

# Excess Sensitivity of High-Income Consumers

LORENZ KUENG\*

Northwestern University and NBER<sup>†</sup>

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## Abstract

Using new transaction data, I find that consumption is excessively sensitive to large, regular, predetermined, and salient payments from the Alaska Permanent Fund, with a large average marginal propensity to consume (MPC) of 25% for nondurables and services. The MPC is heterogeneous, monotonically *increasing* with income, and the average is largely driven by high-income households, who have MPCs above 50%. The micro data and the properties of the payments rule out most previous explanations of excess sensitivity, such as liquidity constraints and inattention. Using a sufficient statistics approach, I show that the welfare loss from excess sensitivity depends on the MPC and the relative payment size as a fraction of income. Since the two statistics are negatively correlated, the welfare losses are similar across households and small (less than 0.1% of wealth), despite the large MPCs.

**JEL Classification:** D12, E21, G11.

**Keywords:** consumption excess sensitivity, MPC heterogeneity, welfare loss.

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<sup>†</sup>Department of Finance, Northwestern University’s Kellogg School of Management, 2001 Sheridan Road, Evanston, IL 60208, and National Bureau of Economic Research. E-mail: l-kueng@northwestern.edu.

# 1 Introduction

Does consumer spending increase in response to large, regular, predetermined, and salient payments? If so, which households respond the most? Standard models of intertemporal consumption behavior – building on the life-cycle/permanent income hypothesis (LC/PIH) or the buffer stock model (Zeldes (1989), Deaton (1991), Carroll (1997, 2001)) – predict that in the absence of financial frictions, households will adjust their consumption plans only when they receive new information about their lifetime resources. Hence, consumption should not respond to such payments, and households should smooth out any predictable income changes by managing liquid assets. Significant responses are therefore called *excess sensitivity* of consumption.<sup>1</sup>

These questions have important policy implications. The effectiveness of government stimulus programs, for example, crucially depends on their answers, since many government cash transfers such as stimulus checks are highly predictable. Cash injections in turn only stimulate the economy if the average consumer deviates from these benchmark models. This theoretical prediction has therefore been frequently tested and rejected: Predictable changes in income often cause changes in household spending. However, the predictable income changes used in those tests might not be salient to consumers, are often only one-time or very infrequent events, and are typically small (see e.g. Jappelli and Pistaferri (2010), Fuchs-Schündeln and Hassan (2016)).

To answer these questions, I combine new transaction-level account data from a personal finance website with the repeated quasi-natural experiments provided by the large annual Permanent Fund Dividend (PFD) payments from the Alaska Permanent Fund, the state’s broadly diversified sovereign wealth fund.<sup>2</sup> Since 1982, the fund has been making annual lump-sum payments of \$1,650 on average in October to every Alaskan citizen, including children. This amounts to a total payment of \$4,600 for the average Alaskan household who has 2.8 members. These transfers are a substantial source of income for many households and they receive considerable attention from news and social media. Hence, these large, regular, and salient payments provide a unique opportunity to test intertemporal consumption theory in a policy-relevant environment.

Even though the properties of the PFD payments should in principle favor the standard model, I find evidence of significant excess sensitivity:

1. The marginal propensity to consume nondurables out of the PFD payments is 25% on average.
2. MPCs are heterogeneous across households, monotonically *increasing* with income, and the average response is largely driven by high-income households, who have MPCs above 50%.

The new account-level transaction data and the properties of the PFD rule out most previous

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<sup>1</sup> Standard theory predicts smoothing of consumption (or marginal utility) instead of spending, 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 use the term MPC, and I use ‘nondurables’ to include both nondurables and services.

<sup>2</sup> Hsieh (2003) was the first to use the PFD payments to test the standard theory; see the discussion below.

explanations of excess sensitivity:

3. Liquidity cannot explain the observed MPCs, because most households in the sample hold substantial amounts of liquid assets (both in levels and as a fraction of income), in particular these high-income households. These households could easily smooth the PFD payments. In the data, having few liquid assets (checking and saving account balances) predicts higher MPCs only for lower-income households.
4. There are no anticipation effects in nondurable spending, despite the fact that the payments are fully predetermined in September, when the Governor announces the dividend, and highly predictable several months and often years in advance. (This absence of anticipation effects is evidence of *excess smoothness*, which I discuss in Section 4.) Instead, spending increases instantaneously by 12% in October when the dividend is distributed. The cumulative MPC is 25% and is reached after only one quarter (i.e. the impulse response function, IRF) of nondurables to these predictable income changes is flat after 3 months).<sup>3</sup>
5. Alaskans do pay attention to the PFD throughout the year, even though there are no anticipation effects in nondurable consumption. Google search intensity for the term “Permanent Fund” is highest in September, when the dividend is officially announced, and from January to March, when each Alaskan has to apply again for the next dividend.
6. Costs of acquiring information about the size of the next dividend are very low. A narrative analysis shows that the size of the next dividend is frequently and accurately predicted by the local media (newspapers, radio and television) throughout the year. Journalists can forecast the dividend well because it is based on a public formula that uses a 5-year moving average of the fund’s income from assets, and the Alaska Permanent Fund Corporation publishes these monthly incomes on its website.

The standard model of intertemporal consumption behavior is inconsistent with Facts 1 to 3. Excess sensitivity in this model is entirely due to temporarily low liquidity, which typically results from negative income or positive expenditure shocks. However, consumers who respond the most to the PFD payments have substantial amounts of liquid wealth. Similarly, the theory would predict that households have high MPCs only if current income is low relative to permanent/long-term income. However, the estimated MPCs are increasing in both current income (‘high liquidity’) and permanent income (‘being rich’).

These issues carry over to recent extensions of the standard theory, including models with consumption commitments and illiquid assets, where illiquid assets have higher returns but are costly to liquidate (Chetty and Szeidl (2007), Kaplan and Violante (2014)). These models cannot

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<sup>3</sup> While the spending response of nondurables is large, purchases of durable goods also react to the PFD payments, including an economically and statistically small anticipation effect in September. In contrast to the IRF of nondurable spending, the IRF of durables follows a hump-shaped pattern, consistent with intertemporal substitution of spending, where households time durables purchases to the arrival of the cash flows. Since standard theory predicts smoothing of marginal utility from the service flow of durables, this significant response to predictable income changes is in principle compatible with standard models of demand for durables.

explain why households with sufficient liquidity respond to predictable income changes. Moreover, since there are no information frictions in these models, consumers should respond when news about future PFD payments arrives, not when the payments themselves arrive. This is inconsistent with the lack of anticipation effects (Fact 4).

Therefore, any model with forward-looking, optimizing consumers that tries to match Facts 1 to 4 requires some form of inattention. However, Facts 5 and 6 pose a serious challenge to models with rational inattention (Reis (2006), Luo (2008), Gabaix (2016)). Rational inattention can potentially explain the lack of anticipation effects and the response in October if agents update only infrequently, and if these updates occur in October. However, it cannot explain why consumers respond to the PFD payments rather than the PFD forecast error between updating periods. Moreover, Alaskans do pay attention to the dividend throughout the year (Fact 5), and the costs of acquiring rational PFD forecasts are very low (Fact 6).

Finally, the standard buffer stock model calibrated to match observed incomes or liquid asset holdings or the PIH model with rational inattention calibrated to match the fund's income and dividend process cannot generate the estimated MPCs, even if we ignore the implications of rational expectations and assume that consumers are positively surprised every October by the entire amount of PFD payments.

The final three facts rule out additional explanations of excess sensitivity that do not easily fit into the previous discussion:

7. Durability cannot explain the excess sensitivity, because “strictly nondurables” (e.g. restaurant or grocery spending) also respond (Lusardi, 1996), and the effect on nondurables is persistent – the IRF of nondurables is flat instead of hump-shaped as predicted by standard models of durable purchases (Hayashi, 1985).
8. Paying recurring bills such as rent, utilities, or loan payments with PFD income is difficult, because the PFD payments are annual and change from year to year, while recurring bills typically occur monthly and are often constant (Stephens (2003), Gelman, Kariv, Shapiro, Silverman and Tadelis (2014)).
9. Local economic conditions do not affect the contemporaneous size of the PFD, because the fund is broadly diversified in financial and real assets, and because of the formula's 5-year moving average. Moreover, the formula only uses data for the fiscal year which ends in June, a full quarter before the dividend is paid out. Finally, the fund's revenue from mineral royalties has substantially declined over time as a fraction of the fund's total market value, and it is less than 0.6% today. Hence, oil price shocks that could disproportionately affect non-PFD income of Alaskans do not affect the annual PFD payments contemporaneously.

What could explain this puzzling behavior? To make progress, I use another property of the dividend – that the payments are lump-sum. Therefore, the contribution of the PFD payments to a household's annual income varies considerably in the cross-section. Using a sufficient statistics approach (Chetty, 2009), I show that the welfare loss from excess sensitivity depends on the

correlation between two statistics: the behavioral response to the payments (MPC) and the *relative payment size* as a fraction of (permanent) income. Since the relative payment size decreases with income, Fact 2 implies that these two statistics are negatively correlated.

As a result, the welfare losses are similar across households and small (less than 0.1% of wealth), despite the large and heterogeneous MPCs. Observed consumption behavior therefore exhibits near-rationality (Akerlof and Yellen (1985), Cochrane (1989), Browning and Crossley (2001)): Deviations from the standard model only lead to small utility costs. Hence, the standard theory does not provide powerful predictions for high-income households' spending behavior since the loss from not smoothing the payments is small. At the same time, the standard model correctly predicts that lower-income households should smooth the payments more, since for them the costs of not smoothing can be substantial. Hence, the welfare-loss calculations show that the standard model's assumptions only restrict non-smoothing behavior of lower-income consumers.

Why do higher-income consumers spend a large fraction of their payments? On the one hand, welfare-loss calculations offer little guidance since they are not a positive model of behavior. On the other hand, these calculations suggest that standard optimization-based models with rational consumers are probably not a useful guide either. Without additional information, we are therefore left to speculate. Two mechanisms that are potentially consistent with the observed behavior are mental accounting and social interactions. First, mental accounting (Thaler, 1985) suggests that households might see the unearned PFD income as an annual windfall, and richer households might feel less guilty squandering it than the less affluent. Second, the fact that almost everybody receives these payments regularly at the same time of year suggests that social norms or common practices might have evolved, and richer households can afford to spend more lavishly on these occasions – by throwing a 'PFD party' for example.

Finally, it is important to point out a limitation of the new account-level transaction data, which are provided by a large personal finance website (PFW): The sample is neither representative nor randomly drawn. To address this concern about external validity, I compare the average MPC based on the PFW data to estimates based on the Consumer Expenditure Survey (CE). The CE covers many fewer Alaskan households per period but spans the entire period since the first dividend was paid out in 1982. After taking into accounts differences in household income in the two samples and the fraction of Alaskans that do not receive the dividend, I find that the spending response to the PFD payments is similar in the two datasets, with an average MPC of about 15%.

Studying the spending response in the CE also allows me to reconcile these results with the only previous study of the consumption response to the PFD payments (Hsieh, 2003). That study uses CE data from 1980 to 2001 and finds a small and insignificant response. Instead of dollar changes in spending, the main specification regresses log changes on PFD payments normalized by family income, thereby estimating an elasticity rather than an MPC. Unfortunately, income in the CE suffers from substantial non-classical measurement error, which attenuates the estimated

spending response. To show this, I replicate the small and insignificant spending response using the same confidential data, which is available only at the Bureau of Labor Statistics (BLS). I then 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 elasticity that matches the estimated average MPC.

The paper is organized as follows. Section 2 describes the PFD and Section 3 describes the household-level data. Section 4 provides non-parametric and parametric evidence of excess sensitivity and compares the estimates to previous estimates of MPCs out of predictable income changes. Section 5 performs external validity checks using the CE. Section 6 analyzes the heterogeneity of MPCs. Section 7 discusses the implications of these results for models of intertemporal consumption behavior and Section 8 concludes.

## 2 The Alaska Permanent Fund Dividend

The main analysis in this paper builds on the properties of the dividend payments, which are the focus of this section, and on new high-quality expenditure and income micro data, which are discussed in the next section.

### 2.1 Institutional Background

Since 1977, the State of Alaska has been investing the royalty income it receives from 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.

At the end of each fiscal year, on June 30, roughly 10% of the fund’s cash flows generated over the current and four previous fiscal years is set aside to be paid out in October by the Alaska Permanent Fund Dividend Division (APFDD) based on a public formula set in state law.<sup>4</sup> Hence, the dividend roughly follows a 5-year moving average of the fund’s income from assets. Dividend payments are therefore regular annual cash flows that are highly predictable and relatively large. The rest of the fund’s income is typically reinvested, although the legislature has in principle the authority to use it for any public purpose. Previous attempts to appropriate more earnings for government funding produced significant public backlash.

### 2.2 Dividend Properties

The Permanent Fund Dividend (PFD) has several useful properties for testing predictions of intertemporal consumer spending theories. This section describes the most important ones.

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<sup>4</sup> 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 from assets in the current and previous four 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.

**Independence from Local Economy** The fund is 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. Moreover, the fund’s mineral royalties have substantially declined over time as a fraction of the fund’s total market value, from 12.2% in 1982 to 0.5% in 2016 (see Appendix Figure A.1).

**Eligibility** With very few exceptions, every person who has been a resident of Alaska for the previous year and indicates an intention to remain an Alaskan resident, including children, is eligible to receive the dividend.<sup>5</sup> One might be worried that the size of the dividend could be manipulated by households or that a sudden change in family size could coincide with a surprise in the dividend amount received, which in turn could be correlated with changes in spending. However, to qualify for the dividend, an individual must have been an Alaska resident for the entire calendar year preceding the application date. New residents, such as newborns or 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 has become 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. Even sudden changes in family size therefore should not lead to surprises in the amount of dividend income received in that year.

**Size** The average dividend per capita was \$1,650 from 1982 to 2014 in real dollars of 2014, using the local CPI for Alaska. The average Alaskan household has 2.8 members and hence receives on average \$4,600 every October (\$5,600 from 2010 to 2014). The dividend payments are therefore much larger than the one-time tax rebate of \$300 to \$600 per household in 2001, which has been studied extensively in the literature (e.g. [Johnson, Parker and Souleles \(2006\)](#)).

The dividend is paid lump-sum to every eligible applicant and is therefore independent of family income. This lump-sum characteristic leads to substantial variation in how much the dividend contributes to a household’s annual income, which makes it distinct from other transfers that depend on family characteristics, such as means-tested transfers or unemployment insurance. Table 1 shows that the dividend is about 7% of annual income of the typical household in the CE (both current and permanent income, proxied by total expenditures) and 3% in the PFW data, which over-represents high-income households. In Section 6 I use this property of the dividend to explore heterogeneity in MPCs as a function of the dividend’s contribution to a household’s annual resources.

