Waiting for the Paycheck:

Individual and Aggregate Effects of Wage Payment Frequency*

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Abstract

In the United States workers receive their salaries weekly, biweekly, semimonthly or monthly, depending on job characteristics and state-level regulation. In this paper I show that the frequency of pay affects the within-month patterns of household expenditures and aggregate economic activity. To identify causal effects, I exploit exogenous variations in pay frequency in the US, both at household and state levels. First, I take advantage of a source of random variation in the pay frequency of *retired couples*. Monthly pensions are paid in different weeks depending on recipient's day of birth, which leads to otherwise similar *retired couples* having, by chance, one or two paydays every month. I find that households with two paydays have smoother expenditure paths along the month. Second, I compare the pattern of economic activity in states with different pay frequency requirements, exploiting state variation in legislation that originates in laws enacted at the beginning of the 20th century. States requiring weekly payments exhibit a smoother within-month path of aggregate economic activity, measured by air pollution, traffic accidents and information from time use surveys. On the other hand, in states with laws requiring a lower pay frequency the economic activity significantly increases during pay weeks, which may lead to costly congestion in sectors with capacity constraints (roads, hospitals, restaurants, etc.). These results have important policy implications in a context where firms and workers do not internalize these congestion costs.

Keywords: Frequency of payments, consumption smoothing, within-month business cycles, congestion.

JEL Classification: J33, E21, E32

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1 Introduction

There is wide variation, across and within countries, with respect to the frequency of wage payments. Under standard assumptions, pay frequency should not affect expenditure patterns because the timing of consumption should not track the predictable timing of income. However, in this paper I present empirical evidence showing that higher frequencies of pay lead to smoother patterns of household expenditures and aggregate economic activity.

From a theoretical standpoint, a low pay frequency could lead to within-month cycles in expenditures if, for instance, consumers have taste for immediate gratification (hyperbolic discounting). Under low pay frequencies, the short-run impatience of these consumers generates an excessive accumulation of purchases immediately after they are paid. The higher the frequency of pay is (e.g. weekly instead of monthly), the smoother their consumption path becomes (Van Wesep and Parsons (2013)).

When many consumers with this short-run impatience are paid at a low frequency and all at the same time, their aggregate behavior generates within-month business cycles, which are particularly problematic in sectors with capacity constraints and relevant menu costs (restaurants, groceries, hospitals, etc). Thus, in this paper I argue that pay frequency matters from both, an individual and a collective perspective: the frequency at which someone is paid affects not only her but also others' wellbeing, the latter through congestion externalities. The congestion is a consequence of low pay frequencies driving expenditures cycles, which generate costly congestion in sectors with capacity constraints. Because these external costs are not internalized by those generating them, and because naive consumers with taste for immediate gratification will not be aware of their time inconsistency, the market equilibrium would yield suboptimally low frequencies of pay. This raise the necessity for welfare-increasing interventions, to increase pay frequency up to the socially optimal level.

There is anecdotal evidence of workers and firms asking for this type of intervention. At the end of 19th C. workers in several US states lobbied for weekly wage payments. At that moment, the custom was to pay workers monthly, and this movement leads to most states adopting laws requiring more frequent payments. These laws, implemented with the objective of "protecting the workman against the temptations" (Paterson (1917)), remain active today. More recently, in 2008, the Senate of Michigan proposed a bill asking for changing the food stamp distribution from a unique payment on the first week of the month to a semimonthly payment. The bill was advocated for retailers and suppliers, who indicated that food stamp recipients spend most of their benefits shortly after they are paid, generating (congestion) problems to stores in terms of staffing, cash flow, inventory, and quality control. The rationale for this bill presented by the Senate was that the semimonthly distribution of food stamps would address the concerns of grocers as well as the needs of recipients to smooth consumption (New York Times, (2006) and Bill 120 Michigan, (2008)).

In this paper I empirically identify the effects of pay frequency, by exploiting exogenous variation in the frequency of payments in the United States at both household and state levels. At the household level, I take advantage of random variation in the pay frequency of *retired couples* (households in which both spouses are retired). This variation is generated by the fact that, in the United States, Social Security benefits are paid in different weeks depending on recipient's day of birth.[1] Random variation in the timing of pay generates two groups of retired couples: those with both spouses receiving their paychecks the same day (*one payday*) and those in which spouses are paid in different weeks of the month (*two paydays*). This allows me to test whether different frequencies of payments produce different within-month expenditure profiles. Using data from the Consumer Expenditure Survey (CES), I compare the pattern of daily expenditures of retired couples with one payday to the pattern observed in households with two paydays. Results show two important findings: (1) not all households smooth consumption between paychecks, and (2) the ability to smooth depends on the *frequency of payments*. Retired couples with two paydays seem to have a smooth consumption path over the month, while households receiving only one payment spend significantly more the week they are paid than the weeks they are not.

At the state level, I exploit variation in the legislation of wage payment frequency across states, and compare the within-month trends of several proxies of daily economic activity –time spent shopping, air pollution, and traffic accidents– in states requiring weekly or semimonthly payments. I show that in those states requiring payments only twice a month the economic activity is significantly higher in the usual weeks of pay (the first week of the month and the week of the 15th), while within-month economic activity is smoother in states requiring weekly payments.

[1]Since 1997, retirees are paid on either the 2nd, the 3rd or the 4th Wednesday of each month, depending on their days of birth (1st-10th, 11st-20th, or 21st-31st respectively).

This paper is related to the research analyzing consumption smoothing over the short-run, in particular between paychecks. These papers find excess sensitivity within the month, that is, they reject the consumption smoothing hypothesis over the short-run. Stephens (2003), Stephens (2006), Stephens et al. (2011), Mastrobuoni and Weinberg (2009) and Shapiro (2005) compare household consumption expenditures or calorie intake before and after receiving the paychecks, and show that households have problems smoothing their consumption between paydays. Other studies also show that mortality rises immediately after income receipt (Evans and Moore (2011), Evans and Moore (2012) and Andersson et al. (2014)).[2]

I contribute to this literature in several ways. First, I exploit random variation that allows me to identify the causal effect of the frequency of pay on expenditure smoothing. I show that households can smooth consumption between paychecks if they receive frequent payments. Although results from previous literature suggest that an increase in the frequency of payment would help to smooth consumption, to the best of my knowledge this is the first empirical paper presenting evidence about the effect of different frequencies of payment on expenditures smoothing.[3] Second, the setting of US Social Security payments I exploit –with enough variation in the timing of pay–, allows me to disentangle the effect of paycheck receipt from any other mechanism that could drive changes in expenditures after payment, e.g. beginning of the month effects.[4] Third, I show evidence that even in a period with much more access to technology –which may help people to smooth their consumption–, individuals still have problems smoothing their consumption when they receive their pays at low frequencies.[5]

[2]Meanwhile the works of Browning and Collado (2001) and Hsieh (2003) compare the pattern of expenditures among the year of households who receive anticipated bonuses and those who do not receive them, and find suggestive evidence that the consumption smoothing hypothesis do indeed hold true over the year.

[3]One exception is the work of Stephens et al. (2011). They study a change in the timing of Japanese public pension benefit disbursement and see whether this adjustment of the frequency of income payments affects the consumption smoothing behavior of households (prior 1990 Japanese pensions were paid every third month and after February 1990 pension are paid every other month). However, the authors make an important caveat to their findings and explain that they cannot provide a powerful test of consumption smoothing because there is little variation in the setting they analyze (a consequence of using monthly expenditures data while benefit checks are distributed the middle of the month).

[4]Previous research analyzing the link between consumption after the arrive of paychecks (from pensions or food stamps) could not control for week fixed effects because in their settings there were not variation in paydays. Not enough variation leads to confounding effects with beginning of the month effects.

[5]While my research covers the years from the late '90s to late '00s, previous literature used data for the late '80s to the beginning of '90s. Credit cards, which could be useful to smooth consumption, were more common in the period I analyze than in these previous years.

The paper is also related to two articles analyzing general equilibrium effects of the individual non-smoothing behavior between paychecks. Hastings and Washington (2008) use scanner data from a US supermarket to document that benefit recipients (Food Stamps or cash welfare assistance) do relatively more of their food shopping at the beginning of the month (when these benefits are distributed), and show that the increase in aggregate demand induced by benefit delivery results in food price increases at the store. Evans and Moore (2012) also find that a cycle within the first day of the month exists for a range of economic activities, and the authors suggest that the increase in mortality rates at the beginning of the month may be due to short-term variation in levels of economic activity.

I contribute to this literature by analyzing aggregate effects of different pay frequencies. The state variation I exploit allows me to present evidence suggesting that the monthly cycle in economic activity is not a mere first-of-the-month effect, but it is related to the timing and –more importantly– to the frequency of pay. My analysis using data on time use, air pollution and traffic accidents, evidences within-month cycles in aggregate activity under low pay frequency schemes. Because these measures I use are proxies of activity in sectors with congestion problems, results rise concerns about the negative externalities generated by low pay frequencies.

At the end of the this paper I present a conceptual framework that helps to understand the relationship between frequency of wage payments and the pattern of daily expenditures. This framework also illustrates how total welfare could vary under different pay frequencies, and why the frequency of payment may need to be regulated. The model is based on Van Wesep and Parsons (2013), which to date is the only study that formally analyzes the relationship between the frequency of wage payments and workers' consumption patterns. I extend the model by incorporating congestion costs and by calculating the theoretical welfare effects of increasing pay frequency under alternative scenarios.

In the model economy, population consists of hyperbolic consumers, for whom higher pay frequencies leads to smoother consumption paths. A low pay frequency would affect social welfare as it leads to expenditures cycles resulting in costly congestion in sectors with capacity constraints; external costs that are not internalized by those generating them. Although increasing pay frequency could be welfare-improving under several circumstances, neither firms nor workers have the right incentives to implement higher frequencies when needed, leaving room for regulation. The inefficiency arises because higher pay frequencies increase labor costs (cost of processing paychecks more frequently, etc), and while welfare gains from increasing pay frequency could more than compensate the rise in transaction costs, agents do not internalize these gains. Workers are naive, so their overconfidence of their future behavior do not let them to see that higher pay frequency would directly improve individual welfare by helping them to smooth consumption. In addition, neither workers nor firms internalize the negative impact that their low frequencies of pay have on sectors with capacity constraints, through congestion effects.[6] Thus, an intervention requiring higher pay frequencies could be welfare improving if the level of short-run impatience of consumers is sufficiently high, transaction costs are low, and/or the costs of congestion are large.

The rest of the paper is organized as follows. Section 2 describes the institutional context of payment frequencies in the US. Section 3 describes the data set used in the empirical study. Section 4 presents the empirical strategy. Section 5 describes the main results. Section 6 presents the conceptual framework, and Section 7 concludes.

2 Institutional framework

To study the impact of payment frequency on within-month patterns of household expenditures and aggregate economic activity, I take advantage of two exogenous variations in the frequency of payments in the United States. First, I analyze *retired couples* (households with both spouses retired), and exploit a random variation in the number of times these households receive their Social Security payments every month. Second, I exploit US state variation in the legislation of wage payment frequency. This section explains the institutional sources of these two variations in pay frequency.

2.1 Social Security Payments in the United States

Around 54 million people receive Social Security benefits in the US. The earliest retirement-age is 62, with reduced benefits, while full retirement benefits can be obtained at 65.[7] Social Security benefits are paid along the month according to the following rule: indi-

[6]The coordination problem arises first because not all firm's consumers are firm's workers, so even a firm with capacity constraints will not experience the potential negative effects generated by their workers's consumption cycles, and second because the within month cycle in purchases generated by their workers with such consumption patterns do not negatively impact their own production costs if they do not have congestion problems.

[7]For individuals born after 1942, full retirement benefits can be obtained at 66 instead of 65.

viduals retired before May 1997 are paid on the 3rd of the month, and individuals who become eligible for Social Security benefits after May 1997 are paid on either the 2nd, the 3rd or the 4th Wednesday of each month.[8]

Under the new system of payment –applying for individuals who start receiving Social Security benefits after May 1997–, individuals born between the 1st and the 10th day of the month are paid on the 2nd Wednesday of each month; those born between the 11th and the 20th day of the month, are paid on the 3rd Wednesday; and those born between the 21st and the 31st day of the month, are paid on the 4th Wednesday.

