BANCA D'ITALIA

EUROSISTEMA

Mercati, infrastrutture, sistemi di pagamento

(Markets, Infrastructures, Payment Systems)

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The papers published in the 'Markets, Infrastructures, Payment Systems' series provide information and analysis on aspects regarding the institutional duties of the Bank of Italy in relation to the monitoring of financial markets and payment systems and the development and management of the corresponding infrastructures in order to foster a better understanding of these issues and stimulate discussion among institutions, economic actors and citizens.

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ISSN 2724-6418 (online)
ISSN 2724-640X (print)

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Via Nazionale, 91 - 00184 Rome - Italy
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Designed and printing by the Printing and Publishing Division of the Bank of Italy

Banknote migration and the estimate of circulation in euro area countries: the Italian case

by Claudio Doria*, Gianluca Maddaloni**, Giuseppina Marocchi*,
Ferdinando Sasso***, Luca Serrai*, Simonetta Zappa*†

Abstract

In this paper we examine the difficulties faced by euro-area National Central Banks, since the changeover, in measuring banknote circulation in their respective countries, as a consequence of banknote migration across euro-area countries. Then, we describe a methodology for estimating Italian circulation, which integrates net issuance with information on banknote migration gathered from the Bank of Italy's survey on international tourism. We also propose empirical approaches that can provide indications on migration and circulation for individual denominations as well. Since the changeover, Italian circulation has increased significantly. Inflows from abroad have been recorded for all denominations, except for the €50 banknote. Circulation has been increasingly concentrating on medium denominations (€20 and €50); high ones (€100, €200 and €500) have been marginalized, while the use of lower ones (€5 and €10) has gradually decreased. These trends mainly reflect limits on cash payments and anti-money laundering controls.

JEL Classification: E41, E42, K42.
Keywords: Cash, tourist flows, ATM, money laundering.

Sintesi

Il lavoro illustra le difficoltà incontrate dalle Banche centrali nazionali dell'Eurosistema, a partire dal changeover, nel determinare la circolazione nei rispettivi paesi, a causa della migrazione delle banconote all'interno dell'area. Viene quindi presentata una metodologia di stima della circolazione italiana che integra le informazioni relative alle emissioni nette con quelle sulla migrazione delle banconote, tratte dall'indagine sul turismo della Banca d'Italia. Vengono inoltre proposti approcci empirici in grado di fornire indicazioni sulla migrazione e sulla circolazione anche dei singoli tagli. Dal changeover, la circolazione italiana è cresciuta sensibilmente; sono stati registrati afflussi dall'estero per tutti i tagli ad eccezione del 50€. La circolazione è andata concentrandosi sui tagli medi (50€ e 20€); i tagli alti e apicali (100€, 200€ e 500€) sono stati marginalizzati; quelli bassi (5€ e 10€) hanno subito una graduale erosione. Su ciò hanno influito i limiti di importo ai pagamenti in contanti e i controlli a fini antiriciclaggio.

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† Chapter 3 and appendixes A2 and A3 are by Claudio Doria, Giuseppina Marocchi, Luca Serrai e Simonetta Zappa; the remaining parts are by Gianluca Maddaloni and Ferdinando Sasso.

CONTENTS

Introduction[1]

Central banks analyse banknote circulation for various purposes: conducting monetary policy, drawing up retail payment policies and estimating the amount of banknotes to produce and distribute. To this end, they are interested in estimating the total amount of banknotes in circulation and the balance of notes held for transactional or store of value purposes, as well as, in the case of currencies for which there is high international demand, the shares of notes stored domestically and held abroad.

Central banks are also interested in analysing banknote circulation by denomination. In fact, different denominations meet different and somewhat specific needs (e.g. the transactional, precautionary and store of value needs of individuals and businesses), and are put into circulation via different channels (e.g. ATMs, traditional branches). Moreover, some denominations (particularly higher value notes) tend to be used in connection with illegal or underground transactions. In this context, central banks, in their capacity as issuing institutions, are required to meet the overall demand for cash, provide an adequate mix of banknote denominations and promote the efficiency and reliability of the 'cash cycle', that is the set of processes and channels through which banks and other cash handlers (i.e. companies specialized in cash processing and transport) distribute and handle banknotes.

The total amount of notes in circulation is measured by their net issuance, i.e. the difference between the banknotes issued by the central bank and those returned to it over time, from the first year of issuance. However, since banknotes circulate as untraceable bearer instruments, mere net issuance data do not clarify the reasons underlying banknote demand nor the areas where they circulate.

Various methods have been proposed to estimate the different components of banknote circulation. Bartzch et al. (2011a) and Deutsche Bundesbank (2018) used direct methods for Germany, drawing on a variety of sources (e.g. surveys on tourist expenditure and information on net shipments, namely banknote shipments between commercial banks in the euro area and legal persons outside the euro area operating on the foreign exchange market, and surveys on the cash held by households, firms and banks). Analogously, as part of its balance of payment statistics, the Bank of Italy has been estimating national circulation by aggregating net issuance with information on banknote flows from/to abroad since 2015, drawing on its own survey on tourism and its statistics on net shipments. Conversely, indirect methods are used to extract information on cash demand from the statistical analysis of net issuance data, as well as from various indicators relating to cash variables directly operated by central banks (e.g. withdrawals, lodgements). One of the main indirect methods is the seasonal method proposed by Sumner (1990) to estimate the transactional circulation of US dollar banknotes and, later, by Judson (2017) to estimate the foreign circulation of the US dollar. This method was also adopted to estimate the circulation of the Deutsche Mark before the changeover (Seitz,1995), the circulation of euro banknotes outside of the euro area (Bartzch et al., 2021), the foreign circulation of euro banknotes issued by the Bundesbank (Bartzch et al., 2011b and Bartzsch and Uhl, 2017) and the transactional circulation of euro banknotes in Italy (Baldo et al., 2021).

Indirect methods include works aiming to estimate the balances held either for transactional or store of value purposes based on the return rate of different denominations (i.e. the ratio between the banknotes lodged at a central bank and the average stock in circulation), which measures how many times total banknotes in circulation return to the central bank on a yearly basis, on the assumption that denominations demanded for transactional purposes return with a higher frequency. Lalouette and

[1] We thank Giovanni D'Alessio, Stefano Guglielmi, Gianmatteo Piazza, Giorgia Rocco and an anonymous referee for useful comments. All remaining errors are ours.

Esselink (2018) applied this method to euro banknotes in circulation. When the 2nd series of euro banknotes was launched, it became possible to estimate transactional balances for some denominations based on information on the time required for the new notes to replace those of the 1st series (Politronacci et al., 2017; Deutsche Bundesbank, 2018 and Zamora-Perez, 2021).

Various works focusing on euro banknotes (Deutsche Bundesbank, 2018; Zamora Perez, 2021 and Baldo et al., 2021) show significant growth in the demand for cash since the changeover to the euro in 2002, alongside a reduction in the use of cash in transactions (a phenomenon known as the "cash paradox"),[2] which emerges from surveys on the use of cash and other retail payment instruments. This seems to suggest that the growth in cash circulation may be traced back mainly to store of value needs and to foreign demand.

Another aspect to consider is that it is increasingly difficult for individual euro-area national central banks (NCBs) to analyse domestic cash circulation. Since the changeover, they have been cooperating in the issuance of euro banknotes which circulate freely across euro-area countries and are partly lodged at NCBs other than those issuing them. Banknote flows among euro-area countries (banknote migration) are structurally unbalanced: some countries tend to originate outflows, whereas others, typically tourism-intensive ones, tend to receive inflows. Individual NCBs' net issuance tends to deviate more and more from national circulation in their respective countries, sometimes taking on incongruous (even negative) values that are not easy to interpret. This is why, since the changeover, the value of banknote circulation posted in the balance sheets of NCBs is determined on the basis of conventional criteria.

