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PAYMENTS IN SPAIN**

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THE FALLING SHARE OF CASH PAYMENTS IN SPAIN

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Abstract

The shift away from cash and checks toward cards is illustrated using a number of measures, including an econometric model. Applied to Spain, the share of cash in (legal) transactions may have fallen by up to 20% during the 1990s. A forecast of the future use of cash and cards is presented and implications for government revenues and the banking industry are outlined.

Key Words: payments, cash use, card use, banking.
JEL: E41, C53, G21

1 Introduction.

Two essential services are provided by banks. They intermediate deposits into loans and promote economic growth by matching savings with investment. They also provide payment services to consumers and business firms, services which are needed to facilitate the trade and exchange associated with economic activity.

In providing payment services, banking firms and other payment processors need to forecast the likely future demand for various payment instruments—from providing cash through branch offices and ATMs to increasing the availability of card terminals to expanding computer and telecommunication facilities involved in processing electronic payments. In addition, governments obtain revenues from issuing cash and consequently are interested in projections of its future use.

Our purpose is to provide an estimate of the use of cash and electronic card payments in Spain. While anecdotal information suggests that the share of cash in payments is falling, the speed and extent of this reduction is not obvious. We focus on legal, reported activities as opposed to determining the value of cash used in the underground economy associated with tax evasion and other illegal activities generally. A primary goal is to provide a 5-year forecast of the future use of cash and electronic card payments. This requires an estimate of what the share of cash use has been in the recent past.

In what follows, Section 2 outlines and contrasts the current use of cash and other payment instruments in Spain with that in other European countries. Spain appears to rely more heavily on cash than either Germany or France and initiates fewer non-cash payments per person. Although the large expansion of ATMs has made it easier to obtain cash, a rapid growth of card terminals at the point of sale and the rise in direct debits have all contributed to a decline in the share of cash used to purchase goods and services, to pay bills, to make payroll disbursements to employees, and to make low value business transactions after 1993.

A simple direct calculation using data on the value of point-of-sale transactions and the value of card and consumer check payments is developed to approximate the unknown value of cash transactions in Section 3 while a behavioral model of cash use is developed and estimated in Section 4. This model uses time-series information on changes in the value of cash outstanding, the value of card and consumer check payments, the number of ATM and card terminals in place, the interest rate, and the value of point-of-sale transactions. In Section 5, the econometric cash share estimate is used in a logistic S-curve model to forecast changes in cash and card payments five years ahead. Section 6 contains a summary of our results and conclusions.

Table 1: Cross-Country Indicators of Cash and Non-Cash Payments, 2000

Country:	CURR/GDP	Non-Cash Transactions per Person per Year
Spain	8.9%	56
Germany	6.2	177
Portugal	4.7	94
Sweden	4.3	127
France	3.2	196

2 Inferring Cash Use Across Countries and in Spain.

2.1 Cash Use in Europe.

Cash has many useful attributes as a payment instrument. It is universally accepted as a means of payment, is a mobile store of value, and is easy to obtain from banking offices or (today) from ATMs. It is also cheap to produce. It only costs about 0.08 Euros to print a 100 Euro note. As cash production is a government monopoly, the difference between its production cost (0.08 Euros) and its face value (100 Euros) represents revenues for the government. In reality, the value of cash outstanding is non-traditional debt since it may have to be redeemed in the future if cash use falls absolutely.

While this production cost rises as currency wears out and is replaced with new notes, the existence of cash reduces the need for governments to borrow to meet their budgeted expenditures. By borrowing less, governments save the interest expense they would otherwise have to pay. With an interest rate of 5%, borrowing costs are reduced by 5 Euros annually for each 100 Euro note put into circulation. This cost savings clearly more than offsets the cost of replacing currency as it wears out since even the most used notes have an average lifetime before replacement of about 1.5 years.¹

Over time, cash has been replaced in many types of transactions by the increased use of non-cash payments—checks, debit cards, credit cards, and giro payments (credit transfers and direct debits). This replacement of cash has reduced government seigniorage revenues from what they would otherwise have been. Offsetting this trend of cash replacement in legal trade and exchange has been the increased use of cash associated with various illegal activities, the largest of which is apparently tax evasion.

