A Penny Saved: Prices and the Timing of Paycheck Receipt

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Abstract

This paper explores a puzzling empirical regularity: households pay less for foods as the time since receipt of their last paycheck increases. I leverage randomization with regard to paycheck timing to causally identify the effect of time since paycheck receipt on prices. Estimates of the decline in prices range between 5% and 6% percent, over the course of a month. I investigate several potential explanations for this behavior, including credit constraints and stockpiling. I find evidence that the effect is driven by low-income households and exacerbated by stockpiling behavior.

Key Words: Unit Values, Paycheck Timing, Permanent Income Hypothesis.

JEL Classification: D91, E21.

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1 Introduction

This paper documents a puzzling decline in the prices paid for food items over the course of a monthly paycheck cycle: households furthest from receipt of their paychecks pay 5% to 6% less than households who have just been paid. To the best of my knowledge, this empirical regularity has not been previously reported. Leveraging randomization with regard to paycheck timing, I am able to causally establish a link between the timing of paycheck receipt and transacted prices that goes beyond simple correlation. This decline is particularly startling because households must solve the same allocation problem each and every month. As this finding is unexpected, I explore several hypothesis as to how and why households influence the price they pay over the paycheck cycle.

This research contributes to the growing literature that examines how households affect the prices they face in response to changes in circumstances. Recent work by Aguiar and Hurst (2005, 2007) finds that the prices households pay vary over the lifecycle; households with low marginal value of time, such as retired households and the unemployed, invest in shopping related activity to produce lower prices. McKenzie and Schargrodsky (2005) find that households increase shopping intensity in response to a macroeconomic shock, a lower cost food basket. This paper directly contributes to this line of research by considering variation in prices in response to a stable predictable income transfer over a much shorter interval, the monthly paycheck cycle.

This paper also adds to the extensive literature that studies consumption responses to predictable and stable income transfers as a means of testing the rational expectations version of the Life-Cycle/Permanent Income Hypothesis (LCPIH). Under the LCPIH, household expenditure should not respond to predictable and well understood variation in income, such as the arrival of a monthly paycheck. Work in this area has drawn sharply different conclusions and remains unresolved. Shapiro and Slemrod (1995), Parker (1999) and Souleless (1999) all find evidence of excess sensitivity of expenditure to anticipated changes in income. In contrast, Browning and Collado (2001) consider variation in expenditure in response to an anticipated bonus in a sample of Spanish households and find no evidence of excess sensitivity. This paper uses an empirical approach similar to recent work by Stephens (2003,

2006), who finds excess sensitivity in monthly expenditures in response to the arrival of anticipated income. In contrast to previous work that has focused on *expenditure*, this paper asks whether the *prices* paid by households for food respond to predictable variation in income, specifically to paycheck receipt. As the timing of a paycheck is well known in advance to households, the LCPIH suggests that prices should not vary over the paycheck cycle. Studying variation in prices paid over the course of month offers a novel means of re-examining the LCPIH. Indeed, these results cast earlier work, which finds violations of the LCPIH over relatively short periods in a new light. Results below suggest that some of the excess sensitivity in expenditure found in previous work may be due to changes in the prices low-income households pay over the paycheck cycle. The implication is that consumption may be less sensitive to paycheck receipt than expenditure.

The paper proceeds as follows. I begin by describing the expenditure data used to compute prices over the paycheck cycle. I then motivate the identification strategy that leverages randomization with regard to paycheck timing. Next, I explain an empirical methodology that links observable unit values to unobservable prices and present the main results. Finally, I explore several hypotheses as to why and how prices decline over the paycheck cycle.

2 Data and Identification

The data used in this study are drawn from the British Expenditure and Food Survey (EFS) for survey years 2001–02, 2002–03, 2003–04, 2004–05, and 2005–06. The EFS is a large nationally representative survey of household expenditure and income collected by the Office of National Statistics (ONS) and the Department for Environment, Food and Rural Affairs. The EFS has a number of advantages over other comparable expenditure surveys – notably the Consumer Expenditure Survey (CEX) – for the purposes of this research. Unlike the CEX, information on physical quantities is made available to researchers, which allows the computation of unit values. A further advantage of the EFS is that expenditure on food is separated into relatively detailed subcategories; the EFS contains information about expenditure on 231 food-at-home items and these form the basis of the subsequent analysis. Appendix A contains a list of the food categories.