With regard to banknote circulation in Italy, Rinaldi (2019) and Baldo et al. (2021) noticed the strong impact of the introduction of severe limits on the value of cash payments, especially on the demand for higher denominations. Baldo et al. (2021) highlighted the strong increase, since the changeover, in the demand for cash balances for precautionary and store of value purposes and focused particularly on the dramatic increase in cash demand during the Covid-19 pandemic, which can be traced back not only to precautionary needs but also to operational bottlenecks in the cash cycle.

This paper pursues two main objectives. First, we intend to examine how the information content of the net issuance of individual NCBs has changed since the changeover to the euro and what this entails for the analysis of cash circulation in individual euro-area countries, with particular reference to those that are importers of banknotes, such as Italy. Second, we intend to contribute to the analysis of cash circulation in Italy by focusing on aspects so far less explored, such as banknote migration from/to Italy, circulation by denomination and a comparison with euro-area trends.

With regard to the first objective, we conclude that, since the changeover, the net issuance of individual NCBs has no longer provided a correct measure of the circulation created by the NCBs themselves. From a methodological point of view, correct estimates may be prepared mainly by using direct methods. Starting from such estimates, indirect methods lend themselves to calculating the various components of national circulation. Moreover, even incongruous net issuance values have information content which, to a certain extent, may be extracted. Specifically, negative net issuance provides indications – generally largely underestimated – on banknote net inflows from abroad cumulated since the changeover. In some cases, net inflows can be redistributed over time, thereby making it possible to estimate national circulation. In detail, in the case of the launch of the 2nd series of euro banknotes, the emergence of incongruous values makes it possible to estimate national circulation for denominations held mainly for transactional purposes.

[2] Bailey (2009), Jobst and Stix (2017), and Bech et al. (2018) analysed this phenomenon also with regard to non-euro area countries.

With regard to Italy, this paper draws on an analysis of banknote flows from/to abroad sourced from: (i) the Bank of Italy's survey on tourism and statistics on net shipments, which do not provide a breakdown by denomination; and (ii) banknote migration data inferred from the incongruous net issuance values for the various denominations. Starting from this information, we then try to extract estimates or at least indications on the circulation of individual denominations in Italy.[3]

We conclude that, since the changeover, Italy has received net inflows from abroad for all denominations but the €50 banknote, for which outflows have exceeded inflows. Inflows have been especially substantial for the apical denominations and smaller for the lower value ones.

The share of cash balances held for transactional purposes, out of total domestic circulation, was especially large in the late 1990s, towards the end of the legal tender status of the Italian lira, and has been gradually decreasing since the changeover.

After growing initially, the demand for higher value notes has progressively decreased since the changeover. Apical denominations have increasingly fallen out of use since 2011, and circulation has converged more and more on medium denominations, whereas the share of lower value notes has gradually decreased. These trends reflect, on the one hand, the effects of cash payment restrictions and of regulatory provisions to contrast the use of cash for money laundering and, on the other hand, the banking system's decision to distribute banknotes mainly through ATMs stocked, to a large extent, with medium denominations.

A similar shift away from apical denominations and towards medium value notes has not emerged in other euro-area countries, though they are also characterized by cash payment restrictions and increasing recourse to ATMs.

This paper is organized as follows: Section 1 focuses on the net issuance of the Eurosystem and of individual NCBs and on estimates of banknote circulation in the euro area and in some euro-area countries. Section 2 deals with the information content of the net issuance of individual NCBs and points out the limitations of the main empirical estimation methods used in this case. Section 3 examines the information collected by the Bank of Italy through its survey on tourism expenditure and its statistics on net shipments. Section 4 illustrates the estimates of banknote circulation in Italy and assesses the contribution of banknote inflows. Section 5 analyses net issuance trends broken down by denomination and provides estimates and indications on banknote migration and circulation at the individual denomination level. Section 6 examines how the reasons underlying demand for cash in Italy have changed over time. Finally, Section 7 concludes the paper.

1. Eurosystem's and individual NCBs' net issuance

1.1 Euro banknote total circulation (Eurosystem's net issuance)

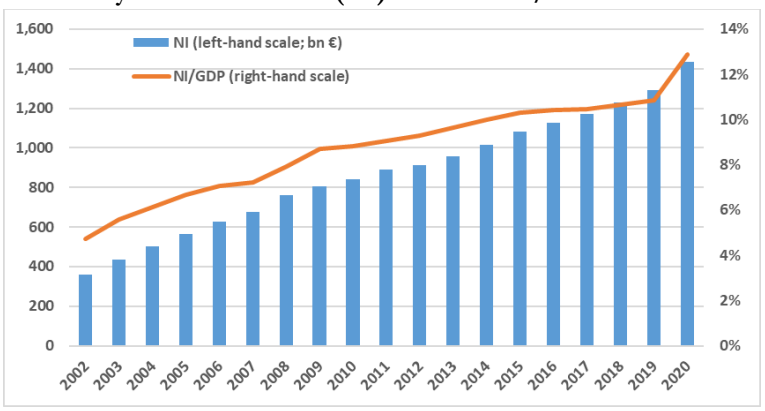
The total value of euro banknotes in circulation – measured by the Eurosystem's net issuance – has been increasing significantly from the changeover: it grew from 358.5 billion euro at end 2002 to 1,292.7 billion euro at end 2019, at an average yearly growth rate of 7,8%. Later on, in 2020 and 2021, circulation recorded a sharp increase (on average 9,3%), reaching 1,544.4 billion euro, in relation to the impact of Covid-19 pandemic on the demand for cash. The ratio circulation/GDP, increased from 4.7% in 2002 to 10.9% in 2019, reached a peak of 12.5% at end 2021 (Fig. 1).

[3] In this paper we classify euro banknote denominations as: low (€5 and €10), medium (€20 and €50), high (€100) and apical value notes (€200 and €500).

The composition of total circulation by denomination has changed over time: at end 2002 high and apical value notes represented the most widespread ones with a share of 48%, as compared with 45% of medium denominations. Until 2010, the share of high and apical denominations increased reaching a peak of 58% whereas the share of medium denominations fell to 38.8%. Later on the growth rates of high and apical value notes slowed down whereas the growth of medium denominations accelerated: at end 2021 the latter notes represented the most widespread ones with a share of 50.6%; the share of high and apical denominations decreased to 46.7%. Low denominations' share gradually decreased over the period considered (Fig. 2).

Figure 1

Eurosystem net issuance (NI) and ratio NI/euro area GDP



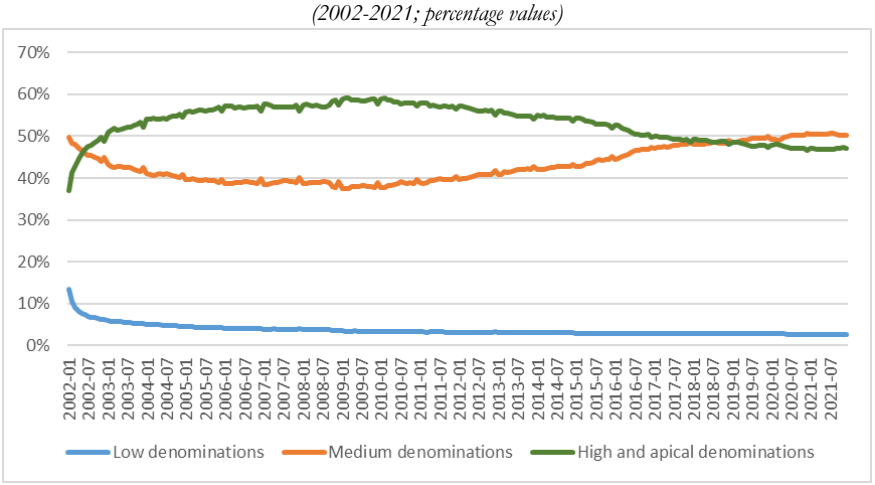
Source: Authors' elaboration on ECB data.