While we know the value of the stock of cash that is in circulation, it is very difficult to determine the value of the flow of cash used for payments. Indeed, cash payment flow data are not available in any country. It is even more problematic to try to determine the flow of cash payments between legal and

¹ Spain, Greece, Ireland, and Portugal have all decided not to issue 500 Euro notes, which is the largest note. While these notes will still be issued in other countries and will be accepted in Spain, it is recognized that very large denomination notes facilitate illegal activities.

Table 2: Indicators of Cash Use in Spain, 1986-2000 (in percent)

	1986	1988	1990	1992	1994	1996	1998	2000
CURR/GDP	7.8	8.2	9.0	10.2	11.1	10.3	9.7	8.9
CURR/M1	20.4	19.1	19.7	23.5	24.9	25.0	20.7	20.4
CASH/POSsales	85.8	82.8	79.0	84.8	87.1	83.6	80.8	79.9

illegal activities. As a result, most attempts to approximate the use of cash in a country have used indirect measures, such as the stock of currency and coin in circulation (CURR) relative to the value of goods and services being produced domestically (GDP).

The ratio of the value of currency and coin in circulation to the level of GDP (CURR/GDP) for Spain and four other European countries is shown in Table 1. The countries are ranked by their apparent reliance on cash, with Spain being the highest (at 8.9%) and France the lowest (at 3.2%) among the ...ve countries shown.² In principle, it would be expected that the greater a country's stock of cash relative to GDP, the lower the number of non-cash transactions per person in that country. This expectation holds for Spain which has the fewest non-cash transactions per person per year (56) and for France which has the most (196) but only weakly holds for the other countries.³ As seen, Spain appears to rely relatively heavily on cash for payments using either of the measures in Table 1.

2.2 Evolution of Cash Use in Spain.

Two approximate indicators of cash use in Spain are shown in Table 2. The ratio of cash (CURR) to GDP rises after 1986, reaches a peak in 1994, and falls 20% from this peak by 2000. An alternative measure is the ratio of cash to the M1 measure of the money supply. The stock of cash funds the (unknown) flow of cash payments while M1, which includes the stock of cash plus liquid bank deposits, funds both cash and non-cash payments. The ratio of cash to M1 reaches a peak in 1995 and also falls 20% by 2000. The falling share of cash is accompanied by a rise in the number of non-cash payments per person. Indeed, non-cash payments were 27 per person in 1990 and doubled to 56 by 2000. Although Spain relies relatively heavily on cash to make payments compared to other European countries, after 1993 this reliance has been reduced by shifting to non-cash instruments. We now present two more direct measures of cash use in Spain.

²The assumption here is that for the same level of economic activity (GDP), countries that use a large amount of cash for payments will also have to hold a larger stock of cash to support these payments. As the turnover of cash can easily differ among countries (e.g., as when cash is more easily accessed via ATMs in one country versus another), the rankings shown in Table 1 are only approximate.

³Specifically, Germany has the second highest CURR/GDP ratio—suggesting a relatively low use of non-cash payments—but uses almost as many non-cash payments per person as does France which has the lowest CURR/GDP ratio in the table.

3 Determining Cash Use Directly.

In the past it was not uncommon to use cash for bill payments, wage disbursements, and some large value financial transactions. Since the 1950s and 1960s, this practice has been largely replaced in most developed countries by safer and more convenient check and giro payments. As a result, the use of cash in Europe since 1980 has been primarily restricted to consumer POS transactions (POSales) where cash, debit and credit cards, and (in some countries) checks are the typical payment method.

The use of cash at the point-of-sale can be approximated by obtaining an estimate of the total value of all point-of sale payments (POSales) and subtracting the value of non-cash payments presumed to be made at the point-of-sale. For our purposes, POSales include purchases at all retail stores, hotels, restaurants, and expenditures for entertainment, medical services, rental housing, and transportation (gasoline, car rental, train, bus, subway, and taxis). Debit and credit card payments (CARD) are almost entirely made at the point-of-sale as are most (but not all) consumer-related check payments (CHECK).

One way of approximating the unknown value of cash use (CASH) is obtained from the equality $CASH = POSales - CARD - CHECK$, with the qualification that the value of consumer check payments is only approximate.⁴ The implied share of cash using this equality is shown in the last row of Table 2. The share of cash in POSales rises to a peak of 87.6% in 1993 then falls to 79.9% by 2000. The reduction cash use from its peak is 9%, which is lower than the 20% reductions seen for the other two cash indicators in Table 2.

