The Economics of Bill Payments: An Empirical Analysis*

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Abstract

The growing economic literature dedicated to payment instruments mainly focus on payments at point of sale. Yet, credit transfers and direct debits used in bill payments are much more used in the Euro area than checks, payments cards and other payment instruments. The main objective of this paper is therefore to verify whether the standard framework stated for payments at point of sale is relevant to study the economics of bill payments. Using an original data set, we show that the main predictions of the standard model do not hold. First, consumers do not seem to be sensitive to transaction costs in bill payments and second, the transaction size does not influence the choice of the payment instruments. These results argue for a new theoretical framework to analyze the use of payment instruments in bill payments.

Key Words: Payment Instruments, bill payments.
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1 Introduction

Since several years, the study of payment instruments became a major topic of interest for economists. One of the key issues of these studies is to explain how and why consumers choose different payment methods. To answer these questions, several theoretical and empirical contributions have been proposed. The theoretical framework of reference is that of Whitesell (1989)[1]. The author has shown that when the transaction costs for each payment instrument differ and when this difference depends on the transaction size, the demand for currency and deposits may be considerably affected.[2] The role of the transaction size in payment choice models has been tested and confirmed by several empirical studies (Mot and Cramer, 1992; Boeschoten, 1998; Hayashi and Klee, 2003; Bounie and François, 2006; Klee, 2008).

Although important, the main limit of the aforementioned studies is to focus on payments at point of sale to the detriment of bill payments. Yet, bill payments are as much important as payments at point of sale for at least two reasons.

First, according to the last statistics provided by the European Central Bank (2006) for the year 2004, credit transfers and direct debits used in bill payments respectively account for 30.3% and 28.7% of the total transactions carried out in the Euro area compared to 11.3% and 27.6% for checks and card payments. Likewise, when we get a closer look at the relative importance of credit transfers and direct debits as a percentage of total value of transactions, we observe that credit transfers account for 92.6% (3.1% for direct debits) whereas checks and card payments amount to 3.1% and 0.4%.

Second, bill payments differ from payments at point of sale in many ways.

[1] Santomero (1974, 1979) and Santomero and Seater (1996) have developed formal models in which demand for currency and deposits depends on rates of return and fixed costs of transaction. Although important, these models have never been tested since they are highly sensitive to discontinuities in payment behavior (Folkertsma and Hebbink, 1998).

[2] This approach has been extended by Shy and Tarkka (2002) for several payment instruments.

To begin with, they are by definition recurrent, and consumers may anticipate their spendings. In addition, the average amount of a bill is much higher than a purchase at point of sale.[3] Finally, traditional payment instruments are maladapted to bill payments and specific electronic payment instruments such as direct debits are available for consumers. Now, these payment instruments are really different since they are not necessarily initiated by the payer but by the beneficiary. Indeed, in the case of a direct debit, it is the beneficiary who initiates the payment by instructing his bank to collect the amount owed by the payer. In this payment process, the debtor agrees in advance that the beneficiary may collect the bill by direct debit (pre-authorized direct debit). As a result, the fixed cost per transaction usually incured by consumers to make a payment by cash, checks, etc. (*e.g* time to fill a check), does not exist anymore.

Following what we just commented on, several questions arise: how well does the standard approach fit bill payments? Does the transaction size still influence the choice of payment instruments in bill payments? Does the recurrence of payments affect payment patterns? These are the questions we tackle in this paper.

Using an original data set, we show that the main predictions of the standard model do not hold. First, consumers are not sensitive to transaction costs and second, the transaction size does not influence the choice of payment instruments. To the best of our knowledge, this paper is the first to estimate the impact of bill characteristics on the choice of payment instruments. The unique study related to bill payments is due to Mantel (2001) who mainly analyzes the influence of demographic and financial characteristics on the adoption and the use of bill payments.

The remainder of this paper is structured as follows. In the second section,

[3]According to the European Central Bank, the average value per transaction amounts to 12,411 euros for the year 2004 for credit transfers and 434.6 for direct debits compared to 55.9 for card payments.

we present a review of the literature. In the third section, we describe on the one hand the data set we use to test the standard approach and, on the other hand, we present and discuss the estimation results. The last part concludes.