The slowing down of the growth of apical denominations can be related, inter alia, to the ECB decision – announced in May 2016 and implemented since the first semester 2019 – to discontinue the €500 issuance in consideration of the possibility for this denomination to be used in illicit activities. However, the reduction in €500 has been partly compensated by the growth of other high denominations: from end 2015 to end 2021, the €500 note share decreased from 26.7% to 14.1%; those of the €200 and €100 notes increased respectively from 4.0% to 9.1% and from 20.7% to 23.5%.

Figure 2

Eurosystem's net issuance: composition by denomination

(2002-2021; percentage values)



Source: Authors' elaboration on ECB data.

Various papers on euro banknote circulation highlight the relevance of the demand for euro banknotes for store of value purposes as well as of the demand from countries external to the euro area. Bartzch et

al. (2021) estimate that a share between 30 and 50% of the Eurosystem net issuance flowed out of the euro area from 2002 to 2019[4]. According to Lalouette and Esselink (2018) the share of transaction balances was between 15% and 25% of total circulation; according to Zamora-Perez (2021) the same aggregate accounts for a share between 13% and 30%. Accordingly, the estimate of balances held for store of value purposes, calculated as the residual of preceding components, would be included between 27.5% and 50% of total euro banknote circulation.

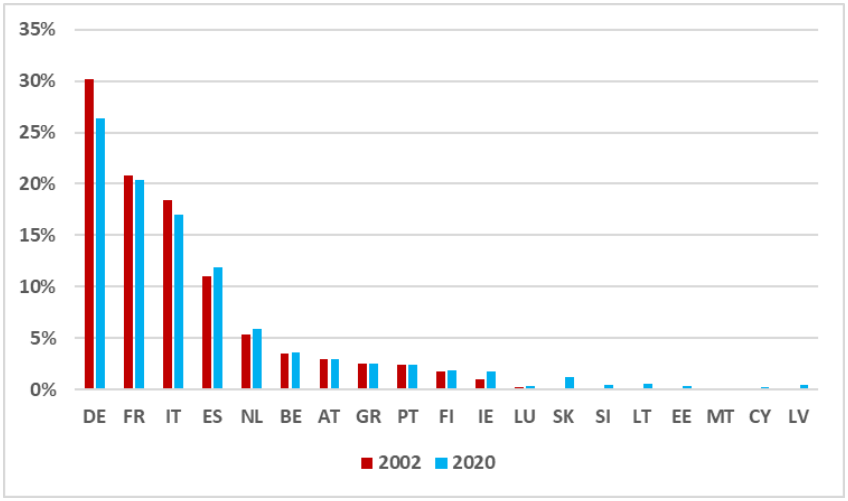
According to surveys promoted by the ECB on the use of cash in euro area countries, the share of cash payments at points of sale decreased from 79% in 2016 to 59% in 2022 in terms of number of transaction whereas from 54% to 42%[5] in value terms.

1.2 Individual NCBs' net issuance

Since the changeover, individual NCBs record "banknote in circulation" in their balance sheet on the basis of a conventional criterion: 8% of Eurosystem net issuance is attributed to the ECB; the remaining 92% is allocated among individual NCBs in proportion to GDP and population in their respective countries. Such allocation keys (c*apital keys* in the official terminology) are updated every 5 years and when new Member States join the euro area. From 2002 to 2020 modest variations were recorded (Fig. 3).

Figure 3

***Capital key* 2002-2020**
(percentage values)



Source: ECB data.

The capital key criterion, which is instrumental to the allocation of monetary income within the Eurosystem[6], does not allow to approximate the actual trend of banknote circulation in individual euro-area countries. In fact, by construction, national circulation calculated on the basis of capital key tends to

4 The minimum level is obtained as the sum of net shipments, equal to 13% of the total, and an estimate of remaining flows (tourism, remittances) worked out by assuming that the dynamic of banknote circulation within the euro area, from the changeover, has been close to the one of euro coins; the maximum level, instead, is obtained on the basis of the seasonal method. On the use of euro at the external of the euro area see also ECB (2021).

5 See in particular Esselink and Hernández (2017) and ECB (2022). Rocco (2019) deals with the results concerning Italy of the survey referred to 2016 promoted by the ECB.

6 The monetary income is the income accruing to NCBs in the performance of the ESCB's monetary policy function (art. 32 of the Statute of the ESCB/ECB); it is equal to the net income deriving from the financial assets held against notes in circulation and deposit liabilities.

closely approximate the dynamic of Eurosystem's net issuance: it is not affected by phenomena or shocks specific to individual euro-area countries which do not result in GDP or population variations (such as, changes in cash payment limits and in anti-money laundering controls on cash payments). Moreover, according to the capital key criterion, euro banknotes held at the external of the euro area are allocated to individual euro-area countries in proportion to their respective capital keys whereas, as it will be shown below, such banknotes can be mainly traced back to outflows from specific euro-area countries (in particular Germany).

The decision to adopt a conventional aggregate may depend on the circumstance that, in a monetary union, national central banks' net issuance, due to banknote migration, tend to be highly distorted, as shown below in paragraph 2.

Already at end 2002, significant differences emerged between individual NCBs' net issuance and capital key-based national circulation[7]. In particular, for Germany, Spain, Ireland, Austria and Luxembourg, NCBs' net issuances were much higher than the capital key-based circulations; by contrast, capital key-based circulation exceeded net issuance for France, Belgium, the Netherlands, Finland and Portugal. The two aggregates where very close to each other for Italy and Greece (Table 1).

Table 1

Net issuance and circulation based on capital key per country: shares out of Eurosystem's net issuance

Countries	Capital key (%)		Capital key-based circulation (mln €)		Net issuance (NI) (mln €)		NCBs NI/ Eurosystem NI (%)	
	2002	2020	2002	2020	2002	2020	2002	2020
DE	30.24%	26.4%	108,424	378,156	128,879	821,003	35.95%	57.23%
FR	20.78%	20.4%	74,517	292,988	36,037	167,742	10.05%	11.69%
IT	18.39%	17.0%	65,935	243,701	66,389	177,570	18.52%	12.38%
ES	10.98%	11.9%	39,369	171,059	54,805	9,979	15.29%	0.70%
NL	5.28%	5.9%	18,938	84,068	15,530	11,245	4.33%	0.78%
BE	3.54%	3.6%	12,685	51,642	6,879	40,770	1.92%	2.84%
AT	2.91%	2.9%	10,444	41,987	17,012	7,175	4.74%	0.50%
GR	2.54%	2.5%	9,104	35,483	9,151	21,665	2.55%	1.51%
PT	2.37%	2.3%	8,513	33,575	5,342	- 19,345	1.49%	-1.35%
FI	1.73%	1.8%	6,185	26,350	2,878	17,372	0.80%	1.21%
IE	1.05%	1.7%	3,761	24,292	5,771	41,949	1.61%	2.92%
LU	0.18%	0.3%	645	4,725	9,862	99,533	2.75%	6.94%
SK		1.1%	-	16,428	-	16,538	0.00%	1.15%
SI		0.5%	-	6,907	-	10,688	0.00%	0.75%
LT		0.6%	-	8,303	-	5,735	0.00%	0.40%
EE		0.3%	-	4,041	-	2,331	0.00%	0.16%
MT		0.1%	-	1,505	-	1,832	0.00%	0.13%
CY		0.2%	-	3,087	-	982	0.00%	0.07%
LV		0.4%	-	5,590	-	- 255	0.00%	-0.02%
TOTALE	100.0%	100.0%	358,535	1,434,507	358,535	1,434,507	100.0%	100.0%

Source: Authors' elaboration on ECB data.

[7] In the present paper, the capital key-based circulation for country A is calculated by multiplying the total Eurosystem's net issuance by NCB A's capital key; therefore, the 8% share attributed to the ECB is not considered.