Changes in this cash share ratio over 1986-2000 can usefully be divided into three time periods. As an annual average over the years indicated in the first column of Table 3, the following equality holds for each row: $\Phi POSales = \Phi CARD + \Phi CHECK + \Phi CASH$ (where $\Phi CASH$ is a residual). For example, the average value of transactions at the point of sale from 1986 to 1990 rose by 9.65 billion euros annually. Of this, only .64 billion euros was from debit and credit cards while 2.60 billion was from estimated consumer check payments. This leaves 6.41 billion euros attributed to the change in cash payments and results in a yearly -1.7 percentage point reduction in the share of cash as a percent of all POS sales. During this period the cash share fell from 85.8% in 1986 to a low of 79.0% in 1990.

The data we have is more reliable for the 1990s. From 1991 to 1993, the cash share rose to 87.6% in 1993 which is the highest share observed over the 1986-2000 period. While a large rise in the value of consumer check payments was the reason for the falling cash share in the first period (1986-90), a large reduction in the yearly value of check payments from 1991 to 1993 (-3.47 billion) is the reason for the rising cash share during this second period.⁵ This reduction in

⁴ An appendix is available from the authors by request that contains the data used in the paper and their sources.

⁵ Check payments fell for two reasons. First, and most importantly, bank fees on check use rose to help offset the higher interest rates then being paid to attract deposits after branching restrictions on savings banks (which have about half of all deposits) were removed

Table 3: Average Annual Change in Payment Values by Instrument (in Euro Billions)

Years	POS Sales	Card Payments	Check Payments	Cash Payments	Change in Cash Share
1986-1990	+9.65	+.64	+2.60	+6.41	Falling -1.7
1991-1993	+8.10	+1.39	-3.47	+10.18	Rising +4.3
1994-2000	+4.10	+2.43	+.18	+1.49	Falling -1.3

check payments meant that the value of cash transactions seemingly experienced a considerable increase (rising by 10.18 billion a year).

It is only in the last period, 1994-2000, that electronic debit and credit card payments start to strongly replace cash at the point of sale. Sixty percent of the average yearly 4.10 billion euro rise in point-of-sale payments from 1994 to 2000 was accounted for by the 2.43 billion rise in card payments, with smaller increases in check and cash payment values. The resulting average annual -1.3 percentage point decline in the share of cash in point-of-sale payments reduced the cash share to 79.9% in 2000 (very close to the low value of 79.0% attained earlier in 1990). This time, however, there seems to be no reason to expect that the cash share will reverse its decline in the future (as occurred when the growth of check payments over 1986-90 was reversed over 1991-93). The share of cash is expected to continue to fall and that of electronic card payments to rise. This is because the expansion of card payments over 1994-2000 was associated with a 403,000 increase in card terminals—an expansion that doubled the total number of terminals in place from their inception to 1994. A reversal—shifting from cards to cash—would have to be associated with either a dramatic reduction in the number of EFTPOS terminals in place and/or a significantly higher price (in terms of reduced convenience or higher cost) of making a card payment relative to using cash. Neither of these things seem likely.

4 A Behavioral Model of Cash Use.

4.1 Model Specification.

A weakness in the direct measure of cash use just presented lies in our estimate of the value of consumer POS check payments which, of necessity, is only a rough approximation. No direct data exists on this value for Spain (nor for almost any other country). Consequently, we develop and estimate an econometric model which allows the parameters in the equality $CASH = POS_{sales} - CARD - CHECK$ to differ from their implied values of 1.0 and considers other important influences on cash use as well.

in 1989. A second, less important reason, was that a recession had started to depress consumer expenditures generally and this tends to reduce purchases of higher value items (reducing check use).

Traditional money demand analysis has been concerned with how the stock of currency outstanding (as part of the money supply) is affected by the level of economic activity and the interest rate. Our analysis, based on Snellman, Vesala, and Humphrey (2001) and Humphrey, Kaloudis, and Øwre (2000), extends the money demand literature to estimating the use of cash for legal transactions in a country. We relate the flow of cash being used by consumers to changes in the stock of currency outstanding along with traditional determinants of changes in this stock such as the level of economic activity and the interest rate. In addition, we incorporate information on the value of card and check payments along with the diffusion of the technology that influences the substitution among cash, cards, and checks. This concerns the number of available card or electronic funds transfer point-of-sale (EFTPOS) terminals that allows card payments to replace both cash and checks at the POS. The concurrent expansion of ATM terminals is also included since this has made it easier to use cash. A force in the background, which can not be directly included due to a lack of data, has been the direct and indirect pricing of many payment transactions (e.g., checks) and the assessment of ATM fees.

