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by Francesco Columba

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TRANSACTION TECHNOLOGY INNOVATION AND DEMAND FOR OVERNIGHT DEPOSITS IN ITALY

by Francesco Columba*

Abstract

The objective of this paper is to analyze the effect of transaction technology innovation on the demand for overnight (i.e. demand) deposits in Italy. The rapid diffusion of ATM and POS during the last decade may have helped to change money demand patterns and therefore standard econometric analysis that do not account for these developments may suffer from an omitted variable problem. Using data on 95 Italian provinces from 1991 to 1999, I find that transaction technology innovation has a positive effect on overnight deposits. Accounting for this innovation in the regressions reduces the estimated income elasticity. Panel analysis which exploits the cross-section heterogeneity seems to give interesting insights.

JEL classification: E41.

Keywords: demand for money, omitted variables, transaction technology.

Contents

* Bank of Italy, Economic Research Department and University of Rome, Tor Vergata.

1. Introduction [1]

Krueger: "Have you thought much about how debit cards and the kind of new financial products that are available, how that alters the situation?'" (i.e. the money demand function). Baumol: "No, but you've just given me an idea. It's the next thing I'll think about"[2].

The last two decades have witnessed a wave of innovations in transaction technology (Automated Teller Machines (ATMs), Points of Sale (POS), credit cards). Between 1991 and 1999 in Italy the number of ATMs and of POS increased at an average annual rate of 18.4 and 98.4 per cent respectively and most of the euro-area countries have experienced a similar, rapid diffusion of these new technologies. Financial and transaction technology innovation has been considered relevant for the analysis of the stability properties of monetary aggregates. However, partly owing to the fact that the phenomenon has gained relevance only in relatively recent years (especially POS) there have been relatively few attempts to account for it, particularly within the framework of traditional time series analysis. The omission of proxies for this kind of innovation from money demand equations may bias the estimated parameters, particularly the income elasticity and hence the velocity of money, and suggests a potential impact on euro-area monetary aggregates that deserves careful scrutiny.

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[2] Krueger (2001).

To investigate this issue we analyze the effect of the spread of ATMs and POS on overnight deposits[3], by far the most prominent component of the monetary aggregate M3[4]. We use a panel data set comprising 95 Italian provinces from 1991 to 1999 which allows us to exploit the cross-section variability of the data and to overcome some of the problems linked to a potential aggregation bias of the estimates based on national data. To our knowledge, the effect of transaction technology innovation on Italian monetary aggregates has been explored partially and with reference to ATMs and credit cards but not to POS[5].

ATMs allows easier cash withdrawals from overnight deposits, altering the ratio between the cost of holding cash and the cost of holding overnight deposits. The POS technology allows the card holder to buy items by debiting immediately his bank account; POS purchases are an alternative to cheques but also to cash because the payment is irreversible. A theoretical model by Paroush and Ruthenberg (1986) suggests that the introduction of ATMs should increase the share of demand deposits at the expense of currency holdings, under the assumption that the cost of holding demand deposits is reduced with the introduction of ATMs. I expect the effect of POS to be similar to that of ATMs[6]. In a Baumol-Tobin model perspective the lower cost should be the result of the decrease in time, and hence in transaction cost, necessary to draw on a demand deposit. Indeed, their empirical findings are in line with the a priori: more ATMs lead to a higher level of demand deposit holdings and a lower level of currency holdings. According to Zilberfarb (1989) the assumption that the cost of holding demand deposits is reduced with the introduction of ATMs must be empirically tested and therefore the sign of the effect of ATMs on demand

[3] Overnight deposits in the European Central Bank definition of the euro-area monetary aggregates are deposits held by the public, i.e., using a different terminology, demand or sight deposits.

[4] Overnight deposits, in September 2002, accounted for 89 per cent of the Italian component of the euro-area M1 and 53 per cent of the Italian component of euro-area M3. In the euro-area monetary aggregates overnight deposits accounted for 87 per cent of M1 and 35 per cent of M3. Italian contributions to M1 and M3 accounted for 20 and 14 per cent of euro-area M1 and M3 respectively.

[5] See Attanasio, Guiso and Jappelli (2002).