At end 2019, the divergences among countries were much larger. A group of countries (Germany, Luxembourg, Ireland, Finland, Belgium, France) was characterized by relatively high net issuances' growth rates (from now on "countries with dynamic net issuance"); their overall share out of total Eurosystem's net issuance increased from 53.4% in 2002 to 84.5% in 2019; in particular, the German share increased from 35.9% to 58%. By contrast, the overall share of Spain, Portugal, Greece, the Netherlands, Italy and Austria decreased considerably (Fig. 4.a). Moreover, at the end of 2019, net issuance took on negative values in three countries (Portugal, Austria, Latvia).

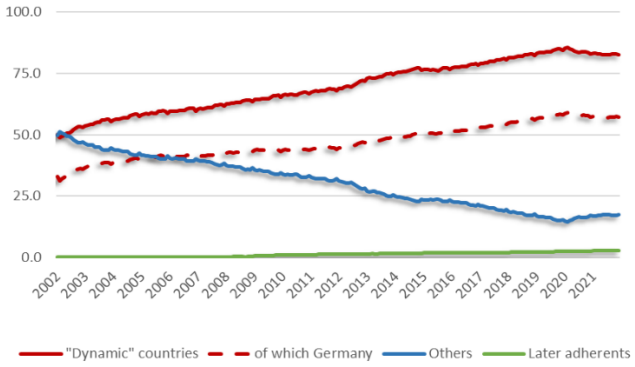
However, in years 2020 and 2021, characterized by limitations to people movements at domestic and international level in relation to the Covid-19 pandemic, such trends reversed: the share of the group of "countries with dynamic net issuance" decreased by 1.5% to 82.6%, the share of the remaining countries increased to 17.4%.[8] At end 2021 Austrian net issuance returned in positive area.

The shares of the "countries with dynamic net issuance" increased also with regard to different denominations from 2002 to 2019: for low denominations from 57.7% to 146.9%; for medium value notes from 53.0% to 83.4%; for high and apical ones as a whole from 52.5% to 81.9% (Fig. 4.b). Then, in the years 2020-21, such a trend slowed down for low denominations and for high and apical ones whereas it overturned for medium denominations. Of course, opposite trends emerged for the group of the remaining euro-area countries as a whole.

Figure 4.a

Net issuance for groups of countries: share of Eurosystem net issuance

(percentage values)

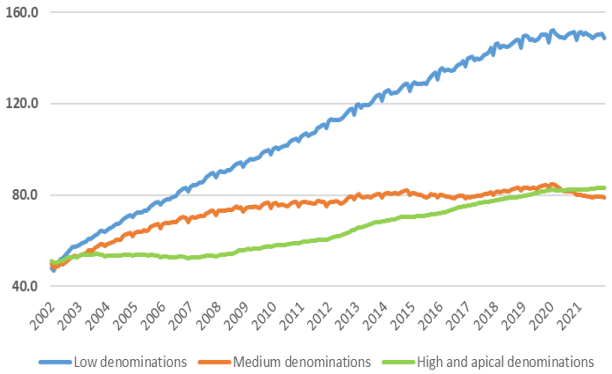


Source: Authors' elaboration on ECB data.

Figure 4.b

Group of countries with dynamic net issuance: share of Eurosystem net issuance by denomination

(percentage values)



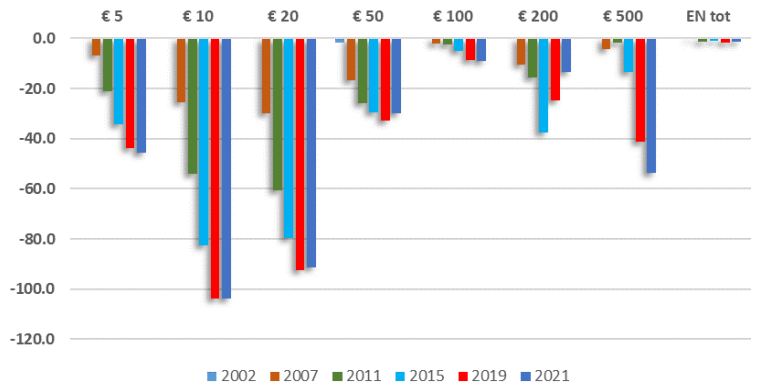
Source: Authors' elaboration on ECB data.

Since 2002, incongruous net issuance values emerged with increasing frequency and relatively high values; this holds in particular for low denominations and the €20 note and, from 2016, for the €500 note (Fig. 5); however, such incongruous values have been decreasing for the €200 note from 2016 and for most denominations in years 2020-2021 interested by the Covid-19 pandemic. At end 2021, in all euro area countries, except Germany and Slovakia, net issuances took on negative values for at least one denomination. In the same period, also Bundesbank's €5 and €10 net issuances took on incongruous values with opposite sign: they were higher than total Eurosystem's net issuances.

[8] At end 2020, the countries which joined the euro area later than 2002 accounted for 2.6% of the total; among them, Latvia recorded negative net issuance.

Figure 5

Negative net issuance:
shares out of total net issuance per denomination
(percentage values at December each year)



Source: Authors' elaboration on ECB data.

A number of contributions, focusing on Bundesbank's net issuance, highlight the relevance of banknote outflows from Germany. According to estimates put forward in Deutsche Bundesbank (2018), around 70% of Bundesbank net issuance circulated at the external of Germany, of which 50% at the external of euro area and 20% in other euro-area countries. Moreover, banknote stocks held at the domestic level for store of value purposes accounted for more than 20% of total Bundesbank net issuance whereas those held for transactional purposes accounted for 5%-10%. The growth of Bundesbank net issuance could be traced back to the high dynamic of foreign demand for euro banknotes and, to a lower extent, to an increase in domestic hoarding; by contrast, transactional balances remained constant.

2. The information content of individual NCBs' net issuance

2.1 The information content of net issuance

The information content of individual NCB's net issuance can be analysed by comparing the general case of a central bank in a country not joining a monetary union with that of a national central bank in a country joining the European monetary union.

In the general case, the total amount of central bank's banknotes in circulation (TOT_CIRC) is measured by its own cumulated net issuance (NI), that is the difference between total banknotes issued (*Withdrawals*) and total banknotes returned (*Lodgments*) to the central bank from the initial year of their issuance:[9]

$$NI_t = \sum_{i=1}^{t} (Withdrawals_i - Lodgments0_i) = TOT\_CIRC_t \quad (1)$$

If all issued banknotes remain in the issuing country, total circulation coincides with the national circulation (NAT_CIRC). Otherwise, total circulation consists of two components: (i) the banknotes circulating in the issuing country (NAT_CIRC) and (ii) those circulating abroad (FOR_CIRC):

$$TOT\_CIRC_t = NAT\_CIRC_t + FOR\_CIRC_t \quad (2)$$

9 Net issuance may diverge from actual circulation as it includes lost and destroyed banknotes.

The stock of banknotes circulating abroad is equal to the difference between cumulated outflows and inflows to/from abroad. This aggregate cannot be directly measured by a central bank on the basis of the statistics on banknotes issued and received in lodgments but may be estimated by surveys:

$$\text{FOR\_CIRC}_t = \sum_{i=1}^{t} (Outflows_i - Inflows_i) \quad (3)$$

National circulation may be also expressed as the difference between the net issuance and the net balance between cumulated outflows and inflows (which is equal to foreign circulation):

$$\text{NAT\_CIRC}_t = \text{NI}_t - \sum_{i=1}^{t} (Outflows_i - Inflows_i) \quad (4)$$

In the general case, all the mentioned aggregates (NAT_CIRC, FOR_CIRC, TOT_CIRC, NI) measure stocks of banknotes in circulation and are necessarily non-negative.

Diversely, in the case of an individual Eurosystem's NCB, such relationships are no longer valid. The individual NCB, on the one hand, issues euro banknotes which in part migrate abroad and are lodged at other NCBs; on the other hand, receives lodgments of euro banknotes issued by other NCBs.