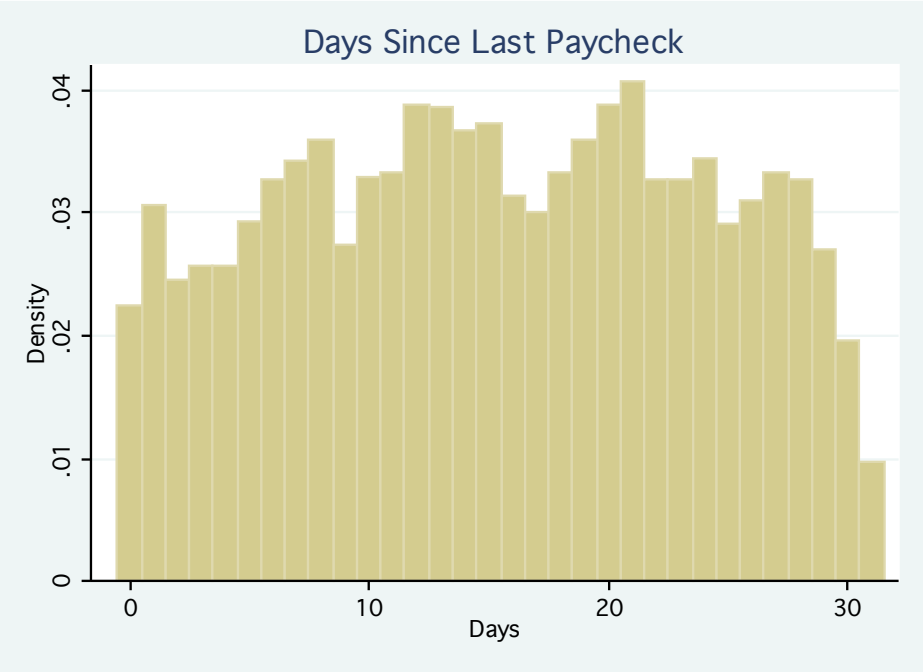
The EFS consists of a series of questionnaires that collect information on recurrent household expenditures, infrequent expenditures, household demographics and detailed income information. The ONS staggers interviews evenly over the course of the year and interviews

occur throughout the month. As a part of the interview, the EFS collects information on the timing of paycheck receipt. Households are asked to have their most recent pay stubs available when they are initially interviewed. In the following analysis, I use the date of paycheck receipt of the household reference person. The ONS defines the reference person to be the person who is legally responsible for the household accommodation. If two or more members of the household meet this definition, then the household reference person is defined as the person with the higher income. Following the interview, each household member is asked to maintain an expenditure diary over a two-week period. Each entry in the diary contains information about a single transaction, including total expenditure and physical quantity. For the purposes of this study, I focus on food because these comprise the most detailed and frequently transacted items captured in the diaries.

Identification of the effect of paycheck receipt on prices paid relies on the fact that the start date of the expenditure diary is essentially random to the household. As a result, households are interviewed and begin to log their food purchases at random intervals from the date of receipt of their last paycheck. This permits a causal identification of the effect of paycheck arrival on the set of unit values chosen by a household. Shapiro (2005) and Stephens (2006) use similar identification strategies. Note that I do not observe the date of paycheck receipt for other earners in the household. While ideally this information would be recorded, its omission will not result in detecting a paycheck effect where none is present for two reasons. First, if one accepts that households are observed at random intervals from the day of the primary earners paycheck receipt, presumably they are also observed at random intervals from the day of secondary earners paycheck receipt as well; omitting a variable that in uncorrelated with those in the model does not bias results. Second, in that some households may choose to coordinate employment in such a way that their pay dates are correlated within a household, the key variable of interest will be measured with error. As a result signs and significance will be biased towards zero and results will understate the true magnitude of any paycheck effect.

As a check of whether or not the assumption of randomization is plausible, I plot the distribution of "Days Since Paycheck" for the households in the sample on the day they begin their expenditure diaries in Figure 1. Diary start dates appear to be somewhat uniformly distributed, with the expected exception that fewer households are observed 29, 30 and 31 days from the receipt of their last paycheck. As a secondary check on the validity of the randomness assumption, I compare household characteristics for households that begin their

Figure 1: Days Since Paycheck Receipt



diaries between 0 and 15 days after the receipt of their paychecks and households who begin their diaries between 16 and 31 days after the receipt of their paycheck. I present information on weekly income, whether the head of household is female, household size and the share of the household between the ages of 0 to 5, 5-17 and greater than 60 for each group.

Table 1 shows that households who begin their expenditure diaries between 1 and 15 days from the receipt of their last paychecks are statistically indistinguishable from those that are observed between 16 and 31 days from the receipt of their last paycheck. This provides some evidence that household characteristics are uncorrelated with the paycheck cycle. Note these variables are not used in the main analysis, where household level heterogeneity is controlled using a fixed effects approach. The final estimation sample consists of 904789 transactions made by 11598 households. The average household in the sample is observed making 78 purchases of roughly 40 different food items. Finally, households purchase foods at between 4 and 5 distinct retail chains (e.g. Sainbury , Tesco) over the two week diary period.

