

The Impact of ATM Transactions and Cashless Payments on Cash Demand in Austria

Helmut Stix

The aims of this study are twofold: to determine the levels of cash inventories held by Austrians and to examine how ATM transactions and cashless payments affect their demand for cash.

The key results of this study are based on survey data on the cash withdrawal habits of Austrians aged 14 and over. The results suggest that the cash held by this group of individuals for transaction purposes accounts for only a relatively small share of the total cash in circulation (approximately 10%). Furthermore, it can be seen that individuals who use ATMs withdraw cash more frequently and consequently hold significantly smaller amounts of cash than individuals who do not use ATMs.

The study also deals with cashless payments, which were found to have had an impact on the use of cash: the share of cash payments has fallen since 2000 (projections suggest a decline of some 6 to 7 percentage points from 2000 to 2002). This development is attributable primarily to robust growth in debit card transactions. Despite the rise in cashless payments, currently the share of cash payments (in value terms) is likely to be above 70%, so that cash remains by far the most important means of payment in Austria.

The results of this study therefore show that ATM transactions and the increased use of cashless payments have had a significant impact on cash demand in Austria and will probably continue to do so in future. Since, however, cash withdrawal and payment habits are unlikely to change overnight, this development should not have much impact on monetary policy.

I Introduction

Although central banks keep detailed statistics on the development of monetary aggregates, owing to the anonymity of cash very little is known about individual cash demand, i.e. about who holds how much cash and for what purpose. This study aims to shed some light on this issue. Its goals are twofold: to determine the amounts of cash held by Austrians and to examine how ATM transactions and cashless payments affect their demand for cash.

From a central banking perspective, cash circulating in a monetary area that is used for transactions is of particular interest, as these holdings are directly related to economic activity and to price formation.¹ Since, however, a significant proportion of cash in circulation is hoarded, or circulates abroad, the level of transaction holdings and their development over time can be computed only indirectly on the basis of aggregate data. In addition, such estimates are made more difficult by sharp fluctuations in the stock of cash in circulation – a phe-

nomenon which emerged around the time the euro was introduced. This study will therefore attempt to determine cash demand and its determinants not on the basis of aggregate data but by using primary statistical information derived from microdata. Most of the results are therefore based on four surveys on the cash withdrawal habits of Austrians commissioned by the OeNB from May 2003 to February 2004. These surveys provide for an up-to-date and detailed picture of cash withdrawal habits and their implications for cash holding by Austrians.

This is of particular importance when seen against the backdrop of payment practices that are currently in the throes of transformation. For instance, growth in the total value of payments at point-of-sale (POS) terminals (debit card payments) from 2000 to 2003 was some 83%. At the same time, ATM transactions continued to register modest growth. The rise in cashless payments and increased ATM use raise the question of what impact this development has

¹ See Fischer et al. (2004).

on central banks from an economic perspective. For instance, it is argued that increased cash substitution could have implications for monetary policy.² In addition, declining cash demand reduces central banks' seigniorage revenues.³ To evaluate the significance of such effects, the current extent of cash substitution first needs to be quantified. However, relatively few studies in the current literature are available on this subject. The results, which are largely based on empirical analyses of macroeconomic time series, indicate a negative effect of card payments on the demand for cash, whereas the results relating to the effect of ATM transactions are less conclusive.⁴ In contrast, microeconomic studies point to a significantly negative impact of ATM transactions on the demand for cash. For the most part, however, these studies are based on relatively old data (Avery et al., 1986 for the U.S.A.; Boeschoten, 1992, for the Netherlands) and do not quantify the strength of the effect (Attanasio, et al., 2002 for Italy use data until 1995). For Austria, moreover, no current study is available. The focus of this study, therefore, is to examine the impact of ATM transactions and cashless payments on the demand for cash in Austria.

This study is structured as follows: First, a brief synopsis of growth in ATM withdrawals and POS (EFTPOS, electronic funds transfer at point of sale) payments will be presented in chapter 2. Chapter 3 starts with a dis-

cussion of the theoretical foundation of this study, followed by a description of the data used. In principle, ATM transactions and cashless payments can impact on cash holding in two ways. First, ATM transactions could speed up the velocity of cash in circulation. This implies that, for a given value of cash transactions, individuals hold lower average cash balances. Second, the option of cashless payments also changes the volume of transactions effected with cash, entailing changes in cash demand. This study will therefore discuss these two effects separately. First, different aspects of Austrians' cash withdrawal habits and the estimation results of a microeconomic cash demand function are analyzed (chapter 4). In a second step, the development of the share of cash payments (in value terms) in total transactions over the last few years is assessed in chapter 5. This will allow conclusions to be drawn about the change in the demand for cash caused by cashless payments. Chapter 6 concludes and summarizes the key results of this study.

2 Growth in POS Payments and ATM Transactions

Table 1 summarizes some key figures about the Austrian ATM and POS network. The total number of automated teller machines, i.e. ATMs (both ATMs outside banks and bank lobby ATMs), has grown considerably in the last few years, mainly triggered by the rise in the number of lobby

² For example, Markose and Loke (2003) argue that an impact on monetary transmission is possible: In an economy with an extensive payment card network, the extent of substitution between cash or POS payments responds very sensitively to changes in interest rates. This means that situations could arise where "... interest rate rises (cuts) targeted at curbing (expanding) bank lending may prove to be difficult" (ibid, p. 473).

³ Although this effect may be statically small, the discounted sum of reductions in future seigniorage revenues can be substantial.

⁴ Although many studies indicate a negative effect on cash demand, others do not establish a significant correlation. For an overview of the literature, see Stix (2004).