2 Literature review

The literature on the economics of payment instruments goes back to the transaction demand for money *à la* Baumol (1952) and Tobin (1956). In these studies, a cost-minimizing consumer has to decide the optimal stock of cash to be held for transaction purposes given the cost of a withdrawal (a fixed fee per withdrawal) and the interest earnings foregone on money holding. Extending this approach to several payment instruments, Whitesell (1989, 1992) and Shy (2002) explicitly assume that the consumer's problem during a purchase merely consists in choosing a payment instrument which minimizes the holding and transaction costs. In Whitesell (1989), for instance, an individual is assumed to make purchases of various prices P, with $0 < P < \infty$. Transactions are supposed to be uniformly distributed over a continuous unit period. Then, if $F(P)$ represents the value of spending on all transactions of price P, the expected total spending is given by $Y = \int_0^\infty F(P)dP$.

The individual has the possibility to pay with cash or with an alternative payment instrument (*e.g.* check, debit or credit card, etc.). Each transaction carried out with the alternative payment instrument is attended by costs. Let us note u the fixed cost of using the alternative payment instrument for a transaction of size P and $v.P$ the variable cost related to P. The total cost of a transaction of size P is then $C = u + v.P$. On the contrary, paying cash is attended only by a variable cost $v.P$ for a purchase of size P. This cost is due to interest earnings foregone on money holding. Then, the alternative payment instrument will not be used for small value transactions because of u and, if the parameters are well chosen, cash will be only used for small value payments, for which the interest earnings foregone will be minimal.

This theoretical framework has been tested in several empirical studies (Mot and Cramer, 1992; Boeschoten, 1998; Hayashi and Klee, 2003; Bounie and François, 2006; Klee, 2008). Globally, controlling for individual characteristics, all these studies confirm that the transaction size affects significantly the choice of payment instruments. However, one of the main limits of these studies is to focus only on payments at point of sale. To the best of our knowledge, the only contribution dedicated to bill payments is to the initiative of Mantel (2001). Exploiting a US 1,300-person survey, the author examines the influence of demographic and financial characteristics (*e.g.* demographics (age, gender, etc.), consumer financial (income, homeowner, etc.) and product adoption (PC owner, cellular phone owner, etc.)) on consumer decision-making among competing bill payment instruments. Using a series of binomial logistic regressions, the results suggest that there are important differences between nonusers, low users, and high users of bill payment services. Nevertheless, although the study mentions the role of payment-specific factors such as the dollar size of a payment, the regressions do not provide an estimation of such effects.

The objective of the next part aims precisely at gaining insight into the effect of such variables on the use of payment instruments in bill payments.

3 Data description, model and empirical test

This part intends to test whether the standard approach stated for payments at point of sale is relevant to understand the way people pay bills. First, we introduce the data set we use in the estimation. Second, we extend the standard model to bill payments and, finally, we discuss the estimation results.

3.1 Data

We administrated a survey from March to May 2005 on a sample of about 525 French consumers who pay electricity bills on their own. Prior to comment on descriptive statistics, it is worth noting to precise two points. First, we decided to focus on electricity bill payments since there is a public monopoly in France that proposes to all consumers throughout the territory the same set of payment solutions. In other words, consumers are not subject to supply side constraints whatever their location in France. Second, we are exclusively interested in the survey to consumers who pay personally their electricity bills (and not to the household's electricity bill payments).

Globally, the survey intended to collect, during face-to-face interviews, information on payment instrument adoption and uses, bill payments and sociodemographic characteristics. More precisely, the questions about electricity bill payments were concerned with the average amount of the bill, its frequency and the payment instrument used to settle the debt.

It is clear from the analysis of the responses that consumers use two main types of payment solution. The first one is to the initiative of consumers. They can directly pay the beneficiary by using cash or they can order to the bank the payment of the bill by using a check, a credit transfer or a payment card. We will call hereafter this first type of payment method a *manual payment*. The second type of payment solution is to the initiative of the beneficiary with the use of direct debits. In this case, the debtor agrees in advance that the electricity company may collect the bill at a predetermined frequency by direct debit (pre-authorised direct debit). The company's bank then sends information to the payer's bank to collect the funds. The payer's bank debits the payer's account, and the beneficiary's bank credits the beneficiary's account. Clearing and settlement between banks take place in analogy to card payments. This type of payment solution will be called hereafter an *automatic payment*.

In Table 1, we give some descriptive statistics about manual and automatic payments[4]. Globally, out of 525 respondents who declare to pay personally electricity bills, 40% use an automatic payment and 62% of the latter pay their electricity bills bimonthly. We also observe that the average amount per bill is 1.6 times higher for automatic payments than for manual payments.