Table 1: **Summary Statistics by Period**

Period	Income	Female	Household Size	Share LT 5	Share 5-17	Share GT 6
0 -15 Days	796.15	0.37	2.64	0.06	0.17	0.0
since pay	(673.69)	(0.48)	(1.15)	(0.14)	(0.23)	(0.22
16-31 Days	783.55	0.37	2.64	0.06	0.17	0.0
since pay	(489.36)	(0.48)	(1.17)	(0.14)	(0.23)	(0.20
Total	789.91	0.37	2.64	0.06	0.17	0.0
	(589.58)	(0.48)	(1.16)	(0.14)	(0.23)	(0.21

3 Model

For each household i at transaction j, I write the natural logarithm of price price per unit for food t as the average price for food t, captured here by a food fixed effect denoted f_t, the number of days since paycheck receipt, and a well behaved error term ϵ_{ijt}.

$$\ln p_{ijt} = \alpha + \beta \text{ Days Since Paycheck}_{ij} + f_t + \epsilon_{ijt}, \tag{1}$$

If households are observed at random dates from their paychecks then β captures variations in price caused by the number of days since the head of household received their last paycheck. In expectation, absent any effect of paycheck timing, households simply pay the average price, $\alpha + f_t$.

Note that prices, p_{ijt}, are generally unobservable in expenditure surveys [1], rather households report expenditure and physical quantities, dividing one by the other yields expenditure per unit or unit value, denoted v. Deaton (1988, 1997) proposed decomposing unit values v, into the product of the overall price level p and an expensiveness index, often referred to as quality, denoted π, $v = p\pi$. Taking logarithms yields,

$$\ln v_{ijt} = \ln p_{ijt} + \ln \pi_i. \tag{2}$$

To begin, I model the natural logarithm of the expensiveness index $\ln \pi_i$ as a household specific quality fixed effect u_i; this implies that households have a demand for quality that is constant across all foods. Given the somewhat restrictive nature of this assumption I

[1] See Crawford, Lainsey and Preston(2003) for a complete overview of the relevant literature.

investigate and attempt to relax it in a subsequent sensitivity section.

Combining equations 1 and 2 yields the basic estimating equation,

$$\ln v_{ijt} = \alpha + \beta \text{ Days Since Paycheck}_{ij} + f_t + u_i + \epsilon_{ijt}. \tag{3}$$

If households are randomized with regard to the start date of their expenditure diary, then equation 3 is sufficient to causally identify the effect of paycheck timing on unit values. However, including relevant additional covariates will improve the precision of the estimate of β. To this end, I include day of week dummies to control for the normal variation in shopping behavior over the course of a week. I also control for the fact that there are a limited number of days in a month on which households are likely to receive a monthly paycheck and include a set of day-of-month dummy variables. Day-of-month dummies also control for general equilibrium effects that may result from retailers acting strategically in the face of a limited number of paydays. Finally, following Ahmed, Brzozowski, and Crossley (2007) who find evidence of survey fatigue in the second week of the Canadian Food Expenditure Survey, I control for this possibility by including a dummy variable equal to one during the second week of the expenditure diary. Incorporating these additional explanatory variables yields an extended version of 3,

$$\begin{aligned} \ln v_{ijt} &= \alpha + \beta \text{ Days Since Paycheck}_{ij} + \delta \text{ Week 2}_{ij} + \sum_{k=2}^{7} \zeta_k \text{Day of Week}_k \\ &\quad + \sum_{l=2}^{31} \eta_l \text{Day of Month}_l + f_t + u_i + \epsilon_{ijt}. \end{aligned} \tag{4}$$

Equation 4 imposes a linear structure on the effect of "Days Since Paycheck". A priori, there is no particular reason to expect ln(unit values) to vary linearly in days since paycheck receipt. To investigate possible nonlinearities, I discretize "Days Since Paycheck" into a series of dummy variables, which yields equation 5,

$$(5)\ \ln v_{ijt} = \alpha + \sum_{n=1}^{30} \beta_n I_n(\text{ Days Since Paycheck}) + \delta \text{ Week } 2_{ij} + \sum_{k=2}^{7} \zeta_k \text{Day of Week}_k + \sum_{l=2}^{31} \eta_l \text{Day of Month}_l + f_t + u_i + \epsilon_{ijt}.$$

Where $I_n(\text{ Days Since Paycheck})$ is an indicator variable which takes on a value of one if the household received their paycheck n days ago and zero otherwise.

4 Results

I begin by comparing the results of estimating several variants of the simplest model (3): without either household or food item fixed effects, including only food fixed effects and finally including both household and food fixed effects. These different specifications provide an informal check of the assumption that households are randomly observed at various points in the paycheck cycle. Under the assumption of random observation the day on which they begin their diaries, and by extension number of days since paycheck receipt, should be uncorrelated with other explanatory variables. In all instances, I use cluster robust standard errors to control for arbitrary within household correlation.