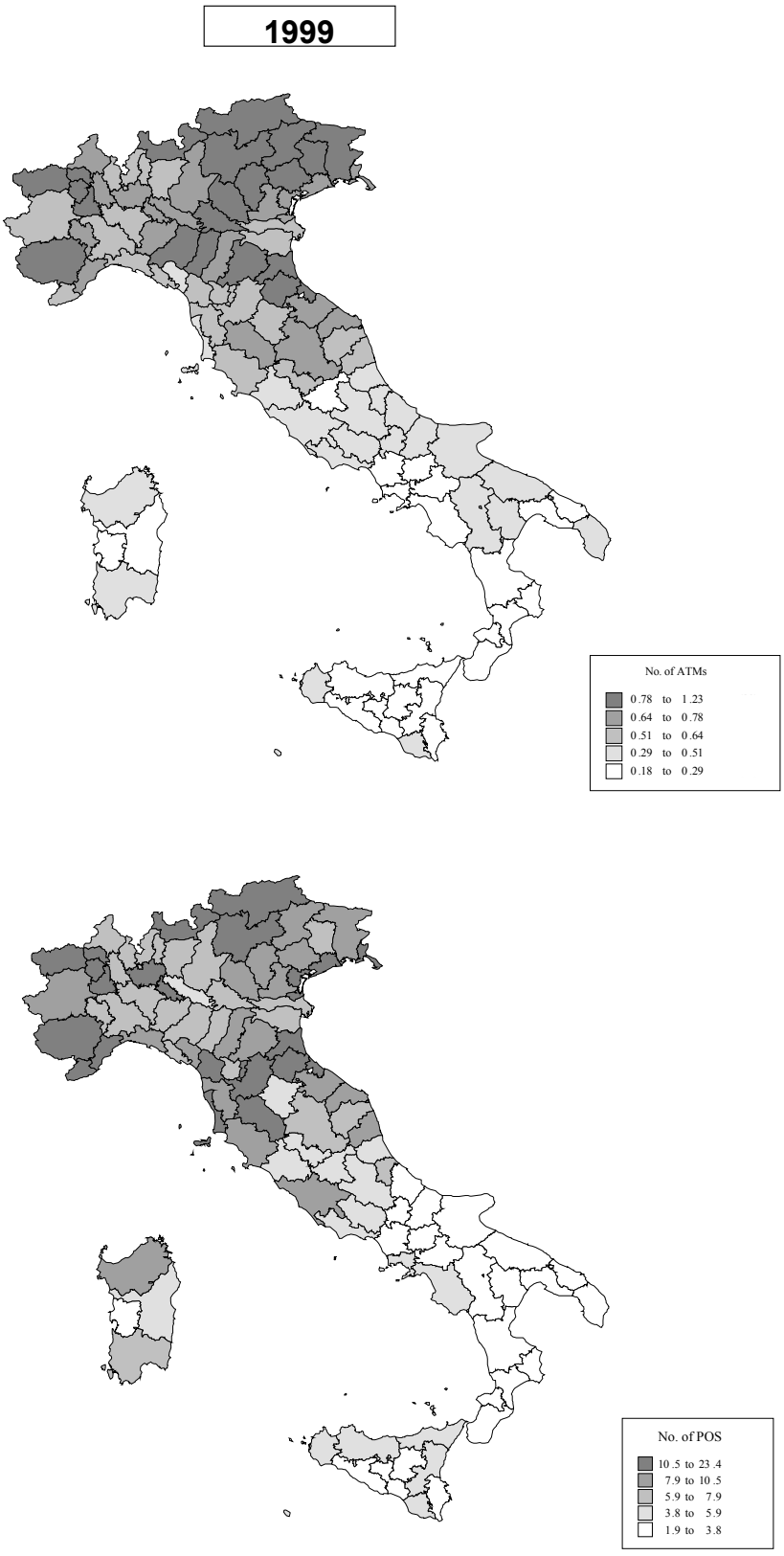
[6] We do not know of any papers that use a theoretical model to examine the effects of the spread of POS on demand deposits. In the case of credit cards there are some papers that investigate their influence.

deposits cannot be assumed a priori to be positive. However, his empirical results support the findings of Paroush and Ruthenberg.

Based on these a priori and these empirical findings, we expect the effects of the diffusion of ATMs and POS on overnight deposit demand to be positive. Unlike Paroush and Ruthenberg, up to now we have been unable to test for the presence of a substitution effect between overnight deposits and currency, as data on currency holdings at the sub-national level are currently unavailable. Likewise, we are unable to analyze the impact of credit cards, even if it is an interesting issue raised in the literature, because the relevant data disaggregation is not available. Nevertheless, we believe that our results suggest that accounting for transaction technology innovation has the potential to significantly improve on standard time series which overlook this dimension.

Section 2 describes the spread of ATMs and POS in Italy. Section 3 reviews the existing literature. Section 4 presents the methodology and the data; section 5 discusses the empirical analysis comparing the results with those of other authors. Section 6 reports the robustness checks performed and section 7 draws the conclusions. An appendix describes the data.

Figure 1



Sources: Bank of Italy, ISTAT.
The figure shows the distribution of the number of ATMs and POS per thousand residents in the Italian provinces in 1999.

2. The spread of ATMs and POS in Italy

The spread of ATMs and POS was particularly sharp during the 1990s but with differences between the two types of terminal, particularly as regards their distribution within Italy and its pattern of evolution. If we look at the pattern of diffusion of these facilities per thousand inhabitants we can examine the expansion along two dimensions, the time-series and the cross-section.

At the national level, over the period the increase in the facilities was substantial for both types of terminal; the number of ATMs per thousand inhabitants increased from 0.2 in 1991 to 0.5 in 1999, while over the same period POS increased from 0.7 to 7.4.

As far as the geographical distribution of ATMs and POS is concerned, if we look at Figure 1 showing the situation in Italy in 1999, it is evident at a glance that terminal facilities per thousand inhabitants were widely spread across Italian provinces. In particular, in the northern regions the number increased from 0.3 and 1.1 in 1991, respectively for ATMs and POS, to 0.8 and 10.2 in 1999 (in central Italy from 0.2 and 0.8 to 0.5 and 8.2), while in the southern regions it went up respectively from 0.1 and 0.2 in 1991 to 0.3 and 3.6 in 1999, widening through the 1990s the initial gap between North and South in per capita endowment of the terminals needed to take advantage of the new transaction technologies.