The basic behavioral model is expressed in three equations. The first states that changes in the use of cash ($\Delta CASH$) is related to the value of all consumer payments where cash, cards, and checks typically occur (ΔPOS_{sales}) minus the sum of changes in the value of card ($\Delta CARD$) and check ($\Delta CHECK$) payments:

$$(1) \quad \Delta CASH = \lambda \Delta POS_{sales} - \Delta CARD - \mu \Delta CHECK \quad (\text{flow to flow})$$

where:

$$\mu = (\mu_0 + \mu_1 EFTPOP).$$

The parameter λ is estimated and not presumed to equal 1.0 (as was the case in the previous section) since other influences may well dominate in the statistical determination of cash use. The value of consumer use of cash at the point-of-sale is unknown while good information exists for the value of card payments (which is why no parameter is estimated here). The value of consumer checks used at the POS is not directly observed but is approximated by multiplying the average value of a card payment in each year (usually around 60 Euros) by the volume of all checks written each year. Check volume reached a peak of 270 million items in 1990 in Spain but has been falling since then.⁶ The relationship between checks and the other variables is allowed to vary as the number of EFTPOS terminals per unit of population (EFTPOP) expands and affects the substitution among checks, cards, and cash.

The second equation states that changes in cash used for consumer payments ($\Delta CASH$) is partly determined by lagged changes in the stock of coin and currency outstanding ($\Delta CURR_{t-1}$) and changes in the interest rate (Δr):

$$(2) \quad \Delta CASH = \gamma \Delta CURR_{t-1} + \alpha_1 \Delta r \quad (\text{flow to stock})$$

where:

$$\gamma = (\gamma_0 + \gamma_1 ATMPOP).$$

⁶ The problem here is in trying to distinguish between the relatively low value checks written by consumers, which are believed to account for the majority of check volume, and the fewer higher value checks typically written by businesses.

Yearly shifts in the number of ATM terminals per unit of population (ATMPOP) can affect the relationship between the stock of currency in circulation and its use in payments. The change in currency stock is lagged one period as it is possible for $\Phi CASH$ and $\Phi CURR$ to be contemporaneously correlated. Central banks have some ability to expand notes in circulation prior to and during an economic expansion when cash use rises while the reverse holds with a recession. However, decisions to print, issue, and circulate currency are clearly made ahead of its use. The number of notes to print are primarily determined by the rate of population growth, the rate of inflation, and the extent to which certain notes (typically those of lower value) wear out and need to be replaced.

Setting the unknown value of $\Phi CASH$ in (1) equal to its value in (2), expressing the result in terms of the use of cards (as cards can substitute for both cash and checks), and allowing the relationship between card payments and the stock of currency ($\bar{\tau}$) as well as checks (μ) to vary over time depending on the number of ATMs and the number of card or EFTPOS terminals per person gives the final equation of the behavioral payment model:

$$(3) \quad \Phi CARD = \alpha_0 + \bar{\tau} \Phi CURR_{t-1} + \mu \Phi CHECK + \lambda \Phi POS_{sales} + \alpha_1 \Phi r + \epsilon$$

where:

$$\bar{\tau} = (\bar{\tau}_0 + \bar{\tau}_1 ATMPOP)$$

$$\mu = (\mu_0 + \mu_1 EFTPOP).$$

The specification of $\bar{\tau}$ and μ allows for shifts in the relationship between cards and cash and cards and checks over time. More ATM terminals favors cash use while more card terminals favors cards. Once (3) is estimated, the change in consumer use of cash for legal activities can be determined from (1) or (2).⁷ Although these two expressions both equal $\Phi CASH$, they can generate different values as they reflect different influences on cash use. There is no reason to expect that changes in the value of cash outstanding and changes in the interest rate should affect cash use for payment purposes in a manner identical to that of changes in point-of-sale transactions net of the value of card and check payments. As it turns out, the cash share results derived from (1) and (2) are within three percentage points of one another in 2000.