Table 1

ATM and POS Growth Rates ¹								
	ATMs	ATMs cash withdrawals	Annual change	POS terminals	Payment transactions	Annual change	Payments	Annual change
	number	number (million)	%	number	number (million)	%	EUR billion	%
1998	4,776	91.5	x	19,240	38.8	x	2.0	x
1999	5,338	96.1	5.0	28,763	58.1	49.7	3.2	57.5
2000	5,913	101.9	6.0	40,170	80.1	37.9	4.5	43.5
2001	6,622	107.0	5.0	58,073	105.6	31.8	5.9	29.6
2002	7,028	109.6	2.4	68,939	140.9	33.4	7.6	29.0
2003	7,499	111.4	1.6	86,200	158.3	12.3	8.3	9.1

Source: Data until 2001: ECB (2003). Data from 2002 onwards: Europay Austria.

¹ The number of automated teller machines refers to the number of operable ATMs outside banks, bank lobby ATMs and cash dispensers. The number of cash withdrawals comprises all ATM withdrawals and the portion of lobby withdrawals that is made by persons who do not hold an account at that bank.

ATMs. By contrast, the number of outdoor ATMs grew at a slower pace.

The development of growth rates of ATM transactions shown in table 1 suggests a slowdown. However, since these figures include only a portion of all lobby transactions, only limited conclusions about the growth in the number of all outside ATM and lobby transactions can be drawn from the data shown in table 1.⁵

The POS network has expanded strongly. This relates to both the number of POS terminals and to the number and volume of payment transactions. Recently, however, the total transaction value has grown at a slower pace (+9%) than in previous years when annual growth of roughly 30% was registered.

At a European level (ECB, 2003), Austria has the third-densest network of ATMs (after Spain and Portugal) in terms of the number of ATMs per inhabitant. The scenario for POS terminals is quite different. With only 7.1 terminals per 1,000 inhabitants, Austria is below the EU average of some 12 terminals.

On balance, these data allow one to conclude that the number of ATM

transactions – mainly due to the growth in lobby transactions – should continue to grow modestly. Although growth in POS volumes has recently slowed, this method of payment is likely to become increasingly important as the density of POS terminals increases.

3 Impact of ATM Transactions and Cashless Payments on Cash Demand

3.1 Theoretical Background

This study's conceptual and theoretical framework is based on the inventory-theoretic model of the transactions demand for cash proposed by Baumol (1952) and Tobin (1956).⁶ When deciding how frequently and, equivalently, how much to withdraw, consumers take two factors into account: the cost incurred per withdrawal (possibly including the opportunity cost of the time required per withdrawal) and forgone interest. Baumol and Tobin showed that the optimal withdrawal amount is proportional to the square root of the total value of transactions and indirectly proportional to the square root of interest rates. This means that if the transaction value

⁵ Transactions made by customers who withdraw money from their own bank lobby ATMs are not included. However, these transactions are likely to constitute the majority of all lobby transactions.

⁶ The original model assumed that cash is the sole means of payment, that expenditures are distributed equally over time and that there is no uncertainty about expenditures.

declines by 1%, the amount withdrawn will decline by 0.5%. Since average cash holdings in this model are half the withdrawal amount, this percentage change in the withdrawal amount implies the same percentage change in average cash balances.

ATM transactions and cashless payments affect optimal cash holdings in two ways. First, ATM transactions are likely to reduce the time-cost per withdrawal.⁷ In this event, consumers would withdraw cash more frequently and so hold smaller amounts of cash on average. However, it could also be that bank counter withdrawals are merely substituted by ATM transactions and that, all things considered, the number of withdrawals does not rise. The initial focus of this study is therefore the question of whether and to what extent ATM use affects withdrawal frequencies and hence the demand for cash.

Second, card payments permit direct access to the payer's account, which means that only part of total transactions is effected in cash. As shown by the literature, this decline in cash transactions has a proportional effect on optimal cash holdings (Markose and Loke, 2003). With a transaction elasticity of 0.5, for example, a 10% decline in the percentage share of cash payment yields a 5% decline in cash holdings.⁸ As a result, the percentage change in the demand for cash can be estimated provided the transaction elasticity of the demand for cash

and the rate of change in the share of cash payments are known. This issue is highlighted in the second part of this study.

3.2 Data Used

The results of the first part of this study are based largely on surveys commissioned by the OeNB on a quarterly basis from the second quarter of 2003 to the first quarter of 2004 and conducted by the Institute for Empirical Social Research (IFES). The target respondents in each of these individual surveys were selected from among a representative sample of 2,000 people living in Austria with a minimum age of 14 years. These four surveys are aggregated in the analysis below.

In accordance with the above-mentioned theoretical model, the demand for cash is determined by the frequency of withdrawals and by the amount withdrawn. Accordingly, survey participants were asked about their usual withdrawal amount, the frequency of their cash withdrawals from ATMs and at bank counters, and their regular cash acquisition from other sources.⁹ The answers regarding withdrawal frequencies are grouped into six categories ranging from "Several times a week" to "Less than once a month". Since it cannot be expected that respondents will remember how much cash they withdrew in the previous month (or their current average cash holdings), the survey question fo-

⁷ For a theoretical model, see Attanasio et al. (2002).

⁸ That ATM transactions make it easier to access cash means these could also affect the percentage share of cash payments (Markose and Loke, 2003). This effect is not examined in the present study.