Comparing the first and second columns of Table 2 shows virtually identical point estimates in models with and without food fixed effects suggesting that "Date of Paycheck Receipt" is uncorrelated with food type. In other words, households do not appear to vary their choice of foods meaningfully over the paycheck cycle. Comparing a model with food fixed effects to a model with both food and household fixed effects (column 3 in Table 2) finds an increase in the magnitude of the estimated coefficient on "Days Since Paycheck." Recall, according to 2, these fixed effect have the interpretation of household specific quality demand parameters. This provides some initial cautious evidence that households may affect average price by varying quality over the paycheck cycle.

Table 3 and Figure 2 summarize the results of estimating equations 4 and 5. In short, I find that households pay less for the same food items as time since paycheck receipt increases. The effect is statistically significant at all conventional levels, across all specifications, and is economically important. Comparing households 30 days removed from their paycheck to households who have just received them suggests between a 5.7% and a 5.2% drop in average

Table 2: Regression Results

VARIABLES	Log(Unit Value)	Log(Unit Value)	Log(Unit Value)
Days Paycheck Receipt	-0.000484	-0.000486**	-0.000716***
	(0.000338)	(0.000242)	(0.000257)
Household Fixed Effect	No	No	Yes
Food Fixed Effect	No	Yes	Yes
Observations	904789	904789	904789
R^2	1.11e-05	0.74	0.742

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

price paid for the linear and nonlinear specifications respectively.

Figure 2 displays point estimates and 95% confidence intervals for the discretized "Days Since Paycheck" variable. Results are consistent with the linear specification, as households furthest removed from their monthly paychecks pay over 5% less on average than households who have just been paid. As expected, point estimates are generally increasing in magnitude as time since paycheck receipt increases. The effect is also statistically significant for most individual coefficients, beginning with the coefficients on those dummies which indicate that it has been more than ten days since the paycheck receipt.

Table 4 presents the results of pairwise one-sided hypothesis tests that coefficients on "Days since Paycheck" in 5 are larger in magnitude (more negative) farther away from the date of paycheck receipt. Specifically, I test the hypothesis coefficients on 1,2 and 3 days from paycheck receipt are smaller in magnitude than the coefficients on 29, 30 and 31 days from paycheck receipt. In addition, I test the hypothesis that values on the diagonal are jointly different. Differences are statistically significantly across all pairwise comparisons save one, and a joint test of the pairwise comparisons along the diagonal is also statistically significant at all conventional levels.

One possibility is that these findings are being driven solely by unusual expenditure pat-

Table 3: Regression Results

VARIABLES	Eq. (4) Log(Unit Value)	Eq. (5) Log(Unit Value)
Days Since Paycheck	-0.00189***	Figure 2
	(0.000639)	
Second Diary Week	0.00935*	0.00875*
	(0.00482)	(0.00483)
Day of Week Dummies	Yes	Yes
Day of Month Dummies	Yes	Yes
Household Fixed Effects	Yes	Yes
Food Fixed Effects	Yes	Yes
Observations	904789	904789
R^2	0.742	0.742

Robust standard errors in parentheses

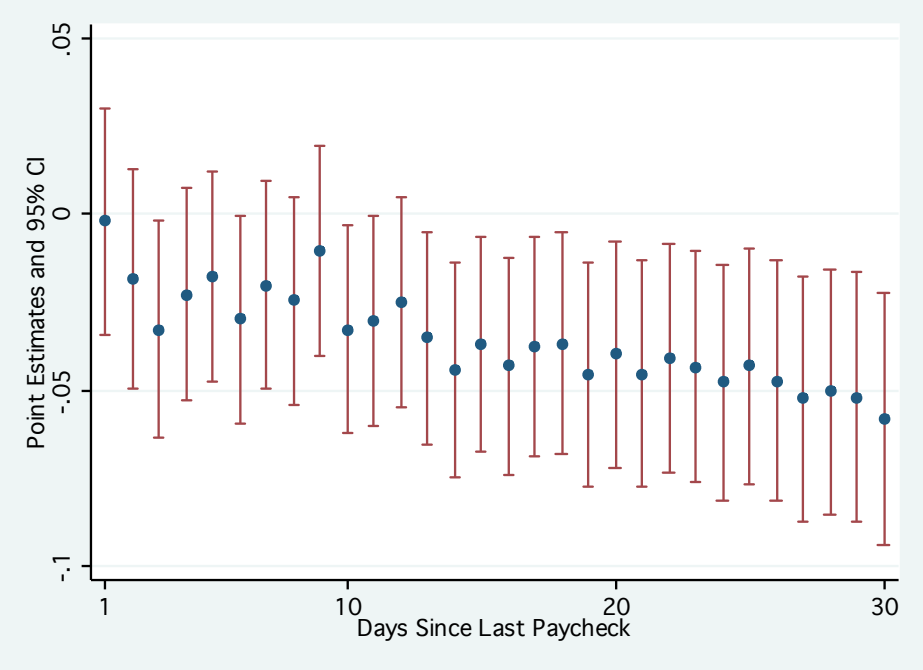
*** p<0.01, ** p<0.05, * p<0.1

Table 4: Differences in days since last paycheck coefficient. Model 5.