If we look at a more disaggregate level, the provinces with the highest numbers of ATMs Trento, Treviso and Bolzano are in North-East Italy, while Oristano, Nuoro and Caltanissetta, all in the (southern) islands, are the ones with the lowest figures. In the case of POS, Bolzano, Trento and Aosta (North-West Italy) are the best equipped provinces, while the ones with fewer terminals are Avellino, Benevento (both in South Italy) and Caltanissetta.

All in all it seems clear that in order to study the effect of the introduction of POS and ATMs on Italian overnight deposits exploiting the cross-section variability of the data with a panel analysis, as we do, may give valuable information.

3. Existing literature

With regard to the relevance of financial innovation, according to Angelini, Hendry and Rinaldi (1994) evidence for Italy shows a structural break in money demand. Financial innovation led to a transition from money as a store of value to money as a transaction medium through a change in the scale variable from net financial wealth in the period 1975-1979 to domestic demand in the period 1983-1991. Regarding the relevance of using disaggregated data, Mulligan and Sala-i-Martin (1992) argue that estimates of money demand using aggregate time series may encounter some difficulties, particularly when taking account of financial technology, which is commonly captured by the error term because of its unobservable nature. They underline that the potential distortion of the estimates of money demand parameters is avoided when money demand is estimated cross-sectionally, as they do, estimating money demand functions with cross sections of U.S. states from 1929 to 1990.

With respect to the role of transaction technology innovation, Mulligan and Sala-i-Martin (1996, 2000) and Attanasio, Guiso and Jappelli (2002) underline that the parameters of money demand are affected by financial technology innovation and this may cause time series analysis to be inappropriate. To overcome the resulting instability of the parameters, the authors in question estimate money demand at the micro level using firm or household data, that allow geographical and time variability to be used. Duca (2000) stresses the relevance of the analysis of financial technology for the analysis of monetary aggregates addressing the "case of missing money", which gave rise to a considerable literature after the paper by Goldfeld (1976).

Concerning the relevance of ATMs, Zilberfarb (1989), building on the Paroush and Ruthenberg model, provides empirical evidence of a positive effect of ATMs on demand deposits using Israeli data. Hester, Calcagnini and De Bonis (2001), using data between 1991 and 1995 for a sample of large Italian banks which have 85 per cent of Italian banking assets, find some evidence supporting the idea that ATMs reduce transaction costs and the demand for currency. Attanasio, Guiso and Jappelli (2002) estimate the demand for cash using data from the Survey of Household Income and Wealth run by the Bank of Italy between 1989

and 1995 and find that ATM-users have a more pronounced elasticity of money demand to the interest rate compared with non-ATM-users.

Drehmann, Goodhart and Krueger (2002) investigated the effects of modern payment technologies, namely POS and ATMs, on the demand for cash, finding no evidence of strong effects. They expected modern cash management technologies to have a strong effect on small banknotes, which are used for everyday transactions and may be substituted by card payments. For the large banknotes they do not forecast a strong effect because these will probably continue to be the notes preferred in the underground economy. Their conclusions are that POS have a significant negative effect on the demand for small banknotes but the advance of ATMs seems to increase the demand for small banknotes. All in all, they conclude that technology is not crowding out small banknotes, while the effect on large notes and hence on total notes in circulation is not clear-cut.

With regard to the relevance of using disaggregate data, the debate on the role of national components of monetary aggregates is tackled by Dedola, Gaiotti and Silipo (2001). The authors stress the role of the analysis of national components of euro-area monetary aggregates and the relevance, in dynamic models, of the method used to estimate parameters of money demand. Considering cross-section or time-series evidence leads to substantial differences in the estimated elasticity of money demand, especially for income elasticity. Focarelli (2002) warns on distortions in the estimates of money demand parameters potentially arising from an aggregation bias and develops a method to correct the biases of the estimates.

4. Methodology and data

The idea is to estimate the demand for overnight deposits by exploiting the remarkable cross-section variability of our data set (Table 1). We estimate a traditional specification (comprising scale variable and opportunity cost) to which we add two new variables to account for the spread of ATMs and POS[7] :

$$(1)\ \log(OD/P)_{jt} = b_0 + b_1 \log(GDP/P)_{jt} + b_2(i_{3m} - i_{od})_{jt} + b_3 \log(ATM)_{jt} + b_4 \log(POS)_{jt} + \varepsilon_{jt}$$

where OD stands for overnight deposits, GDP for nominal gross domestic product, P is the consumer price index of the region to which the province belongs, i_{3m} is the interest rate on 3-month Treasury bills, i_{od} is the interest rate on overnight deposits (hence the difference between the two interest rates is the opportunity cost), ATM is the number of automated teller machines, POS is the number of points of sale, ε_{jt} is an error term. Data are annual, j indexes the Italian provinces and ranges between 1 and 95, t indexes the year , from 1991 to 1999. The time span considered is limited by the availability of data on ATMs, which were not collected provincially before 1991 and from data on nominal provincial GDP[8] which are available until 1999; the total number of observations is therefore 855. In our specification we use OD, GDP, ATM and POS per capita (divided by each province population) to eliminate common trends; we choose gross domestic product as scale variable, consistently with Mulligan and Sala-i-Martin (1992) and with Dedola, Gaiotti and Silipo (2001).

