Explaining Consumption Excess Sensitivity with Near-Rationality: Evidence from Large Predetermined Payments

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August 2016

Abstract

Using new transaction data I find that consumption is excessively sensitive to salient, predetermined, large and regular payments from the Alaska Permanent Fund, with a large average marginal propensity to consume (MPC) of 30% for nondurables and services. This excess sensitivity is very heterogeneous: The deviation from the standard consumption model is largest for households for whom the loss from failing to smooth consumption is smallest in terms of equivalent variation. The estimated MPCs are monotonically *decreasing* in the loss and *increasing* in income for households with sufficient liquidity. I show that the economically and statistically significant excess sensitivity is consistent with households following near-rational alternative plans. For macroeconomic policies, such as an economic stimulus program, these near-rational alternatives might represent the more relevant behavior than the standard consumption model.

JEL Classification: D12, D91, E21, H31.

Keywords: consumption excess sensitivity, MPC heterogeneity, near-rationality.

*First version: July 2015. I thank David Card, Josh Hausman, Lee Lockwood, David Matsa, Brian Melzer, Jonathan Parker (discussant) and seminar participants at the NBER Summer Institute 2016 EF&G Research Meeting, NBER Public Economics 2015 Fall Meeting, Board of Governors of the Federal Reserve System, Northwestern University, George Washington University, University of Wisconsin-Milwaukee, New Economic School, and the Empirical Macro Workshop for useful comments. I am grateful to Laura Achee at the APFC for providing archival data and for patiently answering many questions about the fund. Ryan Pfirrmann-Powell at the BLS provided expert assistance with the confidential CE data. All remaining errors are mine.

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Aggregate consumption constitutes more than two-thirds of gross domestic product in almost all developed economies and is thus a major component of the business cycle. Understanding how consumers respond to cash flows is therefore fundamental for designing economic stabilization programs, such as active fiscal policies and automatic stabilizers. The permanent income life-cycle hypothesis (PILCH), the workhorse model of intertemporal consumption choices used in one form or another in most of the literature, predicts that in the absence of financial frictions, households will adjust their consumption plans only when they receive new information about their life-time resources. Under this benchmark model, a household's optimal consumption plan should smooth out predictable changes in cash flows.

I combine new transaction-level financial data from a personal finance website with the repeated quasi-natural experiments provided by the large annual payments from the Alaska Permanent Fund, the state's sovereign wealth fund, to test this prediction. The fund invests the proceeds from the state's oil revenue in broadly diversified financial and real assets and uses the cash flows from assets to pay out the Permanent Fund Dividend (PFD) annually in early October to almost every person in Alaska.

This paper makes two main contributions. First, it shows that despite the favorable characteristics of the dividend payments for the benchmark model (i.e., predetermined, large, regular and salient), household spending substantially deviates from the model's prediction with an average marginal propensity to consume (MPC) on non-durables and services of 30%.[1] While this deviation from the model is consistent with a large body of previous research, most of these studies use cash flows that are substantially smaller, are often one-time payments, and while in principle predictable in advance might not be very salient in practice. Finding large MPCs in this context also differs from previous studies that have looked at payments of similar size and regularity, such as Browning and Collado (2001) and in particular Hsieh (2003), who studies the same experiment using the Consumer Expenditure Survey (CE). Both studies do not find excess sensitivity in household spending in response to large predictable income changes, which has been interpreted as evidence that excess sensitivity only occurs in response to small or irregular payments.

Second, and more importantly, this paper finds that the average spending response to the dividend payments is largely driven by higher-income households. I document that most of these households hold sufficient amounts of liquid assets and cash-on-hand to income ratios such that they would in principle be able to smooth spending throughout the year. Therefore, liquidity constraints and precautionary saving, which have previously been used as the main explanation for excess sensitivity, fall short of explaining the behavior of these households. Instead, I show that near-rationality explains the cross-sectional heterogeneity in spending responses well. Near-rational plans deviate from the optimal smooth consumption plan of the benchmark model while also respecting the intertemporal budget constraint, but they only lead

[1] Strictly speaking, the model predicts smoothing of consumption instead of spending (or more precisely of expected marginal utility), and most papers therefore call the degree of excess sensitivity the marginal propensity to consume (MPC) out of predictable income changes instead of the marginal propensity to spend (MPS). Spending and consumption might be different for more durable or storable goods, especially at higher frequency, a point I discuss below. Nevertheless, I follow the previous literature and will mostly use the term MPC.

to small utility costs in terms of equivalent variation.

While near-rationality has been mentioned as a potential explanation for excess sensitivity in previous research, this paper is the first one to rigorously show evidence of near-rationality relying on micro data from only one (repeated) experiment. Deviating from consumption smoothing in response to the dividend payments is potentially costly for a significant fraction of Alaskan households. For instance, the dividend in 2010 was $1,281 per person, and since the dividend is paid lump-sum to every person in the household, including children born in the previous year or earlier, it provides substantial cross-sectional variation in the potential cost of failing to smooth consumption. In particular, the dividend is relatively more important for lower-income households as a fraction of annual income. Hence, the experiment has also economic power to reject the benchmark model.

To quantify the cost of suboptimal behavior, I derive the money-metric loss in wealth of deviating from the optimal plan (c^*) which fully smoothes consumption over time. The *potential* ex-ante loss of following the specific deviation (c^{htm}), which spends the entire dividend upon arrival (i.e., hand-to-mouth) while also satisfying the intertemporal budget constraint, is monotonically increasing in the relative size of the payments ($\frac{PFD}{c}$) as a fraction of total annual consumption (c),

$$Loss(c^{htm}, c^*) \propto \left(\frac{PFD}{c}\right)^2.$$

Importantly, this potential loss can be calculated *ex-ante* before the arrival of the payment and can therefore be used as a predetermined predictor of excess sensitivity, in addition to other predictors such as measures of credit constraints that have previously been used in the literature. Sorting households by predetermined potential loss, I find that potential losses explain most of the heterogeneity in MPCs across households that are not liquidity constrained. For instance, moving from the lowest loss quintile to the highest quintile reduces the MPC from 85% to 15%, and this result is robust to conditioning on liquid assets (both levels and cash-on-hand ratios), income, and age, all of which have previously been used to explain excess sensitivity.

To assess whether the estimated MPCs across potential loss quintiles are consistent with near-rational behavior, I calculate the *ex-post* loss that households actually incur given the fact that most household do not fully spend the dividend. While the potential losses increase steeply from less than 0.1% in the lowest quintile to over 3% in the highest quintile, the actual *realized* losses are very small (less than 0.1%) and similar across all quintiles. Households with standard preferences would gain less than a day of consumption per year by fully smoothing the dividend. The responses observed in the data are therefore consistent with near-rational behavior, i.e., with small deviations from the standard model in terms of equivalent variation, even though the observed actions deviate substantially from full consumption smoothing.

While it might be intuitive that the relative size of the payments should predict excess sensitivity, near-rationality also has implications that are perhaps more surprising. For instance, I show that the MPCs are *larger* for higher-income households than for lower-income households, and this relationship is monotonic, even after conditioning on liquid wealth. Of course, this is precisely what one would expect since the dividend payments are a much smaller fraction of higher-income households' budgets.

The result that the MPC is increasing in income and decreasing in the size of the potential welfare loss is particularly striking since it provides a new source of heterogeneity in MPCs *in addition* to traditional liquidity constraints and precautionary saving motives. To show this, I reproduce the standard finding that lower-income households with little liquid wealth have high MPCs, higher than similar households with sufficient liquid assets. Importantly, this result holds even after conditioning on income or the relative size of the payment and hence provides an additional explanation of excess sensitivity for a different segment of the population. Therefore, there are two groups of households that have high MPCs: low-income, low buffer-stock households that seem likely to be liquidity constrained, and high-income households with low utility losses from failing to smooth their dividend payments. MPCs in turn are lowest for lower- and middle-income households who have sufficient amounts of liquid assets.

The finding that the loss from failing to fully smooth consumption is small for most households does not mean that near-rational behavior is not relevant for macroeconomics. The reason is that those small deviations from the standard model are correlated across households and can therefore add up to large aggregate demand shocks. In fact, many active macroeconomic policies have relatively small *direct* impacts on most households' budgets, such as the widely studied fiscal stimulus payments in 2001 and 2008 for example, but nevertheless provide substantial economic stimulus. Hence, even though the associated individual welfare costs of those deviations are small by definition, the observed actions can substantially deviate from the predicted actions under the benchmark model.

Why are the results different from Hsieh (2003), which was the first study to examine spending responses to the Permanent Fund Dividend? That study, which uses the CE sample from 1980 to 2001 finds a small and insignificant response. The main specification regresses changes in log spending on the dividend payments normalized by current family income. Income in the CE survey, however, suffers from substantial measurement error, which attenuates the estimated spending response. To show this, I replicate the small and insignificant spending responses reported in Hsieh (2003) using the same confidential data available at the Bureau of Labor Statistics (BLS). I show that one can use total expenditures—which are more precisely measured in the CE—to instrument for current income, resulting in a statistically significant spending response that is quantitatively similar to the one reported in this paper.

Several characteristics of the PFD make this experiment particularly useful for testing the basic theory and, importantly, for ruling out or at least limiting previous explanations of excess sensitivity. First, the dividend payments are highly *salient and predictable*. They are fully predetermined at least one month before the payment when the annual dividend amount is officially announced in September. They are highly predictable well before September, with most of the relevant information being released several quarters or even years in advance. The high predictability is due to the fact that the payments are based on a public formula which uses the fund's current and previous four annual incomes. Hence, most of the information necessary for predicting the next dividend is already known the day after the last dividend has been paid out. Second, since the payments are *large*, local media report on the likely size of the next dividend throughout the year well before it is paid out in October. Hence, households do not have to predict the next dividend on their own; instead, they can rely on reasonable forecasts provided by the local media. To assess these forecasts I perform a narrative analysis of all local newspapers since the mid-1980s and I also directly calculate forecasts of the next dividend using publicly available data released by the fund. Both series predict the next dividend well and the average forecast error is orders of magnitude smaller than the dividend payments. Third, the payments are *repeated every year*, further limiting surprise as an explanation of excess sensitivity.

Precautionary saving motives do not describe the observed behavior of higher-income households well. The substantial amounts of liquid assets held by most households in the sample (both in levels and as a fraction of permanent income, i.e., the cash-on-hand ratio) and the modest amount of income uncertainty introduced by the dividend payments limits precautionary saving as a reasonable explanation of the observed excess sensitivity. Precautionary saving motives are also inconsistent with both the cross-sectional heterogeneity in MPCs and the observed dynamic response. First, precautionary saving motives predict that the MPCs would be decreasing in income or liquid wealth and hence compete with liquidity constraints. However, estimated MPCs are increasing in income and also in liquid wealth for high levels of wealth where near-rationality effects dominate credit constraints. Second, as the narrative analysis shows, uncertainty about the size of the dividend decreases throughout the fiscal year as more and more relevant information is released, and the dividend is finally completely known at least one month in advance. Despite this reduction in uncertainty, we do not see any corresponding increase in spending in the months leading up to the payments in October.

The results are also not driven by wealthy hand-to-mouth consumers and consumption commitments or by rational inattention and optimization frictions. First, I use *liquid* assets to measure liquidity constraints—cash-equivalent bank account balances—instead of potentially illiquid net worth, which would also include housing wealth. Second, models of consumption commitments, rational inattention and optimization frictions cannot explain why household spending responds to fully predetermined cash flows rather than to new information about those future cash flows. Moreover, as discussed above, the size of new information about future PFDs is much smaller than the dividend itself. Therefore, even if households did rebalance or update only infrequently and only at dates at which dividends are paid out, they should still only react to the new information they received since the last time they changed their consumption plans. However, the observed MPCs are orders of magnitude larger than what one would expect if households only responded to new information about the dividend. Moreover, consumption should as likely decrease as increase on those dates and need not necessarily be related to the nominal amount of the dividend, since forecast errors due to new information are both positive and negative as shown by the narrative analysis. Instead, households respond to the entire dividend amount, not just the news component.

The new transaction data help to address a number of additional concerns that naturally arise when interpreting the spending responses to predictable income changes. For instance, since the website automatically tracks a household's income and spending after it has linked its credit card and other financial accounts, household expenditures recorded in the transaction data are measured with substantially less error than in survey data, particularly for disaggregated spending categories. Since many nondurables and services do have a durable or storable component, especially when looking at frequencies higher than annual, so that spending does not necessarily reflect consumption and the standard model would not necessarily be rejected, the high quality of the spending data allows me to look at more narrowly defined nondurable spending. Focusing on more disaggregated spending shows that spending significantly increases across many categories in response to the dividend, including strictly nondurable categories that have previously been used to address this issue, such as spending on groceries or restaurants.

Similarly, the high frequency of the data allows me to trace out the dynamics of the excess sensitivity and test for anticipation effects. These dynamics reveal two important findings. First, households do not move their nondurable spending forward to the months prior to the payments, even households with sufficient liquid wealth that would not have to borrow against the future dividend. Hence, even though the payments are preannounced, the spending response resembles that of a typical event study. Second, households adjust their spending on nondurables and services within the first three months after receiving the lump-sum payments, and much of the response occurs in the initial month. The cumulative effect of this additional spending is stable after the first three months and there is no evidence of reversal due to intertemporal consumption shifting. The lack of a decline in spending on nondurables in later periods is additional evidence that potential timing differences between spending and consumption, which would be consistent with models of optimal liquidity management, do not explain the large excess sensitivity.

One important limitation of the transaction data is that it is not a nationally representative or a random sample. To address concerns about the external validity of the results, I compare the average MPC based on the new transaction data to similar estimates obtained using the CE which covers many fewer Alaskan households per period but spans the entire period since the first dividend was paid out in 1982. After accounting for differences in sample composition and the fraction of Alaskans that do not receive the dividend, I find that the spending response to the dividend payments is similar in the two datasets.

The paper is organized as follows. Section 1 derives the approximate economic loss of failing to fully smooth consumption. Section 2 describes the micro data and the Permanent Fund Dividend. Section 3 shows non-parametric and parametric evidence of excess sensitivity. Section 4 uses the economic loss statistic to predict heterogeneity in MPCs among households with sufficient liquid assets. Section 5 shows that credit constraints help predict high MPCs for lower-income households with low levels of liquid assets. Section 6 performs a thorough robustness analysis of the excess sensitivity results and extends the analysis along several dimensions, including the external validity check using the Consumer Expenditure Survey. Section 7 concludes.

1 Near-Rationality and Excesss Sensitivity

Many studies have used quasi-experiments to document excess sensitivity of household consumption; see e.g., Jappelli and Pistaferri (2010) for a recent survey. The insight that excess sensitivity in consumption could be related to near-rational behavior goes back at least to Cochrane (1989) who surveys early excess sensitivity tests based on aggregate time series, while Browning and Crossley (2001) and Fuchs-Schuendeln and Hassan (2015) survey more recent tests based on micro data.

This paper is one of the first to provide direct evidence at the household level that near-rationality predicts excess sensitivity using a single source of income, i.e., using variation *within* the same research design. The only other studies I am aware of that analyze whether payment size can explain excess sensitivity in the cross-section using a single income source are Kreinin (1961), Souleles (1999), and Scholnick (2013), all of which use a quadratic function of the level of payments and find mixed or inconclusive results due to a lack of statistical power.[2] However, in this section I show that the loss from suboptimal behavior is a monotone function of the *relative* size of the payment scaled by household consumption instead of the level of the cash flows. This distinction is not only conceptually important, but it turns out to be also empirically relevant. Using the unscaled squared size of the dividend in levels instead of the relative size of the cash flows, I find that the coefficient on the quadratic term is statistically insignificant and also economically small, while the linear term—the average excess sensitivity—is unaffected by adding the quadratic term and remains economically and statistically significant.

1.1 Loss from Sub-Optimal Consumption Plans

To derive a loss statistic from following a sub-optimal consumption plan, we need to define the optimal plan under the nominal benchmark model. Denote this optimal consumption plan given wealth w and prices p (interest rates) by c^*, such that $c^*_w = \arg\max_c\{U(c) \text{ s.t. } p'c \leq w\}$, with $p'c^* = \sum_t R^{-t}c^*_t = w$ and life-time utility $U(c) = \sum_t \delta^t u(c_t)$.[3] Following Gabaix and Laibson (2002), consider a deviation $\tilde{c}_w$ from this optimum, which also has to satisfy the intertemporal budget constraint, $p'\tilde{c}_w = w$. Using the envelope theorem, i.e., combining the

[2] Parker (1999) also analyzes near-rationality as an explanation for excess sensitivity, but instead focuses on differences in MPCs across different types of goods with different degrees of durability, as they imply different costs from failing to smooth spending.