Days Since Paycheck	1	2	3	Joint Test
29	10.27***	4.58**	1.23	
30	14.85***	8.21***	3.54**	
31	13.30***	7.03***	2.85**	
Joint Test				4.18***

*** p<0.01, ** p<0.05, * p<0.1

Figure 2: Point Estimates and 95% Confidence Interval for Estimates of Days Since Paycheck Receipt



terns in the days immediately before or the days immediately after the receipt of a paycheck. To explore this possibility, I reestimate model 4 omitting transactions that occurred in the first five days after paycheck receipt and also omitting transactions that occurred in the last five days before expected paycheck receipt. Signs, significance and magnitudes were essentially unchanged in this specification. Because monthly paychecks are likely concentrated near the beginning or ending of a month, I repeat the above exercise omitting the first five calendar days of a month and omitting the last five calendar days of a month. Again, signs, significance and magnitudes were essentially unchanged. Finally, one might be concerned that the act of completing an expenditure diary will induce a household to shop more carefully; the implication being the observed decline in prices could simply be a function of time under observation. While this is at odds with the results presented in Figure 2, I reestimate model 4 including individual day of diary dummies and signs, significance and magnitudes are essentially unchanged.

5 Discussion

Having established a robust causal link between the timing of paycheck receipt and the prices paid for foods, I now attempt to explore the reasons for which and mechanisms by which this decline in prices paid occurs. First, I evaluate a series of hypotheses as to *why* households might pay less over the paycheck cycle. I then turn to a second set of hypotheses to investigate *how* households produce lower prices over the paycheck cycle.

5.1 Causes

While the findings above are causal in a statistical sense, they offer little insight as to why households pay less over the paycheck cycle. I now consider several explanations for the observed decline in prices. First, I investigate whether the relationship between timing and prices is stronger for low-income households, who are presumably more likely to face income constraints. Second, I look at whether households are shopping opportunistically by purchasing some items only when prices are low, for example when they are on sale.

Table 5: Regression Results: Results by Income Quantile

VARIABLES	(1) Full Sample	(2) 0th–25th	(3) 25th–50th	(4) 50th–75th	(5) 75th–100th
Days Since Paycheck	-0.00188***	-0.00396***	-0.000585	-0.00106	-0.00160
	(0.000707)	(0.00142)	(0.00133)	(0.00150)	(0.00135)
Second Diary Week, Day of Week, Day of Month, Food and Household Fixed Effects					
Observations	737419	184518	184354	184484	184063
R^2	0.742	0.745	0.751	0.747	0.747

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

5.1.1 Income Constraints

One possible explanation for the average decline in price is that households in the lower part of the income distribution are credit constrained. This may result in low-income households searching for lower prices when they are furthest removed from the date of paycheck receipt. To investigate this possibility, I rerun the preceding analysis for four quartiles of the income distribution. Note that as income information is not available for every household, the sample sizes are smaller than in the previous table[2]. Results are presented in Table 5.

In sum, Table 5 offers support for the hypothesis that the decline in prices over the paycheck cycle is being driven by households at the lowest end of the income distribution. Households in the lowest quartile experience a statistically significant and economically important decline, roughly 10% over the course of a 30 day paycheck cycle. Households above the 25th quantile do not experience any observable declines. Moreover, the estimated daily decline for households in the lowest quartile is roughly twice as large as for the sample as a whole.

[2]I segment based on income rather than total expenditure as would be typical; expenditure is potentially endogenous in the current context.

5.1.2 Sale Purchases

An additional hypothesis is that the relationship between prices and paycheck timing is driven by opportunistic shopping behavior. For example, previous research has shown that households spend more in the weeks they receive their paychecks (Stephens 2006). One way of generating the observed pattern of price decline over the paycheck cycle would be for households to shop normally upon receipt of their paycheck, but then shop opportunistically over the rest of the paycheck cycle, for example stocking up on foods when they are on sale. Griffith et al. (2009) find evidence of sale discounts ranging from 2% to 32 % in a sample of British consumers. To investigate this possibility, I separate food into perishable and non-perishable items. The intuition being that perishable commodities (e.g. fresh fruits and vegetables, milk etc.) are more difficult to store and as a result should be less affected by this type of shopping behavior than non-perishable items (flour, rice, canned goods etc.). I then interact the dummy on non-perishable commodities with the main variable of interest "Days Since Paycheck." This is included in an extended version of equation 4 which in light of the results in section 5.1.1, I estimate separately on households above and below the 25th percentile of the income distribution.