Table 1: Statistical description of bill payments

Type of payment solution	Automatic	Manual	Overall
Nb. obs. (%)	206 (39.2)	319 (60.8)	525 (100)
Frequency:			
Bimonthly (nb obs. (%))	128 (62.1)	263 (82.4)	391 (74.5)
Less frequent (nb obs. (%))	78 (37.9)	56 (17.6)	134 (25.5)
Average amount per bill: mean (s.d.)	298 (388)	183 (261)	228 (321)

In the next part, we adapt the standard approach described in Section 2 to bill payments.

3.2 Extension of the standard model to bill payments

Extending the standard model to bill payments is direct and trivial. Let assume a cost C of using a payment instrument i equals to $C_i = u_i + v_i P$, where u_i is a fixed cost of using a payment instrument and $v_i P$ a variable cost which depends on transaction size (P) (with $i = A$ (for Automatic) and $i = M$ (for Manual). By definition, $u_A = 0 < u_C$. Indeed, since direct debits are automatic and initiated by the beneficiary, consumers do not incur a fixed cost per transaction. By contrast, when consumers pay the bill by check, payment card, etc., they incur a fixed cost since they initiate the payment. Therefore, since a manual payment implies a fixed cost per transaction, we should observe that consumers prefer to use automatic payments for small

[4]In this table, we exclude monthly payments since in France this solution is a bundle which associates a fixed amount per month and a mandatory payment by direct debit. In this case, consumers have no choice to use an alternative payment instrument (checks, etc.).

value transactions in order to avoid fixed costs. This conjecture should be all the more true when the frequency of the bill is high and when consumers have a lot of bills to manage. As a result, a first lemma can be formulated.

Lemma 1

An automatic payment should be preferred for a small value payment. By extension, the higher the frequency of a bill payment the higher the use of an automatic payment.

Likewise, let set $v_A > v_C$. Indeed, the variable cost related to an automatic payment is higher than the one incurred for a manual payment for mainly two reasons. First, using an automatic payment implies to lose in part the control of the payment process for consumers. Now, banks can charge a high fee for unauthorized overdrafts whenever the account holder either exceeds his overdraft limit or his balance dips below nil. Now, due to the high average amount of a bill (see Footnote 3), consumers can be reluctant to choose this payment method. Second, regular errors are committed by companies on the exact amount of the bills. Now an error which penalizes a consumer can be detrimental to his financial situation. As a result, a second lemma can be advanced.

Lemma 2

Manual payments should be used for large value payments. The higher the amount of the bill the higher the costs of using an automatic payment.

The combination of Lemma 1 and Lemma 2 leads to formulate the following proposition.

Proposition 1

Automatic payments should be used for small value payments and manual payments for large value payments.

In the next part, using a multivariate analysis, we test these propositions.

3.3 Test and estimation results

In this section, we estimate the probability to use an automatic payment (versus a manual payment) using a standard probit method.

In doing so, we explicitly introduce in the regression[5], the two main explanatory variables which are the average amount of the bill (P) and the frequency of the bill payment. The frequency variable is a dummy variable that indicates if the payment is bimonthly or less frequent (quarterly, annual or biannual). Likewise, we control for several individual characteristics such as age, monthly personal income, education, household size, geographical area, professional status (active or inactive), electronic banking and the number of banking accounts. In particular, we introduce several further variables of interest for our concern. To begin with, we capture the frequency of the control of spendings on checking account[6]. Indeed, by the means of several communication technologies (telephone, electronic banking, etc.), respondents have the possibility to check their daily spendings to avoid overdrafts. Likewise, we also capture two dimensions of the trust related to payment instruments. First, we use a dummy variable to seize if the respondent has subscribed any specific insurance policy against the risks of loss or theft of his payment instruments. Second, we use the subjective evaluation of the risk related to the use of direct debits (Risk). Finally, we account for the number of bills the respondent has to manage with different companies (loans, public utilities, etc.).

Estimation results are provided in Table 2 (Model 1).

First, we observe that the coefficient of the variable "average amount of the bill" is not statistically significant. Interestingly, this result is not in line with the standard model and contradicts the results of the empirical literature dealing with point of sale payments. Therefore, we can conclude

[5]See appendix A for a detailed description of the variables

[6]The frequencies are: daily, once a week, once every two weeks, once a month, less than once a month.

that the probability to use an automatic payment is not influenced by the size of the bill which means that the difference between the variable costs of automatic and manual payment solutions is meaningless for consumers.

Second, and paradoxically, we observe that the coefficient of the variable "frequency" is statistically significant but has the wrong expected sign. Indeed, the higher the frequency the lower the use of an automatic payment solution. This result is again sharply in contradiction with the standard model stated for payments at point of sale. In conclusion, the recurrence of the payment does not impact the choice of the payment solution.