**Salience** A crucial condition for excess sensitivity tests of consumption is that the cash flows are predictable (or even predetermined) and that consumers are aware of them. Since the dividend is a significant source of income for many Alaskan households, it is frequently discussed in the

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<sup>5</sup> Exceptions mostly apply to persons who committed a felony.

local media (shown below) and thus very salient. For instance, the size of the dividend per person is officially announced in mid-September by the Governor, well before the dividend is paid out in early October. The announcement is broadcast live on TV and features prominently in newspapers, on the radio, and on social media. Hence, the dividend is completely predetermined when it is paid out and therefore ideally suited to test for excess sensitivity of consumer spending to regular and large cash flows.

Moreover, between January and March each person must again apply for the next dividend in October, even if that person received the dividend in the previous year. This means that households are forced to pay attention to the dividend at least once a year, which is an important fact to keep in mind when interpreting the spending results through the lens of recent models of rational inattention (see Section 7).

Figure 1 shows monthly Google search activity for the term ‘Permanent Fund’ by users in Alaska from January 2004 to August 2017.<sup>6</sup> We see that search activity is highest in September, when the dividend size is announced, followed by January, February, and March, when households apply for the next dividend. October, the month in which almost all dividends are paid out,<sup>7</sup> has only the fifth highest search intensity, which is only marginally higher than the activity in the remaining seven months. These results support the hypothesis that the Alaska Permanent Fund Dividend is very salient throughout the year, and that most Alaskans expect to receive dividend payments in October.

**Predictability** Not only is the dividend predetermined by September, it is also highly predictable throughout the year. As mentioned above, the dividend amount is based on a 5-year moving average of the income generated by the fund during the fiscal year (July to June) and the number of eligible applicants, both of which are easy to predict. Four of the five annual income statements necessary to calculate the dividend are already known at the beginning of the year. Dividend expectations are therefore fairly accurate already a year in advance. Moreover, since the mid-1990s, all information necessary to estimate the dividend has been published on the APFC’s website and hence is easy for journalists and households to access.

Uncertainty about the next dividend is typically largest right after the previous dividend has been distributed, when the fund’s final annual income statement is still largely unknown. Income uncertainty then gradually declines with each new monthly income statement. The main source of uncertainty remaining between June (end of fiscal year) and September (official announcement) concerns the number of eligible applicants. However, annual changes in the number of eligible applicants relative to the previous year are small (0.9% from 1982 to 2014 and 0.3% from 2010 to 2014) and can be reasonably well predicted based on state population forecasts.

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<sup>6</sup> Reported coefficients are relative to December, which is normalized to zero. The regression includes a linear trend to control for the general trend increase in Google search activities. Other terms such as ‘Permanent Fund Dividend’ or ‘Alaska Permanent Dividend’ yield similar results. I exclude year 2008, when the dividend was paid in September, but the coefficients do not change much when 2008 is included.

<sup>7</sup> Exceptions are the first two years, 1982 and 1983, when dividend checks were mailed throughout the year, and 2008, when the dividend was paid out in September; see Appendix Table A.1.

Throughout the year, local media frequently report on the specific dividend amount they expect to arrive in October. The top panel of Figure 2 shows the dividend forecasts available to households throughout the year based on an extensive narrative analysis of all major Alaskan newspapers, starting in the early 1980s.<sup>8</sup> The following two excerpts reproduce two representative results of the narrative analysis, both predicting the dividend of \$1,281 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

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.

To obtain a sense of the accuracy of these forecasts, Figure 2 also plots the nominal dividend amount per person eventually paid out (blue dashed line with blue dots marking payments in October). I assess the performance of these forecasts by comparing them to forecasts that consider all available information. This series, shown in the bottom panel, is based on new historical monthly income statements starting in the mid-1990s, which I obtained from the APFC's archive. The forecast error of the narrative series in the top panel is similar in magnitude to the forecast error of the 'full-information' market-based series in the bottom panel.<sup>9</sup>

This analysis of dividend expectations shows that monthly changes in the expected dividend (i.e. 'shocks') are orders of magnitude smaller than the dividend itself and therefore cannot explain the large spending response in October documented below. Similarly, additional precautionary saving due to uncertainty about the size of the next dividend cannot account for the substantial spending response, especially among higher-income households who have sufficient amounts of liquid assets.

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<sup>8</sup> Appendix A contains the complete narrative analysis.

<sup>9</sup> Average (median) forecast error,  $x_{t+1} - E_t[x_{t+1}]$ , of the narrative series is \$24 (\$20), compared to \$0 (\$0.03) for the market-based full-information series. I exclude 2008 to make the two series comparable (see the figure notes).

**Voluntary and Involuntary Deductions** The final dividend properties worth discussing are features that cause the amount paid out per person to vary in each year. The potential dividend can differ from the actual amount of cash received because of voluntary and involuntary deductions and because of incomplete take-up. Alaskans can make voluntary contributions by asking the APFDD to contribute part or all of their dividend to charity (since 2009) or up to 50% to the University of Alaska College Savings Plan (since 1991).<sup>10</sup> Involuntary deductions can occur because the government can garnish up to 100% of the dividend to cover outstanding liabilities (unpaid taxes, parking tickets, tuition, fines, delinquent child support payments, etc.) and courts can garnish up to 80% of the dividend payment (since 1998 and up to 55% before), for instance in personal bankruptcy.

As described in the next section, identifying such deductions is difficult in the transaction data and impossible in the survey data. However, the APFDD provides summary statistics based on administrative records that can be used to assess the overall magnitude of such deductions and to decompose voluntary deductions into saving and charitable contributions (see Appendix Table A.2). Charitable contributions in turn could be considered consumption expenditures and hence could be added to the estimated average MPC in Section 4. These direct charitable contributions are 0.23% of dividend payments on average, while contributions to the University of Alaska College Savings Plan are 0.58%, and involuntary deductions are 6.1%.

The dividend’s take-up rate, measured by the number of dividends divided by the state’s population, is 91% on average from 1982 to 2014 (85% from 2010 to 2014), which is relatively high and reflects the simple application process. Alternatively, the ratio is 95% (92%) when dividing by the total number of applications. It is difficult to assess whether people who do not take up the dividend do this on purpose (akin to a charitable contribution), do not pay attention to the dividend, or would not qualify if they did apply.

### 3 Data

This study uses data from two sources of spending data, a personal finance website (PFW) and the Consumer Expenditure Survey (CE), with summary statistics shown in Table 1. The main analysis uses new transaction data from accounts at a large PFW between 2010 and 2014. Each transaction is time-stamped and contains the amount and a full textual description. The micro data is at the user account level, which I will refer to as the household, and is de-identified.<sup>11</sup> Households can link up their credit card accounts, bank accounts, brokerage accounts, and any

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<sup>10</sup> Eligible charitable organizations can participate in the Pick.Click.Give program ([www.pickclickgive.gov](http://www.pickclickgive.gov)). Otherwise, dividends cannot be assigned (pledged) in any legal contract (since 1989), including loans, except to a government agency, a court, or a regional housing authority.

<sup>11</sup> Following convention in the literature, I will refer to both user accounts in the PFW and ‘consumer units’ in the CE as ‘households.’ Baker (2017) tests whether the same transactions (i.e. same amount, time stamp and transaction label) occur on multiple users’ accounts and finds few instances of such overlapping transactions, suggesting that few users have joint accounts listed that are also listed by another user. Appendix B shows that the results are not driven by differences between the number of users per online account and the self-reported number of family members.

other financial account to obtain an overview of their consolidated household balance sheet.

I then use the CE to assess the external validity of the results derived from these new transaction-level data and to compare them to estimates from the previous literature. The CE is the standard data set used and discussed in previous research (e.g. Souleles (1999), Johnson, Parker and Souleles (2006)). It spans the entire period since the first dividend was paid out in 1982, but it covers fewer Alaskan households per period than the PFW sample and follows them only for at most four quarters. As is standard in the literature, I add up self-reported monthly expenditures of each quarterly household-interview to produce ‘three-monthly’ aggregates (January to March for households interviewed in April, February to April for households interviewed in May, etc.). I drop years 1982 to 1984, when dividends were distributed over several months instead of in October (see Appendix Table A.1), and I impose sample selection criteria that are common in the literature.<sup>12</sup>

### 3.1 Measuring Spending

The main analysis focuses on excess sensitivity (and excess smoothness) tests and follows the previous literature, which typically limits household expenditures to nondurable goods and services (nondurables for short), and sometimes restricts them even further to ‘strictly nondurables’ (Lusardi, 1996), which only include items such as food expenditures or personal care. Restricting the analysis to nondurables is necessary since consumption and expenditures can differ due to the durability and storability of certain goods, which is especially relevant for studies that use high-frequency data. Consumers gain utility from the service flow of durables or from the actual consumption of storable goods, while spending on these goods occurs infrequently and could be timed to the arrival of large cash flows. Hence, large responses of spending on durable and storable goods to predictable cash flows might not indicate a deviation from consumption smoothing and thus might not be a valid test of intertemporal consumption models.

Measuring spending in transaction-level data has advantages and disadvantages relative to expenditure surveys. A particular advantage is that all transactions are automatically categorized, thereby reducing measurement error and biases in recollection. The website uses an algorithm to automatically derive a cleaned merchant name (e.g. Safeway) and then categorizes spending (outflows) and income (inflows) into one of over 100 four-digit categories.<sup>13</sup> Appendix Table A.3 maps the website’s categories as closely as possible to NIPA spending categories, which in turn approximate spending categories in the CE data.

A particular disadvantage of transaction data is that some merchant codes do not uniquely map into these spending categories, such that some transactions might include both nondurables

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<sup>12</sup> I drop households with self-employment income or with a student as head of household, with top-coded expenditures, with family size larger than 7 and changes in family size larger than 3 (both corresponding to the top 1% of the distribution), with multiple households per consumer unit, and with decreases in the age of the head or spouse or increases larger than one.

<sup>13</sup> Outflows from accounts (e.g. spending) are recorded as negative numbers, while inflows into accounts (e.g. income) are recorded as positive numbers.

and durables. I address this new measurement issue of transaction-level data in four steps. First, to be conservative, I classify such ambiguous transactions as durable spending, thereby excluding them from excess sensitivity tests. For instance, transactions at Walmart and Target are a mix of nondurables and durables. The website’s algorithm assigns them code 2, ‘Shopping’, which I classify as durables (Appendix Table A.3). Other merchants can be more easily assigned to nondurables. For instance, transactions at Safeway, Whole Foods, Trader Joe’s, etc. are consistently assigned code 701, ‘Groceries’.<sup>14</sup> Second, I test for reversals in nondurable and service expenditures in the long run; this would be a sign of intertemporal substitution of spending, which is typical for durable and storable products (e.g. Mian and Sufi (2012), Baker, Johnson and Kueng (2018)). Section 4 shows that durable expenditures indeed have a hump-shaped response to the PFD payments as one would expect, but nondurables and services do not. Third, I limit the analysis to goods that are ‘strictly nondurable’, in particular food (e.g. grocery shopping, restaurants, coffee shops and bars). Section 4 shows that spending on such strictly nondurables also significantly increases in the quarter of the dividend payments. Finally, in Section 5 I use the CE, which does not suffer from this issue, and find similar results after accounting for differences in the sample composition.

A related issue are uncategorized transactions, check transactions, and ATM cash withdrawals, which cannot be assigned to a spending category (nondurables or durables) because the transaction description does not identify the merchant of the purchased good. Table 1 shows that these ‘other items in total expenditure’ make up a substantial fraction of total expenditures.<sup>15</sup> To deal with this issue, I use the narrower, more conservative measure of nondurables for the main analysis that focuses on excess sensitivity tests. I then gradually extend this measure to include unassigned transactions and durables purchases that are paid for with a credit card (e.g. clothes, electronics, and software) but exclude larger durables (e.g. cars), which are often financed with a consumer loan and a down payment by check and hence not identifiable as a durables purchase.

Policymakers often care about these total expenditures when trying to stimulate the economy, including shifting spending intertemporally to periods with lower economic activity. Hence, estimating the response of total expenditures to the dividend payments is important for policy makers, while excess sensitivity tests – which use only nondurables – contribute to our understanding of the underlying economic mechanisms.

### 3.2 Identifying Dividend Receipts

Dividend receipts are easier to identify in the PFW data than in the CE data. In the PFW data, dividend receipts via direct deposits can be inferred directly from their transaction

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<sup>14</sup> Whenever possible, the website’s algorithm assigns different transactions from the same merchant to distinct categories. E.g. ‘Kroger’ is assigned to ‘701: Groceries’ while ‘Kroger Fuel’ is assigned to ‘1401: Gas & Fuel’.

<sup>15</sup> Among these ‘other items in total expenditures’, uncategorized transactions have the largest share in total expenditures (20%), followed by check payments (15%) and cash withdrawals (5%). Mortgage and rent payments are also in this category and make up 10% of total expenditures.

description, even if they are not the full amount due to voluntary or involuntary deductions. Identifying dividend receipts in the form of a check, on the other hand, is more difficult, because checks typically lack an informative transaction description. Fortunately, dividends received as checks are only a small fraction of all PFD distributions between 2010 and 2014 according to administrative records (and even less so in the PFW sample). I identify PFD checks as those checks which match the exact amount of the dividend in the 12 months from October to September of the next year. Using this algorithm, I identify 81% of Alaskans who receive a dividend, which is consistent with aggregate take-up statistics. However, 97% of these are direct deposits, which is much higher than the 83% based on administrative records. This difference is a combination of the fact that more PFW users use e-banking (and hence direct deposits) relative to the general population, and that payments via checks are more difficult to identify in the PFW data.

A related issue is the fact that the timing of dividend receipts is exogenous only for households that receive them within two business days of the official disbursement date, or within five business days for the few households that receive the dividend as a check in the mail (Appendix Table A.1 shows the monthly distribution of check disbursements). Households that receive delayed direct deposits could, however, be endogenously selected since these delays could be caused by incorrect applications or by applications that must be further investigated by the APFDD. For this reason, I restrict the main analysis to PFD direct deposits received within two business days of the exogenously set distribution date, which is in the first week of October. This restriction also simplifies the interpretation of the dynamic response (anticipation effects and lagged responses). Appendix B shows that including check deposits and late direct deposits does not significantly affect the results because these are only 3% of all PFD direct deposits.

