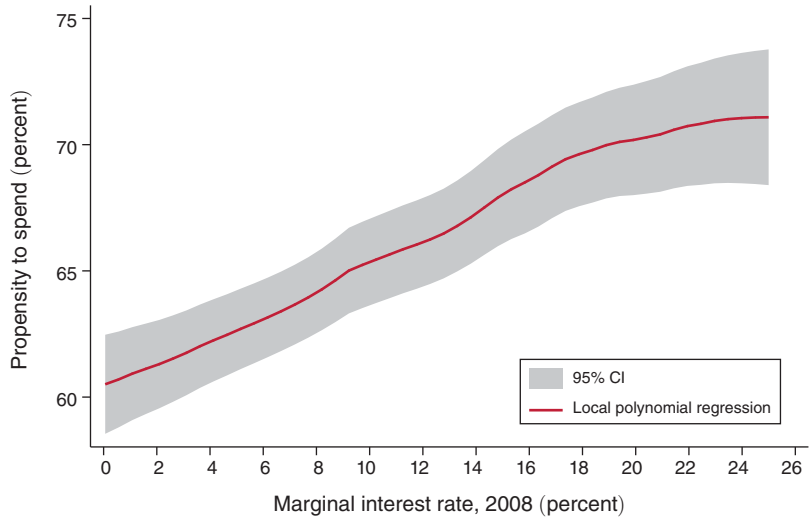

Figure 8. Household Propensity to Spend and the Marginal Interest Rate

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 are 5,037.

the marginal interest rate decreases only slightly, to about 0.4, but it is still precisely estimated.

In column 3 of Table 1, 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. 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 coefficient on the 2008 income level is estimated imprecisely, but the measure of permanent income is precisely estimated and the estimate 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.

In column 4 of Table 1, 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 2 percentage points lower propensity to spend, and adding a child to the family is associated with a 2 percentage points higher propensity to spend. The

Table 1—Spending Share in Percent of SP Payout Regressed on Covariates (OLS)

	(1)	(2)	(3)	(4)	(5)
Liquidity					
Marginal interest rate, 2008 (pct.)	0.537	0.362	0.313	0.297	0.295
	(0.081)	(0.087)	(0.087)	(0.088)	(0.088)
Liquid assets/disposable income, 2008 (pct.)		−0.060	−0.043	−0.031	−0.031
		(0.013)	(0.013)	(0.013)	(0.013)
Debt service/disposable income, 2008 (pct.)		0.099	0.180	0.135	0.139
		(0.065)	(0.066)	(0.075)	(0.076)
Size effect					
SP payout/disposable income, 2008 (pct.)			−1.362	−1.196	−1.187
			(0.281)	(0.286)	(0.286)
Income controls					
ln(income), register			−2.789	−3.228	−3.124
			(1.922)	(1.964)	(1.961)
ln(permanent income)			−10.781	−8.330	−8.478
			(2.293)	(2.533)	(2.531)
std[ln(income)]			0.161	0.010	0.023
			(1.794)	(1.926)	(1.923)
Income developed better, 2009			2.037	1.389	2.057
			(1.967)	(1.965)	(2.022)
Income developed worse, 2009			−0.338	−0.571	−0.538
			(1.980)	(1.997)	(2.097)
Demographic controls					
Age				−0.189	−0.177
				(0.081)	(0.084)
Woman (d)				2.149	2.141
				(1.378)	(1.380)
Single (d)				0.800	0.73
				(1.697)	(1.697)
Number of children				2.081	2.030
				(0.677)	(0.678)
Education, short (d)				−0.568	−0.531
				(1.653)	(1.653)
Education, medium (d)				−2.134	−2.133
				(1.967)	(1.966)
Education, long (d)				−4.309	−4.386
				(2.559)	(2.564)
Homeowner (d)				0.170	0.008
				(1.885)	(1.888)
Expected constraints					
ΔE[credit possibility 2010] $<$ 0, 2009 (d)					1.063
					(1.939)
ΔE[credit possibility 2010] $>$ 0, 2009 (d)					−0.326
					(2.350)
ΔE[income 2010] $>$ 0, 2009 (d)					−1.875
					(1.712)
ΔE[income 2010] $<$ 0, 2009 (d)					0.013
					(2.067)
Taxreform ⇒ perm. income increase (d)					−0.925
					(1.428)
Taxreform ⇒ perm. income decrease (d)					−4.133
					(2.202)
Constant	59.696	62.794	238.750	219.434	220.539
	(1.075)	(1.473)	(18.462)	(21.052)	(21.074)
Observations	5,037	5,037	5,037	5,037	5,037
R^2	0.008	0.014	0.044	0.050	0.051
RMSE	46.47	46.35	45.66	45.57	45.57