Migration of a banknote may be examined by distinguishing two stages: (i) its outflow to a foreign euro-area country where it circulates for a certain period; (ii) its lodgment at a NCB other than the issuing one (see Box 1).

Until the banknote migrated abroad remains in circulation in another euro-area country, it meets part of the local demand for cash in substitution for banknotes issued by the local NCB. As a consequence, in a euro-area country receiving systematic net inflows from abroad (e.g., a tourism-intensive country), the NCB's net issuance will be lower than national circulation; the opposite holds for a country originating systematic banknote outflows. For a country receiving systematic banknote inflows, it is convenient to express national circulation as the sum of net issuance and cumulated net inflows from abroad:

$$\text{NAT\_CIRC}_t = \text{NI}_t + \sum_{i=1}^{t} (Inflows_i - Outflows_i) \quad (5)$$

In such a context, all the aggregates in (5) still correctly measure stocks of banknotes in circulation: the net issuance measures the total circulation created by the NCB whereas the net balance between cumulated inflows and outflows measures the amount of foreign banknotes circulating in the importing country.

Diversely, after the banknote is lodged at the foreign NCB, the two NCBs' net issuances no longer measure correctly the circulations they respectively created. In fact, when a euro banknote issued by an NCB is lodged at another NCB, the net issuance of the issuing NCB remains unchanged even though an "its own" note was withdrawn from circulation, whereas the net issuance of the NCB at which the banknote is lodged declines even though all "its own" banknotes are still in circulation. Therefore, the former NCB's net issuance overestimates, whereas the latter NCB's one underestimates, the circulations they respectively created. Such distortions are compensated in the Eurosystem's net issuance which provides a correct measure of euro banknote total circulation.

More in general, individual euro-area NCBs' net issuances no longer identify stocks of banknotes in circulation. In fact, they may take on incongruous values (e.g., negative values or values higher than total Eurosystem net issuance), not conceivable for banknote stocks. For their part, cumulated banknote net inflows/outflows correctly measure the *flows* of migrated banknotes, but they no longer identify either the *stock* of foreign banknotes circulating in an importing country, or, in the case of an exporting country, the *stock* of the banknotes issued by the respective NCB and circulating abroad. In fact, banknotes flown abroad tend to be returned to euro-area NCBs other than the issuing ones.

Negative values of a NCB's net issuance emerge when, as a result of prevailing net inflows since the changeover, cumulated lodgments exceed cumulated withdrawals. It may be useful to analyze the conditions under which such a phenomenon tends to emerge. From (5) it follows that – in the case of a banknote importing country – the net issuance of the local NCB may be expressed as the difference between national circulation and cumulated net inflows:

$$NI_t = NAT\_CIRC_t - \sum_{i=1}^{t} (Inflows_i - Outflows_i) \qquad (6)$$

The growth of cumulated net inflows results in an increasing gap, in absolute value, between national circulation and net issuance. However, if the dynamic of cumulated net inflows is lower than that of national circulation, net issuance will increase; conversely, if it is higher, net issuance is set to decline and, sooner or later, to take on negative values (see appendix A1 for further considerations).

It should be considered that incongruous net issuance values for a group of Eurosystem's NCBs entail incongruous net issuance values, with the opposite sign, for the group of the remaining NCBs as a whole: a negative aggregate net issuance for the former group entails, for the latter one, a positive aggregate value higher than the total Eurosystem's net issuance; as a matter of fact, the sum of the net issuances of the two groups must be equal to the total Eurosysem's net issuance.

Box 1: Migration of a banknote between euro-area countries: effects on net issuance and national circulation in individual euro-area countries and in the euro area.

We assume, for sake of simplicity, that the monetary area consists of only country A and country B and that a €100 note is issued by NCB A. After the banknote is issued, net issuance and circulation increase by €100€ for NCB A and the Eurosystem, as well as for country A and the euro area; conversely, NCB B's net issuance and country B's circulation remain unchanged.

If such a banknote migrates to country B, country A's national circulation drops by €100 whereas country B's one increases by the same amount. Diversely, net issuances of both NCB A and NCB B do not change; also the Eurosystem's net issuance and the euro area circulation remain unchanged.

Lastly, when such a banknote is lodged at BCN B, banknote circulation in country B and in the euro area drops by €100; also the Eurosystem's net issuance declines by the same amount. However, BCN A's net issuance does not change as it continues to record such a note as still in circulation; conversely, BCN B's net issuance drops by €100 due to the lodgment of such a note, which had not been issued by BCN B. However, the overestimation of the exporting NCB's net issuance is matched by the underestimation of the importing NCB's one. Therefore, withdrawals and lodgments of migrated banknotes at different NCBs are offset in the Eurosystem's net issuance which correctly measures euro banknotes circulation.

Migration of a euro banknote between euro area countries
impact on net issuance, national circulation and euro area circulation

	NCB A/Country A		NCB B/Country B		Eurosystem/Euro area	
Banknote issued by NCB A	Net issuance	National circulation	Net issuance	National circulation	Net issuance	Area circulation
- in circulation in country A	+100	+100	0	0	+100	+100
- lodged at NCB A	0	0	0	0	0	0
- migrated and in circulation in country B	+€100	0	0	+€100	+€100	+€100
- migrated and lodged at NCB B	+€100	0	-€100	0	0	0

2.2 Information content of negative net issuance

Negative values of net issuance are not to be interpreted as an indicator of either a drop to zero of the national circulation, or of the crowding out of the local NCB, by foreign NCBs, in its role as issuing institution. Of course, the national circulation cannot take on negative values.[10]

Negative net issuance values at time *t* indicate that, from the *changeover* to time *t,* circulation was partly fed by banknote migrated from abroad; such values (taken with positive sign) provide some indications on the size of cumulated net inflows from abroad; however, such indications are significantly biased. First, as it can be inferred from (5), such values underestimate the actual size of migration by an amount equal to the value (as a rule unknown) of national circulation. In fact, when negative net issuance emerges, migration from abroad consists of two components: (i) an "emerged" component equal to the very amount of negative net issuance (taken with positive sign); (ii) a "submerged" one equal to national circulation. Second, negative net issuance at time *t* provides information on cumulated net inflows from the changeover to time *t* which, in absence of further information, cannot be redistributed over time and, therefore, cannot be used to estimate the evolution of circulation over time. Still, negative net issuance values tend to emerge only in the long term, thereby providing indications on migration only with large time lags[11].

Relationship (5), representing national circulation as the sum of net issuance and cumulated net inflows, is not easy to interpret due to the heterogeneous nature of the two addends but also to the distortions implicit in net issuance. Through simple algebraic manipulations, national circulation may be expressed as the sum of two homogeneous variables: (i) total banknotes (both national and foreign) put into national circulation (equal to the sum of banknotes issued by the local BCN and net inflows)[12]; (ii) total (both national and foreign) banknotes withdrawn from circulation, equal to the NCB's lodgments:

$$\text{NAT\_CIRC} = \sum_{i=1}^{t} \left(Withdrawals_{NCBi} + Inflows_{other\_NCBsi} - Outflows_{NCBi}\right) - \sum_{i=1}^{t} \left(Lodgments_{i}\right) \qquad (7)$$

The previous considerations help us in the analysis of some of the trends emerging in euro-area countries' net issuances, highlighted in paragraph 1.2. As shown in Figure 5, the phenomenon of negative net issuance affects lower denominations to a larger extent than high value ones. This does not necessarily depend on a more intense use of low value notes in travels abroad. In fact, high value notes coming from abroad lend themselves to be hoarded by residents; this results in an increase in circulation and therefore in the "submerged" component of migration. Conversely, low value notes tend to be lodged more rapidly at the importing country's NCB, which favors a faster emergence of negative net issuance values.