Table 6 presents the results. In general, non-perishable foods are significantly less expensive than perishable foods. This is true for both groups. More importantly, the effect of paycheck timing is larger for non-perishable foods than for perishable foods for those households below the 25th percentile of the income distribution. While the effect is relatively small, over the entire paycheck cycle the cumulative effect is economically important and statistically significant at the 5% level. This provides some modest evidence that the decline in prices over the pay period for low income households may be partially driven by opportunistic shopping behavior, i.e. purchasing storable commodities when their prices are relatively low.

5.2 Mechanism

Above, I explored several explanations for *why* average prices paid by households might decline as a function of time since paycheck receipt. I now investigate two mechanisms by which households might procure lower prices. First, in the spirit of Aguiar and Hurst (2005), I investigate whether households shop more intensively to produce lower prices, as the number of days since paycheck receipt increases. Secondly, I investigate the possibility

Table 6: Regression Results: Bulk Purchasing

VARIABLES	Less than 25th Log(Unit Value)	Greater than 25th Log(Unit Value)
Days Since Paycheck	-0.00349**	-0.000923
	(0.00142)	(0.000813)
Non Perishable Commodity	-2.017***	-1.786***
	(0.197)	(.0901)
Days * Non Perishable	-0.00116**	-0.000538*
	(0.000545)	(0.000285)
Second Diary Week, Day of Week, Day of Month, Food and Household Fixed Effects		
Observations	184518	551829
R^2	0.745	0.744

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 7: Regression Results: Search

Weeks Since Paycheck	Number of Stores
7 – 13 Days	0.296***
	(0.0308)
14 – 20 Days	0.191***
	(0.0301)
21 –28 Days	0.191***
	(0.0307)
Household Fixed Effects	Yes
Observations	20261
R^2	0.00367

Robust Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

that households lower the prices they pay by substituting from higher quality to lower lower quality foods over the paycheck cycle.

5.2.1 Search

There are several possible mechanisms by which households may produce lower prices over the paycheck cycle. The first is search, if a household's marginal value of time declines as households move further from their paycheck or credit constraints become binding, households may invest in additional shopping effort. To this end, I construct a variable that measures the number of stores in which a household purchased foods, in each of two diary weeks following receipt of their paychecks. I regress this measure of shopping intensity on week since paycheck dummies and a household fixed effect. Table 7 summarizes the results of this regression.

Table 7 shows that households make purchases at a larger number of stores in the periods after receiving a paycheck, relative to the first seven days after paycheck receipt. The effect is statistically significant at all conventional levels but small. After the first week, households shop in approximately 0.2 to 0.3 more stores, an increase of roughly 10%. While these

results are suggestive, note the overall explanatory power of the model is extremely low. More importantly, this approach will fail to detect shopping trips on which no purchases were made. For example, if a household were to search at several stores but only purchase at the store with the lowest prices, the estimate above would understate the extend of search. As a result, these estimates should be interpreted as a cautious lower bound on the increase in search activity over the paycheck cycle.

5.2.2 Quality

One margin household may use to affect the paid price per unit is quality. The decline in prices paid over the course of the paycheck cycle for foods may be driven entirely by substitution from higher to lower quality foods within the reasonably disaggregated commodity groups considered here. In that quality is both unobserved and unobservable [3] I am unable to fully test this possibility. When moving from prices to unit values, a maintained assumption (in the form of equation 2) was that quality was constant within a household. While this is a generalization of the Deaton (1988) approach, it is still restrictive. In an effort to investigate the possibility that quality varies within a household, I include a set of variables that proxy for quality in equation 4: store fixed effects. Given the importance of store specific private labels in the United Kingdom, store dummies serve as a reasonable proxy for average quality; for example consider the difference between say ASDA (Walmart) and Waitrose (Whole Foods). Table 8 presents the results of this regression. As before, I estimate separate regressions for households above and below the 25th percentile of the income distribution.