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 are reported in parentheses. 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 bachelor 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.

parameter on a dummy variable for having a long education shows that people with a long education have a 5 percentage points lower propensity to spend. This parameter is, however, imprecisely estimated. 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 of Table 1, 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. The parameters on these variables are imprecisely estimated and confidence intervals include zero. 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 have explanatory power.[13,14]

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

C. *Comparison with Other Measures of Liquidity Constraints and Additional Analyses*

This section presents additional empirical analyses. First, we examine the robustness of our approach to computing the interest rate on marginal liquidity. Second, we compare the ability of the marginal interest rate and conventional measures of liquidity constraints to predict spending of the stimulus. Third, based on hypothetical questions, we analyze the importance of the magnitude of the SP payout for the spending propensity and its relationship with liquidity constraint tightness. Finally, the last subsection summarizes the results of a number of additional robustness checks.

[13] Online Appendix Table EA.3 presents summary statistics for all of the right-hand-side variables entering the regressions in Table 1. The table reveals that 8 and 13 percent of the respondents indicate that they expect better/worse credit access in 2010 than in 2009. Thirteen percent expect their income to decline and 20 percent expect their income to increase. Thirty-seven percent expect their income to increase with the 2010 tax reform and 12 percent expect it to decline. While these are not small numbers, we cannot rule out that the lack of precision of the estimates associated with these dummy indicators is the result of lack of variation.

[14] Browning and Crossley (2009) finds 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: (i) large items (for example, televisions, cars, white goods, computers, maintaining/improving the house) or unusual items (for example, travels, nice clothes, eating at restaurants); (ii) everyday spending (for example, food); (iii) do not know." Sixty-seven 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 confirm the results from Table 1.

Alternative Ways of Calculating the Marginal Interest Rate.—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 deposits. However, 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 observations in this category. In Table 2, column 1, we have reproduced column 5 from Table 1. In column 2 of Table 2, we have estimated the same specification 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 imprecisely estimated and the confidence interval spans zero. However, it also spans 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 face 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 2 (even 1) 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 of Table 2, 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 everyone and allocated a range equal to 0 for the 6 percent