While Alaskans who do not (yet) qualify for the dividend might in principle be a good control group, the transaction data unfortunately does not cleanly identify them. Alaskans who do not receive a dividend payment in the PFW sample could have failed to receive this payment for a variety of reasons: they did not qualify for the dividend, their entire dividend was garnished, they instructed the APFDD to directly donate the full dividend amount (e.g. to a charity), or the dividend payment was not identifiable from the transaction description or the transaction amount.<sup>16</sup> Such households might be very different from the treatment group of households for whom I can measure dividend receipts, and hence they are potentially a bad control group.<sup>17</sup> 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 a similar industry composition. This comparison group controls for seasonality, inflation, secular trends, and business cycle fluctuations. I then drop households with a self-reported family size above 8 or that receive more than 7 dividends (the top 1% of both distributions) and households

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<sup>16</sup> For instance, if the household received a partially garnished dividend in the 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.

<sup>17</sup> Appendix B reports similar results when including these Alaskan households in the control group.

where the absolute difference between the number of dividends received and the self-reported family size is larger than 4 in any period.

Turning to the CE, measuring the amount of cash a household receives from the PFD is more challenging because the CE does not ask Alaskan households directly whether they received the dividend and how large the payment was. Dividend payments must therefore be imputed based on family size, state of residence, calendar year, and the annual fraction of households in the administrative data that do not receive the dividend at all or in full. Since the state identifier for Alaska is suppressed in the public-use CE sample before 1996, I access the confidential CE data at the BLS, although I find similar results with the shorter public sample (see [Kueng \(2015\)](#)).

### 3.3 Measurement Issues in Account-Level Data

Additional advantages and disadvantages of account-level data are explained in more detail in [Baker \(2017\)](#), who was the first to use this data. The two most important advantages are the comprehensiveness of the spending, income, and asset data—which is measured at high frequency without the need for households to answer any questions—and the possibility to identify dividend receipts from transaction descriptions. However, there are also distinct disadvantages when using such data relative to survey data.

**Unlinked Accounts** A major concern with account-level data is incompleteness due to unlinked accounts. I follow [Baker \(2017\)](#) and restrict the sample to minimize the effect of this new form of measurement error. Specifically, I restrict the sample to active users (who log in at least once a year) with at least two linked accounts (typically a checking and a credit card account), and I drop users who have less than a year of continuous transaction data, have not entered any demographic information (age, education, etc.), and have large discrepancies between observed and self-reported incomes.

A related concern with missing accounts is that transfers to an unlinked account (cash outflows) could be misclassified as spending, since both are negative numbers. The above data cleaning steps are designed to eliminate such measurement error. Specifically, the website’s algorithm classifies investments (e.g. deposits into a brokerage account) or transfers to another financial account (e.g. credit card payments) as account transfers. In the final sample, I check that all transfer and investment outflows have a corresponding inflow into another linked account within two business days. Finally, it is worth noting that any transfers to an unlinked financial account (say an account at an unknown bank or credit card company) could not be assigned a merchant code and hence would be labeled ‘uncategorized’ and thus excluded from measures of nondurables or durables (see Appendix Table A.3) and from excess sensitivity tests. Merchant codes are assigned only to outflows from a linked credit card account (i.e. spending) or from a linked bank account (e.g. ATM withdrawals or checks).

**Representativeness** Another issue with account-level data (which is a non-random sample) is non-representativeness relative to the general population. Non-representativeness is also an issue with the CE, which is randomly sampled but is not designed to be representative at the state level, only at the national level. Table 1 shows that both the PFD and CE samples are indeed not representative along some important dimensions.

First, liquid wealth (bank accounts) in the PFW sample is much higher than in the general population, although median liquid wealth is substantially lower. For comparison, median bank balances are only about \$4,000 in the Survey of Consumer Finances (SCF), which is comparable to median bank balances in the CE sample.

Second, the typical household in the PFW sample has higher income, both current and permanent, proxied by total expenditures. To compare this to before-tax household income in the Census, I impute before-tax income in the PFW data using the NBER TAXSIM calculator, iterating on observed after-tax income until convergence is achieved. The resulting median before-tax income is \$20,000 higher than median household income of \$72,000 in the American Community Survey's (ACS) 5% sample from 2010 to 2014.

Before-tax median income in the CE, on the other hand, is \$10,000 lower than in the ACS. This is partially a result of missing incomes due to households not completing all income-related questions. For this reason, the BLS started to impute income in 2004. I extend this imputation algorithm back in time using the procedure recommended by Fisher, Johnson and Smeeding (2012), which cuts the gap to \$3,500.

I then compare the before-tax income distributions of both the PFW and the CE samples to quintiles in the 2010-14 ACS for Alaskan households. ACS quintiles one to four have incomes below \$33,000, \$58,000, \$86,000 and \$128,000. The PFW sample is skewed to the right, having 32% of households in the top ACS quintile, while only 11% and 16% in the bottom two quintiles. It is representative for middle-income households (19% and 22% in the third and fourth quintiles). The CE distribution, on the other hand, is skewed to the left, having ACS quintile coverage of 27%, 22%, 21%, 16%, and 14%.<sup>18</sup> Hence, the two data sets complement each other, the PFW sample having more higher-income households while the CE has more lower-income households.

One could try to re-weight the data to make them more representative based on observables. However, one would still be concerned that these households are not representative based on unobservables, and it is not obvious how these unobservables would affect the estimated spending responses. For instance, we might expect users of the website's personal finance services to be more financially savvy and hence exhibit less excess sensitivity to predictable cash flows than similar households based on observable characteristics. On the other hand, PFW users might be households that need help with organizing their finances or might have self-control issues, leading to more cash-flow sensitivity.

I instead embrace the fact that both data sets are not fully representative and explore het-

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<sup>18</sup> Imputed before-tax income in the CE is more representative, with ACS quintile coverage of 18%, 24%, 21%, 21%, and 15%.

erogeneities in dividend responses along the most important dimensions in which the samples are not representative, including income and liquid assets. Moreover, by implementing the same research design in the CE and finding similar results – after accounting for differences in sample composition and the fraction of Alaskans that do not receive the dividend – this paper complements the data quality analysis of Baker (2017), who notes that “there remains the possibility of selection into usage of the website driven by unobservables.”

PFW users in Washington, on the other hand, are very similar to users in Alaska along most dimensions (including income, demographics, and expenditures) and hence are a useful comparison group. One noticeable difference is that the typical Washington household in the PFW sample has substantially more financial assets than the typical Alaskan household. However, this measure excludes the present value of future PFDs for Alaskan households. The observed average (median) difference in total financial assets of \$102,000 (\$45,000) is consistent with the present value of this perpetuity assuming a 2-4% difference between the fund’s expected return and the expected growth rate of PFDs. 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.

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 taxable brokerage accounts. Including these balances as part of liquid wealth would further strengthen the case made below against liquidity constraints being the main explanation for the observed excess sensitivity.

## 4 Spending Response using Transaction Data

In the textbook buffer stock model or the life-cycle/permanent income model with credit constraints, deviations from consumption smoothing are entirely due to temporarily low liquidity, which typically results from negative income or positive expenditure shocks. Hence, one possibility is that these deviations are due to illiquidity. Indeed, previous research finds that excess spending is typically concentrated among households with low liquid assets or low income. At the same time, other factors could influence both excessive spending responses to predictable cash flows and low liquidity or low income, such as preferences for immediate consumption, self-control problems, and other persistent household traits (Parker (2017), Gelman (2016)).

In this section I use the large PFD payments and the PFW data to test for excess sensitivity of consumption. Since the dividend is fully predetermined in October and highly predictable months and years in advance, the textbook models imply that nondurable spending by households with sufficient liquid assets should not systematically respond to the dividend payments.

**Excess Sensitivity** Figure 3(a) documents excess sensitivity non-parametrically by comparing average monthly per capita spending changes on nondurables of Alaskans with that of individuals

from Washington.<sup>19</sup> 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 valid control group, since their spending follows a parallel trend in the absence of the dividend, thereby controlling for seasonal patterns and national-level aggregate shocks.

Using the summary statistics in Table 1, we can calculate non-parametric MPCs, which can then be compared with the parametric MPCs below. The average dividend payment per capita is \$714 (i.e. \$1,999/2.8) and the average excess spending on nondurables by Alaskans relative to Washingtonians is \$87 in October. Hence, the MPC in the first month after dividends are paid is 12%.<sup>20</sup> Furthermore, relative per capita spending drops by only \$57 to \$30 in November, adding an additional 4% to the cumulative MPC. This cumulative non-parametric MPC is 24% one quarter after most dividends have been paid out.

One possible explanation of the excess sensitivity is that non-dividend income might also increase significantly in October, and relatively more so in Alaska than in Washington. Figure 3(b) shows that this is not the case as we cannot reject that relative income growth per capita (excluding the PDF) is the same in October as in other months.<sup>21</sup> However, since the point estimate is positive and non-trivial in magnitude, I assess the potential effect of income changes and other variables such as low liquid assets or household characteristics by estimating standard parametric regressions,

$$\Delta c_{it} = \sum_s \beta_s \cdot \text{PFD}_{i,t-s} + \alpha_t + \text{Alaska}_i + \lambda' x_{it} + \varepsilon_{it} . \quad (1)$$

$c_{it}$  measures expenditures during period  $t$  by household  $i$ ,  $\text{PFD}_{it}$  denotes the dollar amount of PFD payments received by all household members at the beginning of period  $t$ , and  $s$  denotes periods since receiving the dividend (allowing for leads and lags, such as anticipation effects and delayed responses).  $\alpha_t$  are time fixed effects (year-by-month dummies) controlling flexibly for any aggregate effects and seasonality in spending patterns, and  $\text{Alaska}_i$  is a state fixed effect.  $x_{it}$  includes family size fixed effects and – depending on the specification – other controls such as the level of liquid assets, changes in household income not including the dividend, and other household characteristics.  $\varepsilon_{it}$  are changes in spending not explained by either the dividend or the controls. The  $\beta$  coefficients measure the excess sensitivity of spending to receiving predetermined PFD income ( $s \geq 0$ ) and possible spending in advance of the dividend (anticipation effects,  $s < 0$ ).

Figure 4(a) plots the regression coefficients  $\beta_s$  including 6 monthly leads and 8 monthly lags of the dividend payments ( $s = -6, -5, \dots, 8$ ) or 2 quarters of leads and 3 quarters of lags. The regression controls for the main effects of the treatment (state, time, and family size fixed effects) and for the two main alternative explanations of previous excess sensitivity results, low liquid

<sup>19</sup> Monthly per capita spending uses average daily spending per month multiplied by 30 to account for differences in the number of days per month. Appendix Figure A.1 shows similar results for median changes.

<sup>20</sup> Similarly, the non-parametric median MPC is 11%, which is calculated based on the median spending increase of \$78 in October (see Appendix Figure A.2) divided by median per capita dividend income of \$709 (i.e. \$1,417/2).

<sup>21</sup> Appendix Figure A.2 shows this by income quintiles.

assets (say due to past negative income shocks) and contemporaneous changes in income.<sup>22</sup>

Nondurables spending strongly responds to the arrival of the dividend payments. On average, spending increases by 11 cents for each dollar of PFD received in October ( $s = 0$ ), and this increase is highly statistically significant (t-statistic of 5.5). Spending in November ( $s = 1$ ) is only 6 cents lower than in October. 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. 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 4(b) cumulates the net effects to provide the dynamic cumulative MPC together with two standard error bands. It highlights that the MPC point estimate stabilizes within one quarter of the dividend receipt at about 22% – consistent with the nonparametric MPC of 24% – and remains statistically significant over two quarters.

How does this MPC compare to previous estimates of excess sensitivity? Much recent evidence of excess sensitivity is based on one-time cash flows.<sup>23</sup> These one-time payments are typically also much smaller than the PFD payments. Moreover, MPCs are often heterogeneous, and accounting for differences in sample composition is therefore important. Section 6 below shows that MPCs out of the PFD vary mostly by income, and Section 3 highlighted that the PFW sample overrepresents higher-income households. To adjust for the different sample composition, I therefore interact the PFD payments with household income (similar to the analysis in Section 5 below). Evaluating these estimates at median after-tax income in the ACS results in an average MPC of 16%, which can be compared with previous estimates in the literature.<sup>24</sup>

A substantial literature estimates excess sensitivity to recurring payments. The most closely related studies are those that use payments which occur only once or twice a year such that they cannot easily be used to pay regular expenditures.<sup>25</sup> Analyzing a similar sample of higher-income households in the CE, [Parker \(1999\)](#) estimates an MPC of 20% out of the annual additional take-home pay when income reaches the social security payroll cap. Similarly, studies that analyze the spending response to extra paychecks tend to find evidence of excess sensitivity ([Hori and Shimizutani \(2009, 2012\)](#), [Zhang \(2017\)](#)). An exception is [Browning and Collado \(2001\)](#), who find no evidence of excess sensitivity to predictable semi-annual bonus payments in Spain.

**No Anticipation Effects** The textbook model predicts that households with sufficient liquid assets should respond in anticipation of the dividend payments, which are highly predictable and

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<sup>22</sup> Appendix Figure A.3 shows similar results when also controlling for 6 leads and 8 lags of income changes and for time-by-state fixed effects, or when using no additional controls.

<sup>23</sup> For example, several studies use predetermined tax rebates which were part of the stimulus programs in 2001 and 2008 and find nondurables MPCs over the first quarter after receipt in the range of 10% to 40% ([Shapiro and Slemrod \(2003, 2009\)](#), [Johnson et al. \(2006\)](#), [Parker, Souleles, Johnson and McClelland \(2013\)](#)). [Jappelli and Pistaferri \(2010\)](#) extensively survey this literature (see their Supplementary Table 1).

<sup>24</sup> The coefficients for the PFD payments and for the interaction term are 0.016 (s.e. 0.083) and 0.199 (s.e. 0.069).

<sup>25</sup> A number of recent studies have instead focused on recurring monthly payments; e.g. [Stephens \(2003\)](#), [Stephens and Unayama \(2011\)](#), [Gelman et al. \(2014\)](#), [Olafsson and Pagel \(2018\)](#).

salient (see Figures 1 and 2). Failure to detect such anticipation effects is evidence of ‘excess smoothness’ of consumption (Campbell and Deaton, 1989).

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 4(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% at the 95% confidence level.

**Potential Confounding Factors** Table 2 further analyses the average MPC of Figure 4. As there is no evidence for anticipation effects and there are no additional effects three months after the dividends are paid, I collapse the data to quarterly frequency and estimate the MPC over the first quarter ( $s = 0$  in equation 1). Column 1 estimates a baseline specification without controls (except for the main effects of the dividend), finding an average MPC of 28%.