⁹ The questions are: "Roughly how frequently or at what time intervals do you draw cash from ATMs? Approximately how often do you withdraw cash from your account or savings book directly at a bank counter?" "And what amount of cash do you usually withdraw? Please give an approximate or average figure." It should be pointed out that "ATM withdrawal" (the term used here) can also include withdrawals from bank lobby ATMs. For other sources of cash acquisition, the following question was posed: "Do you personally have any other regular sources of cash – e.g. from your parents, cash disbursements from wage or all pension payments, etc.?"

cuses on typical behavior.¹⁰ The average cash holding is then computed to be half the typical withdrawal amount plus minimum balances, the under-shooting of which triggers a further cash withdrawal.¹¹

The surveys are based on the subjective assessments of respondents, thus providing interesting insights into individuals' cash withdrawal behavior. However, these results can also be distorted by implausible answers. This is why cases with particularly high monthly withdrawal amounts (more than EUR 4,000) are not taken into account. Furthermore, there are respondents who did not answer parts of certain questions. Since these cases are not included in the analysis below, the sample under consideration fluctuates between 6,500 and 7,800 persons depending on the assessment.

4 Cash Withdrawal Behavior in Austria

Roughly 69% of all Austrians – or 94% of debit cardholders – use ATMs to draw cash. By contrast, only some 58% of Austrians regularly draw cash at bank counters. Moreover, 14% of respondents regularly acquire cash from other sources (e.g. from their parents, wage or pension payments). Closer examination shows that this applies particularly to young people who are on low incomes and/or in education (for instance, some 65% of all those in education and 24% of those under the age of 35 receive cash on

a regular basis). Although the surveys do not provide any information about the source of these funds, this demographic structure indicates that these payments come primarily from parents or close relatives.

An analysis of the total amount withdrawn indicates that about 53% of total cash withdrawn comes from ATMs and 37% from banks whereas the percentage share of other sources of cash acquisition is around 10%.¹² From an aggregated perspective, compensation in cash (which falls into the latter category) should already be included under ATM and bank withdrawals. For this reason, sources of cash other than ATMs or banks are not considered from table 3 onward.

4.1 Withdrawal Options Used

Table 2, which summarizes the relative percentage shares of individuals drawing cash exclusively from ATMs and those drawing cash exclusively at bank counters, provides insights into withdrawal preferences. This analysis shows that around 37% of respondents withdraw cash exclusively from ATMs, 26% exclusively at banks and 32% from both ATMs and at bank counters. 5% of respondents withdraw cash neither from ATMs nor from bank counters. The important role played by ATMs in cash withdrawal becomes clear if a closer look is taken at debit cardholders only. About half of this group withdraws its cash exclusively from ATMs.

¹⁰ This approach is followed by Avery et al. (1986).

¹¹ Data on minimum balances are available only from the survey for the first quarter of 2004. The calculation of average cash holdings assumes that these minimum balances can be used for all four surveys (i.e. that these minimum balances remain constant from May 2003 to February 2004). If individuals have several cash sources, the average cash holding was calculated to be half the sum of typical withdrawal amounts (Boeschoten, 1992).

¹² Excluding other sources of cash acquisition, ATM transactions account for a 59% share of total withdrawals. The above-mentioned figures are based on withdrawal frequency assumptions that are described in greater detail below (section 4.2).

Table 2

Use of Withdrawal Options

		Cash withdrawal			
		exclusively		both from	neither from
		from ATMs	from bank counters	ATMs and bank counters	ATMs nor from bank counters
		% of respondents			
Total		37	26	32	5
Gender	female	36	29	29	6
	male	37	23	35	4
Income	quartile 1	32	37	25	6
	quartile 2	34	31	31	3
	quartile 3	38	22	37	2
	quartile 4	44	13	41	2
Age	up to 35	47	13	33	6
	35 to 44	45	16	37	2
	45 to 54	38	21	36	4
	55 to 64	32	31	33	4
	65+	15	59	20	6
Education	compulsory school education	30	34	29	6
	senior technical school/high school	37	23	37	3
	high school graduate/college/university	52	10	35	2
Place of residence	up to 3,000 inhabitants	31	30	35	5
	from 3,000 to 5,000 inhabitants	35	29	31	4
	from 5,000 to 50,000 inhabitants	39	26	30	5
	from 50,000 to 1 million inhabitants	51	19	24	6
	more than 1 million inhabitants (Vienna)	34	25	36	5
Card ownership	debit card	50	5	44	1

Source: OeNB.

Table 2 reveals that the choice of withdrawal options varies between different demographic groups. For instance, the choice between ATM withdrawal and bank withdrawal correlates with age: whereas only 15% of respondents above the age of 65 withdraw cash exclusively from ATMs, 59% choose to withdraw exclusively at bank counters. For respondents below the age of 35, however, the picture is the reverse. In this group, 47% withdraw cash exclusively from ATMs and 13% exclusively at bank counters. Furthermore, the figures in table 2 indicate a positive correlation between income and ATM use, as well as between education and ATM use.