Third, to the exception of "Age" and "Insurance", globally the control variables are not statically significant. Nevertheless, we can outline that the oldest people have a higher probability to use automatic payments (either to avoid the fixed cost of check writings or to be sure to pay bills in due time).

These results are fairly robust and are not subject to multicollinearity between the variables frequency and average amount of the bill. Indeed, first, we observe that the standard coefficient of correlation between both variables is equal to 0.47. Second, if we exclude alternatively the incriminated variables (model 2 and model 3 in Table 2), the coefficient associated to the frequency variable is negative and significant, and the coefficient associated to the average amount becomes significant but has the wrong sign.

4 Conclusion

The main objective of this paper was to verify whether the standard framework stated for payments at point of sale is relevant to study the economics of bill payments. The standard model predicts that first the payment solution with the lowest fixed cost per transaction should be privileged for small value transactions and second that the payment solution with the lowest variable cost per transaction should be selected for large value transactions. Applied to bill payments, we should verify that automatic payments

Table 2: Estimations results

Independent variable	-Model 1- coef. (s.e.)	-Model 2- coef. (s.e.)	-Model 3- coef. (s.e.)
Amount of the bill	0.0002 (0.0002)	0.0006*** (0.0002)	-
Frequency	-0.478*** (0.154)	-	-0.560*** (0.135)
Nb of bank accounts	0.063 (0.109)	0.056 (0.108)	0.070 (0.108)
E-banking	0.090 (0.142)	0.066 (0.140)	0.098 (0.141)
Household size	-0.028 (0.052)	-0.034 (0.052)	-0.021 (0.051)
Professional status	-0.218 (0.147)	-0.230 (0.147)	-0.219 (0.146)
Log(Risk)	-0.130 (0.104)	-0.154 (0.103)	-0.122 (0.103)
Age	0.020*** (0.005)	0.020*** (0.005)	0.020*** (0.005)
Education (without diploma excluded):			
$<$ University	0.144 (0.183)	0.136 (0.179)	0.155 (0.183)
University	0.001 (0.219)	0.035 (0.215)	0.005 (0.219)
Income (less than 1,000€ excluded):			
From 1,000 to 2,000 €	0.123 (0.147)	0.104 (0.146)	0.131 (0.147)
$>$ 2,000 €	0.179 (0.216)	0.149 (0.213)	0.190 (0.217)
Do not know or refuse	0.207 (0.213)	0.144 (0.211)	0.221 (0.211)
Control of spendings (daily excluded):			
Once a week	-0.153 (0.227)	-0.131 (0.223)	-0.164 (0.228)
Once every two weeks	-0.191 (0.231)	-0.156 (0.226)	-0.202 (0.231)
Once a month	-0.029 (0.228)	-0.024 (0.225)	-0.042 (0.228)
Less than once a month	-0.018 (0.345)	0.012 (0.343)	-0.007 (0.344)
Insurance	0.297** (0.130)	0.285** (0.128)	0.305* (0.130)
Type of area (rural area excluded):			
Urban area	0.117 (0.136)	0.136 (0.136)	0.105 (0.136)
Paris (and suburb)	-0.108 (0.479)	-0.008 (0.493)	-0.160 (0.469)
Nb of bills	0.073 (0.052)	0.079 (0.052)	0.070 (0.052)
Intercept	-1.261* (0.663)	-1.797*** (0.651)	-1.157* (0.648)
Nb obs.		525	
Log pseudo LL	-304.42	-309.15	-305.09
Pseudo R^2	0.13	0.12	0.13

Dummies by geographical area (8 variables) are also introduced but not reported.
The s.e. are corrected by the White method (1980).
*** means that the coefficient is statistically significant at the 1 percent level,
** at the 5 percent level and * at the 10 percent level.

are used for small value payments and manual payments for large value payments.

Using an original data set, we show that the standard approach stated for analyzing payments at point of sale is not verified. First, consumers do not seem to be sensitive to the fixed costs of using payment instruments and second, the transaction size does not influence the choice of payment instruments. As a result, estimation results do not confirm that the probability to use an automatic payment is higher for small value payments and, similarly, that the probability to use a manual payment is higher for large value payments.

These new results are important for at least two reasons. First, the determinants of the choice of payment instruments are not universal which means that we need to lead further investigations to better understand bill payments and to get a unified standard model of payment instrument choice. Second, this study shows that the well known determinants of the choice of payment instruments at point of sale are different for bill payments. Now, at the moment of the creation of a Single European Payment Area to adopt a set of common standards to achieve interoperability at a European interbank level, we should pay more attention to such a topic in order to foster the development of new payment technologies in the euro area. These researches are not only necessary for banks since payment-related revenues to financial institutions are important but also for the whole society in order to reduce the social costs of the payment systems.