Time dummies a_t are introduced to control for aggregate time variation. Random effects a_j for each of the 95 provinces are assumed to account for geographical heterogeneity in the preference for cash which can not be eliminated totally without the risk of incurring in the omitted variables bias. The cross-section differences may be due to differences in the attitude of the province's population to the use of cash and demand deposits, as Attanasio, Guiso and Jappelli (2002) note.

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[7] The specification is similar to that used by Mulligan and Sala-i-Martin(1992) and Zilberfarb (1989).

[8] Data on provincial GDP are provided by Istituto Guglielmo Tagliacarne.

To estimate the effect of ATMs and POS on demand deposits, we follow Pesaran and Smith (1995). In the static case, according to Pesaran and Smith, four procedures are widely used, pooling, aggregating, averaging group estimates and cross-section regressions; the estimates of the coefficients, if these differ randomly, are consistent in any of the procedures adopted. Owing to the short time span available in our data, we deemed it inappropriate to estimate a dynamic model. In the dynamic case, pooled and aggregate estimators are not consistent. Moreover, due to the dimension of T (9) the mean group estimator is not feasible, however, given the size of N (95), it is possible to average the data over time and to estimate a cross-section regression on group means.

5. Results

We report the results of the pooled (Table 2), cross section[9] (Table 3), and long-run averages regression (Table 2). To document the effect of the introduction of ATMs and POS we estimated the equation with four different specifications: first, without terms accounting for transaction technology; second, with ATMs; third, with POS; and, finally, with both ATMs and POS.

In Table 2 we report the results of the pooling procedure in three different formulations: pooled data, with time effects, with random group and time effects[10]. Random group and time effects are appropriate in our view because of the peculiarities of the Italian provinces with respect to the cash management behaviour and of the spread over time of the transaction technologies. The underlying hypothesis is that the group effects are not correlated with the regressors, which may be considered quite sensible. The use of additional

[9] Between the available estimation methods for the static case we discarded the aggregating procedure and the averaging group estimates because they were almost meaningless with 9 observations in the first case and with 95 different groups and 9 observations per group in the second case.

[10] We estimated the model also with fixed individual effects (within estimator) alone and together with time effects. The coefficients of ATM, POS and opportunity cost were similar to the ones obtained with the other formulations of the model, whereas the income elasticity coefficients were consistently lower. This latter evidence may be due to the fixed individual effects that absorb a lot of the variability in the data and induced us to prefer the random individual effects.

regressors is not feasible due to the lack of data with the required provincial disaggregation. We mainly comment the results with both random and time effects, nevertheless we also report the results for the estimation with pooled data without any other effects and the one with time effects to make evident the changes in the parameters due to the insertion of the mentioned effects.

We find that, in the estimate with random group and time effects, when considering the terms accounting for both types of transaction technology, following a 1 per cent increase in the number of ATMs overnight deposits increase by 0.13 per cent. The effect of POS, as expected, is of the same sign: a 1 per cent increase in the number of POS increases overnight deposits by 0.05 per cent. The elasticity of overnight deposits to the opportunity cost is not significant. The income elasticity through the three formulations decreases, from 1.27 to 1.07, consistently when the terms accounting for transaction technologies are introduced.

The results obtained with a regression with long-run averages, as suggested by Pesaran and Smith, ensure consistent estimates (Table 2). The results confirm the sign and the magnitude of the estimates obtained with the pooling procedure. When considering only one of the terms in turn for transaction technology, the effect of ATMs on overnight deposits is 0.34 per cent while the effect of POS is 0.24 per cent. If ATMs and POS are considered jointly, the effects are not significant and 0.19 respectively; the elasticity of the opportunity cost is around -0.1 per cent. The income elasticity is 1.72 when no transaction technology variable is considered, but it decreases to 0.98 when these variables are introduced in the specification. The results of the cross-section regression, one for each year (Table 3), confirm these results. There are positive effects of ATMs and POS on overnight deposits, increasing over time; the elasticity of the opportunity cost is negative. The income elasticity decreases as more proxies for the innovation in transaction technology are added to the regressions and, additionally, over time.

Our results for the effect of ATMs on overnight deposits are remarkably similar to the ones of Paroush and Ruthenberg (1986), who find that a 1 per cent increase in use of ATMs increases actual real demand deposit balances by about 0.2 per cent. Zilberfarb (1989)

estimates suggest a larger effect: a 1 per cent increase in the number of ATMs (or ATMs debits) increases real demand deposits by 1 per cent. We do not know of papers performing similar exercises for POS, although it may be sensible to use as comparison the ones cited for ATMs.

For income elasticity, our results may be compared with those of Mulligan and Sala-i-Martin (1992), who find a high income elasticity, larger than one, for demand deposits within a cross-section analysis. With regard to the euro-area monetary aggregates, Calza, Jung and Stracca (2000) find a long-run income elasticity of 0.73 for nominal overnight deposits and Stracca (2001) finds the long-run income elasticity of M1 to be 0.76. Comparisons can also be made with authors who studied a broader monetary aggregate. Angelini, Hendry and Rinaldi (1994) for Italian M2 find a less than unitary elasticity to domestic demand in real terms, in equilibrium an elasticity of 0.6/0.7 per cent. Dedola, Gaiotti and Silipo (2001) for euro-area M3 find (with pooling with fixed effects and with long-run coefficients constrained to be equal only across 5 countries) a real GDP elasticity of 1.2; with aggregate time series an elasticity of 1.26 and with group mean estimator an elasticity of 1.25. Focarelli (2002) for euro-area M3 finds an income elasticity ranging between 1.4 and 1.6.