Negative income shocks and low liquid assets are the main explanation of excess sensitivity in the textbook buffer stock model. Column 2 therefore controls for the level of liquid assets as well as quarterly income changes and the level of current year’s income, both measures of temporarily low income. Comparing Columns 1 and 2 shows that the textbook explanation cannot account for the observed excess sensitivity.<sup>26</sup>

Column 3 further adds the average level of total annual expenditures, averaged over all household years, as a measure of permanent income and hence of being ‘poor’. While these two concepts often get confused in policy discussions (temporarily low income vs. low permanent income), they have very different implications in the textbook models. Only temporary low income or low liquidity leads to excess sensitivity, not low permanent income. Column 3 shows that controlling for permanent income does not change the estimated average MPC.

Column 5 adds state-by-time fixed effects, identifying the MPC only using variation in dividend payments within Alaska in the 4<sup>th</sup> quarter. The MPC estimate is largely unchanged, but the precision decreases, with t-values falling from about 6 down to 4. Similarly, estimating equation 1 using only Alaskan households yields an almost identical MPC (25.2% with a standard error of 6.5%; see Appendix Table A.4). Column 4 instead estimates an individual fixed effects model, only using within-household variation (and hence controlling for *changes* in household characteristics), rather than the first-difference specification that is standard in the literature. While the point estimate remains largely unchanged, the precision significantly increases (t-statistic of 7) because fixed effects estimators are typically more efficient than first difference estimators.

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<sup>26</sup> This is the same specification as in Figure 4 but with quarterly data and without leads and lags. The MPC of 26% is consistent with the cumulative MPC based on monthly data, both parametric (Figure 4) and nonparametric (Figure 3). The small difference in the point estimates is due to the fact that using 6 leads and 8 lags at monthly frequency in Figure 4 drops more observations than using first differences at quarterly frequency in Table 2.

**Consumption vs. Spending** Many nondurables 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.<sup>27</sup>

To address this concern, Panel B of Table 2 follows Lusardi (1996) and studies the spending response of disaggregated categories, in particular food at home and food away from home, which are the main components of ‘strictly nondurables’. About 40% of the MPC is concentrated in food, and the magnitude of the grocery spending response in Column 6 is in line with previous research, such as Broda and Parker (2014), who estimate grocery spending responses to the smaller economic stimulus payments in 2008 using the Nielsen Consumer Panel.<sup>28</sup> Column 7 shows that households also spend a significant amount on dining out, which is clearly nondurable. Column 8 shows the same result using a service item, spending on kids’ activities.

The response of disaggregated spending categories in Table 2 and the absence of a reversal of the response of nondurables shown in Figure 4 strongly suggest that the excess sensitivity cannot be explained by intertemporal substitution of nondurable expenditures.

One concern mentioned in Section 3 is cash, which might be used to purchase nondurables and hence would lead the MPC to be downward biased, since cash withdrawals are not included in nondurables. Column 9 shows that while there is a statistically significant increase in cash withdrawals in the 4<sup>th</sup> quarter, its economic magnitude is small and is thus unlikely to cause a significant bias.

**Durables and Intertemporal Substitution** While there is no evidence of intertemporal substitution or anticipation effects in *nondurable* spending, Figure 5 shows that Alaskans do time the purchase of *durables* to the arrival of the predictable dividend cash flows (both intertemporal substitution and anticipation effects). These graphs use the same specification as in Figure 4 but for spending on durables that are purchased with a credit card and hence can be classified accordingly in the PFW data. While the overall pattern is similar to that of nondurables, there are some notable differences. First, the effect is slightly smaller both on impact (8%) and after one quarter (13%) because those transactions only capture smaller durables which are purchased with a credit card. Second, there is evidence of intertemporal substitution of spending (but not necessarily of consumption).<sup>29</sup>

Figure 5(a) shows that purchases of smaller durables fall slightly in September, possibly in anticipation of the dividend payments. While intertemporal substitution does not require house-

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<sup>27</sup> Note that mortgage and rent payments, which are recurring payments, are excluded from nondurables. Moreover, because the PFD arrives annually and changes from year to year, it is difficult to use it to make automatic payments for other recurring payments such as utilities, which are typically also on a monthly cycle.

<sup>28</sup> To increase precision when analyzing disaggregated spending, I use the individual fixed effects estimator.

<sup>29</sup> It is worth repeating that changes in spending on durables do not necessarily provide evidence against the standard model because those changes might not reflect changes in consumption.

holds to be particularly forward-looking,<sup>30</sup> the spending drop in September would be evidence of such behavior. However, this dip is relatively small (2%) and only marginally significant.

**Total Expenditures** For policy questions such as the effectiveness of an economic stimulus program, policymakers are interested in the effect of the dividend on total household spending. The average MPC of total expenditures in Column 10 of Table 2 is 73%, which is very large. However, one should keep in mind that total expenditures include uncategorized spending and checks, which could include unclassified saving transactions (e.g. extra mortgage pre-payments with a check). Moreover, a substantial fraction of this response reflects intertemporal substitution, and some purchases might be financed with credit, further amplifying the total spending response.

In Appendix B I estimate that the average Alaskan household in the PFW sample pays 23 cents of additional federal taxes in the following year for each dollar of PFD income (Appendix Figure A.4). Hence, total expenditures in the 4<sup>th</sup> quarter and additional taxes paid in the following year explain 95% of the use of PFD income. The remaining 5% remains in the bank account for later use or is transferred to savings and investment accounts.

## 5 External Validity using Survey Data

This section assesses the external validity of these excess sensitivity results and relates them to previous research using the Consumer Expenditure Survey (CE).

**External Validity** As explained in Section 3, PFD payments must be imputed in the CE since the survey does not ask households whether they received the payments and how much they received. Panel A of Table 3 shows that Alaskan households in the CE also exhibit excess sensitivity to the dividend payments, with a statistically significant MPC of 8% (Column 1). However, this MPC is substantially smaller than the average MPC in the PFW sample, reproduced for convenience in Column 2. 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 sample 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.<sup>31</sup> This procedure does not account for who receives the dividend (take-up) and whether the dividend is received in full (voluntary and involuntary deductions). Column 3 shows that the added measurement error reduces the MPC from 26% to 20%.

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<sup>30</sup> For example, households could spend the dividend equally on nondurables and durables in October, but run out of nondurables in the following months.

<sup>31</sup> 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 PFD income in the CE.

Second, I take into account the difference in sample compositions. As shown in the next section, the MPC increases with income. Therefore, differences in income in the two samples matter (see Table 1). Column 4 interacts the dividend with after-tax family income. The point estimate implies that for each \$100,000 of income, the MPC increases by about 19 percentage points. Evaluating this linear function at average Alaskan after-tax family income in the CE predicts an average MPC of 10%, which is statistically indistinguishable from the point estimate in Column 1. As a last step, Column 5 uses the observed dividend payment from Column 2 as an instrument for the imputed dividend payments in Column 3. The IV estimate is larger than the OLS estimate, evidence of measurement error caused by the dividend imputation.

**Comparison with Hsieh (2003)** The CE 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 textbook consumption theory. This previous study found no response of spending to the dividend payments using the CE, which are reproduced in Column 6, Panel B. Column 7 closely replicates this non-result.<sup>32</sup> The main difference to the specification used in this paper is that the previous study estimates the effect of the PFD on log-changes in spending (i.e. an elasticity) while equation 1 estimates the effect on changes in spending (i.e. an MPC). To estimate an elasticity, the previous study divides the PFD payments by self-reported family income,<sup>33</sup>

$$\Delta \ln(c_{it}) = \beta \cdot \frac{\text{PFD}_t \times \text{Family Size}_i}{\text{Family Income}_i} + \gamma' x_{it} + \varepsilon_{it}.$$

While normalizing the dividend by income is a reasonable approach, family income in the CE unfortunately suffers from substantial non-classical measurement error and under-reporting, as shown in Figure 6. This measurement error causes a large attenuation bias in the estimated response. Column 8 instead uses total expenditures to normalize dividend payments, which is an alternative, less noisy measure of (permanent) income whose distribution is also shown in Figure 6. This alternative normalization substantially increases the response from 0 to 12%.

Column 9 uses non-Alaskan households as a control group and the full sample from 1982 to 2013, controlling for the main effects (state and time fixed effects, family size, and inverse income) and other family characteristics. To turn the intention-to-treat effect in Column 8 into an average treatment-on-the-treated effect of 14%, I use the fraction of each PFD dollar that the average Alaskan receives (see Appendix Table A.2), which is comparable to the estimates based on the PFW sample.

Finally, Column 10 uses the less noisy measure of the relative dividend size when normalized by total expenditures (Column 9) as an instrument for the noisier measure of relative dividend when normalized by family income (Column 7). This yields an unbiased estimate of the spending elasticity that is almost identical to the MPC in Column 1. Hence, differences in responses using

<sup>32</sup> The companion paper (Kueng, 2015) provides more detail of this analysis.

<sup>33</sup> Family Size is the number of household members in the first interview, assumed to be all dividend eligible.

CE data in Panels A and B are not driven by using logs (Column 10) instead of levels (Column 1).

## 6 MPC Heterogeneity

The high average response documented in Section 4 is striking since 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. Moreover, the typical household in the sample has a substantial amount of liquid assets and relatively high income.

To gain insight into potential mechanisms that underlie this large average response, I analyze heterogeneity in MPCs along three important dimensions suggested by previous research: liquid assets, income, and payment size. Table 4 reports the results from fully interacting the PFD payments with quantiles of these three dimensions (denoted by  $z$ ),

$$\Delta c_{it} = \sum_{q_z} \beta_{q_z} \cdot \text{PFD}_{it} \times \mathbb{1}(z_{it} \in q_z) + \sum_{q_z} \eta_{q_z} \mathbb{1}(z_{it} \in q_z) + \alpha_t + \text{Alaska}_i + \lambda' x_{it} + \varepsilon_{it}, \quad (2)$$

where  $\mathbb{1}(z_{it} \in q_z)$  equals 1 if household  $i$ 's observed measure  $z_{it}$  is in the  $q^{\text{th}}$  quantile of variable  $z$ , and 0 otherwise.

**MPC Heterogeneity by Liquid Assets** I start by exploring differences in spending responses across quintiles of liquid assets, since credit constraints or precautionary saving are the main explanations of excess sensitivity proposed in the literature. For instance, households might want to borrow against future income, but in the case of the PFD 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 in any debt contract. Hence, households need to have sufficient amounts of liquid assets to move PFD-related spending forward in time.

As mentioned in Section 3, I define liquid wealth narrowly by only including cash-equivalent bank account balances. A broader definition of liquid assets might also include financial assets that can be easily liquidated, such as taxable brokerage accounts, and could also include unused credit lines, such as home equity lines of credit. Such a broader measure would make it even more difficult to explain the observed responses with a lack of liquidity, since most households in the PFW sample hold substantial amounts of additional liquid wealth in taxable brokerage accounts (see Table 1).

I use two measures of credit constraints. Column 1 uses quintiles of the level of liquid assets, while Column 2 uses the cash-on-hand ratio suggested by theory (Carroll, 2001). The latter expresses a household's liquid assets as a fraction of average quarterly total spending (averaged over all household years), which proxies for unobserved permanent income. The spending response does not significantly differ across quintiles of the level of PFD payments, while the MPC indeed falls slightly when using the cash-on-hand ratio. However, this profile is not strictly monotone

and not very steep. The bottom row of Table 4 shows that we cannot reject the hypothesis that the MPCs in the first and last quintiles are the same. Moreover, the MPC of 21% for households in the highest quintile, who are most likely unconstrained, is large from the perspective of the standard buffer stock model, while the MPC of 36% seems relatively small for the most constrained households in the lowest cash-on-hand ratio quintile.

**MPC Heterogeneity by Income** Panel B sorts households by income per capita, both permanent income (total expenditures averaged over all household years) and current annual income.<sup>34</sup> The MPC is slightly U-shaped in current income and monotonically increasing in permanent income. Both slopes are highly statistically significant (bottom row and Figure 7(a)), but the U-shape is not. Households in the top income quintile have an MPC around 70% compared with an MPC of about 10% for households in the lowest quintile, for whom the dividend is a substantial source of total family income. These results hold independent of whether we use current income or permanent income and whether we control for negative income shocks or for credit constraints by including the household’s amount of liquid asset.

**MPC Heterogeneity by Payment Size** The finding that the MPC *increases* with income is consistent with results reported in Shapiro and Slemrod (2003) and Johnson et al. (2006), who also find that the higher-income households have a larger MPC, but it runs counter to conventional wisdom. This conventional wisdom builds on the standard textbook model with time separable and homothetic preferences (either LC/PIH models with binding credit constraints or buffer stock models). Section 7 derives sufficient statistics for the welfare loss from not fully smoothing the PFD payments in such models, which is proportional to the *relative* dividend size – the total amount of PFD payments as a fraction of the household’s permanent income.

Since the dividend is a lump-sum payment, the potential welfare loss from spending a large fraction of the dividend instead of smoothing it varies greatly across households. Hence, we might expect that the predictive power of the textbook model is largest for households for whom the dividend contributes the most to income. Columns 5 and 6 therefore sort households by relative payment size, using both permanent and current income. Households for whom the cost from not smoothing the dividend would be highest indeed smooth the dividend to a significant extent (MPC of only 15%). Households for whom the dividend is only a small fraction of income, on the other hand, spend most of it (MPCs above 60%). The MPC declines monotonically in the relative payment size (and hence in the potential welfare loss from not smoothing) and more steeply so when normalizing dividend income by permanent income. The negative slope is highly statistically significant as shown by the probability values in the bottom row.

Columns 7 and 8 show that it is important to measure payment size in relative terms as predicted by theory (i.e. using the relative size of the ‘shock’), instead of the level (Column 7) or a quadratic function of the level of payments (Column 8). The only other studies I am aware

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<sup>34</sup> Average Alaskan current income per capita in each quintile is \$16,000, \$30,000, \$41,000, \$58,000 and \$114,000.

of that analyze whether payment size predicts excess sensitivity in the cross-section using a single source of income changes at the household level are [Kreinin \(1961\)](#), [Souleles \(1999\)](#), and [Scholnick \(2013\)](#), all of which use a quadratic function of the level of payments.<sup>35</sup> They find mixed or inconclusive results, mostly due to a lack of statistical power. Columns 7 and 8 show little evidence of a size effect when using the nominal size of the dividend instead of the relative size as a fraction of household income, thereby providing an explanation for the inconclusive results of these studies. The MPC in Column 7 is largest for households in the lowest dividend quintile and this difference is marginally statistically significant. However, Column 8 uses a quadratic function of the unscaled size of the dividend instead of the relative size of the cash flows, resulting in a statistically insignificant and also economically small coefficient for the quadratic term, while the linear term – the average excess sensitivity – is unaffected by adding the quadratic term and remains economically and statistically significant at 26%.