Results in Table 8 show that including store fixed effects reduces the magnitude and significance of the estimate of the paycheck effect. Including store fixed effects reduces the magnitude of the paycheck timing effect by almost 50%, for households in the lowest quartile of the income distribution. As before, results are driven by households in the lowest quartile of the income distribution. Interpreted narrowly, this finding suggests that low income households shop at stores with lower prices on average as the time since paycheck receipt increases. More broadly, if stores act as a proxy for quality, the reduction in the magnitude of the coefficient on "Days since Paycheck", which follows from including store fixed effects, is consistent with the hypothesis that low income households are trading off quality for price

[3]Note that an Arrow-Debreu commodity is defined as a specific good at a specific time in a specific place. To the extent that elements of a good that affect price will virtually always be unobservable to an outside analyst, quality must also be unobservable

Table 8: Regression Results: Quality

VARIABLES	Less than 25th Log(Unit Value)	Greater than 25th Log(Unit Value)
Days Since Paycheck	-0.00261**	-0.000630
	(0.00131)	(0.000758)
Second Diary Week, Day of Week, Day of Month, Food and Household Fixed Effects		
Observations	172868	552901
R^2	0.754	0.742

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

over the paycheck cycle. This provides imperfect evidence that variation in quality over the paycheck cycle may play a role in explaining the observed decline in unit values. Results are no less striking for being at least partially driven by a variation in quality; a systematic decline in quality over the paycheck cycle runs counter to the spirit of the permanent income hypothesis.

6 Conclusion

In this paper, I document a novel and robust relationship between prices and the number of days since paycheck receipt. I leverage randomization with regard to the key variable of interest, the number of days since receipt of the last paycheck, to causally identify a decline in the prices paid for food over the paycheck cycle. I find that households near the end of their monthly pay periods are on average paying between 5% and 6% less than households near the beginning of their pay period. The magnitude and statistical significance of the effect are robust across a wide range of specifications.

I find considerable evidence that the decline in prices over the paycheck cycle is driven by income constraints. Households below the lowest quartile of the income distribution show large declines, on the order of 10%, whereas households in other portions of the distribution

experience little or no decline. In addition, I find modest evidence that non-perishable foods exhibit a larger decline over the paycheck cycle than perishable foods. I interpret this as providing limited support for the hypothesis that households are shopping opportunistically, i.e. purchasing storable commodities when prices are relatively low.

I also find evidence about how households produce lower prices as they move away from the date of paycheck receipt. In particular, I find that households shop more intensively as time since paycheck receipt increases. This suggest that households trade off time for money over the course of the paycheck cycle. I also find evidence that controlling for the stores in which households make purchases lowers the estimated magnitude and statistical significance of the paycheck effect. To the extent that stores provide a reasonable proxy for quality, one interpretation for this result is that declines in prices paid over the paycheck cycle are being driven by declines in quality within narrowly defined food expenditure categories.

Finally, the present research provides some nuance for findings of excess sensitivity of expenditure to paycheck receipt. Several papers have found excess sensitivity to the receipt of a predictable income transfer. Work by Aguiar and Hurst (2007) found that the well documented fall in expenditure for households after retirement can be partially explained by these households paying lower average prices, as a result changes in expenditure overstate changes in consumption. In a similar vein, the results presented above suggest that some of the excess sensitivity in expenditure is due to changes in the prices low-income households pay over the paycheck cycle. The implication is that consumption may be less sensitive to paycheck receipt than expenditure.

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APPENDICES

A Food List

The following is a list of the 231 food items analyzed.

UHT whole milk ; Pasteurised or homogenised whole milk ; Condensed or evaporated milk ; Yoghurt ; Fromage frais ; Fully skimmed milk ; Semi-skimmed milk ; Dairy desserts - not frozen ; Milk drinks other milks (replaced 200405 onwards) ; Milk drinks other milks ; Non-dairy milk substitutes ; Cream ; Hard cheese - Cheddar type ; Hard cheese - Other UK or foreign equivalent ; Hard cheese - Edam or other foreign ; Cottage cheese ; Soft natural cheese ; Processed cheese ; Beef joints - boned ; Beef steak - less expensive ; Beef steak - more expensive ; Minced beef ; Lamb joints ; Lamb chops ; All other lamb ; Pork joints ; Pork chops ; Pork fillets and steaks ; All other pork ; Bacon and ham joints, uncooked ; Bacon and ham rashers, uncooked ; Ham and bacon ; Cooked chicken and turkey ; Takeaway chicken ; Corned beef - canned or sliced ; Other cooked meat ; Other canned meat and canned meat products ; Chicken - whole or part ; Turkey - whole or part ; Sausages, uncooked - pork ; Sausages, uncooked - beef etc. ; Meat pies - ready to eat ; Sausage rolls - ready to eat ; Meat pies, pasties and puddings - frozen or not frozen ; Burgers - frozen or not frozen ; Complete meat-based ready meals - frozen or not frozen ; Other convenience meat products - frozen or not frozen ; Pate ; Delicatessen type sausages ; Meat pastes and spreads ; Takeaway meat pies and pasties ; Takeaway burger and bun ; Takeaway kebabs ; Takeaway sausages and saveloys ; Takeaway meat based meals ; White fish, fresh or chilled ; White fish, frozen ; Herrings and other blue fish, fresh or chilled ; Salmon, fresh or chilled ; Blue fish, dried or salted or smoked ; White fish, dried or salted or smoked ; Shellfish, fresh or chilled ; Shellfish, frozen ; Takeaway fish ; Tinned salmon ; Other tinned or bottled fish ;