This setup leads to a random variation in the frequency of payments in retired couples: those households with both spouses born in dates such that they receive their paychecks on the same Wednesday have only one payment per month. Those households where spouses are paid in different Wednesdays, meanwhile, have two paydays every month (Table 1).

2.2 State Laws Regulating Wage Payment Frequency in the United States

US states laws requiring the payment of wages at specified times were first enacted at the end of the 19th century and the first decades of the 20th century.[9] Around 1940, nearly all states had enacted this sort of legislation, requiring the payment of wages with a specified periodicity: weekly, bi-weekly, semimonthly or monthly. At that moment, the majority of the States specified that wages should be paid at least semimonthly (Review (1938)), with the exception of New England states which require that wages should be paid weekly (Maine, New Hampshire, Vermont, Massachusetts, Rhode Island and Connecticut).

Prior to these laws, the custom wage payment was to pay workers monthly. According to Paterson (1917), the laws requiring wage payment to the employee at certain regular

[8]This payment scheme implies that nowadays, individuals paid the 3rd of the month are probably those born before 1932 (age$\geqq$65 in 1997), and the new system applies for sure to people born in or after 1936 (age$<$62 in 1997).

[9]In the 19th century laws of this kind were also enacted in many countries of Europe (Switzerland: Federal Law, Mar. 23, 1877, pay at least once every 15 days; Belgium, Act, Aug. 10, 1887, pay at least twice a month; Russia, Law, Mar. 14-20, 1894, wages must be paid at least once a month, and at least twice a month if the duration of the contract is not determined; France passed a bill in 1894 which required that the wages of employees should be paid at least twice a month, the greatest interval allowable to be 16 days; Austria (1898) and Norway (1892) declare laws with the principle that the payment take place each week).

intervals were enacted with the objective of "protecting the workman against the hardships resulting from payment at long intervals and the temptations which inevitably accompany buying on credit. [...] The employer has always [...] sought to make the periods of payments at long intervals. The longer the interval between payments, therefore, the larger the loan which the workingman makes to his employer without interest" (Paterson (1917)).

The demand for weekly payment was first made at around 1875 in Massachusetts. In 1879, a law was passed stating that "cities shall, at intervals not exceeding seven days, pay all laborers who are employed by them [...] if such payment is demanded."[10] Seven years later the law was extended to include all workers and a penalty for violation of the act. Connecticut was the first State to follow the example set by Massachusetts. A law passed in 1886 provided that laborers should be paid weekly. One year after, New Hampshire required to pay the wages earned each week within eight days after the expiration of the week. The New York Legislature in 1890 passed a general labor law requiring to pay weekly. In 1891 in Rhode Island a general weekly payment act was passed. The Indiana Legislature provided in 1891 for the weekly payment of wages to within six days of pay day. The Vermont Legislature passed a law in 1906 which required corporations engaged in certain enumerated classes of business to pay their employees each week.

At the end of the 19th century, most of the remaining States adopted laws for semi-monthly or biweekly payment of wages,[11] while Indiana (1889), Colorado (1895), Maryland (1888), Missouri (1889), Virginia (1887) and Mississippi (1912) enacted laws requiring monthly payments.

These laws remain active today. The majority of states have statutes requiring that –

[10] When the newly-elected governor of Massachusetts, George D. Robinson (1884 – 1887) gave his inaugural address he made the following recommendation to the assembled members of the Legislature: "Why not leave this [regulation of the frequency of payment] to the will of the contracting parties? It has been left there, and the evils and hardships are before us. It is, I submit, always wise and salutary to devise legislation of such a character as will reach the humblest and the poorest citizen, who has no voice but his own to present his needs, – no power in combination with others to emphasize his opinions. [...] Would it not be better for the laborer at mere living wages to have his pay weekly? The advantages are plain. Greater independence of action would result; the cash system would prevail, to the benefit of the seller as well as the buyer; exposure to the vexation and costs of collection suits would be substantially removed, and the lesson of economy be practically taught every day".

[11] Maine (1987), Pennsylvania (1887), Ohio (1890), Missouri (1889), Iowa (1894), Maryland (1896), Kentucky (1898), Arkansas (1909), Tennessee (1913), Virginia (1887), West Virginia (1887), Wisconsin (1889), Wyoming (1890-91), New Jersey (1896), Arizona (1901), Hawaii (1903), Oklahoma (1909), Illinois (1913), Michigan (1913), South Carolina (1914), California (1915), Kansas (1915), Minnesota (1915,), North Carolina (1915), Texas (1915) and Louisiana (1912) (Paterson (1917) and Redmount et al. (2012)).

at least certain– employees receive their wages periodically. Employers may pay employees earlier or more frequently than the minimum periods mandated by state laws, but not later or less frequently unless the law allows such an exception. Almost all of these laws include penalties for violation, subjecting the employer to criminal punishment and/or to a fine.

The most common requirement is semimonthly payments, while some states require weekly, bi-weekly or monthly payments.[12] In 2008, eight states require weekly payments, while semimonthly payments are required in 21 states and in Washington DC.[13] The rest of states require bi-weekly (four) or monthly payments (seven). Finally, there are eight states without specified regulations regarding the frequency of pay.[14] (See Map in Figure 1)

In this paper I focus the analysis on states requiring weekly or semimonthly payments. I do not include states requiring monthly payments because their wages are usually paid more frequently (only 6% of workers are paid monthly in these states). I cannot consider states requiring biweekly payments because when exploiting state laws variation I analyze aggregate data, and for the identification strategy used I need to be able to infer the week of pay of workers, which is possible if the periodicity is weekly or semimonthly but not if it is biweekly. Biweekly paychecks are distributed every two weeks, thus within a state paydays are not necessarily the same for workers who received their first payment in different weeks (some workers can be paid on the 1st and the 3rd week, and others be paid on the 2nd and the 4rd week). On the other hand, semimonthly payments are normally made the 1st and the 15th of each month. If the 15th is not a weekday, wages are usually paid the Friday before. In some places, instead of the 1st. the salary is paid the last weekday of the month.

[12] U.S. Department of Labor, Wage and Hour Division (WHD). http://www.dol.gov/whd/state/payday2008.htm

[13] In some of these states, the weekly or semi-monthly requirement does not hold for all the occupations.

[14] Weekly payments: Connecticut, New Hampshire, Rhode Island, Vermont, Massachusetts, Michigan, New York and Virginia. Semi-monthly payments: Arizona, Arkansas, California, District of Columbia, Georgia, Hawaii, Illinois, Kentucky, Maine, Missouri, Nevada, New Jersey, New Mexico, Ohio, Oklahoma, Tennessee, Utah, Wyoming, Alaska, Louisiana, Mississippi and Texas. Bi-weekly: Indiana, Iowa, Maryland and West Virginia. Monthly payments: Colorado, Delaware, Idaho, Kansas, Minnesota, North Dakota, Oregon, South Dakota, Washington and Wisconsin. States without specified regulations regarding the frequency of pay: Alabama, Pennsylvania, North Carolina, Nebraska, South Carolina, Florida and Montana.

3 Data

I use data from several sources. First I use data from the Consumer Expenditure Survey to analyze the within-month expenditure pattern of households receiving Social Security benefits one or twice a month. Second, I use measures of time spent shopping, air pollution and traffic accidents to proxy economic activity, in order to compare the within-month trends in states that differ in the frequency of wage payments required by law.

3.1 Consumer Expenditure Survey

Information on household's daily expenditures comes from the Consumer Expenditure Survey (CEX), from which I use data for the period 1998-2008. The CEX is conducted in two parts: a quarterly interview and a diary survey. Each household is chosen for only one of these surveys, and each address is representative of around 15,000 other households in the US. I use data from the diary survey, where respondents are asked to keep two one-week diaries (a total of 14 days) for recording all purchases made each day. The starting date of the diary survey for any household is randomly selected.

The dataset contains demographic information of each household member. It does not include information about paydays; however as explained in Section 2 I can infer payday of retirees from their birthday. Birthday information is not publicly available in the CEX, but I requested from the U.S. Bureau of Labor Statistics (BLS) additional information in order to construct a variable that indicates whether the individual was born in the first, second, or third period of the month (ten-day periods). This information allows me to infer the payday of each retiree, and thus the number of paydays in each retired couples.

Sample of Interest

The sample of interest is the set of households with both spouses receiving Social Security payments, and for whom I can infer their paydays. It does not include households where at least one of their spouses probably retired before 1997 and therefore receives the payment the 3rd of the month. The reason is that individuals paid the 3rd are older, so their inclusion in the sample would make the assumption of random assignment of the number of paydays weaker. Nevertheless, the results are robust to the inclusion of these households (see robustness checks in Appendix A). Table 2 shows the summary statistics of the demographic characteristics of the sample of interest.

Expenditure Categories

Following Stephens (2003), I analyze total expenditures, expenditures on nondurables (expenditures on all food and alcohol, tobacco related items, personal care items, public transportation, gas, and motor oil); food and alcohol consumed at home; food and alcohol consumed away from the household; instant consumption (food and alcohol consumed away from the household, participant sports and lessons, entertainment activities and sporting events, among others).[15]

In order to clearly identify the periods pre and post payments, I drop diary day observations that occurred more than fourteen days before the next check will arrive and more than fourteen days after the most recently received check arrived. Table 3 shows the summary statistics of the daily expenditiures of the sample of interest.

3.2 Economic Activity

I use measures of time spent shopping, traffic accidents and air pollution to proxy for economic activity.[16] While time spent shopping can be directly linked to an increase in sales, the relationship between economic activity and air pollution or vehicle crashes may be not as straightforward. However, recent research provides evidence that CO2 emissions and GDP move together over the business cycle. Doda (2014) shows that emissions tend to be above their trend during booms and below it during recessions. Heutel (2012) and Heutel and Ruhm (2013) show the same evidence for the United States. There is also a large literature studying the positive correlation between mortality and economic activity, and the evidence shows that motor vehicle accidents account for the bulk of the cyclicality in mortality. Ruhm (2000) and Miller et al. (2009) find that a one-point increase in unemployment is predicted to reduce traffic deaths by between two and three

[15] All expenditure data are deflated with the CPI into 2000 dollars.

[16] For this analysis, the data from the Consumer Expenditure Survey (CES) can not be used because the samples for the CES are national probability samples of households designed to be representative of the total U. S. civilian population, and are not designed to produce state-level estimates (Bureau of Labor Statistics (2009)). Results using this database are aligned with what we expect, except for the effect of first week of the month on household consumption.

percent. These are thought to be due to individuals driving fewer miles when economic activity decreases. Papers analyzing the effect of paycheck on mortality also suggest that this relationship can be driven by an increase in economic activity that increases motor vehicle fatalities (Evans and Moore (2011), Evans and Moore (2012) and Andersson et al. (2014)). Evans and Moore (2011) point out that "receiving a pay check may, for example, encourage people to go out that day, which by construction increases activity and exposes the consumer to the hazards of driving in traffic".

The three indicators are particularly relevant for this paper because there is daily-state data for all of them, and because of their links to markets with congestion problems. As I show in Section 6, within-month cycles are important in sectors with capacity constraints (restaurants, groceries, traffic, hospitals, etc), because the spikes in activity generate congestion costs.

3.2.1 Pollution

There are six primary air pollutants to measure air quality: ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, particulate matter (PM), and lead. I follow Currie et al. (2009) and Heutel and Ruhm (2013), and focus on carbon monoxide (CO), ozone (O3) and particulate matter less than 10 microns in diameter (PM10), because these three pollutants are most commonly tracked by air quality monitors.