[3] Anticipating the empirical findings I abstract from precautionary saving motives and dividend uncertainty. First, precautionary saving motives would predict that households with low cash-on-hand ratios (cash-on-hand divided by permanent income) would have higher MPCs than unconstrained households. However, I find that higher-income households with high cash-on-hand ratios have higher MPCs than the average household. Sections 4 and 5 analyze the role of precautionary saving motives and liquidity constraints in more detail. Second, assuming perfect foresight of the next dividend is a reasonable approximation based on the analysis of expected dividends in the companion background paper (Kueng (2015a)). While households do obtain new information about the next dividend also within the current year, they already start out with an expected dividend that is fairly close to the next dividend because the size of the PFD depends on the fund's income over the past five years, not just its current income. Therefore, the dividend can typically be well predicted more than a year in advance. Section 2.1 provides a detailed discussion of the dividend's predictability.

first-order conditions to simplify the second-order approximation of $U(c)$ around c_w^*, we obtain

$$U(c_w^*) - U(\tilde{c}_w) \quad \approx \quad -\frac{1}{2}\sum_t \delta^t \cdot \frac{\partial^2 u(c_t^*)}{\partial c^2} \cdot (c_t^*)^2 \cdot \left(\frac{\tilde{c}_t - c_t^*}{c_t^*}\right)^2. \tag{1}$$

The first-order term $\frac{\partial U(c_w^*)}{\partial c}'(\tilde{c}_w - c_w^*)$ is zero because the first-order conditions imply $\frac{\partial U(c_w^*)}{\partial c} = \lambda \cdot p$ and $p'(\tilde{c}_w - c_w^*) = 0$, since both consumption plans satisfy the intertemporal budget constraint.

To quantify the money value of the loss due to local deviations from the optimal plan, we can calculate the amount of wealth necessary to keep the household at the same utility level under the suboptimal plan $\tilde{c}_w$ as under c_w^*. We know that under standard preferences, a proportional change in wealth leads to a proportional change in the optimal consumption profile, i.e., $d\ln(c_s^*) = d\ln(w) \approx \frac{\tilde{w}-w}{w} = \frac{\Delta w}{w}\ \forall s$. Taking a first-order approximation of the value function around the initial optimum, c^*, we obtain

$$U(c_w^*) - U(c_{\tilde{w}}^*) \approx -\frac{\Delta w}{w}\sum_t \delta^t \cdot \frac{\partial u(c_t^*)}{\partial c} \cdot c_t^*, \tag{2}$$

where $c_{\tilde{w}}^*$ is the optimal consumption plan given alternative wealth $\tilde{w}$ in a neighborhood of w. Combining (1) and (2), evaluating $U(c_{\tilde{w}}^*)$ at $U(\tilde{c}_w)$, and assuming an iso-elastic flow utility $u(x) = x^{1-\gamma}/(1-\gamma)$ yields the money-metric proportional wealth loss of the sub-optimal plan,

$$Loss(\tilde{c}_w, c_w^*) \equiv -\frac{\Delta w}{w} \approx \frac{\gamma}{2}\sum_t \omega_t \cdot \left(\frac{\tilde{c}_t - c_t^*}{c_t^*}\right)^2, \tag{3}$$

with "utility-annuity" weights $\omega_t = \delta^t \frac{\partial u(c_t^*)}{\partial c} c_t^* / \sum_j \delta^j \frac{\partial u(c_j^*)}{\partial c} c_j^* = \frac{\delta^t u(c_t^*)}{U(c^*)}$, because $\frac{\partial u(c)}{\partial c} \cdot c = (1-\gamma)u(c)$.

To apply this expression of the loss to the setting of the Alaska Permanent Fund Dividend, we need to specify the alternative behavior $\tilde{c}$. A natural (although extreme) alternative is to assume households are hand-to-mouth consumers (htm); see e.g., Campbell and Mankiw (1989) or Card, Chetty and Weber (2007) who also compare the standard permanent-income model to this alternative benchmark. Specifically, let's consider a deviation from the optimal consumption plan that fully responds to the PFD payments at the time the dividend is paid out (i.e., a MPC of 1), but otherwise fully optimizes along all other dimensions.[4]

Next, we need to take into account that the PFD is paid repeatedly once every year. Therefore, let's divide the household's finite horizon H into h equal intervals of length T, e.g., four quarters in the empirical analysis below. To simplify the analytical expressions, let's also assume no discounting and zero interest rates ($\delta = R = 1$) such that $c_t^* = c^*$ in the benchmark PIH model under certainty. The alternative consumption plan, which spends the entire PFD

[4] In other words, this is a *local* deviation from the standard model's optimal consumption plan c^*. Households behave according to the standard model along all other dimensions. For instance, they smooth all other cash flows like paychecks, social security payments, etc.

amount in the period in which it is paid out,[5] is defined as

$$c_t^{htm} = \begin{cases} c^{htm} & = \; c^* - \frac{PFD}{T} \qquad \text{in periods without dividend payments,} \\ c^{htm} + PFD & = \; c^* + (1 - \frac{1}{T}) \cdot PFD \qquad \text{in periods with dividend payments.} \end{cases}$$

The alternative plan c^{htm} is related to the optimal plan c^* by the fact that both have to satisfy the intertemporal budget constraint, hence $\sum_t c_t^{htm} = \sum_t c_t^* = H \cdot c^*$. Consumption is higher than the optimum when the dividend is paid out, but in turn has to be lower during the other $T - 1$ periods in the interval in order to satisfy the intertemporal budget constraint. Therefore, relative deviations from the optimal plan are given by

$$\frac{c_t^{htm} - c_t^*}{c_t^*} = \begin{cases} -\frac{PFD}{T \cdot c^*} & \text{in periods without dividend payments,} \\ (T-1)\frac{PFD}{T \cdot c^*} & \text{in periods with dividend payments.} \end{cases}$$

Hence, the *potential* loss from fully spending the dividend payments in period T (e.g., in the fourth quarter) is

$$Loss(c^{htm}, c^*) \approx \left(\frac{PFD}{c_T}\right)^2 \cdot \frac{\gamma}{2} \cdot (T-1), \tag{4}$$

where $\frac{PFD}{c_T}$ is the relative size of the dividend as a fraction of total consumption during the interval T, $c_T = T \cdot c^* = \sum_{t=1}^{T} c_t^{htm}$, i.e., annual consumption.

This loss can be calculated ex ante as it does not depend on any behavioral response to the dividend. The actual ex-post loss on the other hand depends on the household's degree of excess sensitivity to the dividend payments. This behavioral response—the marginal propensity to consume (MPC) out of predetermined cash-on-hand—can be estimated by regressing changes in spending on the amount of PFD payments received by a household for different subsamples of households with similar ex-ante potential losses. Therefore,

$$Loss^{ex-post} = MPC^2 \cdot Loss(c^{htm}, c^*) \tag{5}$$

is the actual ex-post loss that households in these subsamples incur by not fully smoothing the dividend payments. The observed consumption behavior is near-rational as defined by Akerlof and Yellen (1985) if it deviates from the optimal plan but this deviation only leads to small wealth-equivalent losses, which in turn depend on the size of the PFD, the household's characteristics (γ and "permanent income" c_T), and the degree of excess sensitivity (MPC).[6]

2 Data and Experiment

The strength of the empirical analysis builds both on new high quality expenditures and income micro data—in particular for higher-income households—and the large dividend pay-

[5] PFD denotes the total amount of dividend payments the household receives in a year.

[6] It also depends on T, which measures how fast the household spends the dividend, i.e., how concentrated the excess sensitivity is. In the empirical analysis below I find that households spend their excess amount over three months on average. Hence, setting $T = 4$ is reasonable.

ments that provide substantial cross-sectional variation in the size of the potential losses from exhibiting excess sensitivity.

2.1 The Permanent Fund Dividend

Since 1977, the State of Alaska invests the royalty income it receives from the oil extraction in the state-owned North Slope region in a sovereign wealth fund called the Permanent Fund. This fund, which is managed by the Alaska Permanent Fund Corporation (APFC), has grown considerably over time and had a market value of $53 billion as of November 2015; see Goldsmith (2001) for a historical account of the fund. The fund's assets are broadly diversified in domestic and international financial and real assets so that the cash flows generated by the fund are unaffected by local economic conditions. At the end of each fiscal year on June 30, roughly 10% of the fund's generated cash flows over the current and four previous fiscal years is set aside to be paid out by the Alaska Permanent Fund Dividend Division (APFDD) based on a public formula set in state law.[7] The dividend is paid out to every person who has been a resident of Alaska for the previous year and indicates an intention to remain an Alaskan resident. The rest of the fund's income is typically reinvested in the fund, although the legislature has in principle the authority to use the fund's remaining earnings for any public purpose. Previous attempts by politicians to appropriate more earnings for government funding have resulted in significant public backlash so that reinvesting the fund's earnings has become the implicit norm.

Since the dividend is a significant source of income for many Alaskan households, changes in the expected next dividend are frequently discussed in the local media. The annual dividend amount, which is based on data that is largely known at the end of June of each year, is officially announced by mid-September or earlier, before the first payments are made in early October. Since the mid-1990s, all information necessary to estimate the dividend is published on the APFC's website. Moreover, monthly changes in the expected dividend are orders of magnitude smaller than the dividend itself since only one fifth of the annual distribution depends on the fund's income in the current fiscal year.

A companion background paper (Kueng (2015a)) documents these facts with both an extensive narrative analysis of all major Alaskan newspapers starting in the early 1980s and with a series of expected dividends based on new historical data of the fund's monthly income starting in the mid-1990s, which I obtained from the APFC's archive. Section 6.5 provides a summary of this complementary study. For convenience, Figure 1 shows the two measures of the expected PFD. Uncertainty about the next dividend is typically largest in November right after the previous dividend has been distributed because next year's income is still largely unknown. Throughout the fiscal year, this uncertainty gradually declines with each new monthly report of the fund's earnings. The main source of uncertainty about the size of the next dividend that remains between the end of the fiscal year in June and the official announcement in Septem-

[7] The public formula for the dividend distribution is $\frac{1}{2} \times 21\% \times (\sum_{s=t-4}^{t} SNI_s - \text{Adjustments}_t)$, where SNI is the fund's statutory net income in the current ($s = t$) and previous four ($s = t-4, ..., t-1$) fiscal years. This sum is adjusted for prior year obligations, operating expenses, designated state expenses, and reserves for prior year dividends. The dividend per person is obtained by dividing the total distribution by the number of eligible applicants.

ber concerns the number of eligible applicants. However, annual changes in the number of eligible applicants are small and can be reasonably well predicted based on state population forecasts. Therefore, additional precautionary saving motives due to uncertainty about the sizes of the dividend cannot account for the substantial average excess sensitivity that I document in the next section, and definitely not for the large MPCs among higher-income households who have sufficient buffers of liquid assets. Moreover, since uncertainty gradually decreases toward September, precautionary dissaving motives should be largest in the months before the dividend payments and should be lowest in October when the dividend is known for certain. The dynamic household spending response discussed below however shows the exact opposite: spending does not increase leading up to September but dramatically increases in October when the dividend is paid out.

2.2 New Transaction Micro Data from Financial Accounts

The main analysis uses new transaction data from accounts at a large personal finance website (PFW) from 2010 to 2014. The micro data is at the user account level, which I will refer to as the household.[8] In the robustness section 6.7 I show that the excess sensitivity results are not driven by differences between the number of users per online account and the number of family members. Households can link up their credit card accounts, bank accounts, brokerage accounts and any other major account related to their balance sheet, giving them a systematic overview of their personal finances. The data and its advantages and shortcomings relative to previous data sources are explained in more detail in Baker (2014) who was the first to use this data.

This paper complements the analysis of the data quality in Baker (2014) in an important way by also implementing the same research design in the CE (discussed below), which is the standard data source used in previous studies. Therefore, the fact that I find similar results using both data sets—after accounting for differences in sample composition and the fraction of Alaskans that do not receive the dividend—provides an external validity check of this new data source.

Identifying Dividend Receipts The timing of the dividend is exogenous for households that receive the dividend within two business days of the official disbursement date set by the APFDD, or within five business days for the few households that receive the dividend as a check in the mail. The timing of delayed direct deposits could however be endogenous since it could be caused by incorrect applications or applications that have to be further investigated by the APFDD. Identification of the dividend receipt is more difficult for mailed checks than for direct deposits since check transactions often lack an informative transaction description

[8] More precisely, the concept of a user account is closer to the concept of a family as defined by the U.S. Census Bureau: "A family consists of two or more people (one of whom is the householder) related by birth, marriage, or adoption residing in the same housing unit. A household consists of all people who occupy a housing unit regardless of relationship. A household may consist of a person living alone or multiple unrelated individuals or families living together." The concept of a family is also closer to the "consumer unit" concept used by the CE. Nevertheless, following convention in the literature I will refer to both user accounts in the PFW and consumer units in the CE as "households."

which typically only states "deposit." I identify PFD check deposits as those that have the "deposit" label and match the exact amount of the dividend in the 12 months from October to September of the next year. Using this algorithm, 81% of Alaskans in the PFW sample receive a dividend. This number is consistent with aggregate take-up statistics based on data from the APFDD. 96% of dividends are received via direct deposits, the rest via check deposits. This number is higher than the 83% reported by the APFDD. The difference is probably due to the fact that more PFW users use e-banking (and hence direct deposits) and the fact that payments via checks are more difficult to identify and the algorithm might miss some.

97% of direct deposits in turn occur within two business days. This is the sample used for the main analysis since the timing of the dividends is exogenously set by the APFDD for these users and because they receive the dividends at the beginning of October which simplifies the interpretation of the dynamic response (anticipation effects and lagged responses). I analyze the effect of including check deposits and late direct deposits in the robustness section 6.7.

While other Alaskan households that do not (yet) qualify for the dividend might in principle be a good control group (setting aside concerns about general equilibrium effects affecting such households), the new transaction data does not cleanly identify them for several reasons. Alaskans that do not receive a dividend payment in the PFW sample could either not have qualified for the dividend but could also have had their entire dividend garnished,[9] could have instructed the APFDD to directly donate the full dividend amount,[10] or the dividend payment was not identifiable from the transaction description and the transaction amount.[11] Such households might be very different than the treatment group for which I identify receiving the dividend and hence are potentially a bad control group. However, in the robustness section 6.7 I show that including these Alaskan households in the control group does not affect the results.

Since the dividend amount is sensitive to the household size I drop observations with self-reported family sizes above 8 or that receive more than 7 dividends, which corresponds to the top 1% in both cases. Accounts where the absolute difference between the number of dividends and the self-reported family size is larger than four in any period are also dropped. Section 6.7 discusses this issue in more detail.

Addressing Potential Issues First, one might be worried that the size of the dividend can be manipulated by households or that a sudden change in family size coincides with a surprise in the dividend amount received, which in turn could be correlated with changes in spending. However, in order to qualify for the dividend, an individual must have been an Alaska resident for the entire calendar year preceding the application date and intend to remain an Alaska resident indefinitely at the time of the application. New residents, such as newborns or

[9] Since 1989 PFD recipients are banned from assigning (pledging) dividends for any legal contract, including loans. However, federal, state and local governments have the right to garnish up to 100% of the dividend (e.g., for outstanding federal income taxes, local parking tickets, tuition, etc.) and courts can garnish up to 80% of the dividend (e.g., in personal bankruptcy).

[10] Since 2009 Alaskans can instruct the APFDD to donate all or part of their dividend to a charitable organization that participates in the Click.Pick.Give program; see www.pickclickgive.com.

[11] For instance, if the household received a partially garnished dividend in form of a check. When it then deposits the check it is impossible to infer the source of this income from the transaction amount, which does not match the full dividend amount, or from the transaction label, which is typically missing for check deposits.

migrants therefore need to live in Alaska for about a year before they become dividend eligible. Similarly, an Estate Application can be filed in the year in which a family member deceased. Hence, the size of the dividend income is given by the size of the PFD per person and the number of eligible household members, where the latter is predetermined at least one year in advance. Hence, even sudden changes in family size should not lead to surprises in the amount of dividend income received in that year.