Moreover, sharp drops in national circulation may favor the emergence of part of the "submerged" component of migration. This seems to be the case of the €500 note after the ECB announced, in May

10 Actually, even zero circulation values are not plausible, as shown by the Italian experience: after the changeover to euro in 2002, the Italian lira banknotes lost their legal tender status but remained convertible at the Bank of Italy until end-February 2012; over this period, the circulation of Italian lira notes decreased significantly but, at end February 2012, it was still positive as part of them, presumably lost or destroyed, had not been returned to the Bank of Italy.

11 In this respect, it should be considered that the initial circulation of euro banknotes (in 2002) was approximately equal to the countervalue of domestic circulation in the pre-existing national currencies; cumulated net inflows from abroad were instead much lower as they only amounted to the net inflow recorded in that initial period.

12 In the first addend of (7), the notes issued by the local NCB and circulating abroad (with positive sign) and the outflows of national banknotes (with negative sign) cancel each other out. Therefore the total banknotes put into circulation may also be expressed as the sum of: (i) banknotes issued by the NCB and circulating at the national level; (ii) cumulated inflows from abroad.

2016, the discontinuation of its issuance; such an announce was followed by a significant increase in the negative net issuance values of the €500 notes alongside a reduction in the negative net issuance values of the €200 denomination, the demand of which likely tended to partly replace that of €500.

By contrast, the general reduction in incongruous values recorded in the period 2020-2021 may be related to lower touristic flows but also, probably, to an increase in the "submerged" component of migration due to an increase in the demand for cash.

2.3 Implications for empirical estimation methods of circulation

The previous considerations are helpful in the evaluation of the various empirical methods used to estimate national circulation.

The direct method - aimed at correcting net issuance by estimates of banknote inflows/outflows from/to abroad - as can be inferred from (5), may provide reliable estimates of national circulation, but not of the stock of euro banknotes issued by a single euro-area NCB and circulating abroad, or of the stock of foreign euro banknotes circulating in an individual euro-area country.

Conversely, significant drawbacks emerge in the use of indirect methods to estimate national circulation. In particular, in the case of a country originating banknote outflows, the use of the seasonal method to decompose net issuance between national and foreign circulation – by exploiting the different seasonal patterns of such aggregates[13] - suffers from distortions implicit in net issuance which, as above discussed, does not represent a reliable measure of total circulation created by a single NCB. As to the case of a banknote importing country, net issuance is lower than national circulation; furthermore, its decomposition between internal and foreign components seems to be problematic insofar as banknotes flown from abroad become part of the national circulation and, therefore, they likely share the same seasonal pattern of national circulation.

However, when national circulation estimates are available, the seasonal method may be properly used to decompose such estimates between the transactional and store of value components.[14] Accordingly, direct and indirect methods may be considered as complementary approaches.

Moreover, indicators such as the return rate (i.e., the ratio between annual lodgments and average net issuance) are not suitable for correctly measuring the share of circulation flowing back, on an annual basis, to the issuing NCB. In fact, banknote inflows from abroad affect both the numerator and the denominator of such a ratio resulting, on the one hand, in higher lodgments and, on the other one, in lower net issuance.

However, some aspects, as a rule not observable, of national circulation may emerge in the presence of extraordinary events such as the launch of the euro 2nd series banknotes, which induced an acceleration in lodgments of the 1st series banknotes at the Eurosystem. The return of 1st series circulation was particularly fast for the lower value notes, mainly held for transactional purposes; the drop in their circulation allowed to measure more reliably the actual size of migration. As above mentioned, some authors exploited such information to estimate transactional balances of some denominations. In the

[13] In the case of a country originating banknote migration, the recourse to the seasonal method to estimate national circulation is based on the assumption that the seasonal pattern of the national circulation can be approximated by the seasonal pattern of the circulation in a similar country, in terms of factors affecting the internal demand for cash, which however is not interested by banknote outflows.

[14] In such a case, the recourse to the seasonal method is based on the assumption that the seasonality of transaction balances may be approximated by the seasonal pattern of transaction variables such as households consumption, retail payments, etc..

following paragraph 5, a method, based on such information, is proposed to estimate the circulation of lower denominations close to the launch of 2nd series banknotes.

3. Estimation of the migration of banknotes to and from Italy

In this paragraph, the Bank of Italy's survey on tourist spending and the Eurosystem's net shipments survey are presented, and the information on the migration of euro banknotes to and from Italy from these data sources is analysed.

3.1 Information sources

In Italy the collection of banknotes flows from and to abroad is conducted as part of the statistical activities for compiling the balance of payments and the "rest of the world" sector of the financial accounts (Table 2). As of September 2015, a revision of external statistics was agreed within the ESCB Statistics Committee (STC) for the EMU area countries in order to include intra-EMU assets/liabilities related to the issuance and circulation of euro banknotes, which were previously not recorded[15].

Box 2: The revision of the external statistics

The external statistics revision included the following changes:

- intra-EMU assets/liabilities for the allocation of banknotes were included in the "other investment" item of the central bank. They correspond to the difference between the circulation calculated based on the capital key ("legal circulation") and the amount of CNIs ("Cumulative net issuance");

- the difference between an estimate of the "national circulation" (i.e., the amount of banknotes held by residents of each member state) and the circulation calculated on the basis of the capital key was included in the "other investment - currency and deposits - assets" item of the private sector.

The overall impact of these two changes on the net international investment position is therefore the difference between the national circulation and the cumulative net issuance, or, in other words, the amount of net inflows of euro banknotes from abroad.

The STC recommended a coordination between compilers of external statistics and financial accounts, in order to guarantee the introduction of a single estimate of the national circulation at national level; however, it left the choice of the estimation methodology to the individual countries.

In the estimation of flows of banknotes to/from abroad, only the main types of transactions that can result in a cash migration are considered:

a) International travel;

b) Sales/purchases of euro banknotes (net shipments) by intra-euro financial institutions specialized in the international trade of currencies with subjects outside the EMU.

Other types of transactions (remittances abroad through the informal channel; cash movements related to illegal activities) are excluded, given the great uncertainty in their quantification. On the other hand,

[15] Before 2015 these figures were not included, also due to an uncertainty about their possible impact on the balance of payments errors and omissions. Over time, the phenomenon has grown in size, contributing to significant errors and omissions in some countries. Furthermore, unlike external statistics, financial accounts had begun to include these items, resulting in inconsistencies between the two statistical domains.

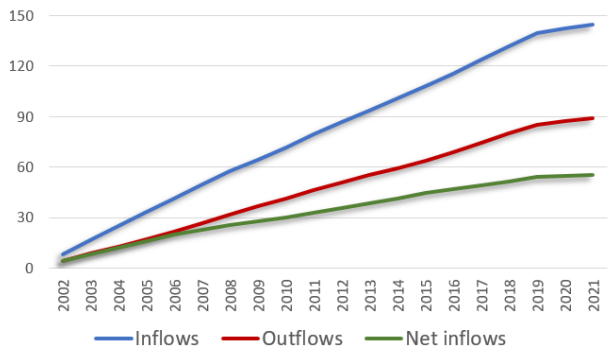
according to some estimates, these components would have for Italy a limited overall impact of negative sign (outflows).

The Bank of Italy's survey on international tourism provides the information to quantify the flows of banknotes linked to international travel (component a) (see Appendix C for more details). On the basis of this information, the inflows and outflows of euro banknotes associated with international travel (Italian travellers abroad and foreign travellers in Italy) are estimated.

From 2002 to 2021, the cumulative gross inflows and outflows from travel were estimated at 145 and 89 billion euros[16] respectively, for a total balance of 55 billion euros (Figure 6.a). On average, net inflows were 2.8 billion euros per year, with a downward trend: the peak values, close to 4 billion euros, were recorded in the early years of the euro changeover, whereas the minimum value (0.5 billion euros) was recorded in 2020 and 2021, in connection with the crisis caused by the Covid-19 pandemic (Figure 6.b)[17].