6. Robustness checks

We ran all the regressions mentioned in absolute levels also without detecting significant differences with the estimates presented. In the specification search we also tried to introduce other variables without satisfying results: the differential between the 10-year Government benchmark security and the interest rate on overnight deposits, a different measure of the opportunity cost, i.e. the differential with the one-year Treasury bill rate, the inflation rate, quadratic terms for ATMs and POS, dummies for the different Italian areas interacted with the opportunity cost.

We also performed the regressions deleting the observations in the first and the 99th percentiles and eliminating outlier provinces without detecting significant changes in both

cases in the estimates. To check the robustness of the estimates and to control for error autocorrelation and heteroskedasticity we also estimated the model with general least squares, assuming an AR(1) correlation structure within the provinces and heteroskedatisticity across the provinces; the results confirm the ones reported.

We also split the sample across time and across geographical areas to control for variation in the time and geographical patterns. The first split is between the years 1991-1995 and the years 1996-1999 in view of the observation from the cross-section results that the income elasticity coefficients displayed a downturn in 1995 and to control for the fast development of the new transaction technologies in the last four years of our data. The estimates run on both the sub-samples confirm the finding of a positive effect of ATMs and POS on overnight deposits (Tables 4 and 5). To test if the evident acceleration in the spread of ATMs and POS in the period 1996-1999 led to a shift between the income elasticity and the elasticities of ATMs and POS with respect to the first sub-sample we used a Chow test. The statistic, which is distributed as F(5,845), is equal to 86.32 and confirms that in the last part of the nineties the positive effect of ATMs and POS on overnight deposits increased while that of the income decreased.

The second split we did was between northern, central and southern Italy to see if overnight deposit demand is robust to geographical sub-sampling; the results show that the positive effect of ATMs and POS are confirmed in each of the three sub-samples. However, differences in the magnitude of the coefficients exist if we look at our preferred formulation, the one with random and time effects and with both ATMs and POS terms; the coefficients of ATMs and POS in northern Italy are higher than in central and southern Italy (Tables 6, 7 and 8). This may be consistent with differences in the use of currency, which is thought to be higher in southern Italy (see Attanasio, Guiso, Jappelli (2002)).

7. Conclusions

The results of this paper are in line with the literature according to which transaction technology innovation matters for monetary aggregates analysis and therefore for monetary policy. Changes in the technologies available to conduct transactions may alter the behaviour

of the public in choosing between alternative monetary assets. Here the focus is on overnight deposits. Starting from a theoretical model which predicts a positive effect of the increase in the availability of ATM terminals on the level of overnight deposits, we test this hypothesis empirically. Moreover, we also test the effect of POS on overnight deposits with the idea that the effect should be of the same sign.

The estimates of the demand for overnight deposits confirm the theoretical a priori. The estimated effect on overnight deposits of a 1 per cent increase in the number of ATMs is positive as expected and is equal to 0.13 per cent when random individual and time effects are considered. The effect on overnight deposits of an increase of 1 per cent in the number of POS is positive, as expected, and is 0.05 per cent.

Based on these estimates, and considering that the annual growth of ATMs was 18.4 per cent on average over the period 1991-1999, the spread of ATMs technology might have been responsible for a 2.3 per cent extra growth in overnight deposits.

Looking at the parameters of interest for monetary policy a few things may be underlined. The income elasticity decreases when ATMs and POS are accounted for, when fixed (provincial) effects are considered, and also through time. The values of income elasticity estimated with long-run average regression range between 1.72 when no transaction technology is considered to 0.98 when it is introduced in the specification. In the estimates with the pooling procedure the income elasticity yields values ranging between 1.76, when no fixed effects are considered and to 0.46 when fixed effects for time and geographical differences are introduced. The effect of the opportunity cost is negative as expected.

These results suggest that transaction technology innovation seems to have an important positive effect on overnight deposits; the resulting total effect on monetary aggregates (e.g. M3) could be smaller, owing to possible effects of the opposite sign on currency in circulation. The overall effect on broader monetary aggregates deserves further research. The empirical evidence is consistent with the hypothesis that not accounting for

transaction technology innovation may create a potentially serious problem of omitted variables in traditional time series analysis.

Tables

Table 1

MAIN FEATURES OF THE DATASET[1]

