DEMAND DEPOSITS AND TRANSACTION TECHNOLOGY INNOVATION

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Abstract

The rapid diffusion of ATM and POS during the last decade may have changed money demand patterns; therefore, standard econometric analysis of money demand that do not account for these developments may suffer from a potentially serious omitted variable problem. This paper analyzes the effect of transaction technology innovation on demand deposits. Using panel data for Italy we have two results. First, transaction technology innovation has a positive effect on demand deposits. Second, accounting for this innovation in the regressions significantly reduces the income elasticity of money demand typically detected in the existing empirical estimates.

JEL classification: E41.

Keywords: money demand, payment economics, transaction technology, ATM, POS.

Contents

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1. Introduction

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"[1].

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; most of the euro-area countries have shared a similar experience. Financial and transaction technology innovation has been considered relevant for the analysis of the stability properties of monetary aggregates. Indeed, ATMs allow easier cash withdrawals from demand deposits, altering the ratio between the cost of holding cash and that of holding demand deposits. Similarly, POS allow purchases to be debited immediately to bank accounts, in principle allowing card holders to economize on cash.

However, partly owing to the fact that these phenomena have gained relevance only in relatively recent years, there have been 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, especially the income elasticity and hence the velocity of money[2], and suggests a potential impact on euro-area monetary aggregates that deserves careful scrutiny.

[1] Krueger (2001).

[2] It can be derived from a standard money demand function, the definition of money velocity of circulation implied by the quantitative equation and the assumptions of stationarity of opportunity cost and of a regime of price stability, that $\Delta v = (1-\beta)\Delta y$. Where v is the medium term trend in money velocity and y is the long-term income elasticity of the money demand equation.

To investigate this issue we analyze the effect of the spread of ATMs and POS on demand 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 achieve identification mainly through the cross-section variability of the data and to overcome some of the problems linked to aggregation biases of the estimates based on national data.

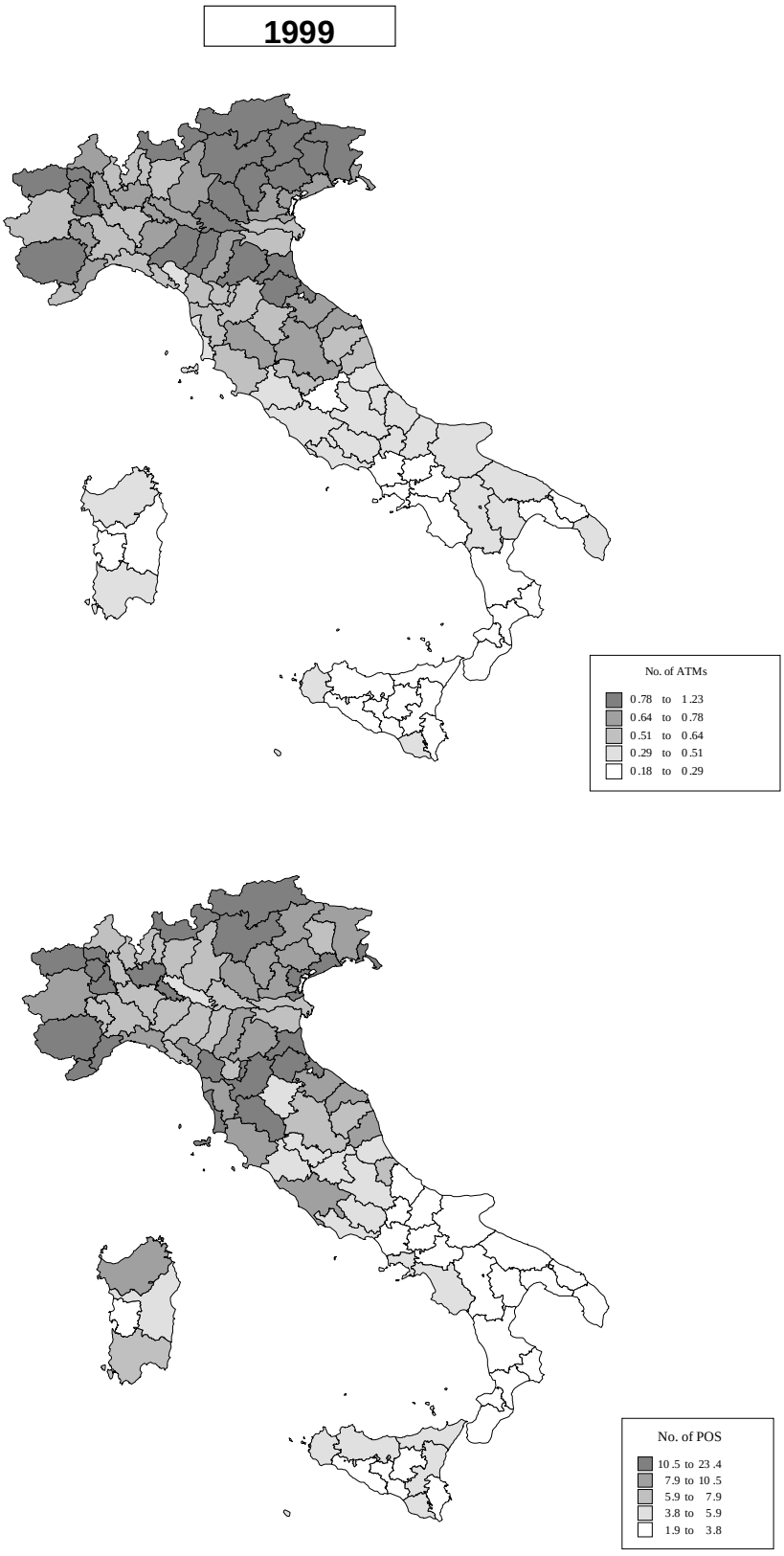
This paper contributes to the literature providing evidence on the positive effect of ATMs on demand deposits with a panel data set. Moreover it finds a positive effect of another form of transaction technology, POS, on demand deposits. Finally it hints to a potential bias of time series analyses that overlook the effects of transaction technology innnovation on money demand function.