## 7 Implications for Models of Consumption Behavior

This section explores the implications of the spending response to the Permanent Fund Dividend payments for models of intertemporal consumption behavior.

### 7.1 Standard PIH and Buffer-Stock Models

The life-cycle/permanent income model with no uncertainty or with certainty equivalence predicts that the MPC out of predetermined or predictable income is zero, which is strongly rejected by the data. Similarly, a standard buffer stock model with homothetic preferences and income uncertainty calibrated to the PFW sample cannot explain the observed spending response (see Appendix D). In such models, failure to smooth consumption is due to temporary low liquidity as a result of negative past income shocks.<sup>36</sup> However, since the PFD is well anticipated several quarters in advance and occurs regularly, consumers in the model take future dividend payments into account when planning their spending. Only households who experience a series of negative income shocks spend a noticeable amount of the dividend upon arrival. However, there are few such households with a sufficiently low cash-on-hand ratio in the data.

The observed MPC is an order of magnitude larger than predicted by these models and does not decline significantly as a function of liquid assets. Instead, the largest response in the data is concentrated among high-income households with large amounts of liquid assets. Moreover, according to the standard model, households should respond to changes in the expected size of the dividend, but the analysis in Section 4 found no anticipation effects. Therefore, the canonical models of intertemporal consumption behavior cannot account for the observed behavior.

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<sup>35</sup> An exception is [Parker \(1999\)](#), who instead focuses on differences in MPCs across distinct types of goods with different degrees of durability, as they imply different costs from failing to smooth spending.

<sup>36</sup> Extensions of this model include consumption commitments ([Chetty and Szeidl, 2007](#)) or costs of turning illiquid into liquid assets ([Kaplan and Violante, 2014](#)), where households rationally trade off earning a higher return on illiquid assets against tolerating fluctuations in nondurable consumption in response to unanticipated transitory income shocks.

## 7.2 Models of Inattention

Since the dividend is highly predictable well in advance of its distribution, potential explanations of excess sensitivity that feature forward-looking, optimizing consumers require some form of inattention.

However, models with *rational* inattention face two important challenges.<sup>37</sup> First, consumers should respond to the dividend forecast error, not the dividend itself. It seems difficult to think of a rational model where people do not expect to receive at least some amount of PFD income every October. But in order to justify the estimated MPCs (which are based on the entire PFD), such models have to assume that consumers do not expect the PFD and are positively surprised every October about the full amount of the PFD. Such expectations do not seem rational.<sup>38</sup>

One extreme case that could be consistent with such expectations are ‘inattentive savers’ in the model of Reis (2006). These consumers optimally choose to never update their information about the dividend and follow a fixed saving plan because their information costs exceed the benefits from having a better consumption plan. However, since consumption of such inattentive savers fully adjusts to any income shock, their MPC would be 100% and hence be too high. In fact, to explain the observed MPCs, such inattentive savers could never learn about the dividend in the first place (i.e. in period 0 when initially making the saving plan for the rest of their life), because if they did they would have to use a positive default expectation for the dividend (e.g. the long-term average dividend as in Gabaix (2016)). Therefore, they would only respond to the difference between the actual and the expected dividend amount, since the long-run expectation of the dividend is incorporated into their fixed saving plan.<sup>39</sup> Moreover, to explain the observed heterogeneity in MPCs, we would further have to assume that the information costs are positively correlated with income.

Similarly, ‘inattentive consumers’ in the Reis model – who form consumption plans during periods of inattention instead of saving plans – should also respond only to new information. But most news about the dividend arrives continuously throughout the year and before October, as shown in Section 2. Hence, rationalizing the lack of anticipation effects and the large effects in October requires that Alaskans systematically update their information sets in October. This is inconsistent with the responses of Google searches in Figure 1, which show that Alaskan households search the internet for information about the dividend already in September. Moreover, every Alaskan needs to pay attention to the dividend between January and March when applying

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<sup>37</sup> Consumers with rational inattention have rational expectations, but optimally choose to update their information set only infrequently if they face information costs.

<sup>38</sup> Appendix C shows that the response to an innovation in the fund’s income from assets by a rationally inattentive PIH consumer who updates only in October is smaller than the interest rate (e.g. 3% if the interest rate is 5%). And even this model response is still too large because it measures the response to a dividend forecast error, while the estimated MPC measures the response to the full dividend amount, most of which is predictable even a year in advance.

<sup>39</sup> Reis (2006) therefore notes that “individual consumption [...] is not sensitive to [...] predictable events.” Moreover, he cites the previous finding by Hsieh (2003), that Alaskans do not seem to respond to the Permanent Fund Dividend, as evidence in favor of his model of rational inattention (see p.1791).

for the next dividend (also clearly visible in Figure 1), and information about the next dividend is easily available from paying some attention to the news media and from talking to co-workers and friends. Finally, the annual dividend amount is announced in September by the governor in a public statement which receives major news coverage. Nevertheless, there is no anticipation effect on nondurable consumption in September.

Second, liquidity constraints do not rule out all anticipation effects if consumers form rational expectations, even in models with limited attention. The reason is that even credit constrained households can and should respond to negative news, which are negative forecast errors between periods of inattention. With rational expectations, such negative forecast errors should be about as likely as positive forecast errors.

### 7.3 Welfare Costs of Excess Sensitivity

Another important feature of the dividend is its large size. One explanation of previous excess sensitivity results is that the stakes in those settings are often small and that consumers would behave more rationally (or more consistent with the standard model) if the stakes were bigger. For instance, the well-studied consumption excess sensitivity to the stimulus tax rebates of 2001, which transferred only \$300-\$600 per household and were intended to be one-time payments. The welfare costs from not fully smoothing these payments even if one could are therefore small.

**A Sufficient Statistics Approach** Appendix E therefore derives sufficient statistics for the welfare loss from failing to smooth the dividend in the context of the permanent income hypothesis (PIH). The model accounts for the fact that the dividend is lump-sum and paid out regularly every year. The loss function is the money-metric percentage loss in wealth from following a potentially sub-optimal consumption plan  $\tilde{c}_i$  relative to optimally smoothing the dividend under PIH,  $c_i^{pih}$ ,

$$\text{Loss}(\tilde{c}_i, c_i^{pih}) \approx (\text{MPC}_i)^2 \times \underbrace{\left( \frac{\text{PFD}_i}{c_i^{pih}} \right)^2}_{\text{potential loss}} \cdot \frac{\gamma}{2} \cdot \frac{T-1}{T^2}. \quad (3)$$

The second-order approximation of this loss function has four components. The first term,  $\text{MPC}_i$ , is the behavioral response of consumer  $i$  to the dividend payments  $\text{PFD}_i$ , i.e. his degree of excess sensitivity. The second term,  $\text{PFD}_i/c_i^{pih}$ , is the *relative* size of the dividend payments as a fraction of the household's average consumption (or permanent income per period). These two terms are directly observable and vary across households, and they both have a second-order effect on the welfare loss.

The last two terms are not directly observable. The third term,  $\frac{\gamma}{2}$ , captures the curvature of the iso-elastic period utility function, the inverse of the intertemporal elasticity of substitution (equivalent to the relative risk aversion in this case). The loss from failing to fully smooth the dividend is smaller if the household is more willing to shift consumption across periods.

The fourth term,  $(T-1)/T^2$ , reflects how much in advance the household anticipates the

dividend and how concentrated his excess spending is. The integer  $T$  measures the typical number of periods between when consumers learn about the size of the next dividend and when the dividend is paid out. Hence,  $T - 1$  is the number of periods consumers learn about the next dividend size in advance of its payment. If the dividend is a surprise in every period ( $T = 1$ ), then the loss is zero. The more foresight consumers have, the smaller the welfare loss (if  $T \geq 2$ ).

The length of a period reflects how fast households spend the excess amount of their dividends. Section 4 shows that households spend their excess amount over three months on average, which thus warrants a welfare analysis at quarterly frequency. Since I do not observe heterogeneity in the amount of information ( $T$ ) or in preferences ( $\gamma$ ), I assume that these terms do not vary across households. Consistent with Section 2, I assume that households learn about the next dividend on average a year in advance ( $T = 4$  quarters) and I set  $\gamma = 2$ , a standard value in the literature.

If we set  $MPC_i = 1$  (hand-to-mouth behavior), then equation 3 captures the *potential* loss from fully spending the dividend upon arrival in the 4<sup>th</sup> quarter, which is proportional to the relative payment size. This potential loss statistic is useful since it is directly observable and predetermined before the dividend is paid out, and it varies across households. Hence, we can sort households by the relative size of their dividend payments and assess whether the potential loss statistic predicts the degree of excess sensitivity,  $MPC_i$ .

Figure 7(a) and Table 4 show that the MPC strongly increases with income (Column 4) and hence decreases with the potential loss statistic (or relative payments size, Column 5). Households for whom it is ex-ante costly to deviate from consumption smoothing because the dividend is a large fraction of their (permanent) income indeed smooth the dividend more. High-income households, on the other hand, for whom the dividend is a small fraction of their income and who deviate substantially from consumption smoothing, suffer only small losses from this excess sensitivity.

**Testing for Near-Rationality** How large are the actual welfare losses across households? Equation 3 implies that due to the negative correlation between the MPC and the potential loss statistic, the two forces have opposite effects on the actual welfare loss. Figure 7(b) plots the welfare loss statistic and its two main components across potential loss quintiles. On average, the potential welfare losses in each quintile are 0.09%, 0.24%, 0.46%, 0.97%, and 4.19%, ranging from giving up 8 hours of consumption per year to more than 2 weeks. Figure 7(b) also shows that the MPC declines as we move to higher potential-loss quintiles, from 86% to 16%. These two main sources of heterogeneity in the welfare loss – the degree of excess sensitivity (MPCs) and the relative size of the dividend (or equivalently the potential loss) – largely offset each other such that the actual economic loss is both similar across consumers and very small, on the order of 0.1%. Consumers 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 (Akerlof and Yellen (1985), Cochrane (1989)), even though the observed MPCs are quantitatively large.

## 7.4 Potential Explanations

How much of the MPC heterogeneity can the relative payment size (or potential loss) and relative liquidity jointly predict? Table 5 sorts households along both dimensions, relative liquidity (cash-on-hand ratio) and relative payment size, while also controlling for the quantiles (main effects),<sup>40</sup>

$$\begin{aligned} \Delta c_{it} = & \sum_q \sum_{\tilde{q}} \beta_{q,\tilde{q}} PFD_{it} \times \mathbb{1}(\text{size}_{it} \in q) \times \mathbb{1}(\text{liquidity}_{it} \in \tilde{q}) \\ & + \sum_q \eta_q \mathbb{1}(\text{size}_{it} \in q) + \sum_{\tilde{q}} \eta_{\tilde{q}} \mathbb{1}(\text{liquidity}_{it} \in \tilde{q}) + \alpha_t + \text{Alaska}_i + \lambda' x_{it} + \varepsilon_{it} . \end{aligned} \quad (4)$$

The MPC declines monotonically with the relative payment size across all liquidity quartiles, and the slopes are statistically significant except for the 3<sup>rd</sup> liquidity quartile (see the p-values in the bottom row). Jointly, the two factors can fully account for the heterogeneity in MPCs across households, although the predictive power of liquidity is lower than that of the relative payment size. Moving from the lowest relative size and liquidity quartiles to the highest reduces the MPC all the way from 1 to 0 (two-sided p-value of equality of MPCs,  $\beta_{1,1} = \beta_{4,4}$ , is 0.01%).

**Predicting Lower-Income Households' Behavior** Table 5 shows that the standard model provides a good description of consumption behavior *if* the stakes are large. Household for whom the dividend payments are relatively large have a smaller MPC (top two size quartiles). These are typically households with low permanent income. Among these households, those who have sufficient liquid assets smooth the dividend well (statistically insignificant MPCs, ranging from -1% to 19%), while low levels of liquid assets predict higher MPCs ranging from 24% to 45%.<sup>41</sup> However, this relationship breaks down when the relative dividend size is low, in which case the relationship is rather U-shaped, with households in the highest liquidity quartiles also having high MPCs (90% and 60%, respectively). This explains why the slope of the average MPC as a function of relative liquidity in Column 2 of Table 4 is not very steep and not statistically significant.

Overall, Table 5 shows (i) that the relative dividend size maintains its predictive power even after conditioning on liquid assets and (ii) that the MPC is decreasing in the amount of liquid assets that households hold *if* the economic stakes are large enough.

How does this compare to the predictions of a standard buffer stock model? The main sources of heterogeneity in MPCs in such a model are differences in relative liquidity and differences in relative payment size, because the concavity of the consumption function implies that the MPC declines with the relative payment size.

<sup>40</sup> To have enough observations in each cell, I restrict this double sort to quartiles.

<sup>41</sup> These MPCs are quantitatively consistent with previous estimates of excess sensitivity to predictable cash flows and with more recent structural models of MPCs (Kaplan and Violante (2014), Carroll, Slacalek, Tokunaka and White (2017)). At the same time, they are also consistent with alternative 'behavioral' explanations, where a third factor causes both excess spending and low liquidity, such as persistent household traits (Parker, 2017).

Appendix D calibrates a buffer stock model which matches the average MPC to assess whether it can quantitatively also match the heterogeneity in MPCs by relative liquidity and by relative payment size.<sup>42</sup> The model has five types of consumers with different permanent incomes, each facing uncertainty in current income. Each consumer receives regular PFD payments in the 4<sup>th</sup> quarter, which are fully anticipated.

Appendix Table A.6 shows that the simulated MPCs across relative payment size quantiles and across liquid asset quantiles are consistent with Table 5 only for households with above median relative payment size (i.e. for lower-income households). However, to match the large average MPC requires all households in the model to hold low amounts of liquid assets, which is inconsistent with the liquid asset holdings of households in the PFW sample. Moreover, even then the model cannot explain the large MPCs of higher-income households if they have sufficient liquid assets (i.e. the MPCs in the top quartile of the cash-on-hand ratio distribution in Table 5).

**Explaining Higher-Income Households' Behavior** The welfare calculations in standard models of intertemporal consumption behavior predict that households for whom the dividend is a large source of income benefit the most from smoothing it. Sorting households by the potential welfare loss shows that this prediction holds up well in the data. However, these welfare calculations also reveal that the standard model is silent about what higher-income households should do with the dividend. What it shows is that whatever they do with the dividend – anything from fully smoothing to fully spending it – does not have large welfare consequences for them. Hence, optimization-based explanations with standard preferences cannot provide powerful predictions for higher-income households' response to the PFD payments. Instead, we have to broaden the set of potential explanations to include non-standard mechanisms, including mental accounting or social interactions as discussed in the introduction.