Carbon Monoxide (CO) is a gas resulting from the incomplete combustion of hydrocarbon fuels. Over 80 percent of the CO emitted in urban areas is contributed by motor vehicles. Ozone is created when oxides of nitrogen (NOx) and volatile organic compounds (VOCs) react in the presence of sunlight and it is a major component of smog. Particulate Matter (PM10) are small particles made up of a number of components, including acids (such as nitrates and sulfates), organic chemicals, metals, and soil or dust particles, which are suspended or carried in the air and have an aerodynamic diameter less than or equal to 10 microns (about 1/7 the diameter of a single human hair).

Data comes from the Air Quality System (AQS) database.[17] This dataset contains daily air pollution concentration data from monitors in cities of the 50 United States and the District of Columbia.[18] The sample covers the period 2000-2013. The first Panel (A)

[17] http://aqsdr1.epa.gov/aqsweb/aqstmp/airdata/download_files.html#Daily
[18] http://www.epa.gov/airdata/ad_glossary.html

of Table 4 shows the summary statistics of the sample of interest.

3.2.2 Fatal Accidents

To analyze the pattern of traffic accidents, I use data from the Fatality Analysis Reporting System (FARS) for the period 2000-2013.[19] This dataset contains information on all vehicle crashes in the United States that occur on a public roadway and involve a fatality. The sample has data for crashes on more than 3520 cities. I sum up all the fatal accidents at the level of state-date and analyze the number of crashes and the number of fatalities. Panel B of Table 4 shows the summary statictics of fatal accidents in the sample of states analyzed.

3.2.3 Time Spent Shopping and Travelling

The information about time spent shopping comes from the American Time Use Survey (ATUS).[20] This survey collects information on all activities done during a designated 24-hour period. The ATUS was first administered in 2003 and has continued throughout every year since. To date there is data for a period of 11 years (2003- 2013).

Each ATUS respondent is asked to provide detailed information on his/her activities during a designated 24-hour period. Time spent obtaining goods and services includes all time spent acquiring any goods or services (excluding medical care, education, and restaurant meals). It includes grocery shopping, shopping for other household items, comparison shopping, coupon clipping, going to the bank, going to a barber, going to the post office, and buying goods on-line. Travel related to purchasing goods and services includes travel related to consumer purchases, to using professional and personal care services, to using household services,to using government services, to civic obligations and participation and to government services and civic obligations. Summary statistics are presented in Panel C of Table 4.

[19]http://www.nhtsa.gov/FARS

[20]I extracted the data from the ATUS Extract Builder database (Hofferth et al. (2013)).

4 Empirical Strategy

This section presents the empirical strategy used to identify the causal effects of pay frequency. First I present the strategy used tho isolate the effect of pay frequency on the within-month pattern of household expenditure, and then the one used to identify its effects on the within-month path of aggregate economic activity.

4.1 Frequency of Pay and Household Expenditures

To test whether the frequency of paychecks distribution matters for expenditures smoothing of households receiving Social Security benefits, I analyze the sample of couples where both spouses start receiving their pensions after 1997 (see Section 2 for more details). The assumption is that both groups of households have the same consumption preferences over the month (households with, by chance, one payday and households with two paydays every month).

The main specification to test whether the frequency of payment matters for the expenditure patterns of retired couples, is the following:

$$\begin{aligned} C^x_{i,t} &= \beta_0 (One\,Paycheck\,this\,Week)_{i,t} + \beta_1 (Two\,Paychecks\,this\,Week)_{i,t} + \alpha_i + \\ &\textstyle\sum_{k=2}^{7} \gamma_k DOW_k + \sum_{s=2}^{14} \tau_s DOS_s + \sum_{m=2}^{12} \phi_m Month_m + \sum_{w=2}^{5} \lambda_w WOM_w + \epsilon_{i,t}, \end{aligned} \tag{1}$$

where $C^x_{i,t}$ is household i's expenditure on category x at day t; α_i is a household fixed effect; DOW_k are day of the week fixed effects; DOS_s is a dummy variable equal to one if it is the sth day of (consumer unit$i$'s) survey; $Month_m$ are month fixed effects; and WOM_m are week of the month fixed effects (1st week for the first 7 days of the month, 2nd for the 8th to 14th, etc.).[21] $One\,Paycheck\,this\,Week$ equals 1 if one and only one spouse received a paycheck between 0 and 6 days from day t and 0 otherwise. $Two\,Paychecks\,this\,Week$ equals 1 if both spouses received their paycheck between 0 and 6 days from day t.

β_0 and β_1 are the parameters of interest, and allows us to estimate whether expendi-

[21] The variation in the timing of pay (2nd, 3rd or 4th Wednesday), allows me to control by week of the month fixed effects. In previous literature it was difficult to control for the week of the month because in other institutional frameworks there was not enough variation in pay days (for instance, under the Social Security payment structure analyzed in Stephens (2003), every pensioner received their payment the 3rd. of the month).

tures on any given diary day depend upon where they fall within the first week after the check arrival or not, for the case in which both spouses received the paycheck that week and the case in which only one received it.

4.2 State Laws of Pay Frequency and Aggregate Economic Activity

In the analysis of within-month economic activity at the state level, I run the following specification using as outcome variables measures of time spent shopping, air pollution or traffic accidents:

$$\begin{aligned} Y^j_{s,t} = {} & \beta_{-2} Week_{-2} + \beta_0 Week_0 + \beta_1 Week_1 + \alpha_S + \\ & \textstyle\sum_{k=2}^{7} \gamma_k DOW_k + \sum_{l=2001}^{2013} \delta_l Year_l + \\ & \textstyle\sum_{m=2}^{12} \phi_m Month_m + holiday_t + \epsilon_{i,t}, \end{aligned} \qquad for\ s\ \in\ j = \{weekly, semimonthly\} \quad (2)$$

where $Y^j_{s,t}$ is the measure of activity at day t in state s requiring semimonthly payments or weekly payments (j identify the type of the state, and regressions are run separately for states with laws requiring weekly payments and states requiring semimonthly payments); α_s is a state fixed effect; DOW_k are day of the week fixed effects; $Year_l$ and $Month_m$ are year and month fixed effects; and *holiday* is an indicator variable for holidays. $Week^m_{-2}$ equals 1 if the observation is between 14 and 8 days before the day 15th (or the previous Friday if the 15th is not a weekday), $Week^m_0$ equals 1 if the observation is between 0 and 6 days from the 15th, and $Week^m_1$ equals 1 if between 7 and 13 days from the 15th. In this case, β_{-2}, β_0 and β_1 are the parameters of interest.

As pollution is measured at city level, I include city fixed effect instead of state fixed effects. When I analyze time use data I also control for (X_i) individual characteristics (sex, age, race, marital status, working status, and family income).

5 Results

5.1 Pay Frequency and Household Expenditure Patterns

As explained in Section 2, the assigned payday of Social Security benefits depends on the beneficiary's birthday. Before starting with the main analysis, I show in Table 5 that this assignment is as good as random. As expected, the day of birth is not correlated with any observable individual characteristic. Panel A presents estimation results of the following specification:

$$\begin{aligned} X_i = \alpha + \beta_1(Male\, born\, 11-20th)_i + \beta_2(Male\, born\, 21-31st)_i + \\ \beta_3(Female\, born\, 11-20th)_i + \beta_4(Female\, born\, 21-31st)_i + \epsilon_i \end{aligned} \tag{3}$$

where X_i is any of the following individual characteristics: age of husband, age of wife, household's income, husband's Social Security income, wife's Social Security income or household Social Security income.

In Panel B of the same table, I present the results of regressing any of these individual characteristics against a variable that indicates whether it is a household with only one payday –both paychecks arrive on the same Wednesday every month. Again, there is no significant relationship between household's characteristics and the pay frequency assigned to the household.

Table 6 presents the results of estimating equation 1 by OLS. The estimated coefficients indicate, for different categories of expenditures, the difference of daily expenditures within 1-7 days since a check arrival relative to daily expenditures during weeks without paycheck receipt. Results show two important findings: not all households smooth expenditures between paychecks, and this effect depends on the frequency of payments. While those households with two paydays seem to be able to smooth their expenditures along the month (variable *"One Paycheck this Week"* is not statistically significant for any category of expenditures), households with only one payday every month expend significantly more the week they receive their payments than the weeks they do not. For this group of households, total daily expenditures and daily expenditures in nondurables increase by 30 dollars and 3.8 dollars respectively during the week of payment, although the coefficients are not statistically significant. Over the week of payment daily expenditures on food significantly increases by 4.6 dollars, food at home is 2.9 dollars higher those days, and food away from home increases by 1.7 dollars. Instant consumption seems to be also higher during the first week after the payday (0.7 dollars higher), however the coefficient is estimated imprecisely.[22]

5.2 Pay Frequency and Within-month Trends in Economic Activity

Table 7 reports the results of the regression specified in equation 2, where the outcome variables are different pollution measures: CO, Ozone or PM10 (particulate matter less than 10 microns in diameter). The first three columns of Table 7 present the results for the sample of states requiring weekly payments, and the last three columns show the results using the sample of states requiring semimonthly payments. The within-month trends are completely different in each group of states. On the one hand, in states requiring weekly payments the level of pollution does not seem to be significantly different along the month, except in the case of CO, which decreases at the end of the month. On the other hand, in the set of states requiring semimonthly payments, there is a significant increase in the levels of CO and PM10 during the two weeks of semimonthly payments (the first week of the month and the week of the 15th).

Table 8 also shows the results of running specification 2, where the right-hand side (RHS) variables are the daily amount of traffic accidents and the number of fatalities in these accidents. Results shown in columns (1) and (2) correspond to the sample of states with legislation requiring weekly payments. In columns (3) and (4) the sample includes states requiring semimonthly payments. In both states there is a first of the month effect, in line with the results of Evans and Moore (2011). However, this effect is higher in the sample of states requiring semimonthly payments. Moreover, in states with weekly payments, the pattern of crashes is not significantly different along the rest of the month, but in those states with semimonthly payments there is another significant increase in the number of fatal accidents and related deaths during the week of the 15th, moment when

[22] These results are robust to using an extended sample of households (including households with both couples retired but in which one or both spouses start receiving the Social Security benefits before 1997), and are also robust to not impute with zeros the expenditures of those days without information in the CEX survey diary (Tables in Appendix A show these results).

workers usually receive the second payment of the month.

Table 9 presents the results of running specification 2 using as outcome the time spent shopping. Columns (1) and (3) show the coefficients when the outcome is total time spent acquiring any goods or services, for the sample of states requiring weekly and states requiring semimonthly payments respectively. In columns (2) and (4), the RHS variable includes time spent on travel related to purchasing goods and services. Results show that in those states requiring weekly payments there is not any significant difference along the month in time spent doing shopping, neither on travel related to shopping. However, in states with semimonthly payments, people usually spent significantly more time in these activities during the first week of the month and the week of the 15th.

5.2.1 Negative Externalities

Table 10 shows the results of running the same specification of equation 2 using as RHS the time spent on travel related to obtaining goods and services, but analyzing the subsample of individuals retired after 1997. As explained earlier in the paper, these individuals do not necessarily receive their payments on the first week of the month and the 15th, as workers do, because Social Security benefits are paid the 2nd, the 3rd or the 4th. Wednesday depending on beneficiary's birthday.[23]

The results indicate that while in those states requiring semimonthly payments there is a significant increase in time spent on traveling to do shopping by retirees during the week of the 15th, there is no significant difference in the evolution of this variable along the month in states with laws requiring weekly payments.

We have seen in Section 5.1 and 6 that these retirees spent more money during the weeks they get their paychecks, that are not necessarily the weeks of the 1st and the 15th. The observed increase in time traveling to do shopping by retirees during the week of the 15th in states with semimonthly payments could be a consequence of an external factor: traffic congestion during the days working people are paid. Thus, these results suggest the existence of a negative externality of low frequency of payments, in this case through traffic congestion which generates a cost in terms of time on other individuals who do not

[23]I keep the sample of retirees who were 62 or younger in 1997, because in the ATUS data this is the only way to ensure that these individuals are receiving Social Security benefits under the new system of payment.

receive their income on the week of 15th and do not spend more during those days. In Section 6 I establish the link between frequency of pay and congestion costs, using the example of traffic congestion.