Figure 6.a

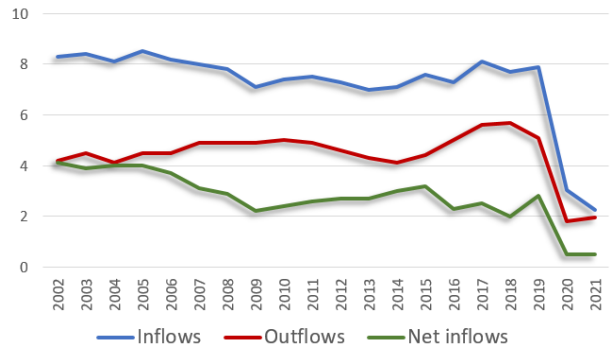
Cumulative inflows and outflows of euro banknotes
(billion euros)



Source: Bank of Italy – Survey on International Tourism.

Figure 6.b

Inflows and outflows of euro banknotes
(billion euros)



Source: Bank of Italy – Survey on International Tourism.

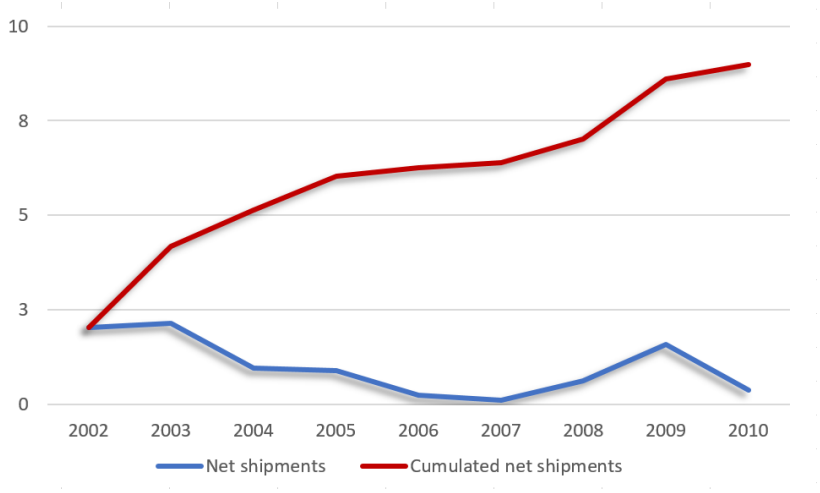
Cross-border shipments of banknotes (component b), are collected from resident banks and reported to the ECB under the statistics "*Cross-border shipments of euro banknotes*" on cross-border movements of banknotes carried out by the banking sector with professional operators counterparts in non-euro area; net shipments recorded a total outflow of around 9 billion euros, fully concentrated in the years from 2002 to 2010 (Fig. 7).

16 In the entire chapter, data for 2021 are provisional.

17 In those two years, net inflows were about one-third of those recorded in the previous two-year period.

Figure 7

***Net shipments*: annual and cumulative data**
(billion euros)

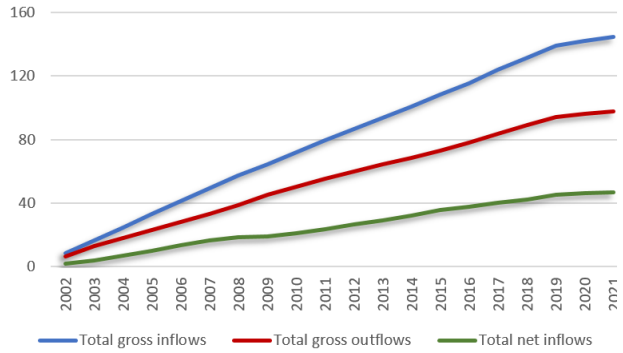


Source: Bank of Italy.

Overall, taking into account also net shipments, the cumulative gross outflows rise to 98 billion euros; the cumulative gross inflows are unchanged (145 billion euros); the cumulative net inflows rise to 47 billion euros (Fig. 8.a).

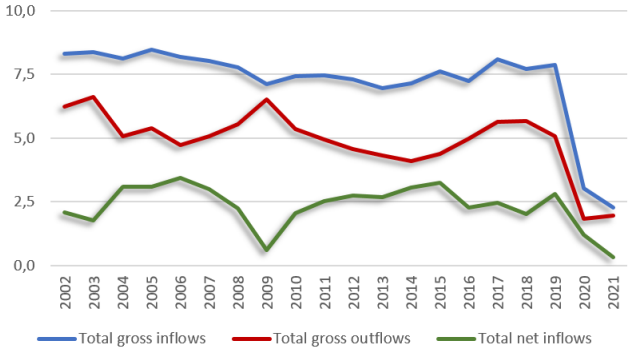
In average annual terms, net inflows from abroad, including net shipments, amount to 2.4 billion euros, without showing a defined and constant trend, beyond the sharp decline recorded in the two-year period 2020-2021 (Fig. 8.b).

Figure 8.a
Cumulative inflows and outflows of euro banknotes
(tourist flows + *net shipments*)
(billion euros)



Source: Bank of Italy - Survey on International Tourism and data on net shipments.

Figure 8.b
Cumulative inflows and outflows of euro banknotes
(tourist flows + *net shipments*)
(billion euros)



Source: Bank of Italy - Survey on International Tourism and data on net shipments.

3.2 The analysis on cash flows following international travellers

The information on cash spending by international travellers can be framed in the broader trends of tourism spending and also examined with reference to the countries of origin and destination of banknote flows.

Over the years, the share of spending in cash by foreigners[18] visiting Italy has been gradually decreasing. For the overall tourist market, the share, which was over 45% of total expenditure in the first few years after the euro changeover (2002-2005), halved in the most recent years before the health emergency (2016-2019), reaching values close to 25%. In the two years affected by the Covid-19 pandemic, the use of cash seems to have further and significantly decreased, probably favoured by the preference of travellers for contactless payment methods[19]. The trend was similar for tourists from all major countries. For those coming from the euro area, the share of cash usage has decreased from 49% on average in the 2002-2005 period to 25% in the 2016-2019 period; for travellers from EU countries outside the monetary union and for those from outside the EU, the share has decreased from 39 to 25% and from 43 to 17%, respectively (Table 2).

Table 2

Foreigners: cash expenditure share of total spending by geographical area of country of residence

	EMU	EU NON EMU	EXTRA EU	TOTAL
2002	49,0	30,4	46,2	46,2
2003	48,9	31,4	48,2	47,0
2004	47,1	40,2	39,9	43,5
2005	49,3	47,0	39,5	45,4
2006	45,2	43,6	35,9	41,4
2007	43,3	40,5	33,5	39,2
2008	41,0	39,9	33,0	38,0
2009	40,6	38,8	33,8	37,9
2010	42,8	40,6	33,4	38,9
2011	41,3	37,5	32,0	37,1
2012	39,1	35,3	31,6	35,5
2013	37,1	34,8	28,7	33,1
2014	36,7	34,2	28,5	32,8
2015	36,8	32,2	28,2	32,4
2016	27,1	25,7	17,5	22,8
2017	26,9	28,2	18,7	23,7
2018	24,8	24,5	16,6	21,4
2019	23,1	22,1	15,6	19,9
2020	21,4	22,6	14,8	19,5
2021	12,2	10,5	10,9	11,6
Total	**36,5**	**33,5**	**28,6**	**33,0**

Source: Bank of Italy - Survey on International Tourism.

[18] For convenience, the term "Italians" is used to identify Italian residents who go abroad; the term "foreigners" identifies non-resident travellers who come to visit our country.

[19] In the period March - June 2020, the sample survey on international tourism in Italy was suspended due to the Covid-19 emergency, and tourism statistics were derived from alternative sources. The survey then gradually resumed in the following months, albeit suffering from the limitations imposed by the regulations on the prevention of the spread of the virus and the stricter rules for access to border points. In light of this, it is advisable to exercise particular caution in the analysis of data referring to the 2020-2021 biennium, also due to the specificities of the traveller profile and the characteristics of travel in that period.