## 8 Conclusion

This paper documents significant excess sensitivity of nondurable consumption to salient, predetermined, and nominally large cash flows from the Permanent Fund Dividend. The MPC out of PFD payments *increases* with household income such that the average consumption response is driven mostly by higher-income households, who have MPCs above 50%. This deviation from standard textbook models of intertemporal consumption behavior cannot be rationalized with most previous explanations of excess sensitivity, including liquidity constraints, inattention, information costs, or durability of expenditures.

To understand these large responses, I derive sufficient statistics for the welfare loss from excess sensitivity in the context of the permanent income hypothesis. The two main statistics are the behavioral response to the payments (i.e. the MPC) and the relative payment size as a

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<sup>42</sup> If the model is instead calibrated to match the observed cash-on-hand ratios across income quantiles in the PFW sample, then the average MPC is essentially zero if the dividend is anticipated, and it is still less than 2% if the dividend is completely unanticipated.

fraction of household income. The relative payment size is negatively correlated with the MPCs since it *decreases* with income. Quantitatively, the two effects largely cancel each other, such that the realized welfare losses are similar across households and small (less than 0.1% of wealth), consistent with households following ‘near-rational’ consumption plans. That is, households for whom the loss would be the largest violate the PIH the least, while households for whom the loss is trivial deviate the most from predicted behavior. The statistically significant deviation from consumption smoothing shown in this paper therefore does not imply a significant deviation in terms of wealth-equivalent losses.

This analysis suggests that the approach of calculating the potential welfare loss from deviating from a model’s predicted behavior measures the economic power of a research design used to test that model’s predictions, in the spirit of [Varian \(1990\)](#). In the case of the PIH, this potential loss is captured mainly by the relative size of the payments. The relative size of the cash flows (together with liquidity constraints and other frictions) could therefore help to reconcile the wide range of MPCs found in previous studies that test for excess sensitivity in household consumption.

While the failure of the standard theory documented in this paper is not economically significant for individual households, it has potentially important implications for policymakers, since these deviations (or ‘mistakes’) are correlated across households and therefore do not disappear in the aggregate. For macroeconomic policies, such near-rational alternatives might therefore be the more relevant behavior than the one predicted by the standard consumption models. For instance, many policy interventions have a large predictable component (economic stimulus programs, automatic stabilizers, etc.) and deviations from optimal behavior in these situations might lead only to small individual welfare losses. At the same time, one needs to consider that the regularity of these PFD payments could increase the spending response (e.g. through social interactions) compared with the response to a one-time policy intervention, thereby limiting the applicability of this setting to other policies.

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. Modeling 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**

A. PFW Sample	State of Alaska			State of Washington		
	Mean	Median	St.Dev.	Mean	Median	St.Dev.
Permanent Fund Dividend						
- annual payments	1,999	1,417	1,357	--	--	--
- per annual after-tax income	2.8%	2.1%	3.9%	--	--	--
- 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
- total expenditures	24,576	19,177	20,993	23,910	18,067	21,719
Income						
- annual after-tax income	99,716	82,294	74,056	96,380	76,872	76,653
- annual before-tax income (imputed) <sup>1)</sup>	119,757	92,267	104,573	116,922	87,702	108,066
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
- 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		
B. CE Sample	State of Alaska			Rest of U.S.		
	Mean	Median	St.Dev.	Mean	Median	St.Dev.
Permanent Fund Dividend						
- annual payments	4,513	3,681	3,096	--	--	--
- per annual after-tax income	18.0%	6.4%	124.4%	--	--	--
- per annual total expenditures	8.6%	6.7%	7.5%	--	--	--
Quarterly Expenditures						
- nondurables and services	8,348	7,643	4,577	6,659	5,775	4,305
- total expenditures	15,353	13,495	9,026	11,377	9,599	7,646
Income						
- annual after-tax income	62,814	55,696	45,315	46,118	35,828	40,632
- annual after-tax income (imputed) <sup>2)</sup>	69,292	61,636	42,662	52,078	43,503	38,217
- annual before-tax income (imputed) <sup>2)</sup>	78,131	68,591	51,603	58,056	46,619	46,411
Net Financial Assets						
- bank accounts ('cash-on-hand')	19,626	4,247	45,915	14,948	1,721	39,797
Demographics						
- family size	2.58	2	1.39	2.55	2	1.41
- age of reference person	43.59	41	14.98	49.18	47	17.68
- education (years of schooling)	13.79	13	2.77	13.20	13	3.18
Number of households <sup>3)</sup>	2,000			165,700		

Notes. Nominal variables are in dollars of 2014 using the local CPI for Alaska and the U.S. CPI for Washington and the 'Rest of U.S.' Except for annual dividend payments, all nominal variables are winsorized at the 1% level. Income includes the Permanent Fund Dividend payments.

<sup>1)</sup> Before-tax income is imputed using the NBER TAXSIM calculator (see <http://users.nber.org/~taxsim>) by iterating on observed after-tax income until convergence.

<sup>2)</sup> The BLS started to impute income in 2004. I impute missing income data in earlier years using the procedure suggested by Fisher, Johnson and Smeeding (2012), which mimics the imputation procedure used by the BLS.

<sup>3)</sup> Numbers are rounded to the nearest hundred to maintain confidentiality.

**Table 2: Excess Sensitivity**

A. MPC of Nondurables					
Specification:	main effects	liquid assets and current income	permanent income	FE estimator	state x time FE
Dependent variable: quarterly nondurables	$\Delta c_{it}$	$\Delta c_{it}$	$\Delta c_{it}$	$c_{it}$	$\Delta c_{it}$
	(1)	(2)	(3)	(4)	(5)
Permanent Fund Dividend payments	0.280*** (0.044)	0.258*** (0.043)	0.262*** (0.044)	0.240*** (0.035)	0.276*** (0.070)
Family size FE	Yes	Yes	Yes	Yes	Yes
Time FE (year-by-quarter)	Yes	Yes	Yes	Yes	
State FE	Yes	Yes	Yes		
Liquid assets		Yes	Yes	Yes	Yes
Current income (level and change)		Yes	Yes	Yes	Yes
Permanent income			Yes		
Household characteristics			Yes	Yes	Yes
Household FE				Yes	Yes
State x time FE					Yes
Observations	44,577	44,577	44,577	47,787	44,577
R-squared	0.106	0.127	0.129	0.680	0.140

B. Disaggregated and Total Expenditures					
Specification:	same as in (4)				
Dependent variable:	food at home	food away	kids' activities	cash withdraw.	total expenditures
	(6)	(7)	(8)	(9)	(10)
Permanent Fund Dividend payments	0.066*** (0.009)	0.019*** (0.005)	0.007** (0.003)	0.028* (0.014)	0.727*** (0.130)
Observations	47,787	47,787	47,787	47,787	47,787
R-squared	0.691	0.640	0.526	0.313	0.675

Notes. PFD payments sum all cash flows received by a household in a quarter. Current income is after deductions and tax withholding and excludes the PFD payments. It includes quarterly changes and current year's income. Permanent income is annual total expenditures, averaged over all household years (and hence is absorbed in the household fixed effects in Columns 4-10, together with the state fixed effects). 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 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 3: External Validity using the Consumer Expenditure Survey (CE)**

A. Comparing CE and PFW					
Dependent variable: $\Delta c_{it}$ , quarterly nondurables	PFW Sample				
	CE Sample (1)	using the observed PFD (2)	using the imputed PFD (3)	dealing w/ sample composition (4)	IV imputed with observed PFD (5)
PFD payments		0.262*** (0.044)			
PFD x family size x Alaska	0.079** (0.036)		0.201*** (0.033)	-0.013 (0.057)	0.227*** (0.038)
PFD x family size x Alaska x income/\$100,000				0.185*** (0.053)	
Control variables	same as Table 2, Column 2				
Observations	385,800	44,577	44,577	44,577	44,577
R-squared	0.006	0.129	0.129	0.130	0.129
Predicted MPC at average CE income				0.104*** (0.039)	
B. Comparison with Hsieh (2003) using CE					
Dependent variable: $\Delta \ln(c_{it})$ , quarterly nondurables	Hsieh (2003) (6)	replication (7)	normalize w/ total expend. (8)	attenuation factor and full sample (9)	IV curr. income w/ perm. income (10)
PFD x family size x Alaska / before-tax income	-0.003 (0.033)	-0.003 (0.005)			
PFD x family size x Alaska / total expenditures			0.123 (0.086)	0.136*** (0.032)	0.076*** (0.023)
Household characteristics	Yes	Yes	Yes	Yes	Yes
Family size	Yes	Yes	Yes	Yes	Yes
Time FE				Yes	Yes
State FE				Yes	Yes
Inverse total expenditures				Yes	Yes
Number of observations (rounded)	806	800	800	559,400	458,000
Number of Alaskan CUs (rounded)	806	800	800	2,800	2,300
R-squared	--	0.009	0.013	0.007	

Notes. Panel A: PFD payments sum all cash flows received by a household 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 tax withholding and additional deductions. Liquid assets are the household's net cash-equivalent bank balances ('cash-on-hand'). Household characteristics include fixed effects for age, education, residential ZIP code (PFW sample only), homeownership status, marital status, and occupation. The predicted MPC in Column 4 uses the two reported coefficients to evaluate the linear MPC function at the average after-tax income of Alaskan households in the CE. Column 5 instruments the imputed noisy dividend measure with the observed dividend used in Column 2, which is based on textual transaction descriptions. Panel B: To maintain confidentiality, sample sizes are rounded to the nearest hundred. Columns 6-8 use only Alaskan households and Column 9-10 use all households. 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 Columns 1-5 and Columns 8-10; OLS standard errors are used in Columns 6-7.

**Table 4: MPC Heterogeneity**

Dep. var.: nondurables $\Delta c_{it}$	A. Liquidity		B. Income		C. Dividend Size			
	liquid assets (1)	cash-on-hand ratio (2)	current income (3)	permanent income (4)	PFD payments divided by perm. income    current income (5)                    (6)		PFD payments: level            quadratic (7)              (8)	
PFD payments x 1 <sup>st</sup> quintile	0.270*** (0.065)	0.357*** (0.059)	0.114** (0.052)	0.080 (0.072)	0.859*** (0.191)	0.602*** (0.181)	0.524*** (0.163)	
PFD payments x 2 <sup>nd</sup> quintile	0.283*** (0.057)	0.253*** (0.065)	0.081 (0.068)	0.163*** (0.055)	0.533*** (0.132)	0.386*** (0.110)	0.195* (0.106)	
PFD payments x 3 <sup>rd</sup> quintile	0.237*** (0.085)	0.292*** (0.101)	0.289*** (0.070)	0.163** (0.069)	0.385*** (0.097)	0.344*** (0.094)	0.235** (0.113)	
PFD payments x 4 <sup>th</sup> quintile	0.181* (0.106)	0.190* (0.098)	0.376*** (0.106)	0.304*** (0.092)	0.263*** (0.081)	0.281*** (0.071)	0.275*** (0.070)	
PFD payments x 5 <sup>th</sup> quintile	0.341*** (0.093)	0.207** (0.095)	0.567*** (0.114)	0.761*** (0.116)	0.156*** (0.046)	0.170*** (0.048)	0.264*** (0.055)	
PFD payments								0.257*** (0.098)
(PFD payments/100) <sup>2</sup>								0.017 (0.197)
Family size FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Quintile FE (main effects)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Income change	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Household characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	44,577	44,577	44,577	44,577	44,577	44,577	44,577	44,577
R-squared	0.128	0.128	0.129	0.130	0.129	0.129	0.129	0.128
p value of test $\beta_1 = \beta_5$	0.5132	0.1557	0.0002	0.0000	0.0188	0.0002	0.1166	

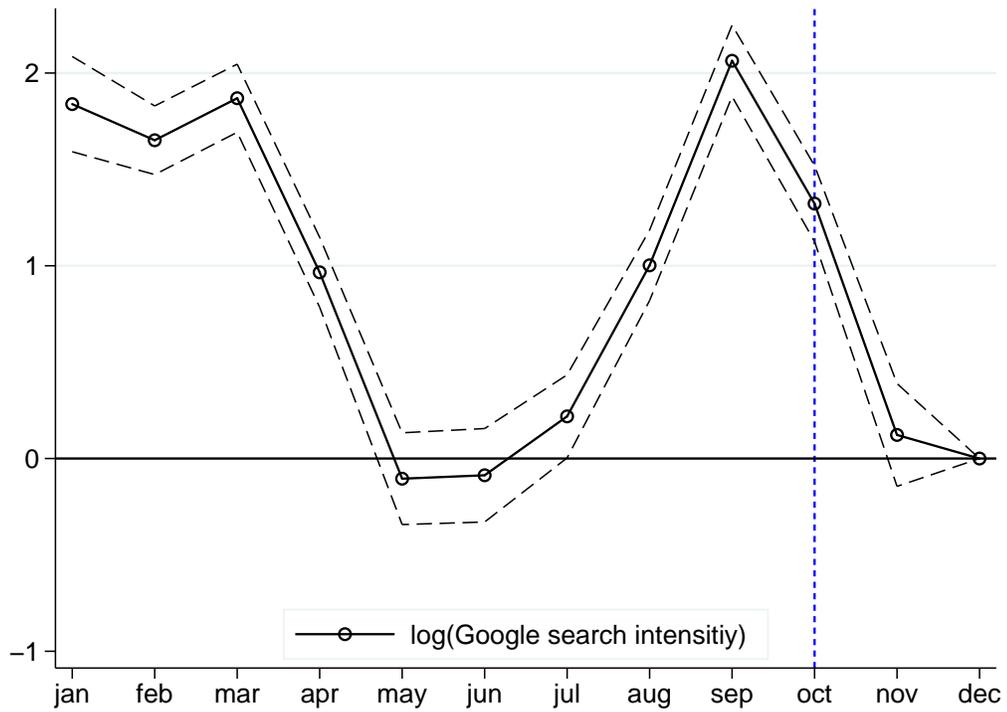
Notes. See description in Table 2. Income change controls for quarterly changes in household after-tax income, excluding PFD payments. Panel A: Liquid assets are net cash-equivalent bank balances. Quintiles use the level of liquid assets in Column 1 and the cash-on-hand ratio in Column 2, which divides liquid assets by permanent income (average total spending averaged over all household years). Panel B: Quintiles in Column 3 use current annual income (after deductions and income tax withholding) and permanent income (annual total spending), both per capita and averaged over all household years. Panel C: Quintiles in Columns 5 and 6 use the relative size of the dividend, which divides payments by permanent and current income, respectively. Quintiles in Column 7 instead use the level of dividend payments. Column 8 uses a quadratic of the level of the dividend, as typically used in previous research.