6 Conceptual Framework

This section presents a simple theoretical framework for analysing the relationship between the frequency of wage payments and the daily expenditure pattern of households. It also illustrates how total welfare could vary under different pay frequencies, and why the frequency of payment might need to be regulated.

The model is based on Van Wesep and Parsons (2013), who explain the link between the frequency of wage payment and expenditure cycles. I enrich the model by including capacity constraints in one sector to analyze the role of congestion costs on total welfare under different frequencies of wage payments. The key ingredients of the model are consumers with short-run impatience plus self-control problems, who generate negative externalities through congestion effects.

The model shows that for individuals with short-term impatience and self-control problems (hyperbolic discounting), the higher the frequency of pay, the smoother is their consumption path. When these workers are paid at a low frequency and all at the same time, their behaviors generate consumption cycles that lead to an excessive accumulation (congestion) of purchases immediately after they are paid.

Increasing pay frequency could be welfare improving if it is too costly to adjust factors or prices to make agents internalize the external congestion costs they generate. However, a regulation that enforces more frequent wage payments might be needed, because firms and workers would not implement it by themselves. This happens since higher pay frequencies raise labor costs,[24] so agents do not have incentives to increase the pay frequency because: (a) workers are naive (overconfidence)[25]; (b) firms and workers do not internalize

[24]For firms, there is a higher cost of processing paychecks more frequently, because every time workers are paid firms pay a cost associated with processing a payroll (costs of printing checks for employees, direct deposit costs charged by banks and time spent by an employee or bookkeeper to calculate the gross pay, deductions and withholding, and net pay). Transaction costs probably also increase for employees, who may have to pay an opportunity cost associated with cashing the check (fees and/or time). Technological advances are significantly decreasing these administrative and transaction costs.

[25]For these workers, this regulation would have the role of a commitment device, externally imposed to overcome the self-control problems of consumers.

the negative impact that low frequencies of pay can have on other sectors with capacity constraints (external congestion costs).[26]

Paying workers less frequently but paying them in different periods (i.e. spreading payments during the month) would also reduce the within-month business cycles. However, more frequent payments for each individual positively affect both, sectors with capacity constraints which would face an smoother pattern of activity, and consumers with short-run impatience who would benefit from a self-control device.

The social planner faces several trade offs. On the one hand, by increasing the frequency of payments she increases the actual cost of labor unit because total transaction costs increase. On the other hand, consumers will have an smoother consumption path under a more frequent payment scheme, which directly increases their long-run utility and indirectly increases it by reducing the congestion costs in sectors with capacity constraints. The model suggests that higher pay frequencies could be welfare improving if the level of short-run impatience of consumers is sufficiently high, transaction costs are low, and/or the costs of congestion are large.

6.1 Setup

In the model economy, population consists of a mass one of identical consumers with discount rates that are much greater in the short-run than in the long-run: they have a short-run preference for instantaneous gratification and a long-run preference to act patiently. The lack of self-control of these consumers is what drives the link between frequency of wage payments and cycles in expenditures.[27] Short-run impatience is captured by consumers with hyperbolic discount functions ($\beta < 1$ in equation 4). Time is finite and discrete, it begins at time 1, and there is no uncertainty.[28]

The representative consumer knows her income in advance and derives utility from a

[26]The coordination problem arises because for each firms not all its consumers are also their own workers, or because the within month cycle in purchases generated by their workers with self-control problems do not negatively impact their own production costs.

[27]The model presented in this paper focuses in one of the possible mechanisms that could generate the within-month expenditures cycles: individuals with short-run impatience. Although there could be other possible explanations for the link between expenditures and pay frequency, no matter what generates the cycle in expenditures the qualitative predictions of the model with congestion costs will be unchanged.

[28]As in Van Wesep and Parsons (2013), I do not consider issues of moral hazard or risk in the production process, nor do address the use of contracts to screen workers.

stream of consumption at different dates. To derive close-form solutions, I assume thet the representative consumer has logarithmic utility function and that her preferences are time-additive.[29,30] Then, consumer's period utility at time t can be expressed as:

$$U_t \quad = \quad log(c_t) + \beta \sum_{s=1}^{T-t} log(c_{t+s}) \tag{4}$$

As time progresses, the individual will change her mind about the relative values of consumption at different points in time, because $\beta < 1$. However, she is naive: she acts as if her future selves will be willing to follow through on her current plans. Without loss of generality I assume there are liquidity constraints, but saving (s_i) is allowed: individual enters period t with s_{t-1} ($s_{t-1} \geq 0$).

There are many firms producing the consumption good in a competitive market. Therefore, firms are wage and price takers, and price is fixed along the periods and normalized to 1. Each firm hires a worker for T periods.[31] Every time the worker is paid the firm also has to pay a cost γ of making the payment.[32] I define w as the wage costs paid every period, before deducting transaction costs. Therefore, if the worker is paid every F periods, every time she is paid she receives $Fw - \gamma$.

As shown in Van Wesep and Parsons (2013), solving the model by backward induction from the day before the next paycheck gives as a result a consumption path that is decreasing over time within the time period of pay. Equations 5 and 6 are the outcome of the maximization problem, and they show how consumption in each period depends on the frequency of payment. Figure 2 shows examples of the pattern of daily consumption under different frequencies of wage payment. For higher F (low pay frequency) and smaller β (high short-term impatience), the variance of consumption increases.

[29] Logarithmic utility function is assumed in order to derive closed-form solutions for consumption.
[30] W.l.g. I assume δ (long-term discount factor) is the same for the consumer and for the firm, and that δ=1.
[31] I assume that the contract offered and reservation utility are such that worker always accepts the contract.
[32] The cost of processing these payments (γ) includes the costs of printing checks for employees, direct deposit costs charged by banks and time spent by an employee or bookkeeper to calculate the gross pay, deductions and withholding, and net pay. These costs have significantly decreased over time.

$$c_1 = \left(\frac{Fw-\gamma}{1+(F-1)\beta}\right) \tag{5}$$

$$c_i = \left(\frac{Fw-\gamma}{1+(F-i)\beta}\right) * \left[\prod_{j=1}^{i-1}\frac{(F-j)\beta}{1+(F-j)\beta}\right] \; for \; i \in \{2,3,...,F\} \tag{6}$$

Proofs can be found in Appendix A of Van Wesep and Parsons (2013). To keep the model simple, I present a three period model ($T = 3$), which is the shortest possible time period that generates time inconsistency effects.[33] I analyze the implied mechanisms of the model and welfare effects under two alternative frequencies of payment: being paid with a lump-sum payment ($F = 3$) or being paid every period ($F = 1$). Proofs of the results can be found in Appendix B.

6.2 Consumption Path and Welfare Analysis in a Three-period Model Without Congestion Costs

When the representative worker is paid at a low frequency of payment (with one upfront pay of $3w - \gamma$ at t=1), the consumption path chosen by the naive agent with self-control problems is:

$$c_1^* = \tfrac{3w-\gamma}{(1+2\beta)},\; c_2^* = \tfrac{2\beta(3w-\gamma)}{(1+2\beta)(1+\beta)} \text{ and } c_3^* = \tfrac{2\beta^2(3w-\gamma)}{(1+2\beta)(1+\beta)}$$

Now consider that the representative worker receives her salary every period t. In particular, every time she is paid she receives $w - \gamma$. Solving the model by backward induction, we get a constant consumption path:

$$c_1^* = c_2^* = c_3^* = w - \gamma$$

Figure 3 compares the consumption paths chosen by the representative worker for different levels of β's under the two payments schemes. When the agent receives one

[33] W.l.g I assume that the agent dies at the end of period 3.

upfront pay, the higher the short-term impatience (low β), the higher is the variance of consumption (there is more consumption immediately after receiving the payment relative to the consumption level in the last period). Consumption paths are similar under both payments schedules when the level of short term impatience is low (high β). The last panel of Figure 3 shows that total consumption decreases when wages are paid more frequently, because in that case there are more transaction costs (γ) which are net losses for the economy.

6.2.1 Welfare

Since time-inconsistent preferences imply that a person evaluates her well-being differently at different times, welfare comparisons when individuals have self-control problems are in principle problematic. I follow Bernheim and Rangel (2005) and O'Donoghue and Rabin (1999), and make welfare evaluations based on a "long-run" welfare criterion ($\beta = 1$).

To formalize the long-run perspective, I suppose there is a –fictitious– period 0 where the person has no decision to make and weighs all future periods equally. The worker's long-run utility is:

$$u_0 = ln(c_1) + ln(c_2) + ln(c_3) \tag{7}$$

In the welfare analysis I compare long-run utilities of the two different frequencies of payment: one upfront payment versus 3 payments. I calculate the long-run utilities under both schemes and show that paying every period dominates paying only once if β is sufficiently low, as illustrated in Figure 4, or the transaction costs (γ) are low enough (Figure 5).

6.3 Model with Congestion Costs

Now, I introduce congestion costs into the model, by assuming that the representative consumer has quasilinear period utility function: it takes a logarithmic form with respect to the composite good (c_t) and it is linear with respect to the damage of congestion (z_t):

$$u_t \quad = \quad ln(c_t) - z_t \tag{8}$$

where $z_t = a\left(\int\, c_{it}\, di\right)^2$, and a is an small positive parameter that indicates the level of damage of total consumption accumulation at time t.[34]

It might be the case, for instance, that z_t represents the combined pollution and accident external costs of traffic congestion. The idea is that consumers need to travel in order to buy good and services (c), and the higher the level of aggregate consumption at a specific moment of time, the higher will be the level of traffic congestion generated by people traveling to shopping. Congestion costs are generated in many other markets with capacity constraints and, under some assumption, the mechanisms found in the model presented here can be extrapolated to what would happen in these other markets.[35] Similar results would be found if we consider another sector with capacity constraints (cost adjustment of factors) and with cost of adjustment of prices (menu cost and information cost for the seller and the consumer respectively). These adjustment costs enable firms to use price mechanisms to smooth the demand along the month without costs. In the case of traffic congestion, we can assume that the costs of adjusting the size of roads within a month is infinite and it is too costly to continuously adjust pecuniary prices for using the roads.

Consumers optimize taking externalities as given: they consider that the level of congestion is fixed. For instance, the representative consumer ignore the costs of pollution and accidents generated from her own driving since these costs are borne by other agents. This free rider problem –each consumer thinks that her car consumption has very little impact on overall level of pollution– makes them to treats the level of congestion as fixed and therefore it does not affect agent's optimization.[36] The following are the period utility

[34] I use the simplifying assumption that this disutility is independent of the amount of the individual's own consumption. This is in line with many examples of congestions costs in the real world, and does not affect the qualitative results of the model.

[35] Capacity constraints is an important feature of many markets (Lester (2011)). While in some markets time is the constraint (doctors can only serve a limited number of clients at once), in other markets space is an issue (restaurants have a limited number of tables), and also sellers' inventory could be occasionally a limiting factor (e.g. agents have a limited number of concert tickets available).

[36] Other assumptions of this model with traffic congestion and its external costs are: (a) there are not pecuniary prices paid by consumers for using the road; (b) capacity is fixed within the period –road capacity is fixed within a month and this is what generates congestion which leads to more time on the road and then higher pollution and traffic accidents–; (c) labor supply is fixed –it is difficult to change hours worked within a month–, then there is a fixed amount of time to be distributed between leisure,

functions the consumer maximizes each period:

$$
\begin{aligned}
u_1 &= ln(c_1) - z_1 + \beta\left(ln(c_2) - z_2 + ln(c_3) - z_3\right) \\
u_2 &= ln(c_2) - z_2 + \beta\left(ln(c_3) - z_3\right) \\
u_3 &= ln(c_3) - z_3
\end{aligned} \tag{9}
$$

6.3.1 Equilibrium

The representative consumer maximizes her utility subject to her budget constraint. Because she takes z_t as given, it does not affect agent's optimization, therefore the competitive equilibrium equals the consumption path presented in Subsection 6.2, for the case without congestion costs.