	1991	1992	1993	1994	1995	1996	1997	1998	1999
Population									
Total (mln)	56.8	57.0	57.2	57.3	57.4	57.4	57.6	57.6	57.7
Mean	0.60	0.60	0.60	0.60	0.60	0.60	0.61	0.61	0.61
Standard deviation	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.65	0.65
Real GDP									
Total (bln)	364	384	394	414	445	470	486	489	503
Mean	3.83	4.05	4.15	4.35	4.69	4.94	5.12	5.15	5.30
Standard deviation	5.19	5.45	5.56	5.87	6.31	6.65	6.91	6.97	7.18
Overnight									
Total (bln)	238	241	258	264	275	293	315	356	390
Mean	2.50	2.54	2.72	2.78	2.89	3.08	3.32	3.75	4.10
Standard deviation	5.38	5.45	5.82	5.76	5.70	6.04	6.50	7.78	9.27
ATM									
Total (No.)	11,599	14,179	16,792	19,574	21,838	24,345	25,533	28,029	30,855
Mean	122	149	177	206	230	256	269	295	325
Standard deviation	188	216	257	279	311	328	330	356	384
POS									
Total (No.)	45,577	64,564	78,265	112,828	154,868	214,672	275,406	344,592	449,566
Mean	480	680	824	1,188	1,630	2,260	2,899	3,627	4,732
Standard deviation	889	1,253	1,424	1,913	2,486	3,321	4,204	5,225	7,457
Prices									
Mean	82.95	87.58	91.45	95.03	100.00	103.68	105.44	107.23	108.97
Standard deviation	1.06	0.86	0.73	0.61	0.00	0.69	0.96	1.26	1.59
i_{od}									
Mean	7.38	7.82	6.43	5.09	5.66	5.78	4.13	2.80	1.37
Standard deviation	0.46	0.58	0.55	0.47	0.43	1.57	1.12	0.81	0.41
i_{3m}									
Mean	12.66	14.48	10.47	8.84	10.73	8.61	6.40	4.96	2.77
No. obs.	95	95	95	95	95	95	95	95	95

Sources: Bank of Italy, ISTAT, Istituto Guglielmo Tagliacarne.
1) Population is expressed in millions, real GDP and overnight deposits in billions. ATM and POS are absolute numbers. i_{OD} stands for interest rate on overnight deposits, i_{3M} for interest rate on 3-month Treasury bills (BOT), both are expressed as percentages.

Table 2

DEPENDENT VARIABLE: REAL OVERNIGHT DEPOSITS[1]

Explanatory variable	pooled	time effects	random and time effects	long-run averages
Real GDP	1.76 ***	1.75 ***	1.27 ***	1.72 ***
Opportunity cost	-0.03 ***	-0.05 ***	0.0	-0.14 ***
No. obs.	855	855	855	95
R - square	0.79	0.79	0.79	0.82
Real GDP	1.41 ***	1.20 ***	1.11 ***	1.06 ***
Opportunity cost	-0.01	-0.05 ***	0.0	-0.13 ***
ATM	0.19 ***	0.29 ***	0.17 ***	0.34 ***
No. obs.	855	855	855	95
R - square	0.81	0.82	0.81	0.84
Real GDP	1.49 ***	1.27 ***	1.16 ***	1.12 ***
Opportunity cost	0.00	-0.04 ***	0.0	-0.10 **
POS	0.11 ***	0.19 ***	0.08 ***	0.24 ***
No. obs.	855	855	855	95
R - square	0.81	0.83	0.82	0.85
Real GDP	1.41 ***	1.11 **	1.07 ***	0.98 ***
Opportunity cost	0.01	-0.04 ***	0.0	-0.10 ***
ATM	0.09 **	0.15 ***	0.13 ***	0.14
POS	0.08 ***	0.15 ***	0.05 ***	0.19 ***
No. obs.	855	855	855	95
R - square	0.81	0.84	0.82	0.86

[1] The opportunity cost is the differential between the interest rate on 3-month Treasury bills (BOT) and the interest rate on overnight deposits. The significance levels are for three, two and one star, 1, 5 and 10 per cent respectively.

Table 3

DEPENDENT VARIABLE: REAL OVERNIGHT DEPOSITS[1]

	1991	1992	1993	1994	1995	1996	1997	1998	1999
Real GDP	1.98***	1.94***	1.89***	1.76***	1.73***	1.66***	1.64***	1.62***	1.53***
Opportunity cost	-0.02	-0.08	-0.10*	-0.17**	-0.23***	-0.03***	-0.04**	-0.05**	-0.17***
No. obs.	95	95	95	95	95	95	95	95	95
R - square	0.78	0.78	0.79	0.78	0.84	0.82	0.82	0.81	0.79
Real GDP	1.37***	1.40***	1.57***	1.26***	1.16***	1.01***	0.98***	1.03***	0.98***
Opportunity cost	0.00	-0.05	-0.09	-0.14*	-0.19***	-0.03***	-0.05**	-0.05*	-0.17**
ATM	0.22**	0.23**	0.14	0.24**	0.30***	0.39***	0.41***	0.41***	0.39***
No. obs.	95	95	95	95	95	95	95	95	95
R - square	0.80	0.80	0.79	0.80	0.87	0.85	0.86	0.85	0.82
Real GDP	1.67***	1.40***	1.37***	1.29***	1.27***	0.95***	1.03***	1.07***	0.99***
Opportunity cost	-0.01	-0.04	-0.03	-0.12	-0.19***	-0.02	-0.03	-0.03	-0.10
POS	0.08*	0.17***	0.18***	0.17**	0.17	0.31***	0.30***	0.29***	0.34***
No. obs.	95	95	95	95	95	95	95	95	95
R - square	0.79	0.81	0.82	0.80	0.87	0.88	0.87	0.86	0.83
Real GDP	1.34***	1.30***	1.40***	1.15***	1.07***	0.77***	0.83	0.83***	0.77***
Opportunity cost	0.00	-0.04	-0.03	-0.11	0.18***	-0.03**	-0.04**	-0.04	-0.12
ATM	0.17	0.07	-0.02	-0.12	0.20**	0.16	0.22**	0.27**	0.23*
POS	0.05	0.16***	0.19***	0.13**	0.10*	0.27***	0.23***	0.22***	0.27***
No. obs.	95	95	95	95	95	95	95	95	95
R - square	0.80	0.81	0.82	0.81	0.87	0.88	0.88	0.87	0.84

[1] The opportunity cost is the differential between the interest rate on 3-month Treasury bills (BOT) and the interest rate on overnight deposits. The significance levels are for three, two and one star, 1, 5 and 10 per cent respectively.