The structure of this work is the following; 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.

[3] Demand deposits are named overnight deposits in the European Central Bank definition of the euro-area monetary aggregates.

[4] Demand deposits, in June 2003, 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 demand deposits accounted for 86 per cent of M1 and 35 per cent of M3. Italian contributions to M1 and M3 accounted for 23 and 16 per cent of euro-area M1 and M3 respectively.

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 ATM and POS terminals.

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

3. Existing literature

A theoretical model by Paroush and Ruthenberg (1986) suggests that the introduction of ATMs increases the share of total money constituted by 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. 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.

Regarding the relevance of using disaggregate 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) and (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”.

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, 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. 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, Dedola, Gaiotti and Silipo (2001) stress the role of the analysis of national components of euro-area monetary aggregates. 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 demand deposits by exploiting the remarkable cross-section variability of our data set (Table 1). Based on the a priori and empirical findings described in paragraph 3, we expect the effects of the diffusion of ATMs on demand deposit demand to be positive. We also believe the effect of POS to be similar to that of ATMs. 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[5] :

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

where DD stands for demand 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 (the closest financial substitute of demand deposits), i_{dd} is the interest rate on demand deposits, (i_{3m} - i_{dd}) is the opportunity cost of holding demand deposits, ATM is the number of automated teller machines, POS is the number of points of

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

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[6]; the total number of observations is therefore 855. In our specification we use DD, 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.

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.

[6] The time span considered is limited by the availability of data on ATMs, which were not collected at provincial level before 1991 and from data on nominal provincial GDP, provided by Istituto Guglielmo Tagliacarne, which are available until 1999.

5. Results

We report the results of the pooled (Table 2), cross section[7] (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[8]. 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. 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 demand 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 demand deposits by 0.05 per cent. The elasticity of demand 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.

[7] 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.

[8] 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.

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 demand 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 demand 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 demand 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.

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 demand 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 demand 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 demand deposits increased while that of the income decreased.

The second split we did was between northern, central and southern Italy to see if demand 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 suggest that 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 demand deposits. Starting from a theoretical model which predicts a positive effect of the increase in the availability of ATM terminals on the level of demand deposits, we test this hypothesis. Moreover, we also test the effect of POS on demand deposits with the idea that the effect should be of the same sign.

The estimates of the demand for demand deposits confirm the theoretical a priori. The estimated effect on demand 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 demand 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 demand 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 add to the literature suggesting that transaction technology innovation seems to have an important positive effect on demand deposits[9] and that developments of new payment instruments, such as e-money, have to be monitored by Central Banks. Moreover, the empirical evidence underlines that not accounting for transaction technology innovation, may create a potentially serious problem of omitted variables in traditional time series analysis of money demand function.

[9] 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 and the overall effect on broader monetary aggregates deserves further research.

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
Demand									
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_{dd}									
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 demand deposits in billions. ATM and POS are absolute numbers. i_{DD} stands for interest rate on demand deposits, i_{3M} for interest rate on 3-month Treasury bills (BOT), both are expressed as percentages.

Table 2

DEPENDENT VARIABLE: REAL DEMAND 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 demand deposits. The significance levels are for three, two and one star, 1, 5 and 10 per cent respectively.

Table 3

DEPENDENT VARIABLE: REAL DEMAND 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 demand deposits. The significance levels are for three, two and one star, 1, 5 and 10 per cent respectively.

Table 4

DEPENDENT VARIABLE: REAL DEMAND 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 demand deposits. The significance levels are for three, two and one star, 1, 5 and 10 per cent respectively.

Table 5

DEPENDENT VARIABLE: REAL DEMAND 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 demand deposits. The significance levels are for three, two and one star, 1, 5 and 10 per cent respectively.

Table 6

DEPENDENT VARIABLE: REAL DEMAND 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 demand deposits. The significance levels are for three, two and one star, 1, 5 and 10 per cent respectively.

Table 7

DEPENDENT VARIABLE: REAL DEMAND 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 demand deposits. The significance levels are for three, two and one star, 1, 5 and 10 per cent respectively.

Table 8

DEPENDENT VARIABLE: REAL DEMAND 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 demand 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 [10] 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 demand deposits: we calculated the interest rate on the basis of the data for demand 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.

Demand 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.

[10] 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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