6.3.2 Welfare

In order to compute welfare, I aggregate the consumption paths chosen for all consumers and again compare long-run utilities under both schemes of pay frequency. The representative agent takes the level of congestion as fixed and then she does not internalize the negative effect of increasing own consumption on the utility of the rest of the agents.

Welfare analysis shows that paying more frequently (every period) dominates only one upfront pay if congestion costs are sufficiently high. Figure 6 displays, for the cases with and without congestion costs and under different levels of short-run impatience (β), the changes in consumer's welfare when frequency of wage payment is changed from one upfront payment to more frequent payments (payments in every period). In the presented parametrization (wage (w)=10; transaction cost (γ)=0.5 and congestion costs (a)=0.01), because congestion costs are sufficiently high, paying every period dominates paying once for every level of short-run impatience (β). In contrast, for the same values of w and γ but if there would not exist congestion costs, paying every period would dominate making one upfront pay only if $\beta \leq 0.65$. Figure 7 shows the relevance of congestion costs by presenting how total welfare changes when pay frequency increases, under different levels of disutility from congestion (a).

travel and shopping, and all these activities are equally valued by the agent.

7 Conclusions

In this paper I show that the frequency of paychecks distribution matters for within-month patterns of household purchasing, and that this has aggregate consequences. In order to identify causal effects I examine two different sources of exogenous variation in pay frequencies in the United States. First, I show evidence at the micro-level by exploiting a random variation in the number of paydays of retired couples –with both spouses receiving Social Security retirement benefits–, for which I compare the daily pattern of expenditures of households with one payday to those observed in households with two paydays. Second, at a more aggregate level, I exploit the US state variation in legislation requiring the payment of wages with some specified periodicity (weekly vs. semimonthly), and compare the within-month pattern of some indicators of economic activity in states requiring different frequencies of payments.

Results show that not all households smooth expenditures between paychecks, and that this effect depends on the frequency of payments: the higher the frequency of Social Security payments, the more able are people to smooth purchases along the month. This is not an exceptional behavior observed in retired couples, because the analysis using state variation in laws concerning the frequency of paydays yields similar results at the aggregate level. In states requiring lower frequencies of wage payments, daily economic activity –proxied by time use, traffic accidents and air pollution– is significantly higher during the weeks of pay. However, this within-month business cycle does not exist in states requiring more frequent payments. In the former group of states, I found evidence suggesting the existence of some negative externalities, on nonworking population, from congestion costs generated by paying workers at a low frequency.

A simple theoretical framework, with hyperbolic consumers whose short-run impatience generates negative externalities through congestion effects, shows a possible mechanism behind the relationship between the frequency of wage payments, expenditures smoothing and its aggregate effects. It also illustrates the gains from regulating the frequency of payments, in which regulation would act as a commitment device for individuals with self-control problems, and would also make agents to internalize the negative impact of their scheme of wage payments on the production costs of other activities with fixed capacity and congestion problems.

The aim of the paper is to show the existence of this relationship between payment frequencies and purchasing patterns, which leads to within-month business cycles in some markets, with relevant consequences in sectors with congestion problems. In order to determine the optimal frequency of payment we should also take into account that an increase in pay frequencies may also rise labor costs –for firms and probably also for employees, who may have to pay an opportunity cost associated with cashing the check (fees and/or time)–. Nevertheless, transaction costs are significantly decreasing over time, which reduces the relevance of this trade-off. Intervention requiring higher pay frequencies could be welfare improving if transaction costs are low, the level of short-run impatience of consumers is sufficiently high, and/or the costs of congestion are large.

In the majority of countries paychecks are distributed at even lower frequencies than in the United States (usually monthly). The evidence presented in this paper and the expected decrease in transaction costs invites to re-think about the optimal frequency of paychecks distribution.

References

Andersson, E., P. Lundborg, and J. Vikström (2014): "Income Receipt and Mortality: Evidence from Swedish Public Sector Employees," *IZA Discussion Paper*, 8389.

Bernheim, B. D. and A. Rangel (2005): "Behavioral Public Economics: Welfare and Policy Analysis with Non-Standard Decision-Makers," Working Paper 11518, National Bureau of Economic Research.

Browning, M. and M. D. Collado (2001): "The response of expenditures to anticipated income changes: panel data estimates," *American Economic Review*, 681–692.

Bureau of Labor Statistics, U. D. o. L. (2009): "Consumer Expenditure Diary Survey. Public Use Microdata. User's Documentation," .

Currie, J., E. A. Hanushek, E. M. Kahn, M. Neidell, and S. G. Rivkin (2009): "Does pollution increase school absences?" *The Review of Economics and Statistics*, 91, 682–694.

Doda, B. (2014): "Evidence on business cycles and emissions," *Journal of Macroeconomics*, 40, 214 – 227.

Evans, W. N. and T. J. Moore (2011): "The short-term mortality consequences of income receipt," *Journal of Public Economics*, 95, 1410–1424.

——— (2012): "Liquidity, economic activity, and mortality," *Review of Economics and Statistics*, 94, 400–418.

Hastings, J. S. and E. L. Washington (2008): "The First of the Month Effect: Consumer Behavior and Store Responses," Working Paper 14578, National Bureau of Economic Research.

Heutel, G. (2012): "How should environmental policy respond to business cycles? Optimal policy under persistent productivity shocks," *Review of Economic Dynamics*, 15, 244–264.

Heutel, G. and C. J. Ruhm (2013): "Air Pollution and Procyclical Mortality," Working Paper 18959, National Bureau of Economic Research.

Hofferth, S. L., S. M. Flood, and M. Sobek (2013): "American Time Use Survey Data Extract System: Version 2.4 [Machine-readable database]. Maryland Population Research Center, University of Maryland, College Park; and Minnesota Population Center," *University of Minnesota, Minneapolis, Minnesota.*

Hsieh, C.-T. (2003): "Do Consumers React to Anticipated Income Changes? Evidence from the Alaska Permanent Fund," *The American Economic Review*, 93, pp. 397–405.

Lester, B. (2011): "Information and prices with capacity constraints," *The American Economic Review*, 101, 1591–1600.

Mastrobuoni, G. and M. Weinberg (2009): "Heterogeneity in Intra-monthly Consumption Patterns, Self-Control, and Savings at Retirement," *American Economic Journal: Economic Policy*, 1, 163–89.

Miller, D. L., M. E. Page, A. H. Stevens, and M. Filipski (2009): "Why are recessions good for your health?" *The American Economic Review*, 122–127.

O'Donoghue, T. and M. Rabin (1999): "Doing it now or later," *American Economic Review*, 103–124.

Paterson, R. G. (1917): *Wage payment legislation in the United States*, 229, Bulletin of the U.S. Bureau of Labor Statistics.

Redmount, E., A. Snow, and R. S. Warren (2012): "The Effect of Wage Payment Reform on Workers' Labor Supply, Wages, and Welfare," *The Journal of Economic History*, 72, 1064–1087.

Review, M. L. (1938): "Laws Requiring Payment of Wages at Specified Times," 47, 1297–1311.

Ruhm, C. J. (2000): "Are Recessions Good for Your Health?" *The Quarterly Journal of Economics*, 115, 617–650.

Senate, M. (2008): "Bimonthly Food Stamp Distribution S.B. 120 (S-1): Analisis as Passed by the Senate," .

Shapiro, J. M. (2005): “Is there a daily discount rate? Evidence from the food stamp nutrition cycle,” *Journal of Public Economics*, 89, 303–325.

Stephens, J., T. Unayama, et al. (2011): “The consumption response to seasonal income: evidence from Japanese public pension benefits,” *American Economic Journal: Applied Economics*, 3, 86–118.

Stephens, Melvin, J. (2003): “"3rd of tha Month": Do Social Security Recipients Smooth Consumption Between Checks?” *American Economic Review*, 93, 406–422.

Stephens, M. (2006): “Paycheque Receipt and the Timing of Consumption*,” *The Economic Journal*, 116, 680–701.

Times, T. N. Y. (2006): “Grocers Seek Twice-Monthly Food Stamp Distributions,” *The New York Times*.

Van Wesep, E. D. and C. A. Parsons (2013): “The timing of pay,” *Journal of Financial Economics*.

8 Tables

Table 1: Frequency of Social Security Payments: Retired Couples

		Husband's birthday (day of month)		
		1st-10th	11th-20th	21st-31st
Wife's birthday (day of month)	1st-10th	**One payday**	Two paydays	Two paydays
	11th-20th	Two paydays	**One payday**	Two paydays
	21st-31st	Two paydays	Two paydays	**One payday**

Notes: Individuals born between the 1st and the 10th day of the month are paid 11th and the 20th day of the month,on the 2nd Wednesday of each month; those born between the are paid on the 3rd Wednesday; and those born between the 21st and the 31stday of the month, are paid on the 4th Wednesday.

Table 2: Summary Statistics and Tests of Mean Differences: Demographic Characteristics of Couples with Two Paydays and Couples with One Payday

	Two Paydays	One Payday	Mean Difference
Husband's age	67.7	67.2	0.5
	(3.9)	(3.3)	(0.25)
Wife's age	65.9	65.7	0.3
	(3.4)	(2.8)	(0.44)
Household income	40,062.6	37,356.7	2,705.9
	(33,862.4)	(32,650.2)	(0.47)
Huband's SS income	1121.9	1131.3	-9.4
	(374.3)	(368.7)	(0.82)
Wife's SS income	707.2	735.5	-28.4
	(316.5)	(310.0)	(0.42)
Couple's SS income	1,829.0	1,866.8	-37.8
	(560.4)	(528.3)	(0.54)
Observations	272	119	

Notes: * Signicant at 10%; **signicant at 5%; *** signicant at 1%. In columns 1 and 2 cells contain means (standard deviations are in parentheses). In column 3 cells contains mean differences (p values are in parentheses).

Table 3: Summary Statistics and Tests of Mean Differences: Daily Expenditures of Couples with Two Paydays and Couples with One Payday

	Two Paydays	One Payday	Mean Difference
Total	137.3	116.4	21.0
	(549.5)	(352.2)	(0.17)
Nondurables	22.8	22.7	0.1
	(33.3)	(34.9)	(0.92)
Food	16.1	16.3	-0.2
	(27.1)	(27.6)	(0.77)
Food at home	10.0	11.1	-1.1
	(22.4)	(24.6)	(0.13)
Food away	6.1	5.3	0.8
	(14.1)	(12.5)	(0.05)*
Instant consumption	7.8	7.2	0.6
	(33.3)	(50.1)	(0.61)
Observations	3,519	1,549	

Notes: * Signicant at 10%; **signicant at 5%; *** signicant at 1%. In columns 1 and 2 cells contain means (standard deviations are in parentheses). In column 3 cells contains mean differences (p values are in parentheses).

Table 4: Summary Statistics: Air Pollution, Traffic Accidents, and Time Use (daily measures)

	States requiring weekly payments	States requiring semimonthly payments
Panel A: *Air Pollution*		
CO	0.46	0.52
	(0.29)	(0.38)
Observations	374,639	1,789,213
O3	0.03	0.03
	(0.01)	(0.01)
Observations	285,844	1,957,165
PM10	20	27.86
	(13.9)	(33.16)
Observations	54,393	785,822
Panel B: *Traffic Accidents*		
Accidents	1.37	2.29
	(1.73)	(2.87)
Fatalities	1.48	2.54
	(1.92)	(3.27)
Observations	37,992	104,478
Panel C: *Time Use (minutes)*		
All goods and services	48.6	47.3
	(81.9)	(82.6)
Travel related to shopping	18.1	17.2
	(35.4)	(36.5)
Observations	21,179	59,879

Notes: Cells contain means. Standard deviations are in parentheses.