Furthermore, it is to be expected that ATM use also depends on sup-

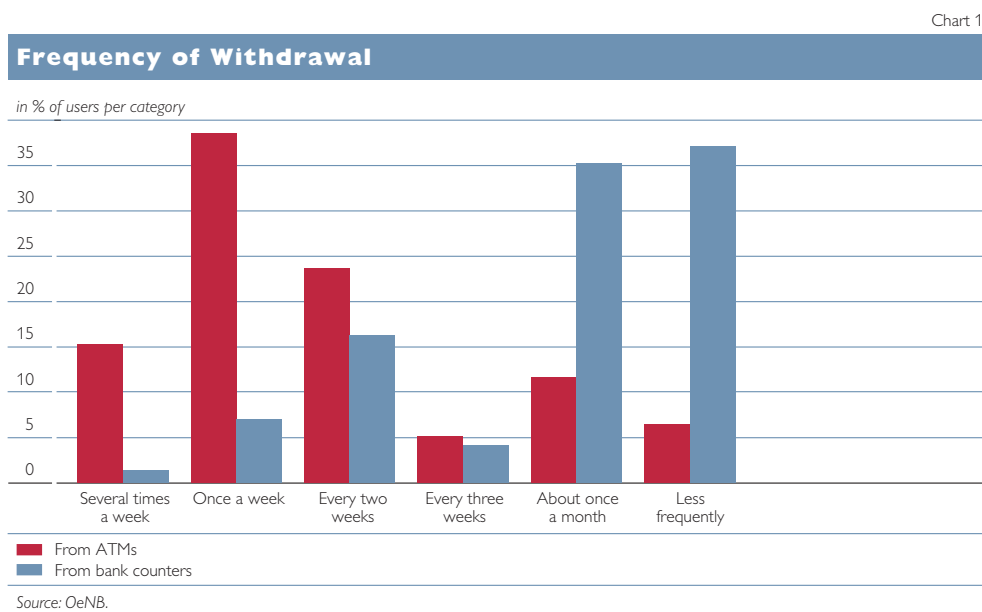
ply-side effects (e.g. the density of ATM and bank networks).¹³ As the surveys do not provide information on this count, this association will be analyzed in terms of the size of place of residence. This accordingly shows that in small localities (less than 3,000 inhabitants) the percentage share of individuals withdrawing cash exclusively from ATMs is less than the Austrian average. By contrast, in towns of 50,000 to 1 million inhabitants this figure exceeds the Austrian average by a wide margin. Interestingly, this does not apply to Vienna where the percentage share of individuals drawing cash exclusively from ATMs is below the Austrian average. Most likely, this is attributable to Vienna's relatively dense network of bank branches.

¹³ Another crucial factor is the withdrawal cost incurred at ATMs relative to those incurred at bank counters. Owing to a lack of data, this factor is not analyzed in the present study.

4.2 Cash Withdrawal Frequency

As ATM or bank withdrawals vary substantially among individuals, we will analyze the frequency of cash withdrawal in a next step. Chart 1 shows a breakdown of answers on withdrawal frequencies ranging from “Less than once a month” to “Several times a week.” Accordingly, 38% of individuals

who use debit cards withdraw cash about once a week, 23% every two weeks and 15% several times a week. Conversely, cash withdrawals at bank counters show a different picture: here, the answers indicate that 35% of the respondents withdraw cash roughly once a month and 37% even more rarely.



However, these figures also include individuals who use both forms of cash withdrawal. If only those respondents who draw cash exclusively from ATMs or exclusively at bank counters are considered, the surveys show that about 82% of (exclusive) ATM users withdraw cash at least every two weeks whereas the percentage share of those withdrawing cash (exclusively) at bank counters is 40%.

The qualitative data on withdrawal frequencies can be converted into quantitative values (withdrawals per month). However, to this end it is necessary to make assumptions about the frequency of use for those categories

to which a definite frequency cannot be allocated. These assumptions were selected as follows: For “Several times a week”, it was assumed that respondents withdraw cash twice a week. For “Less than once a month,” it was assumed that they do so every second month.¹⁴ The resulting withdrawal frequencies per month are summarized in table 3.

This shows that respondents withdraw cash some 3.4 times on average (median: 2.7 times) a month, which is equivalent to an interval of some 9 days between two withdrawals. If we take a look at ATM users and those who do not use ATMs, this shows a

¹⁴ It should be underlined that these assumptions influence both the velocity of cash in circulation calculated below and the estimation results. However, the qualitative results of this study are not affected.

Table 3

Number of Withdrawals and Withdrawal Amounts¹

	Withdrawals per month		Average amount withdrawn			
	average number	median	only from ATMs		only from bank counters	
			average	median	average	median
EUR						
Total	3.4	2.7	166	100	412	300
Gender						
female	3.2	2.2	165	100	398	300
male	3.6	2.7	168	150	432	300
Income						
quartile 1	3.1	2.2	140	100	355	300
quartile 2	3.3	2.2	163	100	418	300
quartile 3	3.5	2.7	173	120	485	400
quartile 4	3.9	3.6	183	150	515	400
Age						
up to 35	4.3	4.3	113	100	267	200
35 to 44	4.0	4.3	169	150	325	200
45 to 54	3.5	2.7	191	150	399	300
55 to 64	2.8	2.2	215	200	453	400
65+	1.9	1.4	262	300	464	400
Education						
compulsory school education	3.0	2.2	179	150	396	300
senior technical school/ high school	3.6	2.7	158	100	456	300
high school graduate/ college/university	4.2	4.3	151	100	462	300
Card use						
uses ATMs	4.0	4.3	x	x	x	x
uses only ATMs	3.8	4.3	x	x	x	x
withdraws only from counters	1.8	1.0	x	x	x	x
uses both	4.3	4.3	x	x	x	x

Source: OeNB.

¹ The sample comprises only individuals who acquire cash only from ATMs and bank counters.

frequency of use of 4 and 1.8 times per month respectively (median: 4.3 withdrawals versus 1 withdrawal). This means that on average ATM users draw cash approximately twice as frequently as non-ATM users. The group comprising individuals who use both options has the highest withdrawal frequency (4.3 times a month). Once again, demographic differences can be seen, with younger people withdrawing cash more frequently than the elderly and persons in higher income categories withdrawing cash more frequently than those in lower income categories.