Table 4

DEPENDENT VARIABLE: REAL OVERNIGHT DEPOSITS;
SUB-SAMPLE 1991-1995[1]

Explanatory variable	pooled	time effects	random and time effects	long-run averages
Real GDP	1.9 ***	1.86 ***	1.47 ***	1.86 ***
Opportunity cost	-0.04 ***	-0.1 ***	-0.02	-0.14 **
No. obs.	475	475	475	95
R - square	0.79	0.79	0.78	0.82
Real GDP	1.56 ***	1.35 ***	1.34 ***	1.30 ***
Opportunity cost	-0.02	-0.08 ***	-0.02	-0.10
ATM	0.15 ***	0.22 ***	0.10 ***	0.25 **
No. obs.	475	475	475	95
R - square	0.80	0.80	0.80	0.82
Real GDP	1.6 ***	1.42 ***	1.34 ***	1.36 ***
Opportunity cost	-0.02	-0.07 **	-0.02	-0.08
POS	0.10 ***	0.15 ***	0.05 ***	0.17 ***
No. obs.	475	475	475	95
R - square	0.80	0.81	0.80	0.83
Real GDP	1.55 ***	1.26 ***	1.22 ***	1.25 ***
Opportunity cost	-0.01	-0.07 **	-0.01 **	-0.08
ATM	0.07	0.11 **	0.10 ***	0.08
POS	0.08 ***	0.11 ***	0.04 **	0.14 **
No. obs.	475	475	475	95
R - square	0.80	0.82	0.81	0.83

[1] The opportunity cost is the differential between the interest rate on 3-month Treasury bills (BOT) and the interest rate on overnight deposits. The significance levels are for three, two and one star, 1, 5 and 10 per cent respectively.

Table 5

DEPENDENT VARIABLE: REAL OVERNIGHT DEPOSITS;
SUB-SAMPLE 1996-1999[1]

Explanatory variable	pooled	time effects	random and time effects	long-run averages
Real GDP	1.61 ***	1.63 ***	1.42 ***	1.61 ***
Opportunity cost	-0.06 ***	-0.04 ***	-0.01	-0.05 **
No. obs.	380	380	380	95
R - square	0.80	0.81	0.80	0.82
Real GDP	1.01 ***	1.01 ***	1.28 ***	0.98 ***
Opportunity cost	-0.04 ***	-0.04 ***	-0.01	-0.05 **
ATM	0.39 ***	0.39 ***	0.12 ***	0.43 ***
No. obs.	380	380	380	95
R - square	0.84	0.84	0.82	0.85
Real GDP	1.12 ***	1.03 ***	1.28 ***	0.99 ***
Opportunity cost	-0.02 **	-0.03 ***	-0.01	-0.04
POS	0.26 ***	0.30 ***	0.10 ***	0.35 ***
No. obs.	380	380	380	95
R - square	0.86	0.86	0.84	0.87
Real GDP	0.93 ***	0.82 ***	1.20 ***	0.78 ***
Opportunity cost	-0.02 **	-0.03 ***	-0.01	-0.04
ATM	0.20 ***	0.21 ***	0.08 **	0.22 *
POS	0.20 ***	0.24 ***	0.09 ***	0.28 ***
No. obs.	380	380	380	95
R - square	0.86	0.87	0.84	0.88

[1] The opportunity cost is the differential between the interest rate on 3-month Treasury bills (BOT) and the interest rate on overnight deposits. The significance levels are for three, two and one star, 1, 5 and 10 per cent respectively.

Table 6

DEPENDENT VARIABLE: REAL OVERNIGHT DEPOSITS; SUB-SAMPLE NORTHERN ITALY[1]

Explanatory variable	pooled	time effects	random and time effects	long-run averages
Real GDP	0.79 ***	0.78 ***	0.73 ***	0.75 ***
Opportunity cost	-0.03 ***	-0.03 ***	0.0	-0.12
No. obs.	369	369	369	41
R - square	0.33	0.35	0.33	0.38
Real GDP	0.78 ***	0.79 ***	0.65 ***	0.81 ***
Opportunity cost	-0.03 ***	-0.03 **	0.00	0.12
ATM	0.01	0.00	0.18 ***	-0.11
No. obs.	369	369	369	41
R - square	0.33	0.35	0.31	0.39
Real GDP	0.74 ***	0.71 ***	0.50 ***	0.71 ***
Opportunity cost	-0.01 *	-0.04 ***	0.00	-0.12
POS	0.05 **	0.09 ***	0.14 ***	0.05
No. obs.	369	369	369	41
R - square	0.35	0.37	0.33	0.39
Real GDP	0.77 ***	0.73 ***	0.47 ***	0.77 ***
Opportunity cost	-0.02 **	-0.04 ***	0.00	-0.12
ATM	-0.10 **	-0.07 ***	0.12 ***	-0.18
POS	0.08 ***	0.10 ***	0.13 ***	0.08
No. obs.	369	369	369	41
R - square	0.35	0.37	0.32	0.40

[1] The opportunity cost is the differential between the interest rate on 3-month Treasury bills (BOT) and the interest rate on overnight deposits. The significance levels are for three, two and one star, 1, 5 and 10 per cent respectively.