Table 5: Randomization test results

	Husband age	Wife age	Household income	Husband SS income	Wife SS income	Household SS income
Panel A						
	(1)	(2)	(3)	(4)	(5)	(6)
Male, 11-20th	0.14	-0.24	2287.81	52.15	41.61	93.76
	(0.48)	(0.43)	(4420.26)	(48.11)	(42.15)	(72.99)
Male, 21-31th	-0.54	-0.32	2280.28	50.65	-14.86	35.79
	(0.41)	(0.38)	(3955.76)	(46.32)	(37.13)	(65.90)
Female, 11-20th	-0.62	-0.47	-1432.97	-37.15	-20.55	-57.70
	(0.46)	(0.39)	(4241.22)	(45.87)	(40.02)	(67.98)
Female, 21-31th	-0.55	-0.37	-806.57	-25.79	-10.04	-35.83
	(0.46)	(0.42)	(4229.79)	(45.72)	(38.27)	(66.89)
N	391	391	382	377	377	377
Panel B						
	Husband age	Wife age	Household income	Husband SS income	Wife SS income	Household SS income
	(1)	(2)	(3)	(4)	(5)	(6)
Both spouses paid	-0.46	-0.28	-2705.92	9.41	28.35	37.76
same payday	(0.38)	(0.33)	(3654.38)	(41.30)	(34.79)	(60.02)
N	391	391	382	377	377	377

Notes: The sample includes all households with both spouses receiving Social Security payments who start receiving them after 1997. There are missing values in the income variables. The coefficient on "Both spouses paid same payday" in Panel B equals 1 if both spouses were born any day of the same interval of the month (1st-10th, 11th-20th or 21st-31st), then both should receive their paychecks in the same day every month. Clustered SE at the level of household are in parentheses. *** p0.01, ** p0.05, * p0.1.

Table 6: Daily expenditures on the week of pay and frequency of payments

	Total	Nondurables	Food	Food at home	Food away	Instant consumption
	(1)	(2)	(3)	(4)	(5)	(6)
One Paycheck this Week	9.978	0.743	0.809	0.783	0.026	-0.668
	(20.903)	(1.644)	(1.397)	(1.113)	(0.608)	(1.804)
Two Paychecks this Week	30.120	3.757	4.601**	2.873*	1.728*	0.687
	(33.204)	(2.514)	(1.807)	(1.587)	(1.003)	(1.246)
Adj. R-squared	0.044	0.100	0.091	0.026	0.142	0.054
N	5068	5068	5068	5068	5068	5068

Notes: The dependent variables are total expenditures in the following categories: total consumption; nondurables; food and alcohol consumed at home; total food expenditures; food and alcohol consumed away from the household and instant consumption away from home. Values are deflated with the CPI into 2000 dollars. Days without reported expenditures are filled in with zeros. The sample includes all households with both spouses who start receiving Social Security payments after 1997, and for whom I can infer their paydates. All regressions include the following control variables: a household fixed effect; day of the week fixed effects; a dummy variable equal to one if it is the sth day of (consumer unit i's) survey; month fixed effects; and week of the month fixed effects. "One Paycheck this Week" equals 1 if one and only one spouse received a paycheck between 0 and 6 days from day t and 0 otherwise. "Two Paychecks this Week" equals 1 if, inferred from their birthdays, both spouses received their paycheck between 0 and 6 days from day t. Clustered SE at the level of household are in parentheses. *** p0.01, ** p0.05, * p0.1.

Table 7: Air pollution and frequency of payments

	States requiring weekly payments			States requiring semimonthly payments		
	CO	O3	PM10	CO	O3	PM10
	(1)	(2)	(3)	(1)	(2)	(3)
2 weeks before (15th) pay	-0.001768	0.000458	0.139918	0.011247***	0.000115	0.800267**
	(0.004014)	(0.000292)	(0.597890)	(0.003860)	(0.000124)	(0.354127)
week of (15th) pay	-0.010068***	0.000107	0.296248	0.006593*	0.000113	0.669102**
	(0.003859)	(0.000285)	(0.511925)	(0.003572)	(0.000119)	(0.330301)
2nd week after (15th) pay	-0.010728***	-0.000415	-0.279509	-0.006807*	0.000092	-0.465053
	(0.004037)	(0.000293)	(0.519944)	(0.003577)	(0.000123)	(0.303297)
Adj. R-squared	0.405	0.380	0.286	0.380	0.476	0.152
N	374639	285844	54393	1789213	1957165	785822

Notes: The dependent variables are one of the following measures of pollution: CO, Ozone or particulate matter less than 10 microns in diameter (PM10). The sample includes states with legislation requiring weekly payments. All regressions include the following control variables: city, month, year and day of week fixed effects, and an indicator variable for holidays. “Week of (15th) pay” equals 1 if that day is 1 to 7 days from the 15th of the month (or the Friday before if 15th is on a weekend). Clustered SE at the level of date are in parentheses. *** p0.01, ** p0.05, * p0.1.

Table 8: Traffic accidents, fatalities and frequency of payments

	States requiring weekly payments		States requiring semimonthly payments	
	Accidents	Fatalities	Accidents	Fatalities
	(1)	(2)	(3)	(4)
2 weeks before (15th) pay	0.041**	0.041*	0.072***	0.084***
	(0.019)	(0.021)	(0.016)	(0.019)
week of (15th) pay	0.021	0.019	0.049***	0.058***
	(0.018)	(0.021)	(0.016)	(0.018)
2nd week after (15th) pay	0.002	0.007	0.015	0.023
	(0.019)	(0.021)	(0.016)	(0.019)
Adj. R-squared	0.501	0.479	0.666	0.639
N	34400	34400	94600	94600

Notes: The dependent variables are the number of accidents or the number of fatalities. The sample used in the regressions shown in columns 1 and 2 includes states with legislation requiring weekly payments. In columns 3 and 4 the sample includes states requiring semimonthly payments. All regressions include the following control variables: state, month, year and day of week fixed effects, and an indicator variable for holidays. "Week of (15th) pay" equals 1 if that day is 1 to 7 days from the 15th of the month (or the Friday before if 15th is on a weekend). Clustered SE at the level of date are in parentheses. *** p0.01, ** p0.05, * p0.1.

Table 9: Time spent obtaining goods and services and frequency of payments

	States requiring weekly payments		States requiring semimonthly payments	
	All goods and services	Travel related to shopping	All goods and services	Travel related to shopping
	(1)	(2)	(3)	(4)
2 weeks before (15th) pay	-0.423	0.125	2.544**	1.274**
	(1.882)	(0.791)	(1.154)	(0.506)
week of (15th) pay	0.927	0.879	3.028***	1.111**
	(2.115)	(0.884)	(1.171)	(0.506)
2nd week after (15th) pay	1.643	1.475	0.606	0.179
	(1.950)	(0.899)	(1.260)	(0.535)
Adj. R-squared	0.032	0.012	0.028	0.009
N	21179	21179	59879	59879

Notes: The outcome variable of regressions of columns (1) and (3) is time spent obtaining goods and services, which includes all time spent acquiring any goods or services. In columns (2) and (4), the RHS variable includes time spent on travel related to purchasing goods and services. All regressions include the following control variables: state, month, year and day of week fixed effects, and a set of demographic characteristics (gender, race, age, number of children and labor status). "Week of (15th) pay" equals 1 if that day is 1 to 7 days from the 15th of the month (or the Friday before if 15th is on a weekend). Clustered SE at the level of date are in parentheses. *** p0.01, ** p0.05, * p0.1.

Table 10: Time spent on travel related to shopping: Sample of retirees with paydays on the 2nd, 3rd or 4th. Wednesdays

	States requiring weekly payments	States requiring semimonthly payments
	(1)	(2)
2 weeks before (15th) pay	-3.344	0.884
	(2.841)	(1.594)
week of (15th) pay	1.584	3.989*
	(3.176)	(2.400)
2nd week after (15th) pay	1.135	-0.953
	(3.170)	(1.820)
Adj. R-squared	0.016	0.027
N	1858	4945

Notes: The outcome variable is time spent on travel related to purchasing goods and services. The sample only includes retired individuals who were 62 or younger in 1997 (cohorts born after 1935, who receive Social Security benefits under the new system where paydays depend on beneficiary's birthday). All regressions include the following control variables: state, month, year and day of week fixed effects, and a set of demographic characteristics (gender, race, age, number of children and labor status). "Week of (15th) pay" equals 1 if that day is 1 to 7 days from the 15th of the month (or the Friday before if 15th is on a weekend). Clustered SE at the level of date are in parentheses. *** p0.01, ** p0.05, * p0.1.

Figures

Figure 1: State Laws Regulating the Frequency of Wage Payments in the United States

(States requiring semimonthly or weekly payments of wages in 2008)

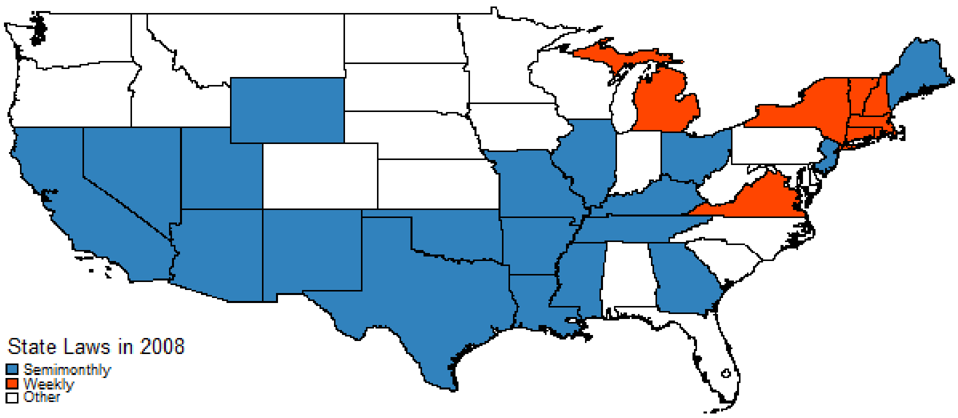
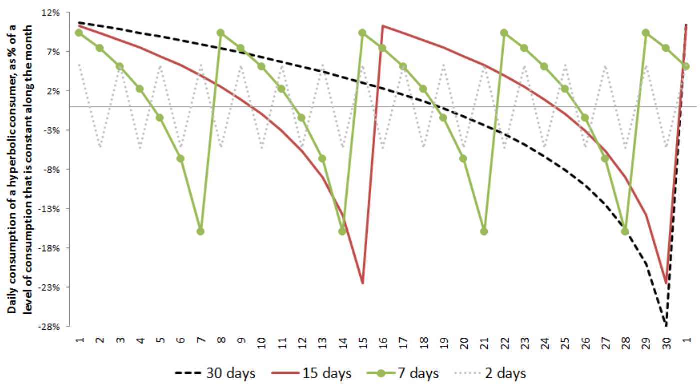
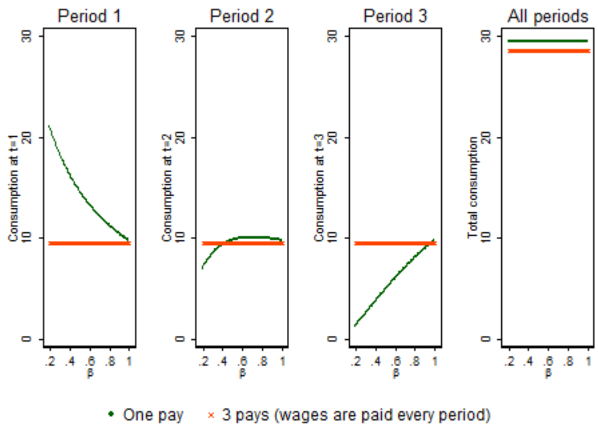


Figure 2: Daily consumption under different frequencies of wage payment



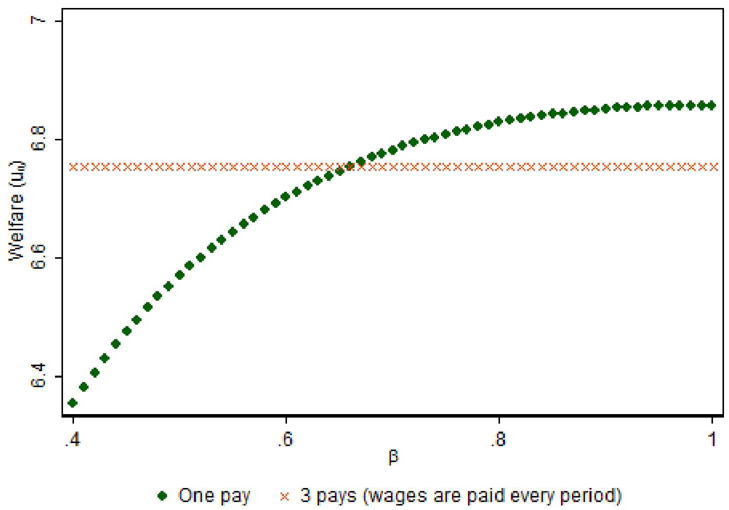
Notes: Log utility function and $\beta = 0.9$.