As mentioned before, only a limited number of comparable studies are currently available. For instance, Attanasio et al. (2002) find that Italians used their debit cards to withdraw cash 4.2 times a month in 1995. For the Netherlands, Boeschoten (1992) finds that individuals withdrawing cash

primarily via ATMs in 1990 had a monthly withdrawal frequency of 3.9. In general, Boeschoten finds that this group withdrew cash approximately 35% more frequently (and cash amounts were some 35% smaller per withdrawal) than that not withdrawing at ATMs. Older data going back to 1986 for the U.S.A. (Avery et al., 1986) yield a similar value of 4.3 withdrawals per month for individuals who usually withdrew cash primarily via ATMs. The relevant comparable figures for Austria are 4 (see Attanasio et al., 2002) and 4.16 withdrawals per month (see the last two studies cited). In view of the fact that it is difficult to compare payment systems of different countries and that interest rate levels differed (the level of interest rates influences the frequency of cash withdrawal), the results for Austria may be considered comparable.

4.3 Withdrawal Amounts

Average withdrawal amounts for respondents who made withdrawals exclusively from ATMs or exclusively at bank counters are also summarized in table 3. As expected, the roughly twice-as-high withdrawal frequency found among ATM-only users is reflected in the level of the withdrawal amount, which is some EUR 166 per cash withdrawal. Individuals who do not use debit cards draw EUR 412 on average. Since the survey questions about withdrawal amounts refer

to typical regular behavior, the use of the median amount appears to be more appropriate. This is EUR 100 for ATM-only users whereas the median for bank counter withdrawals is EUR 300. It can therefore be seen that ATM transactions result in a significantly higher withdrawal frequency and in lower amounts withdrawn.

4.4 Average Cash Holding

The results for average cash balances (based on respondents' answers) are summarized in table 4.

Table 4

Average Cash Balances ¹		Average	Median
		EUR	
Total		215	155
Gender	female	202	155
	male	230	155
Income	quartile 1	175	115
	quartile 2	211	155
	quartile 3	231	180
	quartile 4	254	185
Age	up to 35	143	90
	35 to 44	208	130
	45 to 54	230	180
	55 to 64	255	200
	65+	281	230
Education	compulsory school education	217	175
	senior technical school/high school	233	155
	high school graduate/college/university	196	115
Place of residence	up to 3,000 inhabitants	216	155
	from 3,000 to 5,000 inhabitants	225	155
	from 5,000 to 50,000 inhabitants	206	155
	from 50,000 to 1 million inhabitants	189	130
	more than 1 million inhabitants (Vienna)	242	165
Card use	pays with debit card less than once a month	246	180
	pays with debit card at least once a month	191	115
	uses ATMs	202	130
	uses only ATMs	116	78
	draws cash only from counter	252	180
	uses both forms	312	230

Source: OeNB.

¹ Average cash balances were calculated on the basis of data on the typical withdrawal amount and include minimum cash balances, the undershooting of which triggers a further cash withdrawal. Since data on minimum balances are only available from the February 2004 survey, it was assumed that the average value of the minimum holding is the same for each population group as that of February 2004. The sample comprises only individuals who acquire cash only from ATMs and bank counters.

The table shows that individuals hold an average of EUR 215. Thus, for all Austrians aged 14 years and over, the survey results imply cash

holdings of some EUR 1.3 billion. This is roughly equivalent to a share of 10% of the cash in circulation prior to the introduction of the euro.¹⁵ If

¹⁵ As data on national banknote circulation are no longer available since the euro's introduction, we use cash in circulation at the end of 2000 as a reference.

these results are not statistically distorted, they imply that only a relatively small share of cash in circulation is actually used for transactions. This tallies with results of Boeschoten (1992) for the Netherlands and with those of Paunonen and Jyrkönen (2002) for Finland, who report similar values.¹⁶ In contrast, Fischer et al. (2004) estimate that the share of the transactions demand for cash in euro-area member states' cash in circulation is likely to range between 25% and 40%. If one considers first that the estimate of 10% for Austria reflects only regular withdrawal behavior and, second, that cash holdings of business enterprises and of respondents below the age of 14 are not covered, the share of the transactions demand for cash in total currency in circulation could be at the lower end of the estimate calculated by Fischer et al. (2004).¹⁷ This implies that most of the cash in circulation is either being hoarded and/or being held abroad.

In addition to the expected effects (arising from the previous discussion) on the average cash holding of ATM users, table 4 also shows that, for individuals who make at least one cashless payment per month at a debit card POS terminal, the average cash holding is 23% lower than for that of the relevant comparable group. Furthermore, cash holdings correlate positively with income and age, as they do, to some extent, negatively with the level of education.

From a monetary perspective, the velocity of cash in circulation is of interest. This is defined as total cash expenditures divided by average cash holdings over a certain period of time (in this instance, a month). A higher velocity of circulation means that each euro in circulation enables cash transactions of a correspondingly higher value. In this sense, the velocity of cash in circulation measures the efficiency of cash as a means of payment.

The velocity of cash in circulation thus calculated implies that cash circulates 3.4 times per month, or approximately 41 times a year.¹⁸ Considerable differences within the population are also evident here. For instance, the velocity of cash in circulation for ATM users is 3.8 whereas it is around 2.8 for individuals who withdraw cash exclusively at banks.

Taken together, the results found thus far indicate that the use of ATMs is associated with higher frequencies of withdrawal and thus with lower cash holdings. Moreover, there appear to be differences in the cash holdings depending on sociodemographic characteristics (e.g. age, income and education). However, since the total value of transactions differ between the population groups, definitive conclusions about the effects of these characteristics on cash holdings cannot be drawn from the purely descriptive presentation. The estimation results of multivariate cash demand functions are therefore discussed next.