A Variable description

Table 3: Variable description

Variable	Description	mean (s.d.)
Amount of the bill	average amount (in €) of the electricity bill paid personally by the respondent	228.3 (321.4)
Frequency	dummy variable: 1 = bill paid bimonthly 0 = bill paid less frequently	0.75 (0.44)
Nb of bank accounts	number of bank accounts held by the respondent	1.33 (0.57)
E-banking	dummy indicating if the respondent uses electronic banking	0.31 (0.46)
Household size	number of individuals in the household	2.58 (1.28)
Professional status	dummy indicating if the respondent works or not	0.51 (0.50)
Log(Risk)	log of the subjective evaluation of the risk associated to the electronic payment instrument: from 1 = less risky to 5 = more risky	0.51 (0.59)
Age	age of the respondent	46.7 (16.31)
Education	dummy variables by level of education: without diploma under university university	 0.14 (0.35) 0.60 (0.49) 0.26 (0.44)
Income	dummy variables by level: less than 1,000€ from 1,000 to 2,000 € more than 2,000 € do not know or refuse to answer	 0.35 (0.48) 0.40 (0.49) 0.13 (0.34) 0.12 (0.32)
Control of spendings	dummies indicating the frequency of the control spendings: daily once a week once every two weeks once a month less than once a month	 0.10 (0.30) 0.30 (0.46) 0.25 (0.43) 0.29 (0.46) 0.05 (0.22)
Insurance	dummy indicating if the payment instrument is insured against theft or loss risks	0.61 (0.49)
Type of area	dummies indicating the type of living area: rural area urban area Paris (and suburb)	 0.43 (0.50) 0.41 (0.49) 0.15 (0.36)
Number of bills	number of bills paid personally by the respondent	3.57 (1.21)

References

Baumol W.J. (1952) "The Transaction Demand for Cash - An Inventory Theoretic Approach", *Quarterly Journal of Economics*, 66(4), 545-556.

Boeschoten W.C. (1998) *Currency Use and Payment Patterns*, Kluwer Academic Publishers.

Bounie D. and François A. (2006) "Cash, Check or Debit Card: the Effects of Transaction Characteristics on the Use of Payment Instruments", Telecom Paris Economics and Social Sciences Working Paper No. ESS-06-05.

Folkertsma C.K. and Hebbink G.E. (1998) "Cash Management and the Choice of Payment Media: a Critical Survey of the Theory", *Econometric Research and Special Studies Department*, Netherlands Central Bank, Research Memorandum WO and Enr 532.

Hayashi F. and Klee E. (2003) "Technology Adoption and Consumer Payments: Evidence from Survey Data", *Review of Network Economics*, 2(2), 175-190.

Klee E. (2008) "How People Pay: Evidence from Grocery Store Data", *Journal of Monetary Economics*, 55, 526-541.

Mantel B. (2001) "Why Do Consumers Pay Bills Electronically? An Empirical Analysis", *Economic Perspectives*, Federal Reserve Bank of Chicago, 32-47.

Mot E.S. and Cramer J. (1992) "Mode of Payment in Household Expenditures", *De Economist*, 140(4), 488-500.

Santomero A. (1974) "A Model of the Demand for Money by Households", *The Journal of Finance*, 29(1), 89-102.

Santomero A. (1979) "The Role of Transaction Costs and Rates of Return on the Demand Deposit Decision", *Journal of Monetary Economics*, 5(3), 343-364.

Santomero A. and Seater J.J. (1996) "Alternative Monies and the Demand for Media of Exchange," *Journal of Money, Credit and Banking*, 28(4), 942-960.

Shy O. and Tarkka J. (2002) "The Market for Electronic Cash Cards", *Journal of Money, Credit and Banking*, 34(2), 299-314.

Tobin J. (1956) "The Interest Elasticity of Transaction Demand for Cash", *Review of Economics and Statistics*, 38(3), 241-47.

White H. (1980), "A Heteroscedasticity-consistent Covariance Matrix Estimator and a Direct Test for Heteroscedasticity", *Econometrica*, 48: 817-838.

Whitesell W.C. (1989) "The Demand for Currency versus Debitable Accounts", *Journal of Money, Credit, and Banking*, 21(2), 246-251.

Whitesell W.C. (1992) "Deposit Banks and the Market for Payment Media", *Journal of Money, Credit, and Banking*, 24(4), 483-498.