Second, note that strictly speaking, this analysis estimates a marginal propensity to spend out of cash received (i.e., "cash-on-hand"), not income. Dividend income can differ from the actual amount of cash received both because of voluntary and involuntary deductions. Alaskans can ask the APFDD to contribute part or all of their dividend to charity (see footnote above) or up to 50% to the University of Alaska College Saving Plan. Involuntary deductions on the other hand can occur since the government can garnish up to 100% of the dividend to cover outstanding liabilities (e.g., unpaid taxes, parking tickets, etc.) and courts can garnish up to 80% of the dividend payment, for instance in personal bankruptcy. In the PFW sample, 86% of Alaskans that receive a dividend (via direct deposit or check and at any time) receive the full dividend. 11% contribute part of their dividend directly via the APFDD. Of these voluntary deductions, 50% contribute exactly half of their dividend. I therefore identify voluntary deductions as dividend payments that are half of the total dividend in that year or as dividend income that is reduced by multiples of \$25 (e.g., by \$25, \$50, \$75, etc.) which are the most common donation amounts. Finally, 3% have part of their dividend garnished and many garnished dividend amounts cluster around the 80% maximum for private garnishments. Section 6.7 analyzes the effect of these different sources of variation in payments on the estimated excess sensitivity. Note that this algorithm misses individuals that donate the full dividend to charity or that have their full dividend garnished by the government as I do not observe a financial transaction in those cases.

Third, since I cannot use non-qualifying Alaskans as a control group I instead use a sample of 2,191 households from the State of Washington, which is geographically closest to Alaska and also has similar seasonality and industry composition. Spending on nondurable goods and service as well as durables are defined to match the National Income and Product Accounts as closely as possible; the detailed mapping is provided in Table A.1 of the appendix. To estimate the total impact of the dividend payments on household spending I also include other expenditures (e.g., mortgage and rent, car loan payments, uncategorized expenditures) as well as durable purchases that are paid for with a credit card (e.g., clothes, newspaper and magazines, electronics and software) and hence are typically smaller than say a car purchase. These additional categories together with spending on nondurables and services define total expenditures.

Summary Statistics Table 1 provides summary statistics of the main variables used in the analysis. All nominal amounts are expressed in dollars of 2014 using the local CPI for Alaska and the U.S. CPI for Washington, respectively.[12] The average size of the dividend

[12] The BLS calculates the local CPI for Alaska (more precisely for Anchorage) only semi-annually instead of monthly. Hence, I use the annual CPI to deflate nominal variables for both groups.

per family equals $2,000 and is therefore much larger than the one-time tax rebate of $300 to $600 per households in 2001, which has been studied extensively in the literature. Hence, even in this sample of higher-income households, the annual dividend still represents 3-5% of the annual budget depending on whether it is measured as a fraction of annual income or spending. Moreover, contrary to the tax rebate, the dividend is paid regularly once every year.

Households in Alaska and Washington are very similar along most other dimensions, including income, demographics, and expenditures. While average household income in the data is high, median Alaskan income is similar to median household income of $70,000 in the 2013 American Community Survey (ACS).[13] The average Alaskan household in the PFW sample has much more larger bank balances (savings and checking accounts) than the average Alaskan household in the CE, $41,000 vs. $23,000. To be conservative, I define liquid wealth narrowly by only including cash-equivalent bank account balances, such as savings, checking, money market accounts, and certificates of deposit. Other financial assets can potentially also be easily exchanged for cash, in particular assets in taxable brokerage accounts outside of tax-deferred retirement and college savings accounts. Including these balances as part of liquid wealth would therefore strengthen the case made below against liquidity constraints being the main explanation for the observed excess sensitivity.

Median liquid wealth in the PFW data is much lower than average liquid wealth but is still much higher than in the general population. For comparison, median bank balances of Alaskan households in the CE are only $4,000, which is similar to median bank balances in the Survey of Consumer Finances (SCF).

Finally, the typical household in Washington has substantially more financial assets than the typical Alaskan household. However, note that this measure excludes the present value of future Permanent Fund Dividends for Alaskan households. Given the average (median) PFD payments received by Alaskans in the sample, the observed average (median) difference in total financial assets of $102,000 ($45,000) is consistent with the present value of this perpetuity assuming an expected return above expected dividend growth rate ($r - g$) of 2-4%. Alternatively, given Alaska's population of 737,625 in 2015, the Permanent Fund's market value per person was $72,000 in 2015, which is similar to the observed gap in total financial assets.

3 Average Excess Sensitivity to the Dividend

Under the life-cycle permanent income hypothesis, households should smooth consumption over time, which implies that the level of consumption should be independent of the timing of predictable cash flows. Since spending should not be sensitive to predictable income, finding systematic differences in spending patterns in response to predetermined events such as the Permanent Fund Dividend payments is evidence for so-called excess sensitivity of spending to predictable income changes.

[13] I use the ACS instead of the CE to assess the representativeness of household income in the PFW sample since the CE is not designed to be representative at the state level, only at the national level.

3.1 Nonparametric Evidence

Figure 2(a) shows strong non-parametric evidence of such excess sensitivity by comparing average monthly per capita spending changes on nondurables and services of Alaskans with that of individuals from Washington, the other nearest state.[14] The average monthly changes for the two states are fairly similar except in October when the dividend is paid out, and in the month thereafter. This shows that households in Washington who do not receive the dividend payments are a good control group for seasonal consumption patterns, i.e., their spending follows a similar trend in the absence of the dividend. Similarly, Figure 2(b) shows that per capita income excluding the dividend does not differentially increase in October in Alaska relative to Washington. This strongly suggests that the spending increase in October shown in Figure 2(a) is *caused* by the Permanent Fund Dividend payments.

Using the summary statistics in Table 1 we can turn these numbers into non-parametric MPC estimates, which can then be compared with the parametric MPCs below. The average dividend payment per capita is \$961 (i.e., \$1,999/2.08) and the average excess spending on nondurables and services of Alaskans relative to Washingtonians in October is \$112 with a t-statistic of 5.6. Hence, the MPC in the first month after dividends are paid is 12%.[15] Similarly, relative per capita spending drops by only \$78 the next month (t-statistic of 3.8), which is 8% of per capita dividends thus adding an additional 4% to a cumulative MPC of 16%. This cumulative MPC is 22% one quarter after most dividends have been paid out. These non-parametric MPCs are very similar to the parametric estimates shown below.

Finally, note that spending changes are slightly lower on average among Alaskan households in all other months relative to households in Washington, consistent with the alternative behavior specified in section 1, although these differences are not individually statistically significant. Since there might be aggregate shocks that this approach does not fully control for, I include full time fixed effects (year-by-month or year-by-quarter) instead of only month or quarter fixed effects in all regressions to account for such aggregate conditions.

3.2 Parametric Evidence

The previous analysis uses differences in the time series of average spending changes between households in Alaska and Washington to provide non-parametric evidence of excess sensitivity. Next, I instead use household-level variation in the dividend payment size while controlling for aggregate effects. Following the previous literature, the main estimating equation is

$$\Delta c_{it} = \sum_{s} \beta_s \cdot PFD_{i,t-s} + \alpha_t + \text{Alaska}_i + \lambda' x_{it} + \varepsilon_{it} \ . \tag{6}$$

[14] Per capita figures are calculated by using the OECD household equivalence scale to adjust for differences in family size, which assigns a value of 1 to the first household member, and adds 0.7 for each additional adult and 0.5 for each child below the age of 16. I calculate average daily per capita spending multiplied by 30 to take into account differences in the number of days per month. Figure A1 in the appendix shows similar results for median changes in monthly spending.

[15] Similarly, the nonparametric median MPC is 11%, which is calculated based on the median spending increase of \$78 in October (see Figure A1) divided by median per capita dividend income of \$709 (i.e., \$1,417/2).

c_{it} measures expenditures during period t by household i, PFD_{it} denotes the dollar amount of Permanent Fund Dividend payments received by all household members at the beginning of period t; s denotes periods since receiving the dividend (i.e., allowing for leads and lags, such as anticipation effects and delayed responses); α_t are time fixed effects (year-by-month dummies) controlling flexibly for any aggregate effects and seasonality in spending patterns; Alaska_i is an indicator of whether a household is a resident of Alaska; x_{it} captures family size and other household characteristics for robustness checks; and ε_{it} are changes in spending not explained by either the dividend or the controls. The β coefficients measure the excess sensitivity of spending to receiving predetermined PFD income ($s \geq 0$) and possible spending effects in advance of the payments due to households anticipating the next dividend ($s < 0$).

Anticipation Effects Figure 3 shows the dynamic response of monthly household spending on nondurables and services to the PFD payments by estimating the baseline specification of equation (6), which controls for the main effects of the treatment, i.e., Alaska and time fixed effects and family size. Figure 3(a) plots the regression coefficients including 6 monthly leads and 8 monthly lags of the dividend payments, $s = -6, -5, \ldots, 8$, or two quarters of leads and three quarters of lags.

Importantly, even though the dividend is completely predetermined at least by September, and there is substantial speculation in the media throughout the year about the likely size of the next dividend, Figure 3(a) shows no evidence of any anticipation effects. The point estimates of all leads are close to zero and reasonably precisely estimated for the month prior to the dividend, for example ruling out any announcement effect larger than 2 cents at a 95% confidence level.

Excess Sensitivity While there is no evidence of anticipation effects, spending strongly responds to the arrival of the dividend payments. On average, spending on nondurables and services increases by 12 cents for each dollar of PFD received in October ($s = 0$), and this increase is highly statistically significant (t-statistic of 5.9). Spending in November ($s = 1$) is only 7 cents lower than in the previous month, hence the dividend has a delayed spending effect of another 5 cents relative to September, the month before the dividend payments, and another 7 cents in December relative to November. These are the net or marginal effects of the dividend, which is largest and most precisely estimated in the month of the dividend payment. The point estimates of all subsequent net effects after December are small and not statistically significant. Figure 3(b) cumulates the net effects to provide the dynamic cumulative MPC together with two standard error bands. It highlights that the MPC stabilizes within one quarter of the dividend receipt, and the effect remains statistically significant up to a lag of six months.

Robustness Overall, Figure 3 documents an economically large and statistically significant response of household spending on nondurables and services to the Permanent Fund Dividend payments and there is no evidence of anticipation effects. The response is concentrated in the month in which dividend payments are transferred via direct deposits, and most of the effect occurs within the first quarter after the arrival of the cash flows. In the following, I therefore aggregate the data to quarterly observations and restrict the analysis to the spending response within the first quarter of receiving the dividend (i.e., setting $s = 0$). Therefore, setting $T = 4$ in (4) is appropriate when calculating the potential loss statistic. Column 1 of Table 2 repeats the analysis at quarterly frequency.[16]

Column 2 estimates a quantile regression for the median to show that the excess sensitivity results are not driven by outliers. While the previous analysis uses households from Washington as well as Alaskans in periods without dividend payments as a control group, column 3 uses only variation in dividend payments of Alaskans that do receive a dividend in October. Given the time fixed effects, the identifying variation is coming from differences in the number of checks received per household, including periods without dividend payments, and variation coming from voluntary and involuntary deductions, i.e., differences between dividend income and cash-on-hand. While the precision drops substantially, the point estimate does not change much. In section 6.7 I analyze these different sources of variation in more detail. Column 4 adds controls x_{it}, which include liquid assets (bank balances), income, family size, and fixed effects for age, education, residential ZIP code, homeownership status, marital status, and occupation. The estimated excess sensitivity is unaffected by these controls, in particular by the amount of liquid assets. Hence, liquidity constraints cannot explain the average spending excess sensitivity to the dividend payments for households in the PFW sample.

While the standard specification used in the literature to test for excess sensitivity uses first differences as in equation (6), column 5 instead estimates an individual fixed effects model. The point estimate remains largely unchanged, but the precision increases as fixed effects estimators are typically more efficient than first differences. Finally, column 6 shows that adding controls such as household demographics, income and liquid assets does not change these results. Importantly, it also shows that *changes* in household characteristics, in particular changes in family size, do not affect the results as the fixed effects specification only uses within-household variation.

4 Near-Rationality and Higher-Income Household MPCs

The high average response documented in the previous section is striking for several reasons. First, the nature of the dividend payments should in principle favor the standard model. After all, those cash flows are highly predictable, occur regularly every year, are salient to households living in Alaska, and are fairly large. Second, the typical household in the sample has a substantial amount of liquid assets and relatively high income as shown in Table 1. Since the standard explanations of excess sensitivity, such as liquidity constraints or precautionary saving, do not seem to sufficiently account for the behavior of these households, I use the ex-ante money-metric proportional wealth loss of deviating from perfect consumption smoothing to test whether potential losses can explain the high MPCs among those higher-income households, in particular whether the MPCs are falling in the relative size of the dividend cash flows.

[16] The small difference in the point estimates is due to the fact that using 6 leads and 8 lags at monthly frequency in Figure 3 drops more observations than using first differences at quarterly frequency in column 1 of Table 2.

4.1 Relative Size of Cash Flows and MPC Heterogeneity

Equation (4) shows that the potential loss is a function of two main factors, the relative size of the dividend as a fraction of household consumption (PFD/c) and the curvature of the flow utility function (γ).[17] Since I cannot measure differences in time preferences across households, I will abstract from potential heterogeneity in γ and focus on heterogeneity in PFD/c. However, since theory suggests that binding liquidity constraints might be related to differences in time preferences, I study this issue in more detail in the next section by focusing on the subset of households with low levels of liquid wealth.

MPC Heterogeneity in Potential Losses The relative size of the dividend payment is therefore a sufficient statistic of the costs of sub-optimal behavior. To test the predictive power of the potential loss statistic, I modify the baseline specification of equation (6) and interact the constant and the dividend payments with the quintiles of the relative dividend size, $q = 1, 2, ..., 5$. The relative dividend is calculated by dividing the dividend payments received by a household in a year by the household's average total expenditures per year, where average spending is taken over all observations of a household. On average, the relative dividend size for Alaskan households in each quintile is 1.8%, 2.8%, 3.9%, 5.7%, and 11.7%, respectively. Assuming an intertemporal elasticity of substitution of one half ($\gamma = 2$), these numbers translate to potential relative wealth losses of 0.09%, 0.24%, 0.46%, 0.97%, and 4.19% (see Figure 4(a), right axis). Hence, the potential losses range from 8 hours to more than two weeks of consumption per year. The corresponding regression that estimates cross-sectional heterogeneity in MPCs is

$$\Delta c_{it} = \sum_{q=1}^{5} \beta_q \cdot PFD_{it} \times \mathbb{1}(q_{it}) + \sum_{q=1}^{5} \eta_q \mathbb{1}(q_{it}) + \alpha_t + \text{Alaska}_i + \lambda' x_{it} + \varepsilon_{it} \ . \tag{7}$$

$\mathbb{1}(q_{it})$ equals one if household i is in the q$^{\text{th}}$ shock size quintile and zero otherwise. α_t is again a full set of time fixed effects, which are year-by-quarter time dummies since the data is aggregated to quarterly frequency.

Figure 4(a),left axis, shows that the MPC indeed falls significantly with the increase in the predicted loss. Households in the lowest quintile for whom the dividend is a small fraction of annual spending and hence a less important source of (permanent) income have an estimated MPC of 84%, substantially higher than the MPC of 16% for households in the highest relative dividend size quintile, for whom the dividend is a much more substantial income source. Moreover, the MPC declines steadily as we move from lower to higher quintiles, while the precision of the estimates increases because the relative dividend explains a larger fraction of spending for households in higher quintiles.

[17] As mentioned above, I set $T = 4$ based on the dynamic response of monthly spending. Also note that the loss would depend on the time distance between news about future dividends and the actual dividend payments, which I abstracted from by assuming perfect foresight. However, as shown in Figure 1, this news component is very small. Moreover, since the local media report frequently on the expected dividend throughout the year, heterogeneity in the expected dividend across households is probably small.

Column 2 of Table 3 documents that these results (reported in column 1) are robust to controlling for other potential mechanisms. In particular, the sharp decrease in MPCs as a function of the relative size of the dividend is robust to controlling for liquid assets (bank balances), income, age, and other household characteristics.