Ready meals and other fish products - frozen or not frozen ; Takeaway fish based meals ; Eggs ; Butter ; Soft margarine ; Lard, cooking fat ; Olive Oil ; Other vegetable and salad oils ; Reduced fat spreads ; Low fat spreads ; Imitatation cream ; Sugar ; Jams and fruit curds ; Marmalade ; Honey ; Potatoes - bought Jan-Aug, previous years crop ; Potatoes - bought Jan-Aug, this years crop ; Potatoes - bought Sep-Dec, current crop or new imported ; Fresh potatoes not specified elsewhere ; Fresh new potatoes ; Fresh baking potatoes ; Fresh cabbages ; Fresh brussels sprouts ; Fresh cauliflower ; Lettuce and leafy salads ; Prepared lettuce salads ; Fresh peas ; Fresh beans ; Other fresh green vegetables ; Fresh carrots ; Fresh turnips and swede ; Other fresh root vegetables ; Fresh onions, leeks and shallots ; Fresh cucumbers ; Fresh mushrooms ; Fresh tomatoes ; Fresh vegetable stewpack, stirfry pack etc. ; Fresh stem vegetables ; Fresh marrow, courgettes, aubergine, pumpkin and other vegetables ; Fresh herbs ; Tomatoes, canned or bottled ; Peas, canned ; Baked beans in sauce ; Other canned beans and pulses ; Other canned vegetables ; Dried pulses, other than air-dried ; Tomato puree and vegetable purees ; Chips - frozen or not frozen ; Takeaway chips ; Canned potatoes ; Crisps and potato snacks ; Other potato products - frozen or not frozen ; Peas, frozen ; Ready meals and other vegetable products - frozen or not frozen ; All vegetable takeaway products ; Other frozen vegetables ; Fresh oranges ; Other fresh citrus fruits ; Fresh apples ; Fresh pears ; Fresh stone fruit ; Fresh grapes ; Other fresh soft fruit ; Fresh bananas ; Fresh melons ; Other fresh fruit ; Tinned peaches, pears and pineapples ; All other tinned or bottled fruit ; Dried fruit ; Nuts edible seeds ; Peanut butter ; Pure fruit juices ; White bread, standard, unsliced ; White bread, standard, sliced ; White bread, premium, sliced and unsliced ; Brown bread, sliced and unsliced ; Wholemeal and granary bread, sliced and unsliced ; Rolls - white, brown or wholemeal ; Malt bread and fruit loaves ; Vienna and French bread ; Starch reduced bread and rolls ; Other breads ; Sandwiches ; Sandwiches from takeaway ; Takeaway breads ; Flour ; Buns, scones and teacakes ; Cakes

and pastries, not frozen ; Takeaway pastries ; Crispbread ; Sweet biscuits (not chocolate) and cereal bars ; Cream crackers and other unsweetened biscuits ; Chocolate biscuits ; Oatmeal and oat products ; Muesli ; High fibre breakfast cereals ; Sweetened breakfast cereals ; Other breakfast cereals ; Canned or fresh carton custard ; All canned milk puddings ; Puddings ; Dried rice ; Cooked rice ; Takeaway rice ; Cakes and pastries - frozen ; Canned pasta ; Dried and fresh pasta ; Pizzas - frozen and not frozen ; Takeaway pizza ; Cake, pudding and dessert mixes ; Cereal snacks ; Quiches and flans - frozen and not frozen ; Takeaway crisps, savoury snacks, popcorn, popadums, prawn crackers ; Other cereal foods - frozen and not frozen ; Other cereals ; Tea ; Coffee beans and ground coffee ; Instant coffee ; Cocoa and chocolate drinks ; Malt drinks and chocolate versions of malted drinks ; Mineral or spring waters ; Baby foods ; Soups - canned or cartons ; Soups - dehydrated or powdered ; Salad dressings ; Other spreads and dresssings ; Pickles ; Sauces ; Takeaway sauces and mayonnnais ; Stock cubes and meat and yeast extracts ; Jelly squares or crystals ; Ice cream tub or block ; Ice cream cornets, choc-ices, lollies with ice cream ; Ice lollies, sorbet, frozen mousse, frozen yoghurt ; Takeaway ice cream, ice cream products, milkshakes ; Salt ; Soya and novel protein foods ; Soft drinks, concentrated, not low calorie ; Soft drinks, not concentrated, not low calorie ; Soft drinks, concentrated, low calorie ; Soft drinks, not concentrated, low calorie ; Chocolate bars - solid ; Chocolate bars - filled ; Chewing gum ; Mints ; Boiled sweets ; Fudges, toffees, caramels