4.2 Model Results.

Data on payments are quite limited, both in terms of quality and number of observations. Unfortunately, yearly data are the highest frequency available. As a result, we have few degrees of freedom but at least capture the period after 1993 when cards became an important substitute for cash (Table 3). Estimating (3) using a non-linear procedure with annual data gave the parameter estimates shown in Table 4.⁸ The first set of parameters (under the heading $\Phi CURR_{t-1}$) refers to our preferred specification while the second set illustrates the result if the currency stock variable is not lagged one period.

⁷ The signs of the estimated parameters determine the signs in (1) and (2) while -1.0 is the restriction on $\Phi CARD$ in (1).

⁸ The non-linear subroutine LSQ in the TSP econometric package was used in estimation.

Table 4: Determinants of Cash Used at the Point of Sale

$$\Phi \text{CARD} = \alpha_0 + \beta \Phi \text{CURR}_{t-1} + \mu \Phi \text{CHECK} + \lambda \Phi \text{POSSales} + \alpha_1 \Phi r + \epsilon$$

	ΦCURR_{t-1}	ΦCURR_t	Value of $\beta =$	Value of $\mu =$
α_0	= 555.3*	370.1*	$\beta_0 + \beta_1 \text{ATMPOP}$	$\mu_0 + \mu_1 \text{EFTPOP}$
β_0	= -.668*	-.612*	1990 = -.49	-.11
β_1	= .481*	.759*	1992 = -.45	-.18
μ_0	= -.510*	-.204	1994 = -.39	-.01
μ_1	= .049*	.027	1996 = -.30	.21
λ	= -.037	-.005	1998 = -.21	.39
α_1	= 30.21	1.919	2000 = -.14	.46
adj. R ²	= .32	.82	* indicates t-value >	
Sample size:	= 13	14	critical t _{.05} = 2:447	

Changes in the stock of currency and coin (ΦCURR) were positive for all but one year (2000).⁹ The negative value of β , which varies by year, suggests that larger positive changes in the stock of cash are (all else constant) associated with smaller changes in card use. The change in card use was positive and rising in each year and the negative β indicates that cards and cash are substitutes. The smaller negative values of β over time reflect the fact that changes in the stock of cash were smaller in the last half of the 1990s and so had a smaller substitution effect on card use. The value of μ is first negative and then turns positive. In the early 1990s, the change in consumer check value was negative as check use fell. The negative change in checks times a negative μ indicates that the change in card use was positive and rising, suggesting that cards and checks are also substitutes. In the last half of the 1990s, the change in checks was positive but small. Here the positive change in checks times a positive μ also means that the change in card use was positive.

The values of β and μ make it clear that cards substituted for both cash and checks during the 1990s but it is unclear how intensive this substitution was until we look at λ . That is, the substitution of cards for cash and checks can be "marginal" if the main determinant of the change in card value is the growth of POSSales. In this case, cash and check use may fall only slightly since the positive change of card use would be strongly associated with the positive change in POSSales over the period. This implies that λ is positive and significant. However, λ is negative and insignificant. This means that the main determinant of card use has been its direct substitution for cash and checks and was not significantly affected by the overall growth of POSSales. If POSSales had not increased at all, this substitution would still have occurred. Consequently, the

⁹ The reduction in currency stock in 2000 is the result of the central bank providing a large increase in cash in 1999 to meet the expected rise in precautionary holdings related to the date change for the new millennium. Some of this "excess cash" was withdrawn in 2000.

Table 5: Direct Calculation and Statistical Estimates of Cash Use in Spain

	1990	1992	1994	1996	1998	2000	Change from Peak
CASH/POSsales	79.0	84.8	87.1	83.6	80.8	79.9	-9%
Φ CURR _{t-1}	74.9	76.0	76.3	70.8	65.3	61.7	-21
Φ CURR _t	73.3	75.0	75.9	71.2	66.5	63.7	-18

substitution process has been intensive rather than marginal.¹⁰

The share that cash is of point-of-sale transactions over 1990-2000 is presented in Table 5. The first row repeats (for comparison purposes) the values shown in the last row of Table 2 while the cash shares derived from the two sets of parameter estimates of Table 4 are in the following two rows.¹¹ All three estimates show that cash use has fallen from its peak in 1993 (the same peak year for all three). However, the extent of the reduction is different, ranging from -9% to -21%. Since we have reservations regarding our estimate of the value of consumer checks at the point of sale, we favor the estimates derived from the econometric model. Indeed, these estimates of the change in the share of cash in payments happens to correspond well with the two more approximate indicators shown in Table 2 which both fell 20% from their peak.¹² As a result, our view is that the current share of cash used in point-of-sale (legal) transactions is in the low 60% range and that cash use in Spain—a high cash use country—has fallen significantly during the 1990s. These share estimates are now used to forecast cash use in Spain five years ahead.