Near-Rationality of Observed Behavior What are the actual economic losses that households incur by deviating from full consumption smoothing? Given the potential losses in each quintile and the separate MPCs estimated in Table 3, we can calculate the actual average ex-post losses in each quintile using equation (5). The economic losses across the quintiles are 0.07%, 0.09%, 0.08%, 0.07%, and 0.11%, respectively as shown in Figure 4(a), right axis. The actual economic losses are thus both similar and very small. Households with standard preferences would be willing to give up less than half a day of consumption per year to fully smooth the dividend. Hence, the observed behavior is consistent with small, near-rational deviations from the standard model.

Using Squared instead of Relative Dividend Payments Column 3 shows that measuring the potential costs using the relative size of the dividend instead of the squared dividend in levels, as previously done in the literature (e.g., Souleles (1999) and Scholnick (2013)), is important. The coefficient for the squared dividend payments is both economically and statistically insignificant. Moreover, including the squared term does not affect the coefficient on the relative size of the dividend compared to only using the linear term, the average MPC, which is reported in the bottom row.

Therefore, these results provide strong evidence that the relative size of the cash flow is an important factor for explaining excess sensitivity, and in particular for explaining the dispersion of excess sensitivity in the cross-section of households with sufficient liquid assets.

4.2 Income Per Capita and MPC Heterogeneity

Figure 4(b) makes the same point using a different dimension of cross-sectional heterogeneity in potential welfare losses. If near-rationality explains excess sensitivity, then we would expect the MPC to be *larger* for high-income households for whom the dividend is only a small fraction of annual income. Indeed, Figure 4(b) shows that the MPC is *increasing* in after-tax income per capita. Households in the top income quintile have an average MPC of 61% compared with an MPC of only 12% for households in the lowest quintile, for whom the dividend is a substantial source of total family income. The average Alaskan income per household equivalent in each quintile is \$16,000, \$30,000, \$41,000, \$58,000, and \$104,000, respectively.

The fact that the MPC is steeply increasing in income is robust to including various controls as shown in column 5 of Table 3. Importantly, the income gradient is preserved when controlling for the relative dividend quintiles used in columns 1 and 2. Hence, the two sources of variation—income and the relative size of the cash flows—provide strong evidence of the predictive power of the potential-loss statistic. Interestingly, these findings are consistent with results reported in Johnson, Parker and Souleles (2006) who also find that the highest-income tertile has a larger MPC than the middle-income tertile, although they do not discuss potential reasons for this result. Finally, note that the slope of the MPC is steeper in the relative dividend than in income per capita. This is presumably due to the fact that average annual spending is a better measure of permanent income and hence of the intertemporal budget constraint than current annual income.

While this result might appear obvious after realizing that income is inversely related to the costs from failing to smooth the dividend, it is noteworthy that it stands in contrast to results in many other studies who use income as an alternative measure of liquidity constraints. This is typically necessary since liquid assets tend to be poorly measured in expenditure surveys. The next section shows that low liquid wealth (both in levels and as a fraction of permanent income) indeed also predicts higher MPCs, although the predictive power is lower than that of the potential-loss statistic.

5 Liquid Wealth and MPC Heterogeneity

Credit constraints and/or precautionary saving are the main explanation of excess sensitivity proposed in the literature.[18] For instance, households might want to borrow against future income, but in the case of the Permanent Fund Dividend a law implemented in 1989 prevents individuals from assigning the dividend to any third party other than the government. The dividend can therefore not be used as legal collateral for any debt contract. Therefore, households need to have sufficient amounts of liquid assets to move PFD-related spending forward in time.

Using the Cash-on-Hand Ratio To quantify whether and how much liquidity constraints and precautionary saving can help explain the cross-sectional heterogeneity in MPCs, I use the cash-on-hand to permanent income ratio to measure a household's amount of relative liquidity as suggested by theory; see Carroll (2001). In particular, I use a household's cash-equivalent bank account balances as a fraction of average quarterly total spending, which proxies for unobserved permanent (quarterly) income. Note that this is the same normalization used for calculating the relative dividend size in columns 1 and 2 of Table 3 and hence provides an apples-to-apples comparison of the two mechanisms, liquidity constraints/precautionary saving and near-rationality.

Column 6 of Table 3 shows that the MPC is indeed falling across quintiles of the cash-on-hand ratio as predicted by the standard buffer stock model, with an MPC of 37% in the lowest quintile of cash-on-hand ratios and 23% in the highest quintile. However, this profile is not very steep and not strictly monotone. At higher levels of liquidity, the potential welfare-cost effect seems to dominate the liquidity effect.

While the MPC of 37% seems small for the most constrained households in the lowest quintile, the MPC of 23% for households in the highest quintile on the other hand, who are most likely unconstrained, is large from the standard buffer stock model's perspective, but consistent

[18] I analyze models with wealthy hand-to-mouth consumers, which are related to models of consumption commitment, in section 6.6. Note that in this section I measure potential liquidity constraints using liquid assets ("cash-on-hand"), not net worth which also contains illiquid assets, such as real assets or tax-deferred accounts.

with the near-rational behavior shown above. Moreover, column 7 shows that controlling for the measures of potential welfare losses (income-per-capita and potential-loss quintiles) does not change the liquidity profile of the MPC. The reason is that households with low levels of liquid assets also tend to spend less on average. Hence, many lower-income households end up in the upper quintiles of the cash-on-hand ratio distribution. The MPC in those quintiles is therefore close to the average MPC in the sample.

Comparing Near-Rationality and Liquidity Constraints How much of the MPC heterogeneity can the potential-loss statistic (i.e., near-rationality) and precautionary saving motives explain jointly? To answer this question I sort households according to both measures, by potential loss quintile (q^{loss}) and by cash-on-hand-ratio quantiles ($\tilde{q}^{liq}$) at the same time,

$$\begin{aligned} \Delta c_{it} \;=\; & \sum_{\tilde{q}} \sum_{q=1}^{5} \beta_{\tilde{q},q} \cdot PFD_{it} \times \mathbb{1}(q_{it}^{loss}) \times \mathbb{1}(\tilde{q}_{it}^{liq}) \\ & + \sum_{q=1}^{5} \eta_q^{loss} \mathbb{1}(q_{it}^{loss}) + \sum_{\tilde{q}} \eta_{\tilde{q}}^{liq} \mathbb{1}(\tilde{q}_{it}^{liq}) + \alpha_t + \text{Alaska}_i + \lambda' x_{it} + \varepsilon_{it} \ . \end{aligned} \tag{8}$$

Column 1 of Table 4 splits the potential-loss quintiles by the median cash-on-hand ratio. Both mechanisms contribute to explaining the heterogeneity in MPCs. The relative shock size however has a larger effect on the MPC than the cash-on-hand ratio for these households, consistent with the results in Table 3. Jointly, the two mechanisms can fully account for the heterogeneity in MPCs across households. Moving from the lowest potential-loss and liquidity cell to the highest reduces the MPC from an economically and statistically significant 82% to an insignificant 4% (two-sided p-value of equality of MPCs is 0.2%). Moreover, except for the lowest potential-loss quintile, which has almost identical MPCs, the MPC is higher for households with below-median liquidity but the same potential-loss. As we move to higher potential-loss quintiles, this difference becomes more significant both economically and statistically. The difference in MPCs in the highest potential-loss quintile, in which we would expect the standard buffer stock model to perform the best, we indeed see a statistically significant difference in MPCs of 20% between potentially constrained and presumably unconstrained households. The one-sided test that the MPC is higher for below-median liquidity households in the highest potential-loss quintile has a one-sided p-value of 1.2%.

Pushing the data even more, column 2 sorts the potential-loss quintiles by liquidity quartiles. Again, moving from the cell with the lowest potential-loss and liquidity to the cell with the highest potential losses and highest cash-on-hand ratios reduced the MPC by a factor of 15 from 95% to 6% (two-sided p-value of 0.5%). Importantly, we see that the MPC is steeply declining and monotone in the potential-loss quintile for each liquidity quartile separately. While the standard errors increase substantially due to the fewer observations in each cell, in each case we can reject the hypothesis that the MPC in the lowest potential-loss quintile is larger than the MPC in the highest potential-loss quintile (one-sided p-values of 0.8%, 7.5%, 5.4%, and 0.1%, respectively). Hence, Table 4 shows (i) that the potential-loss statistic maintains its predictive power even after conditioning on liquid assets and (ii) that MPCs are decreasing in the amount of liquid assets that households hold as predicted by the standard buffer stock model, especially when the economic stakes are high.

6 Extensions and Robustness

In this section I address a number of concerns that typically arise in the literature, and I discuss a couple of extensions of the main analysis, in particular an external validity check using the Consumer Expenditure Survey.

6.1 Consumption vs. Spending

Many nondurables and services do have a durable component, especially when looking at frequencies higher than annual, so that spending does not necessarily reflect consumption. One is therefore concerned that households might time the purchase of such goods to the arrival of the dividend cash flows while spreading the consumption of the goods (or more precisely the marginal utility) evenly over the year as predicted by the standard model.

To address this concern I take advantage of the high quality of the expenditure transaction data, especially for disaggregated categories, compared to traditional expenditure surveys. In Table 5 I follow Lusardi (1996) and show that strictly nondurable goods, i.e., goods that arguably have a low durable component, also strongly respond to the dividend payments.[19] Column 1 documents that spending on groceries substantially increases in the first quarter after the dividend is paid out. The magnitude is in line with previous research, such as Broda and Parker (2014) for example, who estimate the spending responses to the smaller economic stimulus payments in 2008 using the Nielsen Consumer Panel. Column 2 shows that households also spend a significant amount on dining out, which is clearly nondurable. Column 3 uses expenditures on a service item—children's activities—to make the same point.

Columns 4 and 5 show that households also use the dividend to service their debts, such as student and car loans (column 5) and mortgages (column 6). These payments can change for two main reasons, either because households are more likely to make the typically fixed payments on time in the quarter they receive the PFD payments, or because they use the dividend to take out new loans or to refinance existing loans. The fact that rental payments, which are also fixed, do not systematically increase in response to the dividend payments (column 7) suggests that households use the dividend mostly for (re)financing.

Focusing on more disaggregated data therefore shows that spending significantly increases across many categories in response to the dividend, including strictly nondurables. Moreover, the absence of a reversal of the response of nondurables shown in Figure 3 strongly suggests that the excess sensitivity of spending on nondurables cannot be explained by intertemporal substitution of expenditures while smoothing the consumption of the service flows.

[19] To increase precision when analyzing disaggregated spending I use individual fixed effects estimators.

6.2 Response of Durables and Total Expenditures

For policy questions such as the effectiveness of an economic stimulus program, we might also be interested in the total effect of the dividend payments on household spending. I therefore analyze the response of durable expenditures to the dividend payments. However, it is worth pointing out that changes in durables spending do not necessarily provide evidence against the standard model because those changes might not reflect changes in the consumption of the service flow from those durables; see the discussion in the previous section.

Figures 5(a) and 5(b) show the dynamic response of household spending on durables that are purchased with a credit card and hence can be classified accordingly. While the overall pattern is similar to that of nondurables and service consumption in Figure 3, there are some notable differences. First, the effect is slightly smaller both on impact (8%) and after one quarter (15%), which is due to the fact that those transactions only capture smaller durables purchases. Second, there is strong evidence of intertemporal substitution of spending (but not necessarily of consumption). Figure 5(a) shows that purchases of smaller durables fall slightly in September (−3%), presumably in anticipation of the dividend payments, and this dip is marginally significant with a t-statistic of 2.2. Figure 5(b) shows that the MPC of smaller durables is hump-sharped. Both results suggest that Alaskan households time the purchase of durables (but not of nondurables) to the predictable arrival of the dividend cash flows. Column 7 of Table 5 provides the corresponding quarterly MPC.

Finally, column 8 uses all forms of spending; see Table A.1. The average MPC of total expenditures is 78%, which is very large. However, one should keep in mind that a substantial fraction of this response reflects intertemporal substitution.

6.3 External Validity using the Consumer Expenditure Survey

To provide external validity of the excess sensitivity results presented above, I use the Consumer Expenditure Survey (CE), which is the standard data set used in previous research. The CE sample spans the entire period since the first dividend was paid out in 1982 up to 2013, but covers fewer Alaskan households per period and follows them only for at most four quarters.

Since the CE does not ask Alaskan households directly whether they received the Permanent Fund Dividend and how large the payment was, the payment has to be imputed based on family size, state of residence, calendar year, and the fraction of households in any year that do not receive the dividend at all or in full either as a check or direct deposit. This fraction can be calculated for each year based on aggregate statistics provided by the APFDD. Because the state identifier for Alaska is suppressed in the public-use CE sample before 1996, I use the confidential data at the BLS. As is standard in the literature, I add up expenditures for each household-interview to "three-monthly" aggregates. Spending on nondurables and services is defined to be comparable to the concept used for the PFW sample, which in turn approximates the NIPA definition; see Table A.1.

Column 1 of Table 6 shows that Alaskan household in the CE also exhibit excess sensitivity to the dividend payments, with a statistically significant MPC of 8%. This MPC however is substantially smaller than the one using which uses PFD transactions identified in the PFW sample, shown in column 2. In order to make these two estimates comparable I apply two adjustments to the PFW sample. First, I apply the same dividend imputation procedure in the PFW sampel as in the CE, since the survey does not ask whether households received PFD payments and how much. Specifically, in the CE I impute the dividend payments based on family size, state of residence, and calendar year, thereby ignoring the information about the exact size of the payments.[20] Column 3 shows that the added measurement error reduces the MPC from 28% to 18%.

Second, I take into account the difference in sample compositions. While the CE is designed to be representative for the entire U.S., it is not representative for subpopulations such as single states. Hence, neither the CE sample nor the PFW sample is a representative sample of the population of Alaskan households. In particular, Alaskan households in the CE have a lower average family income ($63,000 in local dollars of 2014) compared to households in the PFW sample ($100,000). Since the MPC is increasing in income as shown above, these differences in sample composition matter. Column 7 adds an interaction term of the dividend with after-tax family income to the specification used for column 2. The point estimate implies that for each $100,000 of income, the MPC increases by about 20 percentage points. Evaluating this linear function at the average Alaskan family income in the CE predicts an average MPC of 8%, thereby matching the point estimate obtained from the CE sample.

Measurement error introduced by the necessity to impute dividend payments in the CE can therefore explain about half of the difference between the response estimated in the PFW and CE samples, and the other half is explained by composition effects, the fact that both samples represent different segments of the population. As a final step, column 5 uses the observed dividend transactions from column 2 as an instrument for the imputed dividend payments in column 3. The fact that the IV estimate is almost identical to the estimate in column 2 shows that the large drop in the coefficient when going from column 2 to 3 is indeed due to measurement error.

6.4 Comparison with Hsieh (2003)

The CE sample also allows me to reconcile these new results with the estimates provided by Hsieh (2003), who was the first to use this quasi-natural experiment to test the standard consumption model. His analysis found no response of spending to the dividend payments using the CE. One difference is that throughout this paper I estimate the effect of the PFD on changes in spending (i.e., MPCs), while his analysis estimates the effect on log-changes in spending (i.e., an elasticity). In order to estimate an elasticity, the previous study divides the PFD payments by self-reported family income per quarter leading to the following regression,

$$\Delta ln(c_{it}) = \beta \cdot \frac{PFD_t \times FamilySize_i}{FamilyIncome_i} + \gamma' x_{it} + \varepsilon_{it}.$$

[20] This approach follows the idea used in a series of papers by Romer (1986b,a, 1991) who compares pre- and post-WWII macroeconomic time series by making the cleaner post-war data as noisy as the pre-war data. Here, I make the cleaner dividend income measure in the PFW sample as noisy as the imputed income in the CE.

$FamilySize_i$ is the number of household members in the first interview, which are assumed to be eligible for the dividend.

Another companion background paper (Kueng (2015b)) replicates his estimate of the spending elasticity to the PFD payments as closely as possible using his shorter CE sample from 1980 to 2001 and then extends the sample to 2013. This section briefly discusses the main findings from this companion paper, summarized in Table 7. For convenience, column 1 of panel A reproduces the previous estimate (Hsieh (2003), Table 2, column 3) and column 2 of Table 7 closely replicates this result.