**Table 5: Relative Payment Size vs. Cash-on-Hand**

Dep. var.: $\Delta c_{it}$ , nondurables	PFD payments x cash-on-hand quartiles				F test	
	1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>	4 <sup>th</sup>	p value	
PFD pay. x relative size quartiles	1 <sup>st</sup>	1.177*** (0.276)	0.751** (0.295)	0.464* (0.282)	0.943*** (0.301)	$\beta_{11} = \beta_{14}$ 0.5503
	2 <sup>nd</sup>	0.469*** (0.124)	0.410* (0.227)	0.396* (0.208)	0.635*** (0.185)	$\beta_{21} = \beta_{24}$ 0.4406
	3 <sup>rd</sup>	0.451*** (0.092)	0.291** (0.137)	0.194 (0.177)	0.168 (0.148)	$\beta_{31} = \beta_{34}$ 0.0920
	4 <sup>th</sup>	0.247*** (0.061)	0.242*** (0.062)	0.089 (0.093)	-0.014 (0.125)	$\beta_{41} = \beta_{44}$ 0.0525
Control variables	same as Table 2 Col. 2 plus quartile FE					
Observations	44,577				$\beta_{11} = \beta_{44}$	
R-squared	0.130				0.0001	
F test	$\beta_{11} = \beta_{41}$	$\beta_{12} = \beta_{42}$	$\beta_{13} = \beta_{34}$	$\beta_{14} = \beta_{44}$		
p value	0.0008	0.0854	0.1969	0.0028		

Notes. See description in Tables 2 and 3. Cash-on-hand ratio quartiles are computed as in Column 2 of Table 3. Relative dividend size quartiles are computed as in Column 5 of Table 3. Control variables include the variables specified in Column 2 of Table 2 plus fixed effects for cash-on-hand quartiles and relative dividend size quartiles (main effects).

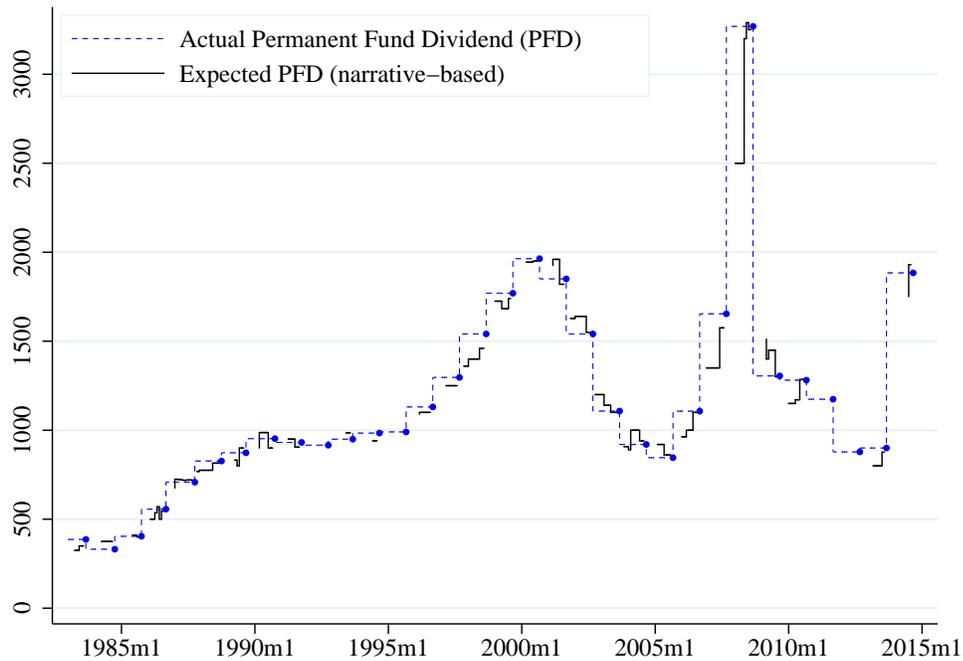
Figure 1 – Dividend Salience: Evidence from Google Searches



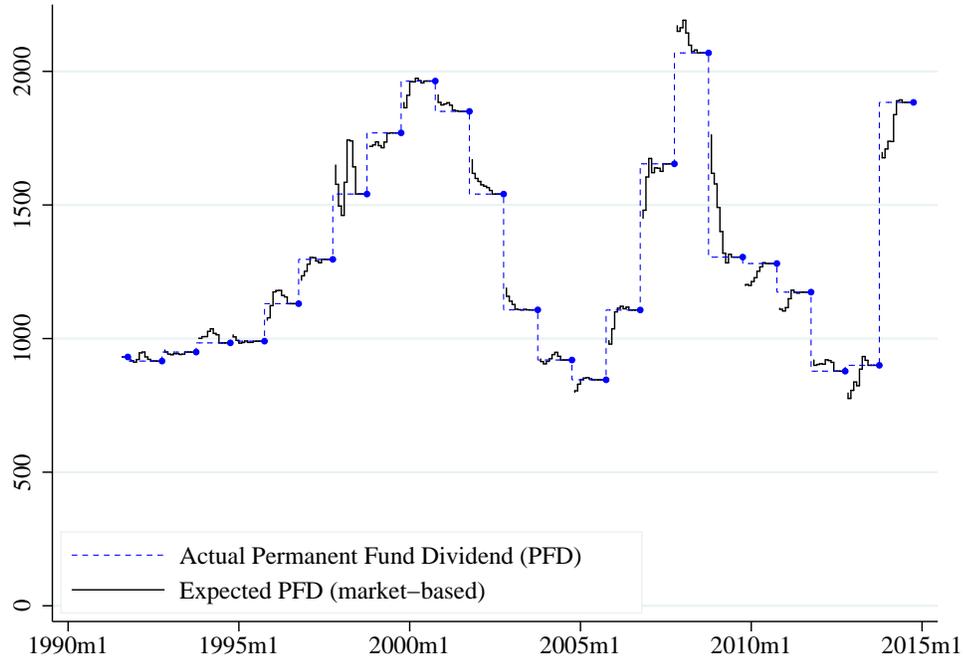
Notes. This figure plots monthly fixed effects  $\beta_m$  of a regression of Google searches for the term ‘Permanent Fund’ by Alaskan users between January 2004 and August 2017, controlling for a linear time trend:  $\ln(\text{Google searches})_t = \sum_{m=1}^{11} \beta_m \cdot \text{Month}_m + \alpha + \gamma \cdot t + \varepsilon_t$ . Data are from Google Trends, a Google application that gives a time series of the relative amount of local search activity for specific search terms on Google.com ([www.google.com/trends](http://www.google.com/trends)). The values of Google Trends represent the number of searches on Google.com for the specified search term relative to the total number of searches on Google.com derived from a sample of all Google search data. Google Trends is normalized such that the highest value for the entire time period and search term is set equal to 100. Its range of values is always between 0 and 100, where higher values correspond to higher ratios of total searches on Google.com for a given search term.

Figure 2 – Expected vs. Actual Permanent Fund Dividend

(a) narrative-based expected dividend



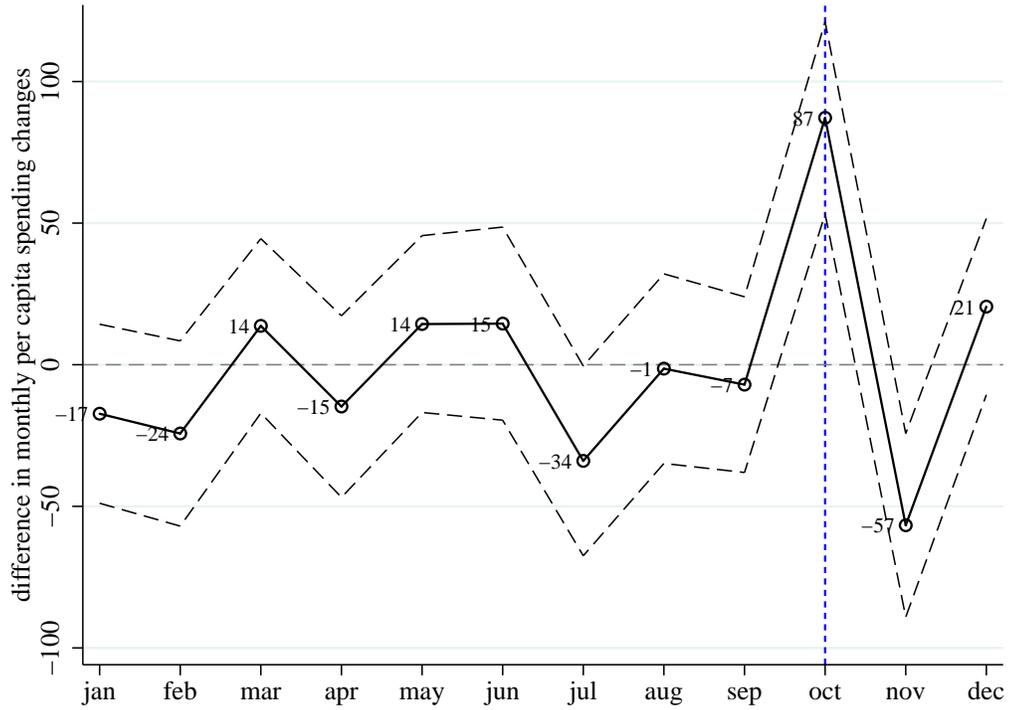
(b) market-based expected dividend



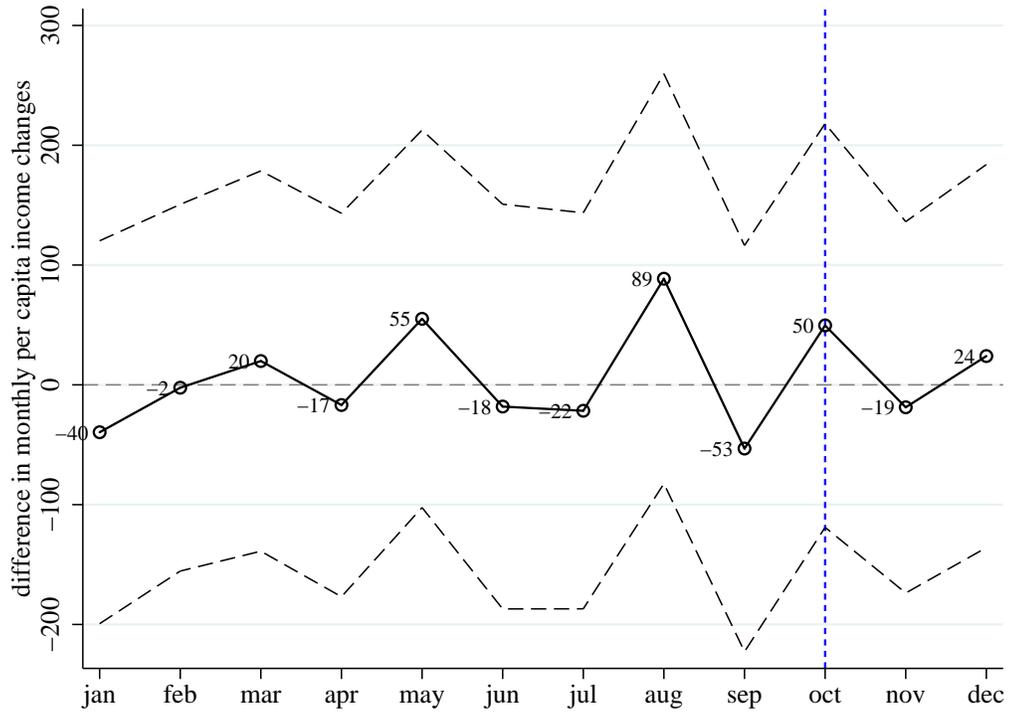
Notes. This figure shows the nominal Permanent Fund Dividend amount (blue dashed line), which is paid out in early October (marked by the blue dots), as well as the expected dividend (a) based on a narrative analysis of all major Alaskan newspapers and (b) based on the public dividend formula applied to monthly income from the fund's assets, which was obtained from APFC's own archive and its public website (see Appendix A). 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 in 2008, which is the dividend predicted by the market-based approach in Panel (b).

Figure 3 – Non-Parametric Evidence of Excess Sensitivity

(a) nondurables spending per capita



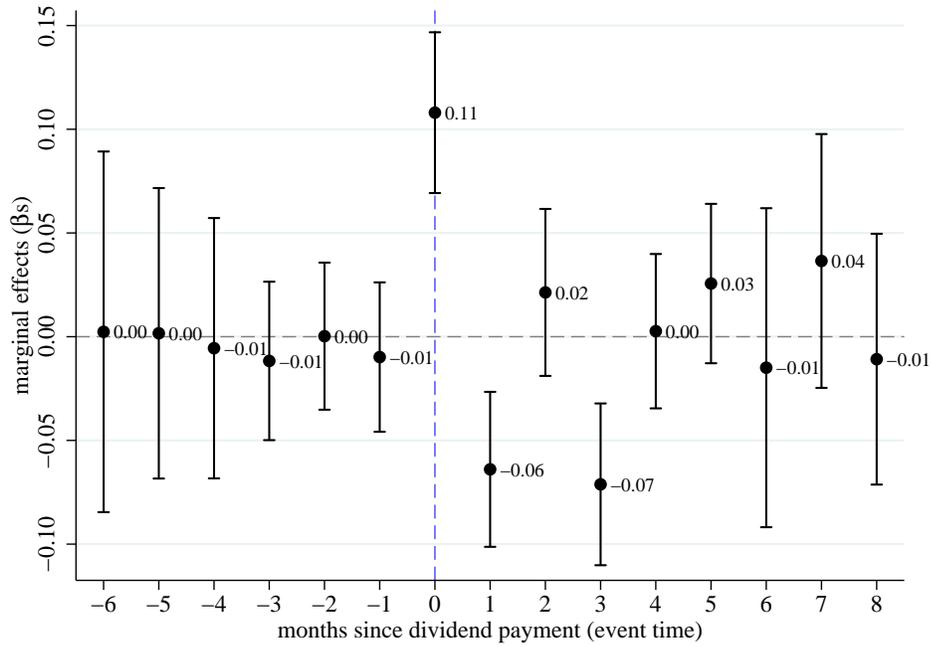
(b) income per capita (excluding dividend)



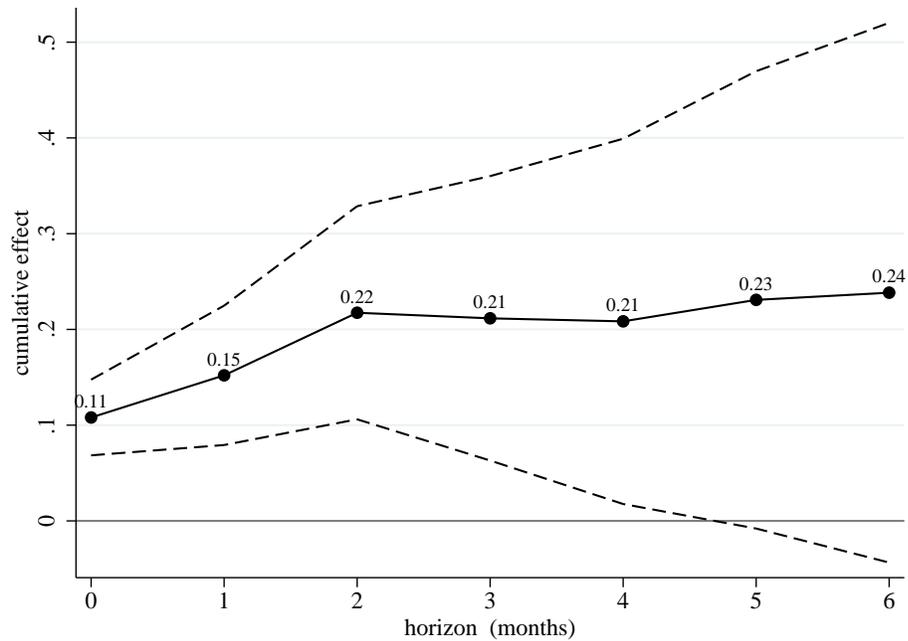
Notes. These figures show the average (median) difference in monthly household per capita spending changes of nondurables and services (after-tax income per capita) between households in Alaska and Washington. The Permanent Fund Dividend is paid out at the beginning of October (blue dashed line). Black dashed lines are 95% confidence intervals.