TABLE 2—SPENDING SHARE IN PERCENT OF SP PAYOUT REGRESSED ON COVARIATES (OLS): ROBUSTNESS ANALYSIS

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Liquidity							
Marginal interest rate, 2008 (pct.)	0.295	0.204			0.423		0.362
	(0.088)	(0.178)			(0.205)		(0.124)
Marginal interest, 2008 deposit account rates = 0 (pct.)			0.232				
			(0.082)				
Interest range, 2008 (pct.)				0.260	−0.152		
				(0.094)	(0.220)		
Average interest rate, 2008 account balance weighted						0.294	−0.163
						(0.154)	(0.219)
Liquid assets/disposable income, 2008 (pct.)	−0.031	−0.017	−0.032	−0.036	−0.030	−0.037	−0.031
	(0.013)	(0.022)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
Debt service/disposable income, 2008 (pct.)	0.139	0.201	0.16	0.156	0.138	0.179	0.136
	(0.076)	(0.128)	(0.075)	(0.075)	(0.076)	(0.074)	(0.076)
Size effect							
SP payout/disposable income, 2008 (pct.)	−1.187	−0.465	−1.212	−1.190	−1.187	−1.192	−1.187
	(0.286)	(0.503)	(0.286)	(0.286)	(0.286)	(0.287)	(0.286)
Income controls							
ln(income), register	−3.124	0.694	−3.35	−3.241	−3.077	−3.140	−3.162
	(1.961)	(2.793)	(1.940)	(1.968)	(1.956)	(1.979)	(1.941)
ln(permanent income)	−8.478	−7.284	−8.125	−8.459	−8.473	−8.458	−8.454
	(2.531)	(4.004)	(2.519)	(2.537)	(2.527)	(2.545)	(2.519)
std[ln(income)]	0.023	2.121	0.035	0.002	0.016	0.069	−0.045
	(1.923)	(3.348)	(1.921)	(1.925)	(1.923)	(1.934)	(1.926)
Income developed better, 2009	2.057	3.086	2.112	2.082	2.065	2.192	2.031
	(2.022)	(3.691)	(2.024)	(2.023)	(2.022)	(2.023)	(2.023)
Income developed worse, 2009	−0.538	−2.217	−0.499	−0.511	−0.525	−0.406	−0.550
	(2.097)	(3.703)	(2.094)	(2.095)	(2.097)	(2.097)	(2.096)
Demographic controls							
Age	−0.177	−0.268	−0.177	−0.176	−0.178	−0.178	−0.176
	(0.084)	(0.147)	(0.084)	(0.084)	(0.084)	(0.084)	(0.084)
Woman (d)	2.141	3.770	2.193	2.133	2.133	2.145	2.113
	(1.380)	(2.486)	(1.381)	(1.380)	(1.380)	(1.380)	(1.380)
Single (d)	0.730	−1.535	0.347	0.976	0.539	0.401	0.809
	(1.697)	(3.188)	(1.698)	(1.711)	(1.728)	(1.699)	(1.703)
Number of children	2.030	1.219	1.924	2.089	2.005	2.080	2.024
	(0.678)	(1.278)	(0.682)	(0.678)	(0.680)	(0.678)	(0.678)
Education, short (d)	−0.531	−1.658	−0.566	−0.573	−0.546	−0.687	−0.530
	(1.653)	(3.029)	(1.654)	(1.653)	(1.653)	(1.653)	(1.653)
Education, medium (d)	−2.133	−4.593	−2.188	−2.243	−2.135	−2.290	−2.188
	(1.966)	(3.479)	(1.969)	(1.967)	(1.966)	(1.969)	(1.968)
Education, long (d)	−4.386	−9.744	−4.468	−4.591	−4.350	−4.648	−4.422
	(2.564)	(4.404)	(2.565)	(2.563)	(2.566)	(2.568)	(2.565)
Owner (d)	0.008	1.741	−0.280	−0.105	−0.063	−0.449	−0.034
	(1.888)	(3.460)	(1.880)	(1.891)	(1.893)	(1.882)	(1.889)
Expected constraints							
ΔE[credit possibility 2010] $<$ 0, 2009 (d)	1.063	6.655	1.010	1.103	1.070	1.217	1.043
	(1.939)	(3.580)	(1.943)	(1.940)	(1.938)	(1.939)	(1.939)
ΔE[credit possibility 2010] $>$ 0, 2009 (d)	−0.326	−1.809	−0.207	−0.266	−0.344	−0.239	−0.336
	(2.350)	(4.194)	(2.344)	(2.348)	(2.350)	(2.347)	(2.350)
ΔE[income 2010] $>$ 0, 2009 (d)	−1.875	1.460	−1.798	−1.862	−1.858	−1.809	−1.860
	(1.712)	(2.995)	(1.713)	(1.712)	(1.713)	(1.712)	(1.713)
ΔE[income 2010] $<$ 0, 2009 (d)	0.013	2.053	0.119	0.067	0.010	0.131	0.009
	(2.067)	(3.721)	(2.066)	(2.067)	(2.067)	(2.068)	(2.067)
Taxreform ⇒ perm. income increase (d)	−0.925	−0.617	−0.997	−0.914	−0.942	−0.941	−0.939
	(1.428)	(2.565)	(1.428)	(1.429)	(1.429)	(1.430)	(1.428)
Taxreform ⇒ perm. income decrease (d)	−4.133	−7.472	−4.148	−4.192	−4.118	−4.201	−4.136
	(2.202)	(3.740)	(2.200)	(2.201)	(2.202)	(2.200)	(2.202)
Constant	220.539	155.553	220.688	222.326	220.113	221.627	221.268
	(21.074)	(36.863)	(21.125)	(21.062)	(21.099)	(21.098)	(21.066)
Observations	5,037	1,689	5,037	5,037	5,037	5,037	5,037
R^2	0.051	0.041	0.050	0.050	0.051	0.049	0.051
RMSE	45.57	46.52	45.59	45.59	45.57	45.61	45.57

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 are reported in parentheses.

of the respondents with no spread or who are only recorded to have one account. The interest rate range turns out to be almost linearly related to the marginal interest rate, i.e., that individuals with a broad 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 parameter on the average interest rate is precisely estimated 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 precisely estimated while the average interest rate is very imprecisely estimated and does not predict spending.