While normalizing the dividend by income is reasonable, family income in the CE suffers from substantial measurement error and under-reporting as shown in the companion paper, which leads to substantial attenuation bias. To show this, column 3 uses total expenditures as an alternative less-noisy measure of (permanent) income to scale the dividend instead of the more noisy family income. This alternative normalization substantially increases the response from 0 to 12%, reflecting the substantial measurement error contained in self-reported family income. Column 4 adds a time fixed effect which is another main effect of the relative dividend variable besides family size. The point estimates are largely unaffected although the precision decreases. Column 5 uses all quarters, including those without dividend payments, and uses non-Alaskan households as a control group to increase the precision. While the point estimates remain largely unchanged (especially in the longer sample in panel B), the precision of the estimates more than doubles. Column 6 adds the inverse of total expenditures, which is the last main effect of the relative dividend size. Column 7 takes into account that take-up of the dividend is not complete and varies from year to year. Using an attenuation factor to inflate the dividend payments by the inverse probability that a member received the dividend turns the intention-to-treat effect into an average treatment-on-the-treated effect which is comparable to the estimates based on the PFW sample. Finally, column 8 shows that one can obtain an unbiased estimate of the spending response as a fraction of self-reported family income by using the less noisy measure of the relative dividend normalized by total expenditures used in column 7 as an instrument for the more noisy relative dividend normalized by family income used in column 2. The corresponding elasticity using this larger income base is 8% in the extended sample, respectively 5% in the shorter sample, confirming that measurement error largely explains the previous non-result, which is attenuated completely toward zero. Also note that the elasticity of 7.6% is almost identical to the MPC of 7.9% in column 1 of Table 6. Hence, differences in the results are not driven by using logs instead of levels.

Measurement error in family income explains 70% of the difference between the previous estimated elasticity of 0 and the elasticity of 14% estimated using total household expenditures to normalize PFD payments, an alternative measure of (permanent) income that is more precisely quantified in the CE. The other 30% of the difference is due to the fact that the latter is based on a longer sample from 1980 to 2013, which contains the much larger variation in annual dividend payments during the 2000s, while the dividend grew almost linearly from 1983 to 2001.

6.5 Anticipation Effects

In order to obtain a complete picture of the impact of the PFD on household behavior, we need to assess what households do with the part of the dividend that they do not spend. One possibility is that they respond to news about future dividends before the dividends are paid out. Although there is no systematic response to leads of the dividend payments at any horizon, this does not fully rule out anticipation effects. Instead, under the rational-expectation version of the standard model, households would rationally only respond to new information about the dividend, and such news shocks should in fact not be systematically related to any predictable variable, in particular not to the calendar month or any lead of the actual dividend.

Narrative Analysis and Market-Based PFD Expectations I quantify the amount of new information released throughout the fiscal year about the next PFD in an companion background paper (Kueng (2015a)) using two approaches, (i) an extensive narrative analysis of all major Alaskan newspapers and local media starting in the early 1980s and (ii) the construction of a market-based time series of expected Permanent Fund Dividends applying the public formula described in section 2.1 to new historical data of the fund's monthly income starting in the mid-1990s obtained from the APFC's archive. The following two excerpts reproduce two representative results of the narrative analysis, both predicting the 2010 dividend of $1,281, which was distributed on October 7, 2010.

Juneau Empire, May 28, 2010: *DIVIDEND LOOKS SECURE*

> "Based on the current value of permanent fund earnings and projections for the remainder of the fiscal year, the permanent fund will likely provide nearly $812 million for dividend payments this year. That comes out to an estimated $1,171 per dividend check for 2010, down a bit from last year's $1,305, according to Empire calculations based on likely dividend applications."

Anchorage Daily News, July 31, 2010: *PFD EXPECTED TO BE SIMILAR TO LAST YEAR'S – $1,250 TO $1,320: INVESTMENT PROFITS WERE ANNOUNCED FRIDAY*

> "The Permanent Fund dividend payment this fall could be very close to last year's $1,305. The size of the payment for qualified Alaska residents will likely fall between $1,250 and $1,320, according to a Daily News estimate. [...]. The Daily News estimate is based in part on Friday's announcement that $858 million in investment profits from the state's oil-wealth savings account will be available for dividends this year. It also factors some assumptions, such as how many people will be eligible for the dividend this year. The state will announce the actual size of this year's dividend in September. The state plans to pay this year's dividend to more than 600,000 Alaskans on Oct. 7. The distribution of roughly $1 billion to Alaskans each fall juices the state's economy as people spend the money with retailers, remodeling companies, airlines, brokerage houses and even bankruptcy attorneys."

Figure 1 plots both series of the expected PFD resulting from this study. The figures show that changes in expected dividends using either measure are orders of magnitude smaller than the dividend itself. Hence, we would not expect households with rational expectations to change their consumption much in the months prior to the dividend based on these news shocks. Moreover, the forecast errors are of course positive and negative, contrary to the actual dividend payment and any of its leads or lags. Therefore, anticipation effects should not systematically be positive and hence cannot explain the observed excess sensitivity. Moreover, the figure shows that uncertainty about the next dividend declines during the fiscal year. Hence, the additional precautionary (dis)saving motives introduced by the decreasing uncertainty about the dividend should increase spending until September, but not in October when uncertainty is lowest.

Residual Income Analysis An alternative way to assess how much households could on average respond in advance to the payments is to estimate how much of the dividend is left after taking into account both the amount spent when receiving the dividend (the excess sensitivity of total expenditures) and the additional amount of federal income taxes due in the next year.

Although the PFD is a program run by the state of Alaska, the dividends for adults are fully taxable for federal income tax purposes, and depending on the amount of the dividend, children's dividends may be taxable too. I estimate the average marginal tax rate (AMTR) paid by Alaskan households on the marginal dollar of dividends received by regressing tax expenditure transactions in the current year on the previous year's dividend, PFD_{it}^{lag}, fully interacted with calendar month fixed effects,

$$T_{it} = \sum_{m=1}^{12} \tau_m \cdot \left(month_m \times PFD_{it}^{lag} \right) + \sum_{m=1}^{12} month_m + u_{it}, \tag{9}$$

where T are the household's tax payments (or refunds) in period t, $month_m$ are the 12 month fixed effects, and τ_m is the AMTR paid in month m. Adding up all 12 tax rates τ_m over the year yields the AMTR paid on one dollar of additional Permanent Fund Dividend income.

Figure 5(c) shows the monthly marginal tax rates τ_m from estimating (9). I restrict the sample of Alaskans to households who receive the full potential dividend amount in form of a direct deposit. This makes sure that they did not elect to have federal taxes withheld from their dividend checks, which would induce a downward bias. Since Alaska does not have a state or local income tax, the federal AMTR is all we need. Although the individual coefficients are not very precisely estimated, we see that households pay 8 cents of additional federal income taxes in February for each additional dollar of PFD received, and another 5 cents in both March and April. The response in all other months is small and statistically insignificant, consistent with the pattern of federal income tax revenues from aggregate statistics.

Adding up the coefficients of the federal marginal taxes across all calendar months yields a point estimate for the federal AMTR of 22.5%, with a standard error of 10.3%. This estimate is similar to independent estimates provided by Mertens (2013), who extends the estimates in Barro and Redlick (2011), finding an AMTR across all tax units in the U.S. between 22.1% and 23.5% in 2010.

Combining the estimated AMTR with the estimated MPC of total expenditures of 78% (Table 3, column 8) leaves little room for large anticipation effects, consistent with the direct evidence provided in Figures 3(a) and 5(a).

6.6 Consumption Commitments and Wealthy Hand-to-Mouth Users

Models with consumption commitments offer an additional interpretation of excess sensitivity. Households have to commit ex-ante to purchasing the stock in order to consume the service flow from durable goods such as housing (e.g., Chetty and Szeidl (2007)). Durable assets are illiquid and involve a transaction cost to turn them into liquid assets (e.g., Kaplan and Violante (2014)). Therefore, households optimally tolerate deviations from the frictionless optimum in more flexible consumption goods, such as spending on nondurables, in response to smaller income shocks.

Consistent with these predictions, I find that homeowners have on average a 24 percent point larger MPC than non-homeowners (34% vs 10%, with a standard error of 7%. More importantly, consumption commitments interact with the expected size of the income shock such that homeowners' tolerate predictable changes in flexible consumption (nondurables and services), but respond less to larger shocks. Therefore, a central prediction of these models is that the relative difference in excess sensitivity between homeowners and non-homeowners should decrease as the size of the shock increases.[21] To test this prediction, I interact homeownership status with quartiles of the relative size of the dividend in order to analyze how the differential responses change as the relative size of the dividend payments increases. Figure 5(d) shows that the estimated difference in the response is indeed declining in the relative size of the dividend, consistent with the theory, although the power is low.

While these results are consistent with models of consumption commitments and wealthy hand-to-mouth consumers, there are two important caveats. First, the typical homeowner in this sample has sufficient money in his bank accounts, a median value of $28,000, so that he does not appear to be credit constrained. This is also the case for each of the relative dividend size quartiles, in which median bank balances range from $35,000 in the lowest quartile to $9,000 in the highest quartile. Consequently, conditioning on liquid assets and income does not substantially affect the results. Therefore, other frictions that differentially affect homeowners, either economic frictions or behavioral biases, probably also play an important role.

Second, an important limitation of optimization-based models of excess sensitivity—which in addition to consumption commitment models also include models of rational inattention (e.g., Reis (2006) and Luo (2008)) and optimization frictions (e.g., Chetty (2012))—is that they cannot explain why household spending responds to fully predetermined cash flows rather than to new information about those future cash flows. In those models, a household's optimal response typically smoothes consumption between dates at which he rebalances his portfolio (consumption commitments), updates his information set (rational inattention), or pays the fixed cost of re-optimization (optimization frictions), which is inconsistent with the large MPCs

[21] This is a distinct prediction for excess sensitivity relative to models with habit formation; see Chetty and Szeidl (2016).

estimated in this paper. Moreover, the size of new information about future PFDs is much smaller than the dividend itself, because the size of the dividend is highly predictable and hence rational forecast errors are small. Therefore, even if households did rebalance or update only infrequently and only at dates at which dividends are paid out, they should still only react to the new information they received since the last time they changed their consumption plans. However, the observed MPCs are orders of magnitudes larger than what one would expect if households only responded to new information about the dividend. Moreover, consumption should as likely decrease as increase on those dates and need not necessarily be related to the nominal amount of the dividend, because forecast errors due to new information are both negative and positive. Instead, households respond to the entire dividend amount, not just the news component.

6.7 Additional Robustness Checks

Table 8 presents additional robustness checks of the baseline results in column 4 of Table 2, which are reproduced for convenience in column 1. For reasons described in section 2.2, the baseline sample restricts Alaskan households to those who receive the dividend as a direct deposit within two business days. Column 2 relaxes this restriction by including delayed PFD direct deposits as well as dividends identified from check deposits. The point estimate increases slightly which could be due to the fact that these additional recipients often have their dividend partially garnished, although we cannot reject that it is smaller than the baseline effect. To investigate this possibility, column 3 restricts the sample of dividend recipients to those that only receive a partial dividend; i.e., they have their dividend reduced due to involuntary or voluntary deductions as discussed in section 2.2. The point estimate is not larger than in column 2 suggesting that these households do not behave differently than households that receive the full dividend amount. To show this, column 4 restricts the analysis to such households that receive the full amount of the PFD, yielding a similar MPC. Column 4 then uses the entire sample of Alaskan households, including those for whom I do not observe a dividend receipt. The point estimate is again similar to the baseline estimate with a slight increase in precision due to the additional observations.

Column 6 shows that controlling for family size non-parametrically does not affect the baseline result much. Note that even with family size fixed effects the model is still identified since the identifying variation comes from the interaction of family size with time effects and also includes a control group of households in Washington that do not receive the dividend. Furthermore, there is variation in the amount of cash-on-hand received even among families of the same size in the same period due to voluntary and involuntary deductions. Column 3 shows that this identifying variation also yields a similar estimate of the average MPC.

One concern with the new PFW data is that family size and the number of users per online account might be very different. This can be for two main reasons. First, it is possible that family members have different accounts but share a common household. Second, most users provide the demographic information when they first sing up for a new account and this information is only infrequently updated, if ever. Hence, family size and the number of users can diverge over time. Note however that it is a priori not clear whether such a discrepancy should bias the estimated MPC and in what direction. To address this issue, column 7 restricts the sample of Alaskans to households whose self-reported family size equals the number of dividend checks received. The estimated MPC is similar to the baseline estimate in column 1, although less precisely estimated due to the smaller sample.

Finally, I link the external validity checks of sections 6.4 and 6.3 by estimating the same regression in log-differences as in Table 7 but now using the PFW instead of the CE sample. As in section 6.3 I divide the PFD payments by quarterly family income averaged over all household observations to estimate an elasticity that is comparable to the baseline specification in level differences. Column 8 shows that the estimated elasticity of 34% is again very similar to be baseline MPC of 28%. Hence, specifying the model in absolute vs. percentage differences does not affect the finding of significant excess sensitivity to the dividend payments.

7 Conclusion

This paper finds significant evidence of consumption excess sensitivity in response to salient, predetermined, and nominally large cash flows. The *potential* loss from failing to smooth consumption and instead consuming the entire predictable cash inflow varies systematically across households. This potential loss is shown to be monotonically increasing in the relative size of the cash flow as a fraction of permanent income, measured as annual household consumption. The *realized* loss on the other hand is endogenous and depends on the response of each household to the cash flow.

Sorting households according to their potential loss shows that households for whom the loss would be the largest violate the basic PIH model the least, while households for whom the loss is trivial violate the standard model's prediction the most. Consistent with households following near-rational alternatives, the *actual* loss taking into account these behavioral responses is small and similar across households. Therefore, near-rational behavior can explain most of the heterogeneity in MPCs across households that are not borrowing constrained. Low levels of liquid assets on the other hand continue to predict high MPCs for lower-income households, in addition to the predictive power of the potential loss statistic.

Hence, the statistically significant deviation of household consumption from the theory's main prediction shown in this paper does not imply a significant deviation in terms of wealth-equivalent losses. The potential loss of deviating from the nominal model—which in the case of the PIH model is captured by the relative size of the predetermined payments—can therefore be used as a measure of economic power of a research design for testing the nominal model's predictions in the spirit of Varian (1990).

This paper is among the first to use a single income source to show that the relative size of the payment and hence the potential loss from not smoothing out this cash flow is a crucial statistic for explaining excess sensitivity in household consumption. The relative size of the cash flows together with liquidity constraints and precautionary saving motives could therefore help to reconcile the large literature that tests for excessively sensitive in household consumption.

Finally, while the failure of the standard theory documented in this paper is not economically significant for individual households, it has important implications for policy. Many policies have a large predictable component, such as economic stimulus programs, automatic stabilizers, and many more. According to the standard model, one would expect unconstrained households to adjust their spending only to the news about such policies, and only if it affects their permanent income or life-time budget constraint. However, not smoothing out those cash flows has trivial costs for most households and for most policies. Therefore, gaining a better understanding of the near-rational alternatives that households follow in response to such relatively small payments is important in order to design effective and robust policies. At the same time, the fact that the deviations from the standard model documented in this paper are consistent with households following near-rational alternatives implies that optimization-based extensions of the standard model might have limited economic power and thus might not be very robust. Modelling near-rational behavior in a parsimonious and robust way thus remains an important challenge for future research.

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Table 1: Summary Statistics

	State of Alaska			*State of Washington*		
	Mean	Median	St.Dev.	Mean	Median	St.Dev.
Permanent Fund Dividend:						
- annual payments (real $2014)	1,999	1,417	1,357	--	--	--
- per annual income	2.8%	2.1%	2.8%	--	--	--
- per annual total expenditures	4.7%	3.6%	3.9%	--	--	--
Quarterly Expenditures:						
- nondurables and services	8,441	7,179	5,858	8,049	6,531	6,103
- durables (paid for with a credit card)	3,116	2,235	3,036	2,971	2,074	3,019
- other items in total expenditures	13,017	8,651	15,607	12,849	8,229	16,060
Income:						
- annual after-tax income	99,716	82,294	74,056	97,074	77,419	77,267
Net Financial Assets:						
- bank accounts ("cash-on-hand")	40,903	11,715	85,484	61,234	21,911	107,198
- taxable (brokerage) accounts	150,708	8,751	461,182	229,808	28,021	599,532
- tax-deferred accounts	164,086	33,952	366,360	164,686	42,666	327,013
- total net financial assets	366,055	108,034	770,065	468,000	153,332	870,699
Demographics:						
- family size	2.80	2	1.37	2.61	2	1.37
- OECD household equivalence scale	2.08	2	0.74	1.99	1.7	0.77
- age	32.18	31	10.67	30.93	31	10.27
- education (years of schooling)	15.34	16	2.22	16.03	16	2.12
Number of households	1,379			2,167		

Notes: Nominal variables are in local dollars of 2014 and, expect for annual dividend payments, are winsorized at 1%. Income is after deductions and tax withholding and includes the Permanent Fund Dividend payments.