¹⁶ Paunonen and Jyrkönen (2002) estimate that about 11% to 12% of Finnish cash in circulation is used by households for transactions. Boeschoten (1992) estimates a share of some 12% for the Dutch population as a whole.

¹⁷ According to unpublished estimates calculated by the OeNB around the time at which the euro was introduced, business enterprises are likely to hold some 8% to 9% of total cash in circulation. To this amount one has to add the cash holdings of those under the age of 14 as well as the sum of cash lost or unaccounted for.

¹⁸ The velocity of cash in circulation reported here does not relate to the average velocity of circulation but to its aggregated equivalent (total expenditure divided by total average cash holdings). Furthermore, it is assumed that cash will actually be spent, not hoarded or repaid into a savings book or account.

4.5 Impact of ATM Use on Cash Demand

To calculate the impact of ATM use on cash demand, average cash holdings are regressed on the monthly volume of cash transactions. The regression equations also include sociodemographic variables. A positive coefficient means that, given a certain transaction volume, average cash holdings are bigger, or conversely, that cash is withdrawn less frequently.¹⁹

The results presented in table 5 only cover individuals who draw cash either exclusively from ATMs or exclusively at banks. Since many survey participants do not have a personal income or have not declared this, two specifications (in each case, including and excluding income) are estimated. In each of these two specifications, the coefficient of the “ATM use” dummy variable measures the percentage change in cash holdings if a person uses an ATM.

Table 5

Estimation Results ¹				
Dependent Variable: Log(Average Cash Holding)				
	Specification 1		Specification 2 (with personal income)	
Constant	0.902***	(0.087)	0.349**	(0.171)
Log(amount withdrawn)	0.552***	(0.012)	0.560***	(0.015)
Age	0.012***	(0.001)	0.012***	(0.001)
Head of household	-0.027	(0.025)	-0.050*	(0.029)
Size of family	0.009	(0.019)	0.011	(0.023)
Men	-0.001	(0.022)	-0.021	(0.025)
Secondary education	-0.034	(0.023)	-0.062**	(0.027)
Higher education	-0.087***	(0.023)	-0.118***	(0.030)
City	0.083	(0.066)	0.029	(0.063)
Small town	0.107*	(0.059)	0.044	(0.058)
Medium-sized town	0.140**	(0.065)	0.094	(0.063)
Large town	0.059	(0.063)	0.036	(0.056)
In education	-0.234***	(0.053)	-0.065	(0.110)
Jobless	-0.079	(0.048)	-0.062	(0.055)
Retired	-0.001	(0.033)	0.027	(0.039)
Household worker	0.050	(0.036)	0.139**	(0.069)
Agricultural worker	0.228***	(0.072)	0.331***	(0.116)
Business enterprise owner	0.115*	(0.060)	0.086	(0.080)
Log(income)			0.086***	(0.025)
ATM usage	-0.573***	(0.023)	-0.594***	(0.028)
R ²	0.58		0.58	
Observations	4,361		2,994	

Source: OeNB.
¹ OLS estimates, robust standard errors in parentheses. *** (**) [*] denote the significance at 1% (5%) [10%]. The dependent variable was calculated survey responses. The sample includes individuals who withdraw cash exclusively from ATMs or exclusively from banks. The results of time dummies and region dummies are not shown.

Irrespective of the specification, the results show that, at the same transaction value, ATM users hold considerably less cash. The point estimates imply that individuals who draw cash exclusively from ATMs have cash holdings that are on average around

42% lower than those of individuals who draw cash exclusively at banks.

The results for the transaction elasticity indicate the presence of economies of scale: a 1% increase in the volume of cash transactions results in an approximately 0.6% increase in

¹⁹ This specification is similar to that of Boeschoten (1992). Since tests have shown that there is no sample selectivity, the equations were estimated using ordinary least squares (OLS). As data on minimum balances are only available for the last survey, the dependent variable was calculated excluding minimum balances.

cash holdings, with the point estimates found to be within the theoretically predicted range.²⁰ Furthermore, the estimation results confirm the previous assumption that cash holdings increase significantly with age. The coefficients of the other variables indicate the effect of the opportunity cost of time: for instance, individuals with higher education who presumably have a higher opportunity cost of time (compensation per hour worked) hold some 8% less cash than people with less education. The coefficients of dummy variables, measuring the employment effect, can also be interpreted in this way.²¹ For instance, individuals in education have cash holdings that are 21% lower than those held by employed persons. By contrast, individuals employed in agriculture and owners of small business enterprises have cash holdings that are 26% and 12% higher respectively than those of individuals in other types of employment.

In the second specification, only individuals disposing of their own income are considered, as a result of which the number of observations is far smaller. The significantly positive coefficient for the level of income again indicates the effect of the time-cost per withdrawal. Individuals on higher incomes incur a higher cost per withdrawal because of the opportunity cost of time and so, for the same transaction amount, draw cash less frequently than individuals on lower incomes. Although in this specification, the effect of other sociodemographic variables is essentially the same, the significance of some of the

results changes. For instance, it can be seen that owners of small business enterprises do not hold significantly higher amounts of cash. By contrast, the effect of those in household employment is significantly positive. Furthermore, individuals with secondary education also have lower cash holdings than those with less school education.