Table 7

DEPENDENT VARIABLE: REAL OVERNIGHT DEPOSITS; SUB-SAMPLE CENTRAL ITALY[1]

Explanatory variable	pooled	time effects	random and time effects	long-run averages
Real GDP	1.97 ***	1.77 ***	1.15 ***	1.09 *
Opportunity cost	-0.04 ***	-0.12 **	-0.02 *	-0.42 *
No. obs.	180	180	180	20
R - square	0.62	0.64	0.57	0.74
Real GDP	1.89 ***	1.54 ***	1.18 ***	1.09
Opportunity cost	-0.03 **	-0.11 **	-0.02	-0.42 *
ATM	0.07	0.16 **	0.05 *	0.00
No. obs.	180	180	180	20
R - square	0.62	0.66	0.59	0.74
Real GDP	1.76 ***	1.17 ***	1.20 ***	0.67
Opportunity cost	0.02	-0.07 **	-0.02 *	-0.26 *
POS	0.14 ***	0.31 ***	0.05 ***	0.33 ***
No. obs.	180	180	180	20
R - square	0.66	0.75	0.66	0.82
Real GDP	1.82 ***	1.19 ***	1.23 ***	0.86 ***
Opportunity cost	0.01	-0.02 *	0.02	-0.31
ATM	-0.10 *	-0.02 ***	0.05 *	-0.29
POS	0.17 ***	0.31 ***	0.08 ***	0.40 ***
No. obs.	180	180	180	20
R - square	0.67	0.75	0.67	0.84

[1] The opportunity cost is the differential between the interest rate on 3-month Treasury bills (BOT) and the interest rate on overnight deposits. The significance levels are for three, two and one star, 1, 5 and 10 per cent respectively.

Table 8

DEPENDENT VARIABLE: REAL OVERNIGHT DEPOSITS;
SUB-SAMPLE SOUTHERN ITALY[1]

Explanatory variable	Pooled	time effects	random and time effects	long-run averages
Real GDP	1.45 ***	1.43 ***	0.74 ***	1.47 ***
Opportunity cost	-0.06 ***	-0.04 **	-0.01 **	-0.06
No. obs.	306	306	306	34
R - square	0.49	0.52	0.46	0.47
Real GDP	1.30 ***	1.30 ***	0.66 ***	1.27 ***
Opportunity cost	-0.04 ***	-0.04 **	-0.01 *	-0.07
ATM	0.07 **	0.07	0.05 *	0.10
No. obs.	306	306	306	34
R - square	0.50	0.52	0.47	0.47
Real GDP	1.27 ***	1.22 ***	0.79 ***	1.1 ***
Opportunity cost	-0.02 **	-0.02	-0.02 **	-0.07
POS	0.07 ***	0.08 ***	-0.01	0.10
No. obs.	306	306	306	34
R - square	0.53	0.54	0.46	0.52
Real GDP	1.32 ***	1.24 ***	0.72 ***	1.22 ***
Opportunity cost	-0.03 **	-0.02	-0.01 **	-0.02
ATM	-0.05	0.0	0.06 ***	-0.08
POS	0.08 ***	0.08 ***	-0.02 **	0.17 *
No. obs.	306	306	306	34
R - square	0.53	0.54	0.46	0.53

[1] The opportunity cost is the differential between the interest rate on 3-month Treasury bills (BOT) and the interest rate on overnight deposits. The significance levels are for three, two and one star, 1, 5 and 10 per cent respectively.

Appendix
The data set

The data set comprises variables for 95 [11] Italian provinces for the period 1991-1999, the number of observations is equal to 855; the frequency is annual.

Automated tellers machines: number of ATMs located in the provinces examined at the end of each year; the source is the banking statistics data set collected by Bank of Italy (Matrice dei conti).

Gross domestic product: gross nominal value added per province: source Istituto Guglielmo Tagliacarne.

Interest rate on overnight deposits: we calculated the interest rate on the basis of the data for overnight deposits of over than 20 million lira, the only one for which data are available with provincial detail; the source is a special data set collected by the Bank of Italy (Centrale dei rischi).

Interest rate on 3-month Treasury bills (BOT) at the end of each year: source monetary statistics collected by the Bank of Italy.

Overnight deposits: deposits held at the end of each year in the branches situated in the provinces examined; the source is the banking statistics data set collected by the Bank of Italy (Matrice dei conti).

Points of sale: number of POS located in the provinces examined at the end of each year; the source is the banking statistics data set collected by the Bank of Italy (Matrice dei conti).

Population: number of residents at the end of each year; the source is Istat (National Institute of Statistics).

Prices: the index of prices used is the consumer price index and it is calculated only for the administrative centre of each region and attributed also to the other provinces of the region because of lack of data; source, Istat data reworked.

[11] We aggregated the data of the eight new provinces created in 1996 with the data of the provinces of which they were part before 1996.

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