Table 2: Average Excess Sensitivity

Dep. var.: Δc_{it} or c_{it}, quarterly nondurables and services	first differences estimator				fixed effects estimator	
	average MPC	median MPC	Alaskans only	adding controls	household FE	adding controls
	(1)	(2)	(3)	(4)	(5)	(6)
PFD payments	0.277***	0.267***	0.238***	0.282***	0.256***	0.246***
	(0.044)	(0.032)	(0.060)	(0.045)	(0.033)	(0.035)
- Time FE (year-by-quarter)	YES	YES	YES	YES	YES	YES
- Alaska FE	YES	YES		YES		
- Household FE					YES	YES
- Family size				YES		YES
- Income				YES		YES
- Liquid assets				YES		YES
- Other household characteristics				YES		YES
Observations	44,577	44,577	16,012	44,577	47,788	47,788
R-squared	0.106	0.068	0.116	0.108	0.670	0.679

Notes: PFD payments sum all cash flows received by a household from the Permanent Fund Dividend Division in a quarter. Income is household income after deductions and income tax withholding. Liquid assets are the household's net cash-equivalent bank balances (cash-on-hand). Other household characteristics include fixed effects for age, education, residential ZIP code, homeownership status, marital status, and occupation. Expenses totaling the exact amount of the annual dividend are excluded in order to avoid any mechanical effects due to misclassified transactions. For robustness, the dependent variable is winsorized at the 1% level, except for the median regression (2). Robust standard errors in parentheses, clustered at the household level, are adjusted for arbitrary within-household correlations and heteroskedasticity.

Table 3: MPC Heterogeneity and Near-Rationality

Dep. var.: Δc_{it}, quarterly nondurables and services	*near-rationality*					*liquidity constraints*	
	by potenital-loss quintiles (relative PFD)		with squared PFD	by income per capita quintiles		by cash-on-hand ratio quintiles	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
PFD payments x 1st quintile	0.839***	0.849***		0.118**	0.122**	0.368***	0.378***
	(0.182)	(0.187)		(0.052)	(0.052)	(0.058)	(0.060)
PFD payments x 2nd quintile	0.599***	0.593***		0.093	0.102	0.260***	0.279***
	(0.130)	(0.133)		(0.068)	(0.071)	(0.068)	(0.069)
PFD payments x 3rd quintile	0.425***	0.414***		0.291***	0.303***	0.316***	0.326***
	(0.097)	(0.099)		(0.071)	(0.073)	(0.099)	(0.101)
PFD payments x 4th quintile	0.269***	0.270***		0.407***	0.422***	0.192**	0.206**
	(0.080)	(0.082)		(0.106)	(0.109)	(0.097)	(0.100)
PFD payments x 5th quintile	0.159***	0.167***		0.611***	0.631***	0.230**	0.243**
	(0.046)	(0.048)		(0.108)	(0.110)	(0.096)	(0.098)
PFD payments			0.278***				
			(0.099)				
$(\text{PFD payments}/100)^2$			0.027				
			(0.201)				
- Time FE (year-by-quarter)	YES	YES	YES	YES	YES	YES	YES
- Alaska FE	YES	YES	YES	YES	YES	YES	YES
- Potential-loss quintile FE	YES	YES	YES		YES		YES
- Income per capita quintile FE		YES	YES	YES	YES		YES
- Cash-on-hand ratio quintile FE		YES	YES		YES	YES	YES
- Family size		YES	YES		YES		YES
- Other household characteristics		YES	YES		YES		YES
Observations	44,577	44,577	44,577	44,577	44,577	44,577	44,577
R-squared	0.107	0.108	0.107	0.107	0.108	0.106	0.108
Average MPC for comparison	0.285***	0.290***	0.290***	0.278***	0.290***	0.277***	0.290***
	(0.044)	(0.045)	(0.045)	(0.044)	(0.045)	(0.044)	(0.045)

Notes: PFD payments sum all cash flows received by a household from the Permanent Fund Dividend Division in a quarter. Shock size in columns 1 and 2 is the amount of PFD payments received per year by a household divided by the household's annualized total spending, where total spending is averaged over all household years. Per capita income for the quintiles in columns 4 and 5 is calculated using the OECD household equivalence scale. The cash-on-hand ratio in columns 6 and 7 is computed as net cash-equivalent bank balances divided by average total spending per quarter averaged over all household years. Other household characteristics include fixed effects for age, education, residential ZIP code, homeownership status, marital status, and occupation. Expenses totaling the exact amount of the annual dividend are excluded in order to avoid any mechanical effects due to misclassified transactions. For robustness, the dependent variable is winsorized at the 1% level. Robust standard errors in parentheses, clustered at the household level, are adjusted for arbitrary within-household correlations and heteroskedasticity.

Table 4: Near-Rationality vs Liquidity

Dep. var.: Δc_{it}, quarterly nondurables and services	by median liquidity		by liquidity quartiles			
	below	above	1^{st}	2^{nd}	3^{rd}	4^{th}
	(1)		(2)			
PFD payments x 1^{st} potential-loss quintile	0.823***	0.863***	0.946***	0.723**	0.557*	1.114***
	(0.240)	(0.249)	(0.281)	(0.336)	(0.334)	(0.328)
PFD payments x 2^{nd} potential-loss quintile	0.631***	0.559***	0.724***	0.539*	0.487*	0.606***
	(0.193)	(0.167)	(0.235)	(0.296)	(0.261)	(0.212)
PFD payments x 3^{rd} potential-loss quintile	0.524***	0.264	0.536***	0.510***	0.178	0.340
	(0.109)	(0.163)	(0.122)	(0.168)	(0.162)	(0.261)
PFD payments x 4^{th} potential-loss quintile	0.336***	0.208	0.392***	0.271**	0.248	0.147
	(0.079)	(0.131)	(0.084)	(0.129)	(0.179)	(0.168)
PFD payments x 5^{th} potential-loss quintile	0.246***	0.042	0.258***	0.234***	0.015	0.067
	(0.050)	(0.083)	(0.065)	(0.072)	(0.081)	(0.138)
- Time FE (year-by-quarter)	YES		YES			
- Alaska FE	YES		YES			
- Family size	YES		YES			
- Potential-loss quintile FE	YES		YES			
- Cash-on-hand ratio quantile FE	YES		YES			
- Income per capita quintile FE	YES		YES			
- Other household characteristics	YES		YES			
Observations	44,577		44,577			
R-squared	0.109		0.109			

Notes: PFD payments sum all cash flows received by a household from the Permanent Fund Dividend Division in a quarter. The potential loss uses the rative dividend size, which is the amount of PFD payments received per year by a household divided by the household's annualized total spending, where total spending is averaged over all household years. Liquidity is measured using the cash-on-hand ratio, i.e. the ratio of net cash-equivalent bank balances to average total spending per quarter averaged over all household years. Per capita income uses the OECD household equivalence scale. Other household characteristics include fixed effects for age, education, residential ZIP code, homeownership status, marital status, and occupation. Expenses totaling the exact amount of the annual dividend are excluded in order to avoid any mechanical effects due to misclassified transactions. For robustness, the dependent variable is winsorized at the 1% level. Robust standard errors in parentheses, clustered at the household level, are adjusted for arbitrary within-household correlations and heteroskedasticity.

Table 5: Disaggregated Spending Response to the Permanent Fund Dividend Payments

Dep. var.: c_{it}, quarterly spending	food: at home	food: away	kids activities	student and auto loan int.	mortgage payments	rent	durables with credit cards	total expenditures
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
PFD payments	0.067***	0.020***	0.007**	0.016*	0.057***	0.001	0.144***	0.783***
	(0.009)	(0.005)	(0.003)	(0.009)	(0.018)	(0.003)	(0.023)	(0.137)
- Time FE (year-by-quarter)	YES	YES	YES	YES	YES	YES	YES	YES
- Household FE	YES	YES	YES	YES	YES	YES	YES	YES
- Family size	YES	YES	YES	YES	YES	YES	YES	YES
- Income	YES	YES	YES	YES	YES	YES	YES	YES
- Liquid assets	YES	YES	YES	YES	YES	YES	YES	YES
- Other household characteristics	YES	YES	YES	YES	YES	YES	YES	YES
Observations	47,788	47,788	47,788	47,788	47,788	47,788	47,788	47,788
R-squared	0.691	0.639	0.526	0.416	0.661	0.504	0.540	0.665

Notes: PFD payments sum all cash flows received by a household from the Permanent Fund Dividend Division in a quarter. (1) is spending on groceries; (2) is spending on restaurants, fast food, coffee shops and bars; (3) is spending on kids activities and babysitting expenses; (7) sums durable spending paid for with a credit card and hence identifiable as durables expenses from the transaction label; (8) sums non-durables, services, durables and other expenses (see Table A1). Income is household income after deductions and income tax withholding. Liquid assets are the household's net cash-equivalent bank balances (cash-on-hand). Other household characteristics include fixed effects for age, education, residential ZIP code, homeownership status, marital status, and occupation. Expenses totaling the exact amount of the annual dividend are excluded in order to avoid any mechanical effects due to misclassified transactions. For robustness, all dependent variables are winsorized at the 1% level. Robust standard errors in parentheses, clustered at the household level, are adjusted for arbitrary within-household correlations and heteroskedasticity.

Table 6: External Validity using the Consumer Expenditure Survey (CE)

Dep. var.: Δc_{it}, quarterly nondurables and services	*CE Sample*	*PFW Sample*			
		using the observed PFD	using the imputed PFD	dealing w/ sample composition	IV imputed with observed PFD
	(1)	(2)	(3)	(4)	(5)
PFD payments		0.276***			
		(0.042)			
PFD x family size	**0.079****		0.184***	-0.044	0.283***
	(0.036)		(0.031)	(0.048)	(0.044)
PFD x family size x income/$100,000				0.201***	
				(0.046)	
predicted MPC at average CE income				***0.082****	
				(0.029)	
- Time FE (year-by-quarter)	YES	YES	YES	YES	YES
- Alaska FE	YES	YES	YES	YES	YES
- Family size	YES	YES	YES	YES	YES
- Income	YES	YES	YES	YES	YES
- Liquid assets	YES	YES	YES	YES	YES
- Other household characteristics	YES	YES	YES	YES	YES
Observations	385,800	50,210	50,210	50,210	50,210
R-squared	0.006	0.107	0.107	0.109	0.107

Notes: PFD payments sum all cash flows received by a household from the Permanent Fund Dividend Division in a quarter. PFD x family size imputes the dividend payments using the full annual dividend per person (PFD) multiplied by family size. Income is household income after income tax withholding (CE sample) and after additional deductions (PFW sample). Liquid assets are the household's net cash-equivalent bank balances (cash-on-hand). Other household characteristics include fixed effects for age, education, residential ZIP code (PFW sample only), homeownership status, marital status, and occupation. The predicted MPC in (4) uses the two coefficients listed to evaluate the linear MPC function at the average after-tax income of Alaskan households in the CE. (5) instruments the imputed (noisy) dividend with the observed dividend used in (2) based on transaction labels. Expenses totaling the exact amount of the annual dividend are excluded in order to avoid any mechanical effects due to misclassified transactions. For robustness, the dependent variable is winsorized at the 1% level. Robust standard errors in parentheses, clustered at the household level, are adjusted for arbitrary within-household correlations and heteroskedasticity.

Table 7: Comparison with Hsieh (2003)

Dep. var.: Δln(c_{it}), quarterly nondurables and services	*Alaskans in 4th quarter only*				*All household-quarters*			
	Hsieh's specification							
	Hsieh (2003)	replication and extension	normalize w/ total expend.	control for aggr. effects	using rest of U.S. as contol	control for all main effects	attenuation factor	IV curr inc w/ perm inc
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Sample Period 1980-2001								
PFD x family size x Alaska / before-tax income	-0.003	-0.003						0.052**
	(0.033)	(0.005)						(0.025)
PFD x family size x Alaska / total expenditures			0.123	0.124	0.090**	0.091**	0.107**	
			(0.086)	(0.112)	(0.036)	(0.036)	(0.043)	
Number of observations (rounded)	806	800	800	800	315200	315200	315200	281500
Number of Alaskan obs. (rounded)	806	800	800	800	4300	4300	4300	3800
Number of clusters (rounded)	--	0	800	800	117000	117000	117000	103400
Number of Alaskan CUs (rounded)	806	800	800	800	1700	1700	1700	1500
R-squared	--	0.009	0.013	0.038	0.009	0.009	0.009	0.010
Panel B: Sample Period 1980-2013								
PFD x family size x Alaska / before-tax income	--	-0.001						0.076***
	--	(0.004)						(0.023)
PFD x family size x Alaska / total expenditures			0.116*	0.134*	0.113***	0.113***	0.136***	
			(0.060)	(0.077)	(0.027)	(0.027)	(0.032)	
Number of observations (rounded)		1400	1400	1400	559400	559400	559400	458000
Number of Alaskan obs. (rounded)		1400	1400	1400	7100	7100	7100	5900
Number of clusters (rounded)		0	1400	1400	206200	206200	206200	166000
Number of Alaskan CUs (rounded)		1400	1400	1400	2800	2800	2800	2300
R-squared		0.004	0.007	0.032	0.007	0.007	0.007	0.009
- Other household characteristics	YES	YES	YES	YES	YES	YES	YES	YES
- Family size	YES	YES	YES	YES	YES	YES	YES	YES
- Time (year-by-quarter) FE				YES	YES	YES	YES	YES
- Alaska FE					YES	YES	YES	YES
- Inverse total expenditures						YES	YES	YES

Notes: To maintain confidentiality, sample sizes are rounded to the nearest hundred. PFD is the annual Permanent Fund Dividend per person. (1)-(4) use only Alaskan households. For comparison, (3)-(4) use the same smaller sample as in (1)-(2) that excludes households with zero self-reported family income, which are droped when normalizing the dividend payments. Other household characteristics include quarterly changes in the number of children, adults, and seniors, and a quadratic in the age of the reference person. Robust standard errors in parentheses are clustered at the household level in (3)-(8), thereby adjusting for arbitrary within-household correlations and heteroskedasticity; OLS standard errors are used in (1)-(2).