Taken together, the results indicate that only a small number of socio-demographic characteristics have an impact on cash holding. These are essentially likely to be age, education and income. Moreover, ATM use has a quantitatively significant impact on the demand for cash. This is likely to be because the time-cost per ATM withdrawal is lower, which means that cash is drawn more frequently on the whole. This helps to economize on cash balances. If the frequency of ATM use changes, a significant impact on the demand for cash can be expected accordingly.

5 Decline in Cash Usage and Cash Demand Owing to Growth in POS Payments

A further significant effect on cash holdings can be caused by cashless payments. Since the last few years have seen a steep rise in payments via POS terminals, it would be interesting to assess the extent to which this development has affected both the use of cash and the demand for cash by households. This chapter therefore presents such an assessment.

Just as for cash holdings, there is not much direct evidence on the use

²⁰ In various different expansions of the Baumol-Tobin model, the transaction elasticity can range between one-third and two-thirds.

²¹ The dummy variables in education, pensions, household employment, agricultural employment and owners of small business enterprises measure the effect relative to other individuals in employment.

Table 6

Growth in Cash Share of Transactions Amount							
	Share in value of transactions 2000	Growth rate		Projected payment shares		Projected change	
		2000 to 2002	2000 to 2003	Assumption: private consumption growth ¹ 2002	Assumption: growth in retail sales ¹ 2002		
	%					percentage points	
Cash	81,5	x	x	76,1 to 76,7	75,1 to 75,6	-6,4 to -4,8	
Check	2,9	-23	x	0,0	0,0	-2,9	
ATM card	11,1	67	83	17,6	18,4	6,5 to 7,3	
Credit card	2,6	35	x	3,4	3,5	0,7 to 0,9	
Loyalty card	1,9	x	x	1,9 to 2,4	1,9 to 2,5	0,0 to 0,6	
Quick card	0,1	772	668	0,5	0,5	0,4	

Source: for 2000 shares: Mooslechner et al. (2002); for growth in volumes: Europay Austria and OeNB.

¹ The 2002 cash payment shares are projected on the basis of the assumed growth in total payments (total payments grow either in line with private consumption, 5.5%, or in line with retail sales excluding motor vehicles, 1.5%) and on the basis of the assumed growth of loyalty card and check payments. The shares thus calculated are an approximate projection.

of different payment methods. Indirect evidence drawn from survey data must therefore be relied on. The OeNB, for instance, conducted surveys in 1996 and 2000 on the use of various payment methods by Austrian households (Mooslechner and Wehinger, 1997; Mooslechner et al., 2002). According to these surveys, debit card payments rose sharply from 2.5% to 11.5% of total payments from 1996 to 2000 whereas the percentage share of check payments and that of credit card payments suffered a steep and a modest decline respectively. Cash payments fell from 84.4% to 81.5% of total payments (in value terms).

The evolution of payment methods since 2000 are summarized in table 6. These data are based on figures published in the Blue Book of the European Central Bank (ECB), which are available only until 2002. Figures for 2003 are currently available only for debit card and Quick payments.

The percentage shares of different payment methods computed from the 2000 survey can be used in conjunction with data on the growth in the different types of payments to extrapolate the current percentage shares of different payment methods for 2002 and 2003. This is based on the consideration that the share of cash payments follows residually from the rise in total transaction value and from the growth in the value of cashless payments. In practice, however, it should be qualified that such a calculation only allows for a rough estimate. There are several reasons for this. First, the shares computed for 2000 are based on survey results which themselves have a certain range of fluctuation. Second, the growth in payment method turnover must be known. However, the growth rates (cited in table 6) of check transactions are likely to reflect primarily check payments by business enterprises.²² Likewise, data from the Blue Book do not provide any insights into the growth of loyalty cards. Several

²² Although data are not available, checks, since the lapse of the check guarantee, are increasingly likely to play only a marginal role in the payment habits of households. For instance, only some 0.8 check transactions (including checks written by business enterprises) per inhabitant per year were made in 2002 (ECB, 2003).

scenarios about the assumed trends of these two payment methods are therefore analyzed below.²³ Third, this calculation requires an estimated growth rate of the total transaction value, i.e. all the cash and noncash private purchases and payments of Austrians. Although these are not directly available, they can be roughly estimated by nominal private consumption growth and retail sales growth.²⁴

The payment shares for 2002 arising from these considerations are summarized in table 6. As is apparent, the share of cash payments – depending on the assumed growth rate of total transactions – posted a decline of between 5 and 6 percentage points. In absolute terms, the share of cash payments in 2002 is likely to have been between 75% and 77%. With a share of 18%, debit card payments registered the steepest rise. The more-than-sevenfold increase in Quick payments led to a rise in the share of Quick payments to some 0.5%. Since debit card payments grew by 9% between 2002 and 2003, an attempt was also made to project the payment shares for 2003. This projection shows that the share of cash transactions at the end of 2003 is likely to have been in the range of 74% to 75%. However, since data on credit card transaction values are not yet available for 2003, this estimate is less reliable than that for 2002.

Despite the caution required in interpreting these results, some trends are nevertheless evident. First, although the share of cash payments is declining, at the end of 2003 it is still likely to have been well in excess of 70%.²⁵ Second, the decline in the use of cash can be attributed primarily to the growth in debit card payments. Third, conclusions about the change in the transactions demand for cash can be drawn from the increase in cashless payments.²⁶ Here simulations show that nominal cash expenditures were declining from 2000 to 2002. At a rough estimate, the rate of change per assumed scenario is between –1% and –7%. Since the transaction elasticity estimated in section 4.5 should range between 0.5 and 0.6, this trend implies a decline in cash demand of some –0.5% to –4%.