Figure 3: Consumption paths under different pay frequencies and β's



Notes: The first three panels show consumption levels at each period of time, and the last panel aggregates total consumption in all periods, for a worker with period utility: $u_t = ln(c_t) + \beta\,(ln(c_{t+1}) + ln(c_{t+2}))$. Green lines display consumption levels when the worker receives only one upfront payment for the three periods (one pay of $3w - \gamma$). Red (flat) lines show consumption when worker is paid at the beginning of every period (three pays of $w - \gamma$). Parameter values: wage (w)=10; transaction cost (γ)=0.5.

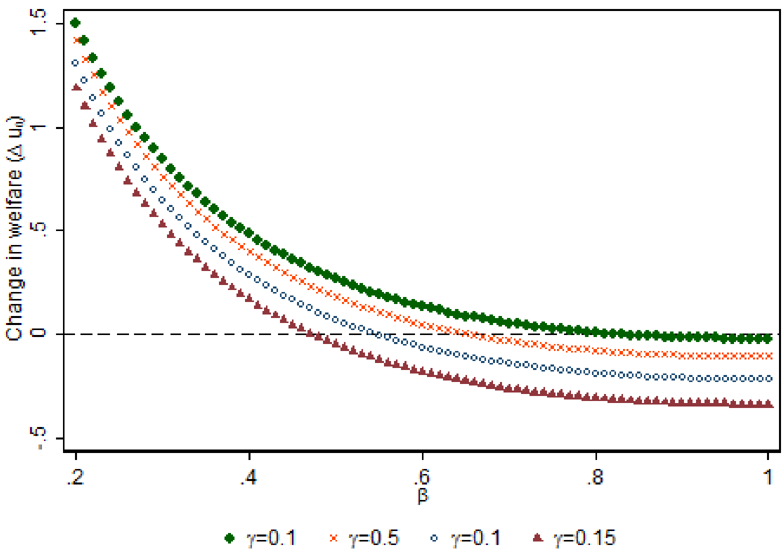
Figure 4: Welfare under different pay frequencies and β's



Notes: This figure shows consumer's welfare for a worker with period utility: $u_t = ln(c_t) + \beta\,(ln(c_{t+1}) + ln(c_{t+2}))$. Green line shows total welfare when the worker receives one upfront payment for the three periods (one pay of $3w - \gamma$). Red (flat) line shows the case when worker is paid at the beginning of every period (three pays of $w - \gamma$). Parameter values: wage (w)=10; transaction cost (γ)=0.5.

Figure 5: Welfare, pay frequency, and transaction costs

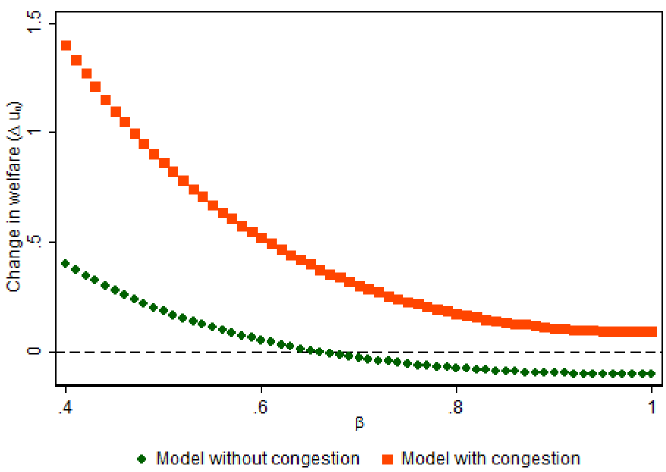
Change in welfare when frequency of wage payment increases, under different β's and γ's



Notes: This figure shows changes in consumer's welfare under different levels of short-term discount rate (β) and transaction cost (γ), when the frequency of wage payments is changed from one upfront payment at t=0 (one pay of $3w - \gamma$) to payments in every period (three pays of $w - \gamma$). Parametrization: wage (w)=10.

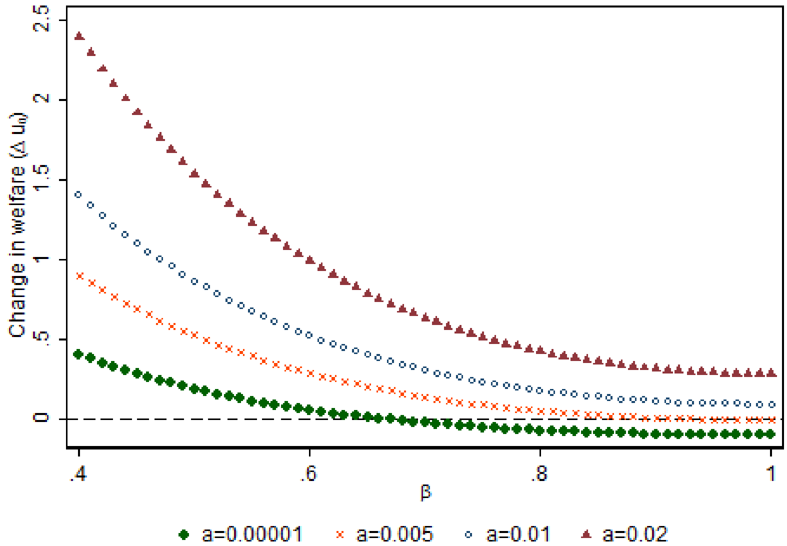
Figure 6: Change in welfare when pay frequency increases

Models with and without congestion costs



Notes: This figure shows, for the cases with and without congestion costs, the changes in consumer's welfare under different levels of short-term discount rate (β), when frequency of wage payment is changed from one upfront payment (one pay of $3w - \gamma$) to payments in every period (three pays of $w - \gamma$). Parameter values: wage (w)=10; transaction cost (γ)=0.5, and (a)=0.01.

Figure 7: Change in welfare when pay frequency increases, under different levels of congestion costs (a) and β



Notes: This figure shows changes in consumer's welfare under different levels of short-term discount rate (β) and congestion costs (a), when frequency of wage payment is changed from one upfront payment (one pay of $3w - \gamma$) to payments in every period (three pays of $w - \gamma$). Parameter values: wage (w)=10 and transaction cost (γ)=0.5.

A Appendix: Robustness Checks

In this Appendix I show that results of Subsection 5.1 are robust to using an extended sample of households. More precisely, in the following analysis I also include in the sample households with both spouses retired but in which one or both start receiving the Social Security benefits before 1997. These individuals are older than those in the sample used in the main specification, and they are all paid the 3rd of the month. I also show that results are robust to not imputing with zeros the expenditures of days without information in the CEX survey diary. Finally, I present results without controlling for week fixed effects.

A.1 Sample: All households with two retirees, independently on when they start receiving the Social Security benefits

Table A.1: Daily expenditures on the week of pay and frequency of payments

	Total	Nondurables	Food	Food at home	Food away	Instant consumption
	(1)	(2)	(3)	(4)	(5)	(6)
One Paycheck this Week	-30.578	0.809	0.426	0.915	-0.490	-1.347
	(26.982)	(1.485)	(1.219)	(1.024)	(0.539)	(1.720)
Two Paychecks this Week	-1.458	1.657**	1.627**	1.309***	0.318	-0.189
	(10.730)	(0.766)	(0.691)	(0.473)	(0.534)	(0.766)
Adj. R-squared	0.016	0.094	0.066	0.054	0.056	0.022
N	20963	20963	20963	20963	20963	20963

The dependent variables are total expenditures in the following categories: total consumption; nondurables; food and alcohol consumed at home; total food expenditures; food and alcohol consumed away from the household and instant consumption away from home. Values are deflated with the CPI into 2000 dollars. The sample includes all households with both spouses receiving Social Security payments. All regressions include the following control variables: a household fixed effect; day of the week fixed effects; a dummy variable equal to one if it is the sth day of (consumer unit i's) survey and month fixed effects. "One Paycheck this Week" equals 1 if one and only one spouse received a paycheck between 0 and 6 days from day t and 0 otherwise. "Two Paychecks this Week" equals 1 if both spouses received their paycheck between 0 and 6 days from day t. Clustered SE at the level of household are in parentheses. *** p0.01, ** p0.05, * p0.1.

A.1.1 Sample: All households with two retirees, and filling missing values with zeros

Table A.2: Daily expenditures on the week of pay and frequency of payments

	Total	Nondurables	Food	Food at home	Food away	Instant consumption
	(1)	(2)	(3)	(4)	(5)	(6)
One Paycheck this Week	-20.163	0.592	0.324	0.709	-0.385	-0.967
	(17.010)	(1.099)	(0.894)	(0.734)	(0.415)	(1.260)
Two Paychecks this Week	1.596	1.436**	1.313***	1.000***	0.313	0.041
	(7.468)	(0.571)	(0.504)	(0.350)	(0.378)	(0.513)
Adj. R-squared	0.022	0.101	0.077	0.048	0.068	0.044
N	28972	28972	28972	28972	28972	28972

The dependent variables are total expenditures in the following categories: total consumption; nondurables; food and alcohol consumed at home; total food expenditures; food and alcohol consumed away from the household and instant consumption away from home. Values are deflated with the CPI into 2000 dollars. The sample includes all households with both spouses receiving Social Security payments. All regressions include the following control variables: a household fixed effect; day of the week fixed effects; a dummy variable equal to one if it is the sth day of (consumer unit i's) survey and month fixed effects. "One Paycheck this Week" equals 1 if one and only one spouse received a paycheck between 0 and 6 days from day t and 0 otherwise. "Two Paychecks this Week" equals 1 if both spouses received their paycheck between 0 and 6 days from day t. Clustered SE at the level of household are in parentheses. *** p0.01, ** p0.05, * p0.1.

A.2 Sample: All households with two retirees, except those with both spouses retired before 1997

Table A.3: Daily expenditures on the week of pay and the frequency of payments

	Total	Nondurables	Food	Food at home	Food away	Instant consumption
	(1)	(2)	(3)	(4)	(5)	(6)
One Paycheck this Week	-32.679	0.820	0.522	0.931	-0.408	-1.313
	(27.852)	(1.506)	(1.224)	(1.029)	(0.538)	(1.740)
Two Paychecks this Week	26.082	4.152	5.292***	3.547*	1.745	0.172
	(42.260)	(2.585)	(1.992)	(1.818)	(1.202)	(1.537)
Adj. R-squared	0.009	0.093	0.071	0.022	0.123	0.034
N	5562	5562	5562	5562	5562	5562

The dependent variables are total expenditures in the following categories: total consumption; nondurables; food and alcohol consumed at home; total food expenditures; food and alcohol consumed away from the household and instant consumption away from home. Values are deflated with the CPI into 2000 dollars. The sample includes all households with both spouses retired and at least on spouse who start receiving Social Security payments after 1997, and for whom I can infer their paydates. All regressions include the following control variables: a household fixed effect; day of the week fixed effects; a dummy variable equal to one if it is the sth day of (consumer unit i's) survey and month fixed effects. "One Paycheck this Week" equals 1 if one and only one spouse received a paycheck between 0 and 6 days from day t and 0 otherwise. "Two Paychecks this Week" equals 1 if both spouses received their paycheck between 0 and 6 days from day t. Clustered SE at the level of household are in parentheses. *** p0.01, ** p0.05, * p0.1.