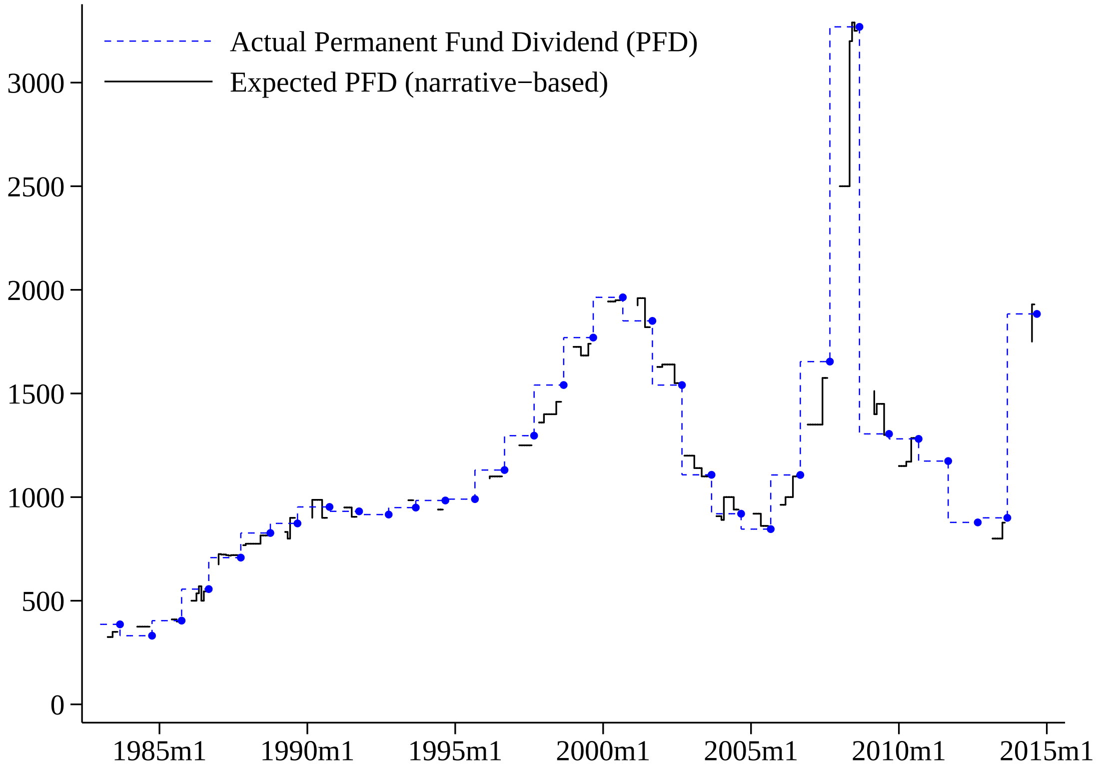
Table 8: Robustness of Excess Sensitivity Results

Dep. var.: Δc_{it} or $\Delta \ln(c_{it})$, quarterly nondurables and services	baseline (1)	all PFDs, incl. checks & delayed (2)	only partial PFD received (3)	only full PFD received (4)	incl. Alaskans without PFD (5)	family size FE (6)	family size = # of users (7)	using $\Delta \ln(c_{it})$ (8)
PFD payments	0.282***	0.305***	0.304***	0.282***	0.304***	0.288***	0.314***	
	(0.045)	(0.044)	(0.093)	(0.048)	(0.042)	(0.045)	(0.057)	
PFD payments / family income								0.339***
								(0.095)
- Time FE (year-by-quarter)	YES	YES	YES	YES	YES	YES	YES	YES
- Alaska FE	YES	YES	YES	YES	YES	YES	YES	YES
- Income	YES	YES	YES	YES	YES	YES	YES	YES
- Liquid assets	YES	YES	YES	YES	YES	YES	YES	YES
- Other household characteristics	YES	YES	YES	YES	YES	YES	YES	YES
- Family size	YES	YES	YES	YES	YES		YES	YES
- Family size FE						YES		
Observations	44,577	45,407	32,540	41,454	50,210	44,577	35,046	44,577
R-squared	0.108	0.108	0.104	0.107	0.107	0.108	0.107	0.211

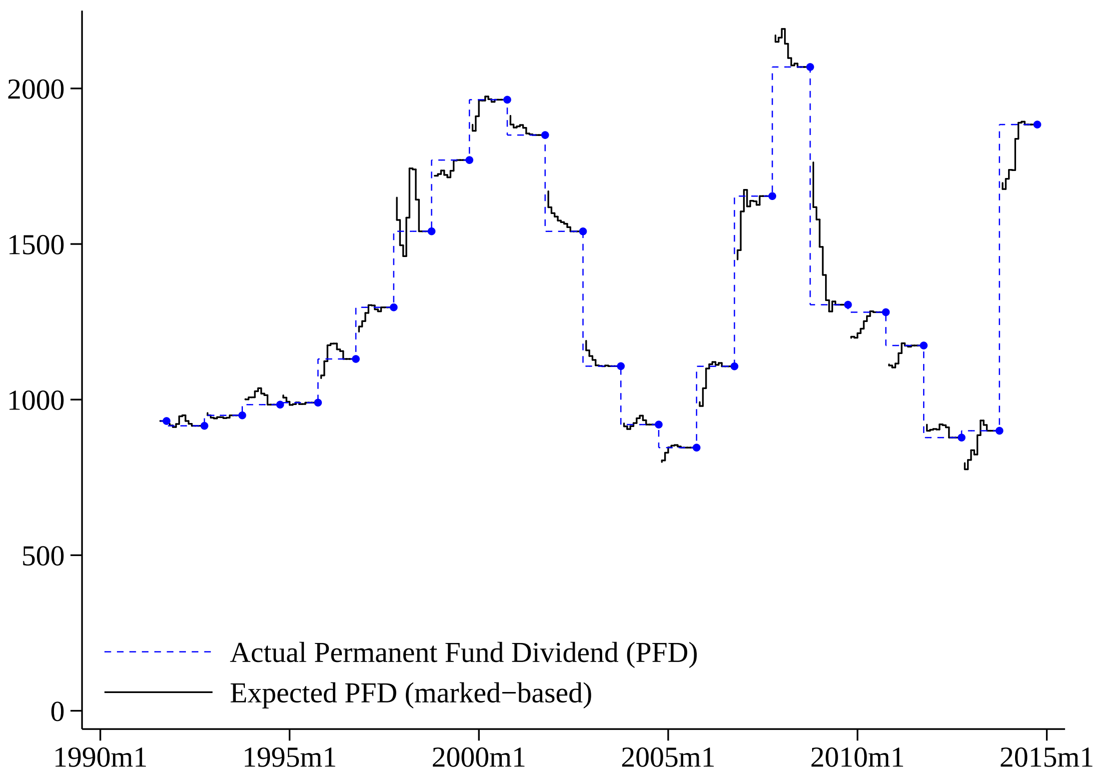
Notes: PFD payments sum all cash flows received by a household from the Permanent Fund Dividend Division in a quarter. Income is household income after deductions and income tax withholding. Liquid assets are the household's net cash-equivalent bank balances (cash-on-hand). Other household characteristics include fixed effects for age, education, residential ZIP code, homeownership status, marital status, and occupation. The dependent variable is spending changes in (1)-(7) and changes in log spending in (8). Family income used to normalize dividend payments in (8) is quarterly income averaged across all household years. Expenses totaling the exact amount of the annual dividend are excluded in order to avoid any mechanical effects due to misclassified transactions. For robustness, the dependent variable is winsorized at the 1% level respectively at 5% for the log changes, which restricts quarterly log spending changes to 100% in absolute value. Robust standard errors in parentheses, clustered at the household level, are adjusted for arbitrary within-household correlations and heteroskedasticity.

Figure 1 – Expected vs. actual Permanent Fund Dividend

(a) narrative-based expected dividend



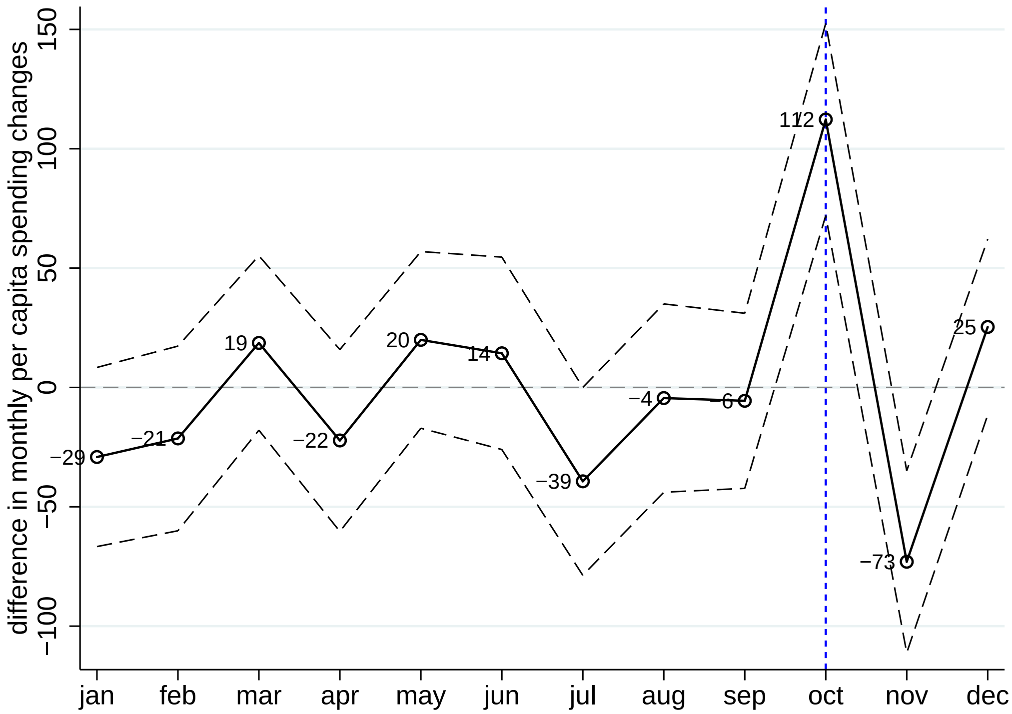
(b) market-based expected dividend



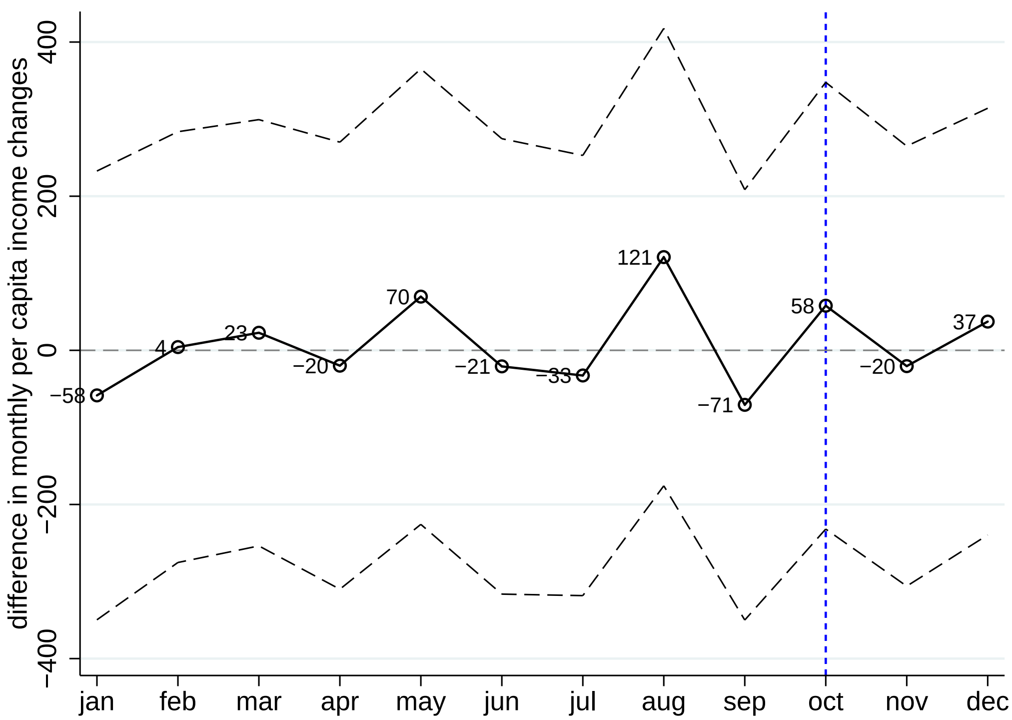
Notes: This figure shows the nominal Permanent Fund Dividend amount (blue dashed line), which is paid out in early October (marked by the blue dots), as well as the expected dividends from the companion background paper (Kueng (2015a)), which are based (a) on a narrative analysis of all major Alaskan newspapers and (b) on the public dividend formula applied to monthly income from the fund's asset obtained from the archives and the website of the APFC. Panel (a) includes the additional one-time Alaska Resource Rebate of $1,200 in 2008. This special payment was introduced by Governor Sarah Palin and added on top of the regular dividend of $2,069, which is the dividend predicted by the market-based approach in Panel (b).

Figure 2 – Non-parametric evidence of spending excess sensitivity

(a) spending per capita



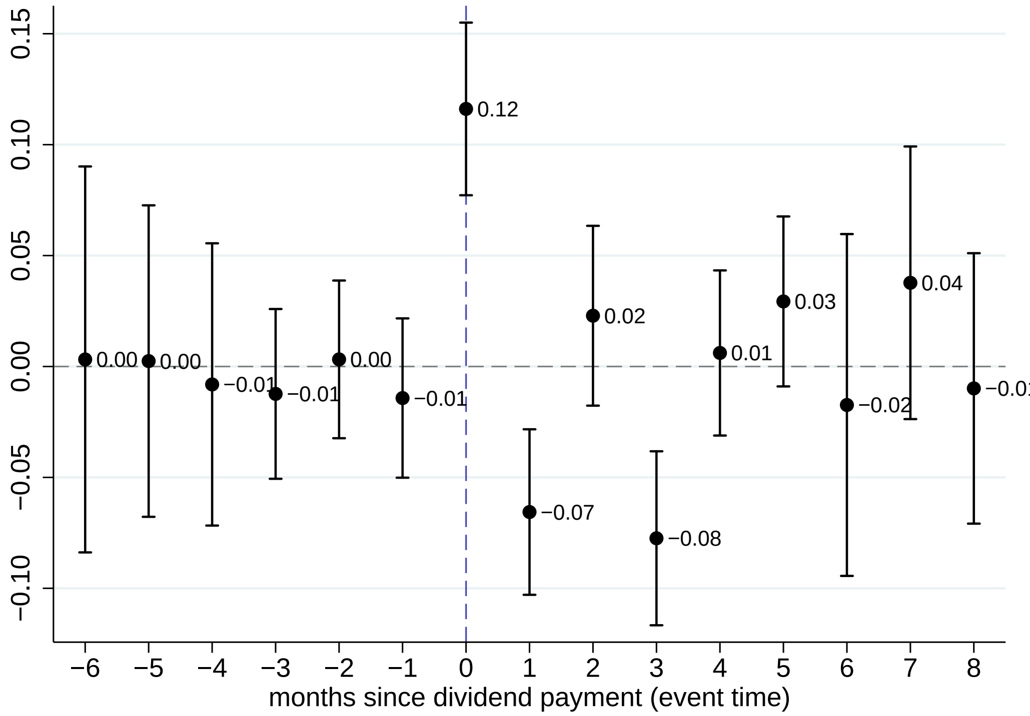
(b) income per capita (excluding dividend)



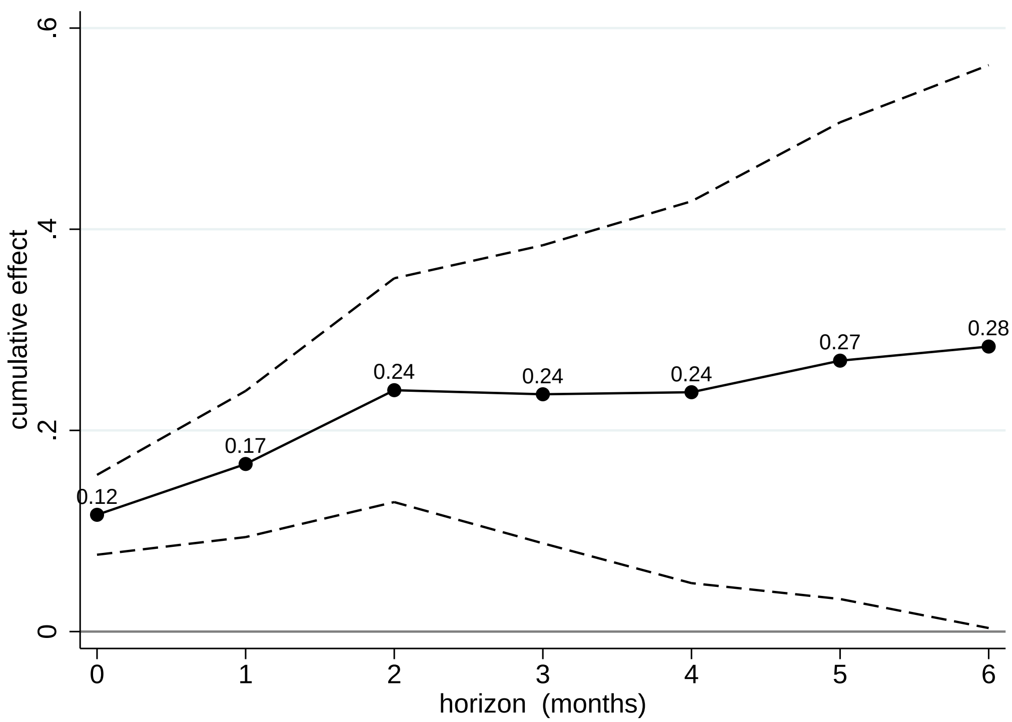
Notes: These figures show the average (median) difference in monthly household per capita spending changes of nondurables and services (income per capita) between households in Alaska and Washington. The Permanent Fund Dividend is paid out at the beginning of October. Per capita spending and income are calculated using the OECD household equivalence scale. Dashed lines are 95% confidence intervals.