Comparison with Conventional Measures of Liquidity Constraints.—Starting with Zeldes (1989), there is a long tradition for using measures of liquid assets to disposable income as a proxy for being affected by liquidity constraints. Recent examples include Johnson, Parker, and Souleles (2006), who estimate the change in consumption expenditures caused by the 2001 federal income tax rebates; they 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) measures 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. Also, the size of debt service relative to income has been used as a proxy. For example, Johnson and Li (2010) shows 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. In this section, we explore whether our measure of liquidity constraint tightness affects inference about the importance of liquidity constraints based on these conventional measures.

The results are presented in Table 3. In column 1, we present results from a regression where only the ratio of liquid assets to disposable income is included as a proxy for liquidity constraints. The effect is precisely estimated and indicates that individuals with a high level of liquidity are less prone to spend the stimulus. In column 2, we add debt service to disposable income. This variable is also precisely estimated and the parameter estimate indicates that individuals with a

Table 3—Spending Share in Percent of SP Payout Regressed on Covariates (OLS): Different Liquidity Constraint Measures

	(1)	(2)	(3)	(4)	(5)	(6)
Liquidity						
Marginal interest rate, 2008 (pct.)			0.295			0.270
			(0.088)			(0.087)
Liquid assets/disp. income, 2008 (pct.)	−0.048	−0.042	−0.031			
	(0.013)	(0.013)	(0.013)			
Debt service/disp. income, 2008 (pct.)		0.200	0.139			
		(0.073)	(0.076)			
(Liquid assets/disp. income) < 1/12, 2008 (d)				5.969	5.185	3.896
				(1.364)	(1.379)	(1.438)
(Debt service/disp. income) > 0.15, 2008 (d)					5.859	5.014
					(1.490)	(1.521)
Size effect						
SP payout/disp. income, 2008 (pct.)	−1.205	−1.198	−1.187	−1.187	−1.179	−1.172
	(0.288)	(0.286)	(0.286)	(0.287)	(0.285)	(0.285)
Income controls						
ln(income), register	−4.052	−3.268	−3.124	−3.405	−2.808	−2.702
	(1.934)	(1.946)	(1.961)	(1.886)	(1.892)	(1.913)
ln(permanent income)	−7.414	−8.371	−8.478	−7.936	−8.583	−8.724
	(2.503)	(2.521)	(2.531)	(2.468)	(2.470)	(2.484)
std[ln(income)]	−0.014	−0.107	0.023	−0.514	−0.384	−0.186
	(1.921)	(1.926)	(1.923)	(1.899)	(1.905)	(1.907)
Income developed better, 2009	2.165	2.210	2.057	2.221	2.284	2.133
	(2.024)	(2.025)	(2.022)	(2.025)	(2.024)	(2.022)
Income developed worse, 2009	−0.270	−0.350	−0.538	−0.486	−0.602	−0.730
	(2.098)	(2.094)	(2.097)	(2.101)	(2.093)	(2.095)
Demographic controls						
Age	−0.216	−0.175	−0.177	−0.246	−0.191	−0.182
	(0.082)	(0.084)	(0.084)	(0.081)	(0.082)	(0.082)
Woman (d)	2.241	2.064	2.141	2.382	2.148	2.171
	(1.380)	(1.382)	(1.380)	(1.381)	(1.381)	(1.380)
Single (d)	0.439	0.415	0.730	0.131	0.140	0.495
	(1.701)	(1.701)	(1.697)	(1.695)	(1.696)	(1.695)
Number of children	2.064	2.097	2.030	2.044	2.061	2.009
	(0.676)	(0.678)	(0.678)	(0.677)	(0.678)	(0.677)