Figure 4 – Excess Sensitivity and Lack of Anticipation Effects

(a)  $\Delta C_{it}^{nd} = \sum_s \beta_s PFD_{i,t-s} + \gamma \Delta inc_{it} + \delta liq\_assets_{it} + time, state, fam\_size FEs + \varepsilon_{it}$



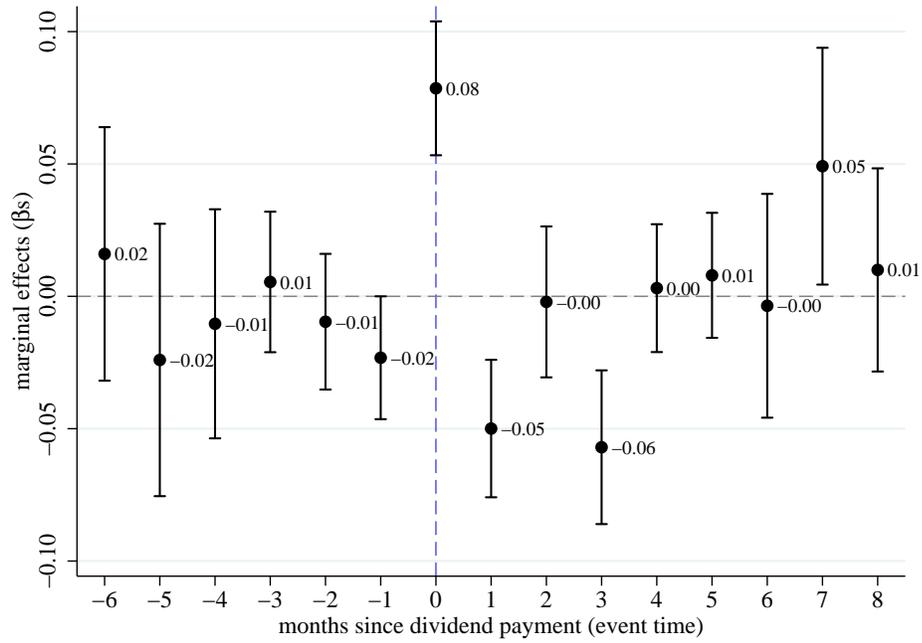
(b) nondurables cumulative MPC



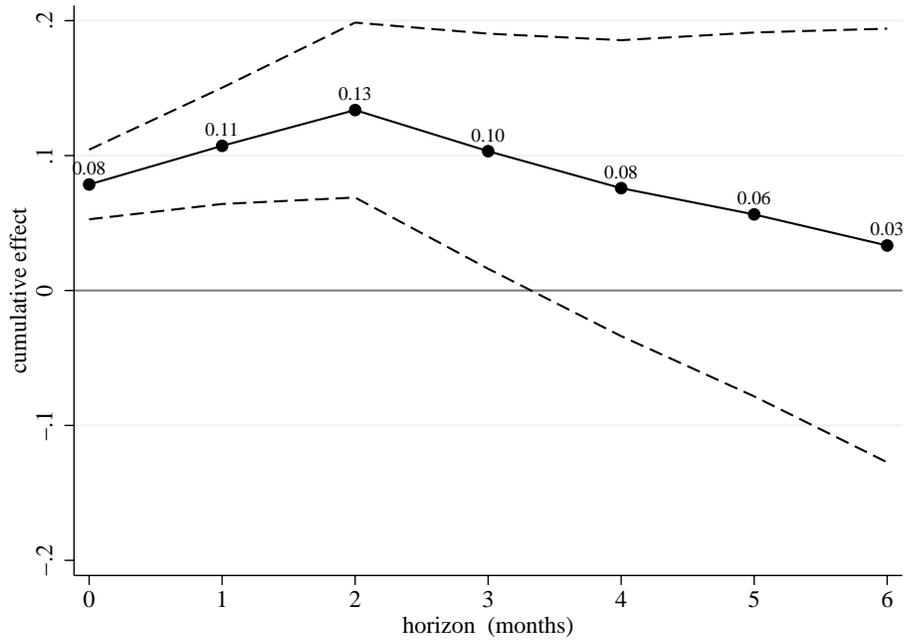
Notes. These figures show the response of household spending on nondurables and services to the receipt of the Alaska Permanent Fund Dividend (PFD) by estimating equation (1). All specifications use changes in levels as the dependent variable. In addition to the main effects (time, state, and family size fixed effects), the controls include liquid assets and monthly changes in after-tax income, excluding the PFD. Panel (a) shows leads and lags of the regression coefficients on the PFD payments received by the household. 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 robust 95% confidence intervals, with standard errors clustered at the household level.

Figure 5 – Durables Response and Intertemporal Substitution

(a)  $\Delta c_{it}^d = \sum_s \beta_s PFD_{i,t-s} + \gamma \Delta inc_{it} + \delta \text{liq\_assets}_{it} + \text{time, state, fam\_size FEs} + \varepsilon_{it}$

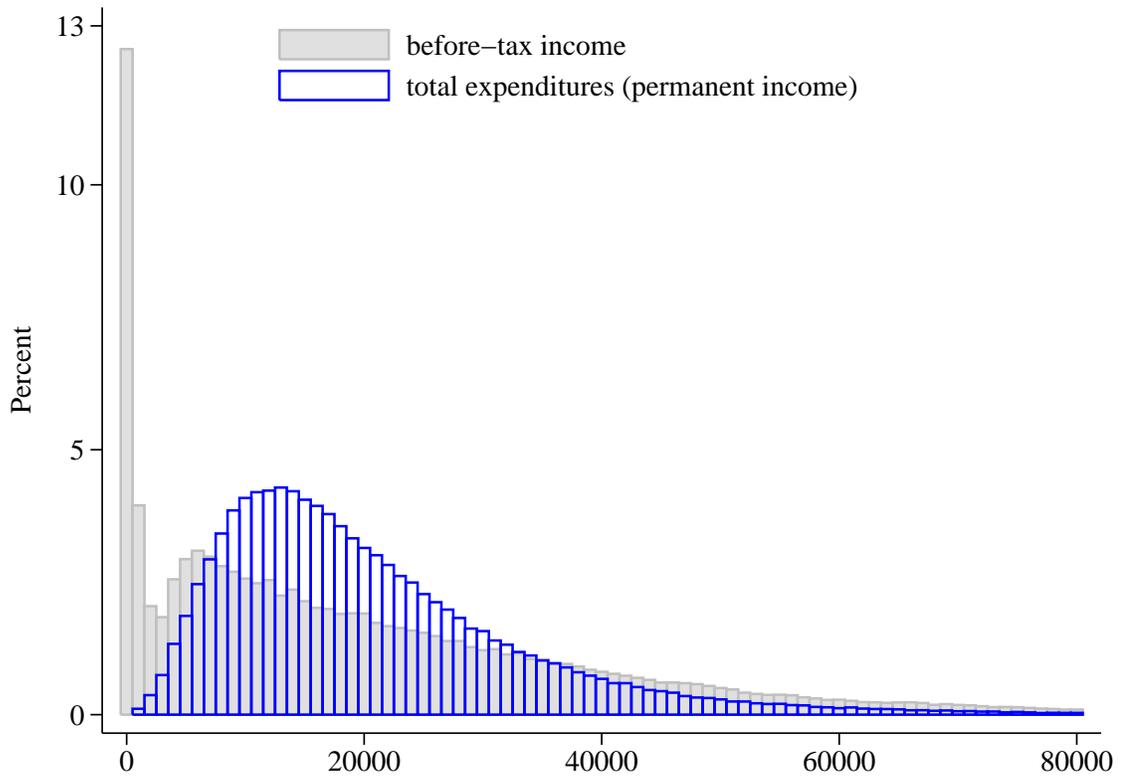


(b) durables cumulative MPC



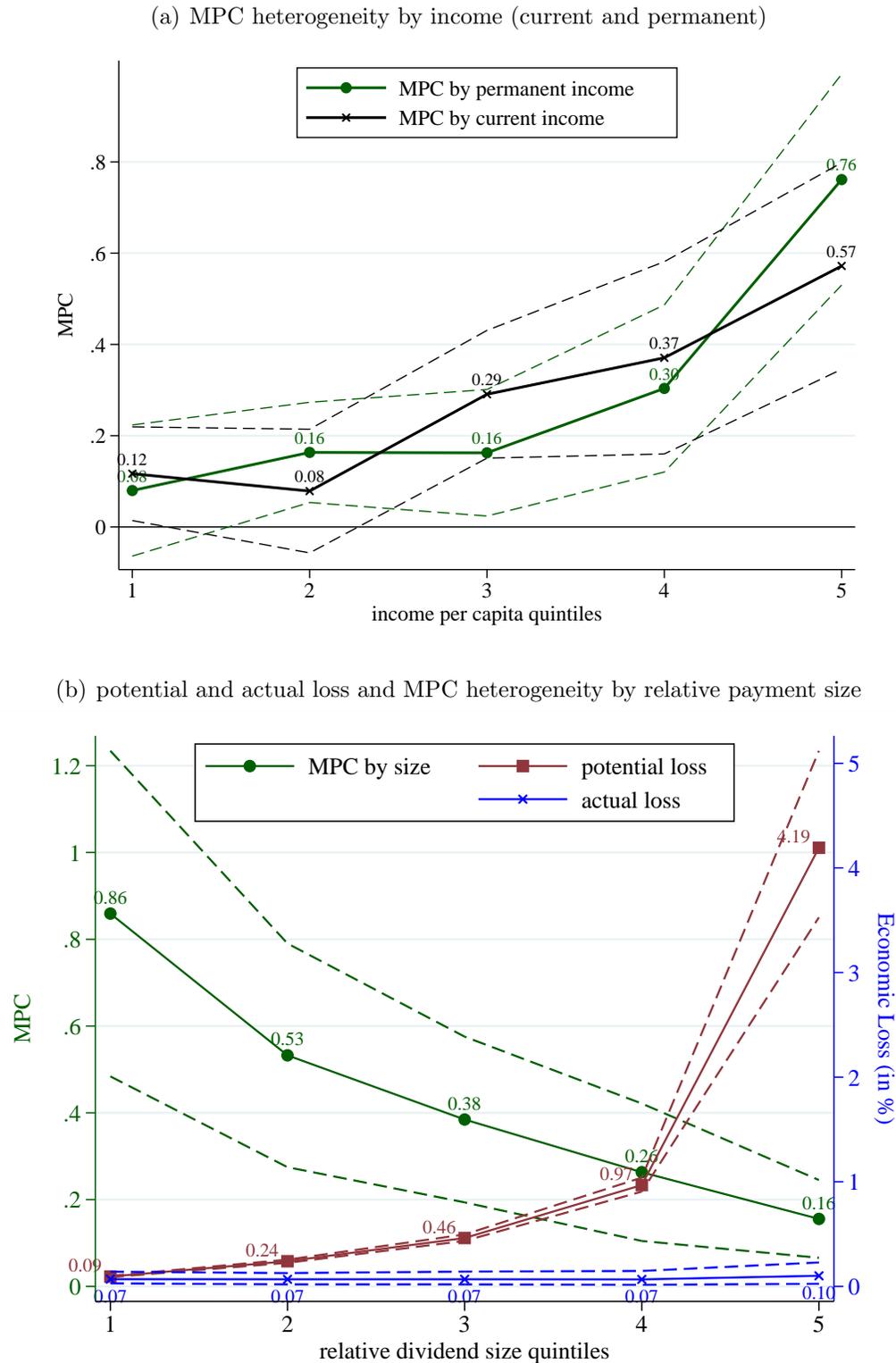
Notes. These figures show the response of household spending on durables paid for with a credit card to the receipt of the Alaska Permanent Fund Dividend (PFD) by estimating equation (1). See description in Figure 4.

Figure 6 – Income Distributions in the CE



Notes. This figure shows the histograms of current and permanent incomes in the Consumer Expenditure Survey (CE), which are used to normalize PFD payments in Section 5. Except for the first bin, all bins have a width of \$1,000. The first bin contains all households with no annual income (\$0); the remaining bins are (\$0, \$1,000], (\$1,001, \$2,000], etc. Current income is annual after-tax income in the initial CE interview. Permanent income is annual total expenditures and hence has no observations in the first bin.

Figure 7 – Homogeneous Welfare Losses Despite Heterogeneous MPCs



Notes. Panel (a) shows the MPC by income quintiles, both current income and permanent income (total expenditures) per capita; see Columns 3 and 4 of Table 4. Panel (b) shows the potential economic loss (red squares) from fully spending the dividend in the 4<sup>th</sup> quarter instead of fully smoothing it throughout the year, assuming a relative risk aversion of 2 (i.e.  $\gamma = 2$  and  $T = 4$  in equation 3). The loss is monotonically increasing with the relative dividend size – the amount of PFD payments received by a household divided by the household’s permanent income (annualized total expenditures). The actual economic loss (blue crosses) takes into account the behavioral response – the MPC shown in green circles; see equation 3. Dashed lines show bootstrapped 95% confidence intervals with 1,000 draws (Panel b) or two robust standard errors clustered at the household level (Panel a).