A.2.1 Filling missing values with zeros

Table A.4: Daily expenditures on the week of pay and the frequency of payments

	Total	Nondurables	Food	Food at home	Food away	Instant consumption
	(1)	(2)	(3)	(4)	(5)	(6)
One Paycheck this Week	-21.000	0.560	0.347	0.675	-0.328	-0.937
	(17.186)	(1.104)	(0.892)	(0.736)	(0.413)	(1.276)
Two Paychecks this Week	23.692	3.792	4.429***	2.874*	1.555	0.500
	(32.323)	(2.388)	(1.709)	(1.500)	(0.963)	(1.162)
Adj. R-squared	0.013	0.103	0.084	0.025	0.129	0.056
N	7385	7385	7385	7385	7385	7385

The dependent variables are total expenditures in the following categories: total consumption; nondurables; food and alcohol consumed at home; total food expenditures; food and alcohol consumed away from the household and instant consumption away from home. Values are deflated with the CPI into 2000 dollars. The sample includes all households with both spouses retired and at least on spouse who start receiving Social Security payments after 1997, and for whom I can infer their paydates. All regressions include the following control variables: a household fixed effect; day of the week fixed effects; a dummy variable equal to one if it is the sth day of (consumer unit i's) survey and month fixed effects. "One Paycheck this Week" equals 1 if one and only one spouse received a paycheck between 0 and 6 days from day t and 0 otherwise. "Two Paychecks this Week" equals 1 if both spouses received their paycheck between 0 and 6 days from day t. Clustered SE at the level of household are in parentheses. *** p0.01, ** p0.05, * p0.1.

A.3 Without controlling by week of month fixed effects

Table A.5: Daily expenditures on the week of pay and the frequency of payments

	Total	Nondurables	Food	Food at home	Food away	Instant consumption
	(1)	(2)	(3)	(4)	(5)	(6)
One Paycheck this Week	2.034	0.697	0.820	0.926	-0.107	-1.134
	(17.289)	(1.588)	(1.315)	(1.027)	(0.588)	(2.159)
Two Paychecks this Week	26.016	3.685	4.597**	2.916*	1.680*	0.426
	(33.082)	(2.495)	(1.795)	(1.583)	(1.003)	(1.241)
Adj. R-squared	0.044	0.100	0.091	0.026	0.142	0.054
N	5068	5068	5068	5068	5068	5068

The dependent variables are total expenditures in the following categories: total consumption; nondurables; food and alcohol consumed at home; total food expenditures; food and alcohol consumed away from the household and instant consumption away from home. Values are deflated with the CPI into 2000 dollars. Days without reported expenditures are filled in with zeros. The sample includes all households with both spouses who start receiving Social Security payments after 1997, and for whom I can infer their paydates. All regressions include the following control variables: a household fixed effect; day of the week fixed effects; a dummy variable equal to one if it is the sth day of (consumer unit i's) survey and month fixed effects. "One Paycheck this Week" equals 1 if one and only one spouse received a paycheck between 0 and 6 days from day t and 0 otherwise. "Two Paychecks this Week" equals 1 if both spouses received their paycheck between 0 and 6 days from day t. Clustered SE at the level of household are in parentheses. *** p0.01, ** p0.05, * p0.1.

A.3.1 Sample: Without controlling by week of month and without filling missing values with zeros

Table A.6: Daily expenditures on the week of pay, depending on the frequency of payments. (Sample of spouses retired after 1997)

	Total	Nondurables	Food	Food at home	Food away	Instant consumption
	(1)	(2)	(3)	(4)	(5)	(6)
One Paycheck this Week	6.464	1.111	1.213	1.233	-0.020	-1.499
	(23.031)	(2.122)	(1.792)	(1.426)	(0.749)	(2.911)
Two Paychecks this Week	34.348	4.510*	5.876***	3.884**	1.992	0.217
	(43.769)	(2.728)	(2.108)	(1.940)	(1.261)	(1.650)
Adj. R-squared	0.024	0.086	0.080	0.023	0.138	0.032
N	3881	3881	3881	3881	3881	3881

The dependent variables are total expenditures in the following categories: total consumption; nondurables; food and alcohol consumed at home; total food expenditures; food and alcohol consumed away from the household and instant consumption away from home. Values are deflated with the CPI into 2000 dollars. The sample includes all households with both spouses who start receiving Social Security payments after 1997, and for whom I can infer their paydates. All regressions include the following control variables: a household fixed effect; day of the week fixed effects; a dummy variable equal to one if it is the sth day of (consumer unit i's) survey and month fixed effects. "One Paycheck this Week" equals 1 if one and only one spouse received a paycheck between 0 and 6 days from day t and 0 otherwise. "Two Paychecks this Week" equals 1 if both spouses received their paycheck between 0 and 6 days from day t. Clustered SE at the level of household are in parentheses. *** p0.01, ** p0.05, * p0.1.

B Appendix: Model

I solve the model using backward induction from the last period.

B.1 Case 1: Equilibrium When Worker Is Paid at a Low Frequency (With One Upfront Pay of $3w - \gamma$ at t=1)

B.1.1 Period $t = 3$

$$\begin{aligned} \underset{c_3}{max}\, u_3 &= ln(c_3) \\ s.t:\ c_3 &\leq s_2^* \\ c_3^* &= s_2^* \end{aligned} \tag{B.1}$$

Because the agent will die at the end of period 3, he would do not keep anything for the next period and consumption of the last period equals savings when entering this period (s_i^* are the savings at the end of period i).

B.1.2 Period $t = 2$

$$\begin{aligned} \underset{c_2,c_3}{max}\, u_2 &= ln(c_2) + \beta ln(c_3) \\ s.t:\ c_2 + c_3 &= s_1^* \\ \Rightarrow c_3 &= s_1^* - c_2 \end{aligned}$$

$$\begin{aligned} \underset{c_2}{max}\, u_2 &= ln(c_2) + \beta ln(s_1 - c_2) \\ FOC:\ \frac{1}{c_2} - \beta\frac{1}{s_1^* - c_2} &= 0 \end{aligned}$$

$$c_2^* = \frac{s_1^*}{1+\beta} \tag{B.2}$$

$$s_2^* = \frac{\beta s_1^*}{1+\beta} \tag{B.3}$$

B.1.3 Period $t = 1$

$$\max_{c_1,c_2,c_3} u_1 = ln(c_1) + \beta\,(ln(c_2) + ln(c_3))$$

$$s.t\; c_1 + c_2 + c_3 = 3w - \gamma$$

$$Let's\, define\, s_1 = 3w - \gamma - c_1$$

$$then\; c_3 = s_1 - c_2$$

$$FOC \begin{cases} \max_{s_1,c_2} u_1 = ln(3w - \gamma - s_1) + \beta\,(ln(c_2) + ln(s_1 - c_2)) \\ \frac{\partial u_1}{\partial s_1}\; \frac{-1}{3w-\gamma-s_1} + \beta\frac{1}{s_1-c_2} = 0 \\ \Rightarrow s_1 = \frac{\beta m(3w-\gamma)+c_2}{1+\beta} \\ \frac{\partial u_1}{\partial c_2}\; \frac{\beta}{c_2} - \frac{\beta}{s_1-c_2} = 0 \\ \Rightarrow s_1 = 2c_2 \end{cases}$$

$$\frac{\beta(3w-\gamma)+c_2}{1+\beta} = 2c_2$$

$$c_2 = \frac{\beta(3w-\gamma)}{1+2\beta}$$

$$s_1^* = \frac{2\beta(3w-\gamma)}{1+2\beta} \tag{B.4}$$

$$c_1^* \;\; = 3w - \gamma - \;\; \frac{2\beta(3w-\gamma)}{1+2\beta}$$

$$c_1^* \;\; = \;\; \frac{3w-\gamma}{1+2\beta} \tag{B.5}$$

From B.2 and B.4:

$$c_2^* \;\; = \;\; \frac{2\beta(3w-\gamma)}{(1+2\beta)(1+\beta)} \tag{B.6}$$

From B.1, B.3 and B.4:

$$c_3^* \;\; = \frac{2\beta^2(3w-\gamma)}{(1+2\beta)(1+\beta)} \tag{B.7}$$

B.2 Case 2: Equilibrium When Worker is Paid at a High Frequency: (Same) Salary is Paid Every Period

When worker receives the salary in each period t the consumption path is: $c_1 = c_2 = c_3 = w - \gamma$. This is because $0 \leq \beta \leq 1$, the individual will try to consume more during the first period. However, because he gets the same wage every month and he can not transfer consumption from the future to the present, his consumption at period 1 will equals the wage received in that period. The same happens the rest of the periods.

B.3 Welfare

Utility at t=0 under a Low Frequency of Wage Payment

$$\tilde{u}_0 = ln(c_1) + ln(c_2) + ln(c_3)$$

$$\tilde{u}_0 = ln\left(\frac{3w-\gamma}{1+2\beta}\right) + ln\left(\frac{(3w-\gamma)2\beta}{(1+2\beta)(1+\beta)}\right) + ln\left(\frac{(3w-\gamma)2\beta^2}{(1+2\beta)(1+\beta)}\right) \tag{B.8}$$

Utility at t=0 under a High Frequency of Wage Payment

$$\hat{u}_0 = ln(c_1) + ln(c_2) + ln(c_3)$$

$$\hat{u}_0 = 3ln\,(w-\gamma) \tag{B.9}$$

B.4 Congestion

B.4.1 Welfare

Worker's Long-run Utility When She Receives One Upfront Payment:

$$\begin{aligned}
\tilde{u}_{i0} &= ln(c_{i1}) - z_1 + ln(c_{i2}) - z_2 + ln(c_{i3}) - z_3 \\
\tilde{u}_{i0} &= ln(c_{i1}) - a\left(\int c_{i1}\,di\right)^2 + ln(c_{i2}) - a\left(\int c_{i2}\,di\right)^2 + ln(c_{i3}) - a\left(\int c_{i3}\,di\right)^2
\end{aligned}$$

Total welfare for all consumers is: $\hat{U}_0 = \int \tilde{u}_{i0}\, di$

$$\hat{U}_0 = \int \left[ln(c_{i1}) - a\left(\int c_{i1}\, di\right)^2 + ln(c_{i2}) - a\left(\int c_{i2}\, di\right)^2 + ln(c_{i3}) - a\left(\int c_{i3}\, di\right)^2 \right] di \tag{B.10}$$

Because there is a mass one of identical consumers, the total long-run utility for all consumers is:

$$\tilde{U}_0 = ln(c_{i1}) - a\,(c_{i1})^2 + ln(c_{i2}) - a\,(c_{i2})^2 + ln(c_{i3}) - a\,(c_{i3})^2$$

$$\tilde{U}_0 = ln\left(\frac{3w-\gamma}{1+2\beta}\right) - a\left(\frac{3w-\gamma}{1+2\beta}\right)^2 + ln\left(\frac{(3w-\gamma)2\beta}{(1+2\beta)(1+\beta)}\right) - a\left(\frac{(3w-\gamma)2\beta}{(1+2\beta)(1+\beta)}\right)^2 + ln\left(\frac{(3w-\gamma)2\beta^2}{(1+2\beta)(1+\beta)}\right) - a\left(\frac{(3w-\gamma)2\beta^2}{(1+2\beta)(1+\beta)}\right)^2 \tag{B.11}$$

Worker's Long-run Utility When Wages Are Paid Every Period:

The long-run utility of the representative consumer is:

$$\hat{u}_{i0} = ln(w-\gamma) - z_1 + ln(w-\gamma) - z_2 + ln(w-\gamma) - z_3$$

Then, following the same procedure as before, the long-run utility of all consumers (mass one) is:

$$\hat{U}_0 = 3ln\,(w-\gamma) - 3a\,(w-\gamma)^2 \tag{B.12}$$