5 Change Over Time Forecast Model.

5.1 Cash Share Forecast.

Changes in the share of cash are associated with the diffusion and adoption of an alternative card payment technology. In many instances, the diffusion of a new technology has been found to closely follow a logistic S-curve which is a

¹⁰For illustration, \bar{A} was restricted to equal 1.0 in (3) and the model was re-run. As expected, (1) gave a predicted cash share of 79.9 which is the same as the directly calculated value for CASH/POSsales shown in Table 2 while (2) gave a cash share of 20.7. The model estimated had an adjusted $R^2 = -.71$ indicating that the restriction is unwarranted.

¹¹The annual estimated change in cash use from (1) or (2), after estimating (3), is cumulated and added to a base value of cash outstanding in 1988 (for row 2 in Table 5) or 1987 (for row 3). It is then divided by POSsales to give the cash shares shown in rows 2 and 3. As the base estimate of CASH is the same as that used in row 1 for the year in question, the cash shares in rows 1 and 2 (1 and 3) are the same in 1988 (1987).

¹²To address the likelihood that the total value of cash in circulation overstates the stock of cash used for legal transactions, we deleted the largest value note (as these typically are the most common in illegal transactions) and re-ran (3). Here the value of CURR_{t-1} is net of all Pta. 10,000 notes outstanding. The resulting cash share in 2000 was 63.7% which compares favorably with 61.7% for the same model in Table 5. We take this as support that our model is apparently robust to alternative measures of the stock of coin and currency in circulation being used for legal, reported activities.

Table 6: Predicted Future Use of Cash in Spain: 2001-2005

$\Phi \text{ CURR}_{t_i-1}$	$\ln(S_t=(1 - S_t)) = a + bt + c$	$a = 1.74$	$b = .081$	$c = .87$	adj $R^2 = .87$	
$\Phi \text{ CURR}_t$	$\ln(S_t=(1 - S_t)) = a + bt + c$	$a = 1.58$	$b = .065$	$c = .81$		
		2001	2002	2003	2004	2005
$\Phi \text{ CURR}_{t_i-1}$		60.8	58.9	56.9	54.9	52.8
$\Phi \text{ CURR}_t$		63.2	61.7	60.1	58.5	56.9

simple function of the passage of time. The adoption and use of the telephone, television, fax machine, mobile phone, and even robots in auto manufacturing tend to follow a logistic curve.

In a detailed empirical comparison, Meade and Islam (1995) have shown that the standard logistic (and related Gompertz) S-curves outperform more complicated models. The logistic curve is linear and symmetric about its inflection point and only requires that two parameters be estimated. The Gompertz models are more flexible but are non-linear and thus more difficult to estimate. For a variety of reasons—small sample size, no inflection point yet in the cost share data of Table 5—the Gompertz S-curve models (not shown) did not converge to a solution when they were estimated. Thus our forecast relies on the following logistic S-curve where the share of all non-cash payments ($S_t = 1 - \text{cash share}$) is a function of time (t):¹³

$$(4) \quad \text{Logistic (linear, symmetric)} \quad \ln(S_t=(1 - S_t)) = a + bt + c.$$

In the logistic model, the pattern of initial and current cash replacement over 1988-2000 is used to predict the remaining pattern of replacement—which is the forecast.

The two estimated logistic models shown at the top of Table 6 are used, respectively, to generate the two cash share forecasts shown in the bottom half of this table.¹⁴ All the estimated parameters are statistically significant and the adjusted R^2 values for the logistic S-curves using the information from the econometric model (the last two rows of Table 5) have a good fit.