Education, short (d)	−0.817	−0.789	−0.531	−0.705	−0.795	−0.563
	(1.654)	(1.653)	(1.653)	(1.652)	(1.650)	(1.651)
Education, medium (d)	−2.538	−2.568	−2.133	−2.535	−2.631	−2.224
	(1.968)	(1.967)	(1.966)	(1.969)	(1.967)	(1.966)
Education, long (d)	−4.786	−4.942	−4.386	−4.800	−4.924	−4.433
	(2.565)	(2.567)	(2.564)	(2.568)	(2.567)	(2.564)
Owner (d)	1.254	−0.898	0.008	1.349	−0.938	−0.402
	(1.681)	(1.864)	(1.888)	(1.682)	(1.795)	(1.805)
Expected constraints						
ΔE[credit possibility 2010] < 0, 2009 (d)	1.679	1.263	1.063	1.439	0.965	0.788
	(1.934)	(1.940)	(1.939)	(1.936)	(1.938)	(1.937)
ΔE[credit possibility 2010] > 0, 2009 (d)	−0.064	−0.210	−0.326	−0.223	−0.301	−0.400
	(2.349)	(2.345)	(2.350)	(2.347)	(2.340)	(2.344)
ΔE[income 2010] > 0, 2009 (d)	−1.528	−1.717	−1.875	−1.557	−1.788	−1.947
	(1.711)	(1.712)	(1.712)	(1.711)	(1.712)	(1.713)
ΔE[income 2010] < 0, 2009 (d)	0.223	0.200	0.013	0.201	0.160	−0.006
	(2.070)	(2.069)	(2.067)	(2.064)	(2.059)	(2.059)
Taxreform ⇒ perm. income increase (d)	−0.928	−0.993	−0.925	−0.888	−0.933	−0.892
	(1.431)	(1.430)	(1.428)	(1.430)	(1.428)	(1.426)
Taxreform ⇒ perm. income decrease (d)	−4.180	−4.257	−4.133	−4.022	−3.969	−3.921
	(2.202)	(2.197)	(2.202)	(2.205)	(2.199)	(2.202)
Constant	225.182	224.63	220.539	220.764	219.053	216.421
	(21.047)	(21.083)	(21.074)	(21.093)	(21.112)	(21.107)
Observations	5,037	5,037	5,037	5,037	5,037	5,037
R^2	0.047	0.049	0.051	0.048	0.051	0.052
RMSE	45.65	45.62	45.57	45.63	45.57	45.53

Notes: The table corresponds to Table 1, except that different proxies for liquidity constraint tightness are used across columns. Column 1 shows the results from regressing the spending share of the SP payout on covariates using only a continuous measure of liquid assets to disposable income as a proxy for liquidity constraints. Column 2 adds a continuous measure of debt service to income. Column 3 includes both these measures as well as the marginal interest rate, and this specification is identical to the baseline specification in column 5 of Table 1. Column 3 includes a dummy variable for the respondent having less than one month worth of disposable income as a proxy for liquidity constraints. Column 5 adds a dummy variable taking the value 1 if debt service constitutes 15 percent or more of disposable income. Column 6 includes both of the measures from columns 4 and 5 as well as the marginal interest rate. A dummy variable is indicated by (d). Robust standard errors are reported in parentheses.

higher debt service to disposable income ratio are more likely to spend the stimulus. The inclusion of debt service to income does not affect the magnitude nor the precision of the estimated parameter on liquid assets to disposable income. In column 3, the marginal interest rate is included among the regressors. This regression is identical to the one presented in column 5 of Table 1. The parameter on the marginal interest rate is precisely estimated, and while the parameter estimates on the liquid asset and debt measures now become smaller, they continue to be estimated precisely.