6 Summary and Conclusions

This study has examined the impact of ATM transactions and cashless payments on the demand for cash. In addition, it has analyzed the cash withdrawal behavior of Austrians, and, in particular, the impact of ATM transactions on cash balances. Owing to the substantial growth in POS payments, this study also examined the impact of this development on the use of cash. A feature shared by both these aspects is that the analysis is not based

²³ It is assumed that the percentage share of check payments has declined to zero. By contrast, it is assumed that the transaction value of loyalty cards will grow either in line with credit card transactions or total transactions.

²⁴ It is assumed implicitly that there were no significant shifts from payment methods that were not included in the survey of 2000 (e.g. payment slips) to payments methods that were included.

²⁵ Should check payments by households still account for a notable share, then the cash share would fall by about the check share. As it can be assumed that the check share has definitely not increased since 2002, the share of cash payments should not be less than 70%.

²⁶ Normally, nominal cash demand rises with nominal transactions growth. If, however, the increase in cashless payments outstrips the nominal growth of all (cash and noncash) transactions, the nominal value of cash transactions can decline.

on aggregate time series data but on survey data.

The findings on the cash withdrawal behavior of Austrians indicate that cash held by Austrians aged 14 and over for transaction purposes accounts for only a relatively small share of total cash in circulation (approximately 10%). Furthermore, it was found that increased ATM use has significant and substantial effects on the demand for cash. For instance, the regression results show that individuals who withdraw cash exclusively from ATMs hold cash inventories that are on average 42% lower than those who do not use ATMs. The results based on a rough estimate of the share of cash payments show that cash in 2002 probably accounted for a share (in value terms) of between 75% and 77%. Compared with 2000, this means the share of cash payments registered a decline of some 6 to 7 percentage points, primarily due to the robust growth in debit card payments.

The results of this study therefore indicate that ATM transactions and the increased use of cashless payments had a significant impact on the demand for cash in Austria and will probably continue to do so in future. This is to be expected, first of all since the number of ATM and lobby transactions contin-

ues to grow in Austria. Furthermore, younger people use ATMs more frequently than the elderly. If younger people do not change their habits in the future, this would likewise imply a future rise in the number of ATM transactions. Second, Austria ranks among those countries in Europe with a high share of cash payments, a relatively low density of POS terminals and a low frequency of POS payments. By contrast, it is estimated that the share of cash payments in countries such as Finland or France, where cashless payments are very frequent, is around 60% (Snellman et al., 2001). The decline in Austria's share of cash payments can therefore be interpreted as a development which puts Austria in line with other countries which have made greater progress down this road.

As far as ATM use and cashless payments are concerned, some countries in the euro area are at the same stage of development as Austria. The results of this study therefore imply that, for the euro area as a whole, the transaction demand for cash will also be affected by ATM transactions and cashless payments. However, since cash withdrawal and payments behavior will not change overnight, this development is unlikely to have an impact on monetary policy.

References

- Attanasio, O., T. Jappelli and L. Guiso. 2002.** The Demand for Money, Financial Innovation, and the Welfare Cost of Inflation: An Analysis with Household Data. In: *Journal of Political Economy* 110 (2). 317–351.
- Avery, R., G. E. Elliehausen, A. B. Kennickell and P. A. Spindt. 1986.** The Use of Cash and Transaction Accounts by American Families. In: *Federal Reserve Bulletin* 72(2). 87–108.
- Baumol, W. J. 1952.** The Transaction Demand for Cash: An Inventory Theoretic Approach. In: *Quarterly Journal of Economics* 66. November: 545–556.
- Boeschoten, W. C. 1992.** Currency Use and Payment Patterns. In: *Financial and Monetary Policy Studies*. Vol. 23. Dordrecht. The Netherlands: Kluwer Academic Publishers.

- ECB. 2003.** Payment and Securities Settlement Systems in the European Union Addendum Incorporating 2001 Figures. Blue Book. September. <http://www.ecb.int/pub/bluebook/bluebook.htm>.
- Fischer, B., P. Köhler and F. Seitz. 2004.** The Demand for Euro Area Currencies – Past, Present and Future. Forthcoming ECB Working Paper.
- Knell, M. and H. Stix. 2003.** How Robust are Money Demand Estimations? A Meta-Analytic Approach. OeNB Working Paper 81.
- Markose, S. M. and Y. J. Loke. 2003.** Network Effects on Cash-Card Substitution in Transactions and Low Interest Rate Regimes. In: *The Economic Journal* 113. April. 456–476.
- Mooslechner, P. and G. Wehinger. 1997.** Aspekte des Zahlungsverhaltens privater Haushalte in Österreich. In: *Berichte und Studien* 4/1997. 44–65.
- Mooslechner, P., H. Stix and K. Wagner. 2002.** Austrian Households' Payment Habits - Results of a Study on the Use of Payment Cards and the Structure of Payment Transactions in 2000. In: *Focus on Austria* 1/2002. 89–117.
- Paunonen, H. and H. Jyrkönen. 2002.** Cash Usage in Finland – How Much Can be Explained? Bank of Finland Discussion Paper 10/2002.
- Snellman, J., J. Vesala and D. Humphrey. 2001.** Substitution of Noncash Payment Instruments for Cash in Europe. In: *Journal of Financial Services Research* 19 (2–3). 131–145.
- Stix, H. 2004.** How Do Debit Cards Affect Cash Demand? Survey Data Evidence. Forthcoming in *Empirica*.
- Tobin, J. 1956.** The Interest-Elasticity of Transactions Demand for Cash. *Review of Economics and Statistics* 38(3). 241–247.