Of primary interest are the predicted shares for the five-year forecast to 2005. This suggests that cash use may continue to fall so that in five years the share of cash used at the point-of-sale may only account for 53% to 57% of the value of sales. The share of cash over 1990-2005 is illustrated at the top of Figure 1. The share of cash may fall by an average of from 1.3 to 1.6 percentage points a year over 2001-2005. This is a slower rate of decline than was experienced over

¹³ The parameter a is an intercept that determines the vertical position of the curve while b is the coefficient of diffusion or the slope of the S-curve. The variable S_t equals 1 minus the cash share since the maximum value of S_t in the logistic model is 1.0 while the minimum possible value of our cash share variable is zero.

¹⁴ A logistic curve using the shares from CASH/POSsales in Table 5, which had a smaller reduction from its peak than the other two share estimates, generated a very flat share forecast. The slope of this logistic curve was not significantly different from zero and the forecasted share for 2005 was slightly higher than the computed value shown in Table 5 for 2000.

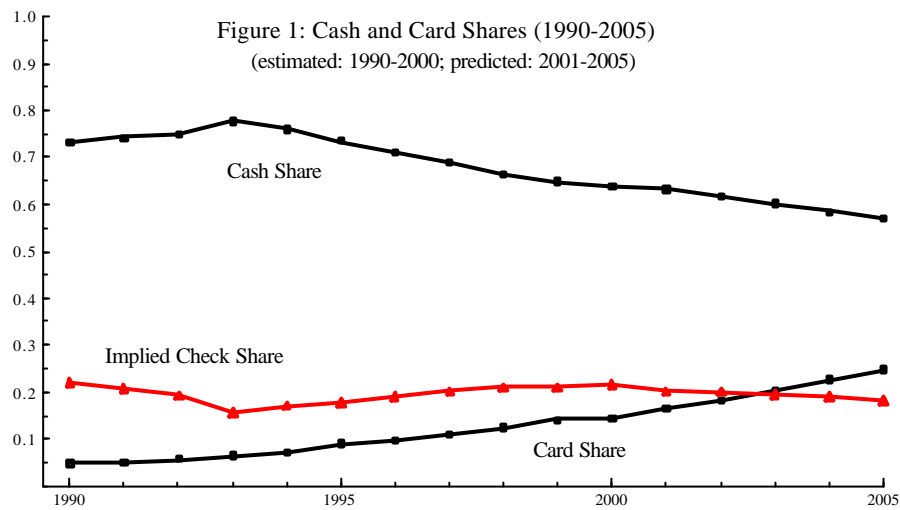


Figure 1:

1994-2000 in Table 5 after the peak in 1993 (where the yearly reduction was 2.0 to 2.4 percentage points). We now turn to what is almost the opposite of the cash share forecast—namely, a forecast of future card use in Spain.

5.2 Card Share Forecast.

The share of debit and credit cards in total point-of-sale transactions over 1990-2000 is shown in the bottom half of Figure 1. Over this period, the share of cards grew by an average of .9 percentage points annually, rising from only 4.8 percentage points in 1990 to 14.5 in 2000. Starting from a small base, the value of card payments rose almost five-fold during this period. The year-to-year change in share values has in all but one year been increasing absolutely, a pattern consistent with the first stage of technology diffusion in a logistic S-curve.

The result of fitting a logistic curve to the 1988-2000 card share data is also illustrated in Figure 1.¹⁵ This forecast suggests that the share of card payments in point-of-sale transactions may rise by 70% over 2001-2005, perhaps rising to 25% of all POS transactions. The implied share of checks in POS payments is determined from one minus the estimated cash and card shares and is essentially flat until 2000 and then starts to fall off. As more payment data becomes available over the next few years, the accuracy of these forecasts will improve. And, as an inflection point in the payment share data becomes

¹⁵The fitted relationship was tight (with an adjusted R² .98) and the coefficients were significant.

evident, it will be possible to predict the saturation point of card technology adoption and have a firmer idea on the minimum point of cash use. We now turn to the implication of these results for the Spanish banking system.

6 Conclusions and Implications.

Historically, cash has long been the primary payment instrument for consumer point-of-sale (POS) transactions and bill payments. Across countries, and relative to their level of GDP, Japan appears to rely on cash payments twice as much as does Europe. Europe, in turn, appears to rely on cash twice as much as does the U.S. Within Europe, Spain relies more heavily on cash and has fewer non-cash transactions per person than does Germany, Portugal, Sweden, or France.