The liquid asset and the debt-service measures are typically applied in the form of threshold dummies rather than as continuous measures. To check whether this affects the insights about the relative ability of the different measures to predict spending out of the stimulus, we repeat the exercise from Table 3, columns 1–3 using threshold versions of liquid assets to disposable income and debt service to disposable income. Specifically, we define a dummy variable to take the value 1 if the individual holds liquid assets worth less than 1 month's disposable income and a dummy variable taking the value 1 if debt service is 15 percent or more out of disposable income. These exact threshold values were chosen based on experimenting with different threshold values and picking the threshold values that had the highest predictive power for spending the stimulus. Table 3, column 4 presents a regression including only the dummy variable for low liquid assets to disposable income. The estimated effect is economically important and relatively precisely estimated, saying that people who are likely to be affected by liquidity constraints spend 6 percent more out of the SP payment than individuals who are not likely to be affected by constraints. In column 5, the dummy variable for having a high level of debt service is added. This variable also predicts approximately 6 percent higher spending, and its inclusion affects neither the magnitude of the effect of the liquid asset dummy nor its precision. In the final column of Table 3, the marginal interest rate is included together with the two dummy variables for low liquid assets and a high level of debt service. In this regression, the marginal interest rate is precisely estimated and of the same magnitude as our preferred estimate presented in Table 1, column 5. The parameter estimate of the liquid asset dummy is slightly muted by the inclusion of the marginal interest rate, but the debt-service dummy is not affected. The main insight gained from the estimations based on threshold values for liquid assets and debt service is, for all practical purposes, similar to the insight from the estimations with continuous measures of liquid assets to disposable income and debt service to disposable income, cf. columns 1–3 of Table 3.

Overall, we conclude that the marginal interest rate captures aspects of spending behavior related to being affected by liquidity constraints that are not captured by more conventional measures. Moreover, inference based on the conventional measures is affected somewhat, but the results suggest that all three proxies for liquidity constraints are relevant predictors of spending the stimulus even when included simultaneously.

Response to Hypothetical Payments of Varying Sizes.—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).[15] 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.[16] This suggests that while liquidity constraint tightness 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 3,116 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 payout 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 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.[17] 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 payout 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 payout.

Additional Robustness Checks.—Estimations are based on OLS, and this can potentially lead to biased estimates as most responses are either zero or one. 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.4 in the online 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

[15] 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.

[16] 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.

[17] We also performed the exercise for the subsample of 3,119 persons who participated in the original survey and found the same results.

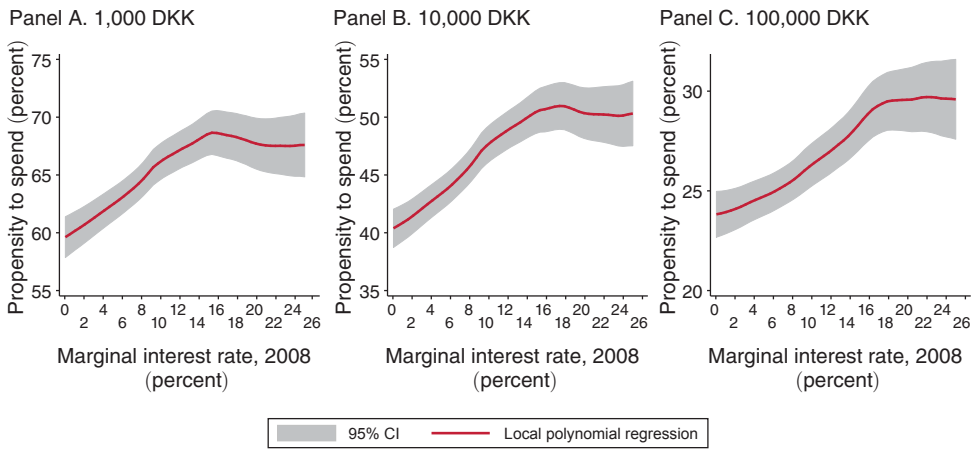

FIGURE 9. HOUSEHOLDS' PROPENSITY TO SPEND AND THE MARGINAL INTEREST RATE FOR HYPOTHETICAL SP PAYOUTS

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 are 5,868.

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 fourth-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.5 in the online Appendix. We also did an analysis where the sample was split into 4 groups according to the income quartiles in 2008 and carried out regressions corresponding to column 5 in Table 1 separately for each of these 4 subgroups. The results from this exercise are reported in Table EA.6 in the online Appendix. 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 constraint tightness. 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 EA.7 in the online Appendix).

V. 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 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 policy. 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 constraint tightness 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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