Figure 3 – Parametric evidence of excess sensitivity: average MPC of nondurables and services

(a) βs from $\Delta c_{it} = \sum_s \beta_s PFD_{i,t-s} + \alpha_t + \text{Alaska}_i + \lambda\text{FamilySize}_{it} + \varepsilon_{it}$



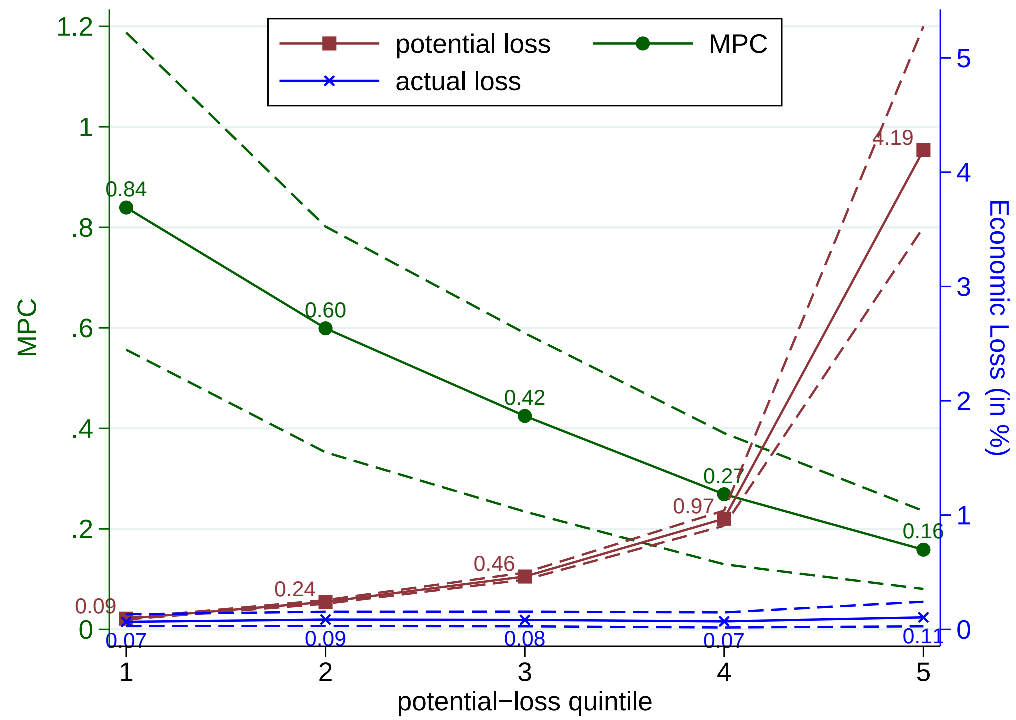
(b) cumulative MPC



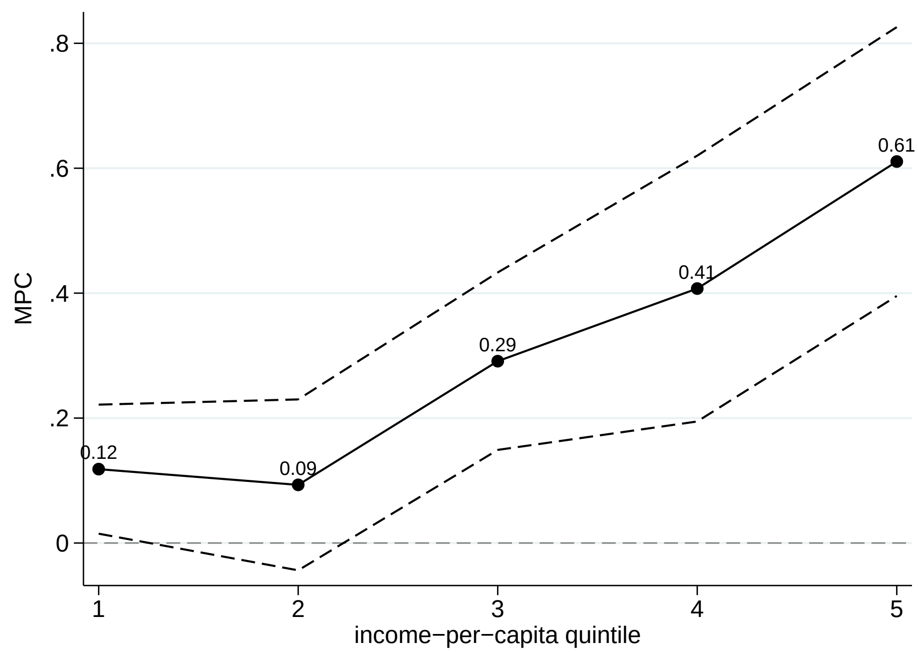
Notes: These figures show the the response of household spending on nondurables and services to the receipt of the Alaska Permanent Fund Dividend (PFD) by estimating equation (6). All specifications use changes in levels as the dependent variable. Panel (a) shows leads and lags of the regression coefficients on the dividend. Panel (b) cumulates the marginal propensity to spend from the beginning of October when the PFD is paid out to the end of April. Bars and dashed lines show two robust standard errors, clustered at the household level, which adjust for arbitrary within-household correlations and heteroskedasticity.

Figure 4 – Near-Rationality and Heterogeneity in MPCs

(a) by potential loss ($\propto$ relative dividend size^2)

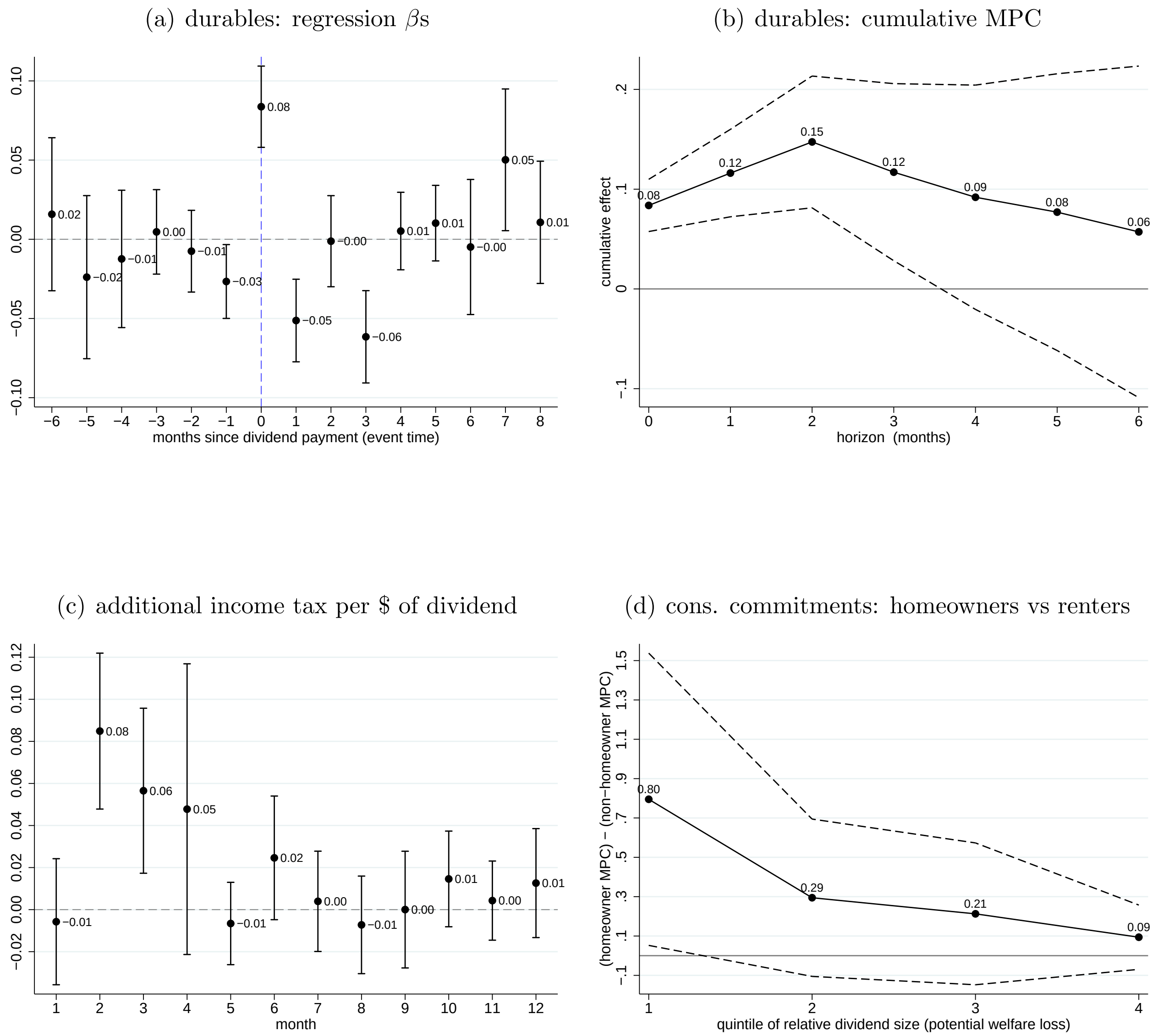


(b) by per capita after-tax income



Notes: These figures decompose the average quarterly MPC in nondurables and services across the two predicted dimensions of potential wealth-equivalent losses by estimating equation (7) without controls x; Table 3 reports the results when adding a full set of controls. Panel (a) uses the potential loss (4) from fully spending the dividend in the 4$^{\text{th}}$ quarter instead of fully smoothing it throughout the year, which is monotone increasing in the relative dividend size—the amount of PFD payments received by a household divided by the household's annualized total expenditures. The actual economic loss is calculated using (5) with $T = 4$ and $\gamma = 2$. Panel (b) uses after-tax income, normalized by the household's OECD equivalence scale. Dashed lines show bootstrapped 95% confidence intervals (panel a) respectively two robust standard errors clustered at the household level (panel b), which adjust for arbitrary within-household correlations and heteroskedasticity.

Figure 5 – Extensions

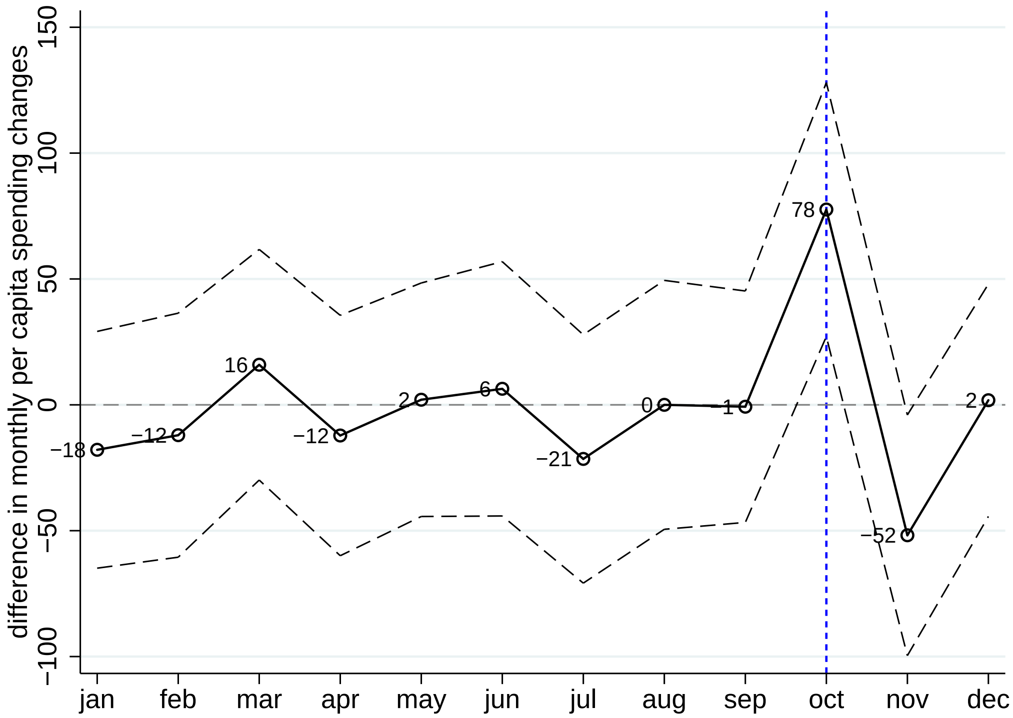


Notes: Panels (a) and (b) show the dynamics of the spending response on durables paid for with a credit card, based on regression equation (6). In addition to Alaska and year-by-month time fixed effects and family size the regression also controls for household income, liquid assets (bank balances), and fixed effects for age, education, residential ZIP code, homeownership status, marital status, and occupation. Panel (c) shows the additional federal income taxes paid in each month due to the previous year's Permanent Fund Dividend, based on regression equation (9). Panel (d) shows the differential nondurable spending response between homeowners and non-homeowners. Bars and dashed lines show two robust standard errors, clustered at the household level, which adjust for arbitrary within-household correlations and heteroskedasticity.

Table A1. Expenditure aggregation

Personal Finance Website Data (PFW)				Consumer Expenditure Survey (CE)
PFW ID	Expenditure	PFW ID	Expenditure	
Non-durables:		*Services:*		*Non-durables and services:*
611	Baby Supplies	1	Entertainment	food at home
7	Food & Dining	101	Arts	food away
701	Groceries	102	Amusement	alcohol at home
704	Coffee Shops	4	Personal Care	alcohol away
706	Fast Food	403	Hair	tobacco
707	Restaurants	404	Spa & Massage	personal care services
708	Alcohol & Bars	406	Laundry	child care
1401	Gas & Fuel	5	Health & Fitness	adult care
1702	Office Supplies	501	Dentist	domestic services
		502	Doctor	gas
Durables:		503	Eyecare	electricity
103	Music	505	Pharmacy	fuel
104	Movies & DVDs	506	Health Insurance	phone
105	Newspapers & Magazines	507	Gym	water
2	Shopping	508	Sports	public transport
201	Clothing	6	Kids	vehicle services
202	Books	602	Babysitter & Daycare	vehicle insurance
204	Electronics & Software	609	Kids Activities	gasoline
206	Hobbies	9	Pets	rental cars
207	Sporting Goods	901	Pet Food & Supplies	rental furniture
606	Toys	902	Pet Grooming	clothes
1003	Books & Supplies	903	Veterinary	tailors
12	Home	10	Education	textiles
1201	Furnishings	1001	Tuition	fees and charges
1203	Home Improvement	11	Financial	occupation expenses
1208	Home Supplies	1102	Life Insurance	entertainment services
1403	Service & Parts	1105	Financial Advisor	reading material
		1202	Lawn & Garden	educational services
Other expenditures:		1204	Home Services	health insurance
603	Child Support	1206	Home Insurance	health care services
610	Allowance	13	Bills & Utilities	life insurance
8	Gifts & Donations	1301	Television	home maintenance
801	Gift	1302	Home Phone	home repairs
802	Charity	1303	Internet	home management
1002	Student Loan	1304	Mobile Phone	home security
1207	Mortgage & Rent	1306	Utilities	home insurance
1404	Auto Payment	14	Auto Services & Transport	parking
16	Fees & Charges	1402	Parking	
1601	Service Fee	1405	Auto Insurance	
1602	Late Fee	1406	Public Transportation	
1604	Finance Charge	15	Travel	
1605	ATM Fee	1501	Air Travel	
1606	Bank Fee	1502	Hotel	
1607	Trade Commissions	1503	Rental Car & Taxi	
20	Uncategorized	1504	Vacation	
2001	Cash & ATM	17	Business Services	
		1701	Advertising	
		1703	Printing	
		1704	Shipping	
		1705	Legal	

Figure A1 – Non-parametric evidence of spending excess sensitivity - median changes



Notes: This figure complements Figure 2(a) showing the median difference in monthly household per capita spending changes of nondurables and services between households in Alaska and Washington. The Permanent Fund Dividend is paid out at the beginning of October. Per capita spending is calculated using the OECD household equivalence scale. Dashed lines are 95% confidence intervals.