Over the past 30 years, all of Europe has been moving away from cash for consumer transactions. Initially, this shift was primarily toward expanding check payments at the point-of-sale and increased use of paper-based giro transactions for bill payments. Later, debit cards started to replace checks as well as cash at the point-of-sale and cheaper electronic giro payments replaced its paper-based counterpart.

In Spain, checks importantly replaced many cash payments during the late 1980s. However, this situation reversed itself in the early 1990s as bank fees for check use rose to help offset higher interest rates paid on deposits. As a result, there was a shift back to cash and card use rose. During the mid to late 1990s debit and credit cards have made substantial inroads on cash and check use in Spain. Indeed, by a number of indicators, it appears that the share of cash in point-of-sale payments reached a local maximum value of 78% around 1993 and fell some 20% from this peak.¹⁶ By 2000, the share of cash had fallen to the low 60% level and our (logistic curve) projection suggests that it may fall by an additional 7 to 9 percentage points by 2005.

The expected reduction in the share of cash used in point-of-sale payments in Spain means that the share going to cards is expected to rise from a share of 14% in 2000 to a share of around 25% in 2005. While there has been some talk about the possibility of a card-based electronic "purse" replacing cash for many small value transactions, experiments and pilot projects in Europe have not been successful (Van Hove, 2000). Although some small value cards have successfully replaced cash in certain specialized applications (for phone, subway, and bus use), their application and acceptance will need to be much more broadly based to have any significant overall effect on the future use of cash. Currently and in the near term, this development will not significantly affect the level of cash use in Spain.

There are a number of implications for the banking system from these projected changes in payment instrument use in Spain. First, with the expected future reduction in the share of cash in point-of-sale payments, the current

¹⁶This is a local maximum since the share of cash was in the mid-80% range during the 1980s).

number of ATMs and small branch offices are likely to be sufficient (or close to sufficient) to meet the future demand for cash by depositors. While there can be other reasons for various banks to attempt to expand the density of their ATM and branch networks, in order to provide greater convenience for their current depositors and in trying to attract new depositors to expand their deposit market share, there seems to be little need to expand the density of these networks overall.

Second, the low and (likely) falling share of consumer checks in POS payments suggests that the relatively labor and transportation intensive process of processing and clearing checks will be reduced further in the future. Indeed, if check use falls absolutely over time, bank check processing operations will experience increasing unit costs. This is due to a reversal of volume-related processing economies of scale realized when check volumes were higher. Consequently, banks will have to consider raising the fees they directly (or implicitly) assess depositors for using checks. The reduction in check use over 1991-93, when fees on check use were raised earlier, suggest that consumers and businesses are sensitive to changes in the cost of using different payment instruments. Increases in check costs to users will merely speed the shift away from checks toward card use at the point-of-sale and toward electronic giro transactions for bill payments, disbursements, and interbusiness transactions.

Third, the expected rise in the share of (mostly debit) cards from 14% in 2000 to 25% of point-of-sale payments by 2005 would represent a 70% rise in card share. Such a large increase in card use requires substantial continued investment in electronic payment processing equipment and telecommunication capacity. As scale economies in electronic payments are quite large, the expected rise in debit card volume will result in a significant reduction in unit cost per transaction. Overall, banks should find that the per transaction cost of providing payment services will fall and contribute to improved profits and return on assets or equity.

Finally, as it costs only about .08 Euros to print a 100 Euro note, the government will obtain less seigniorage revenue from issuing new currency notes than it otherwise would if cash use grew at historical rates.¹⁷ In the more distant future, if cash use falls absolutely, the savings from not having to pay interest on outstanding cash holdings will fall and other revenue sources will have to be found to redeem currency as it is withdrawn from circulation. Should this start to occur, it may make sense for governments to consider the possibility of issuing euros in electronic form on a smart card, as is reportedly being considered by Singapore. In this way, future revenue losses may be minimized, consumers can continue to shift to more convenient and secure payment instruments, and—depending on how the arrangement works—the ability to evade taxes and engage in illegal activities may become more difficult.

¹⁷ This effect is mitigated to some degree by the fact that seigniorage revenues obtained by the Spanish government are not solely dependent on the value of Euros issued and used in Spain. The European Central Bank has devised a different formula for sharing the seigniorage revenues across Euro-using countries.

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