In 2019, travellers from euro area countries met most of their cash expenses in Italy with banknotes they brought with them: the share of gross inflows, in relation to cash spending, ranged from 99.8% of trips without overnight stay to 82.1% of trips with a duration of more than one month, with a clear inverse relationship between duration and inflow share (Table 3). The trend of inflows from other countries of origin shows decreasing shares as the duration of the trip increases, but in a less precise and evident way than for euro-area countries. The phenomenon appears to be linked to heterogeneous traveller preferences in the choice between the amount of euro banknotes brought with them and the amount of currency to be exchanged/withdrawn locally; this is in turn a consequence of the heterogeneity of the countries included in the aggregates of non-euro area, EU countries and non-EU countries. As for outflows (cash withdrawn by foreign travellers visiting Italy and taken abroad at the end of the trip), a direct relationship with the duration of the trip is observed in all areas. Ultimately, in the case of inflows, the different habits regarding the use of cash in the countries of origin seem to constitute the main driver of traveller choices; on the other hand, in the case of outflows, the needs for cash linked to the duration of the stay in Italy, rather homogeneous among travellers from even very different countries seems to prevail.

Table 3

Foreigners: spending indices by country of residence and travel duration

(euro units and percentage values – year 2019)

	Total expenditure per day				Cash expenditure per day			
Nights	EMU	EUnoEMU	extraEU	Total	EMU	EUnoEMU	extraEU	Total
0	59,1	69,3	81,8	68,7	20,8	22,0	14,9	18,6
1-3	139,5	114,9	175,1	141,4	35,3	29,6	43,6	35,7
4-7	106,3	110,5	171,0	121,1	22,8	22,5	30,6	24,4
8-14	78,5	83,8	162,3	109,5	17,2	19,3	18,7	18,0
15-31	48,1	59,4	111,9	77,5	10,7	11,2	13,9	12,2
32+	27,0	42,6	45,7	38,4	6,0	8,5	7,7	7,2
Total	88,1	94,0	130,0	102,6	20,4	20,8	20,3	20,4

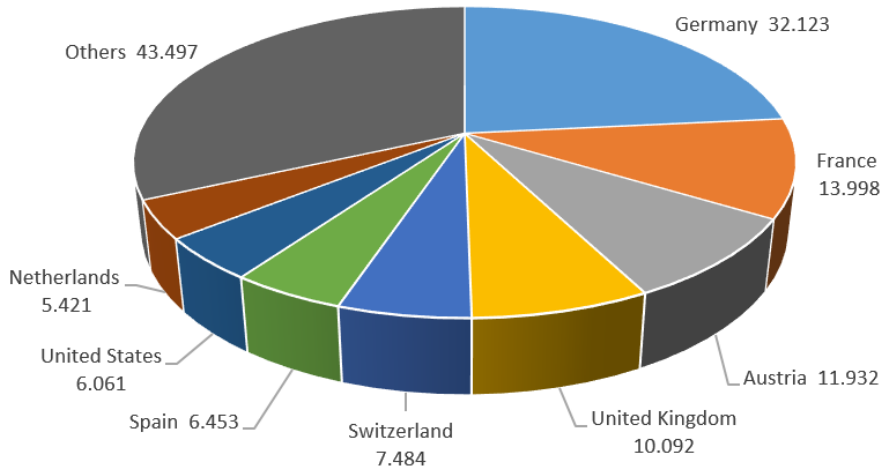
	Cash expenditure share of total expenditure				Inflow share of cash expenditure				Outflow share of cash expenditure			
Nights	EMU	EUnoEMU	extraEU	Total	EMU	EUnoEMU	extraEU	Total	EMU	EUnoEMU	extraEU	Total
0	35,2	31,7	18,2	27,0	99,8	62,3	56,6	83,1	1,2	5,4	12,4	5,1
1-3	25,3	25,8	24,9	25,3	97,0	78,7	83,1	90,0	6,5	9,7	8,0	7,5
4-7	21,4	20,4	17,9	20,2	94,5	83,5	84,3	89,5	9,2	11,3	11,2	10,1
8-14	21,9	23,0	11,5	16,5	91,1	72,5	78,4	83,5	11,2	13,7	11,1	11,6
15-31	22,3	18,8	12,4	15,7	88,8	56,1	71,3	76,1	20,3	11,7	18,4	18,3
32+	22,4	19,9	16,9	18,7	82,1	43,3	74,0	71,9	28,5	34,2	30,7	30,6
Total	23,1	22,1	15,6	19,9	94,2	76,8	78,6	86,2	9,4	12,0	12,8	10,9

Source: Bank of Italy - Survey on International Tourism.

In terms of net inflows, in the period 2002-2021 Germany is the leading country, with a share of around 23%, followed by France (10%) and Austria (9%) (Figure 9). In 2019, Germany accounted for over €1.5 billion in cash inflows, more than twice as much as the second-placed country (Austria).

Figure 9

Cumulative net cash inflows in euros by travelers' country of residence (period 2002-2021, million euros)



Source: Bank of Italy - Survey on International Tourism.

Even Italians show a decreasing propensity to use cash over time[20], similarly to foreigners. Furthermore, a greater inclination to use cash is found in neighbouring countries (Table 4). Overall, the share of cash spending, which was 40% of total spending in the first few years after the euro changeover (2002-2005), halved in the years leading up to the spread of the pandemic (2016-2019). In particular, in the two periods considered, the share of cash use for Italians traveling to euro area countries fell from 44% to 25%. The behaviour of Italians traveling to EU countries not belonging to the monetary union is similar, showing a reduction in the share from 42% to 22%. For Italians traveling to non-EU countries, cash spending has fallen from 37% to 16%. The last two years observed seem to confirm the trend towards a reduction in the use of cash.

[20] As for outgoing flows, it should be considered that the substantive equivalence between cash spending and euro spending, which is recorded for foreigners in Italy, is no longer valid.

Table 4

Italians: share of cash spending on total spending by geographical area of the destination country

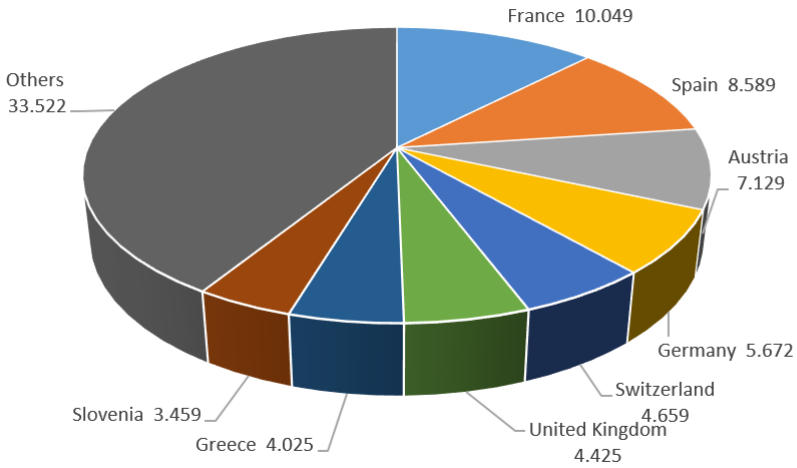
	EMU	EU NON EMU	EXTRA EU	TOTAL
2002	44,3	34,5	36,7	39,6
2003	45,1	37,1	38,8	41,2
2004	44,7	43,6	35,4	40,0
2005	42,8	47,4	36,8	40,4
2006	41,9	45,2	37,2	40,0
2007	42,7	44,5	36,7	40,0
2008	40,1	44,2	35,5	38,3
2009	43,6	43,6	35,9	39,9
2010	42,5	45,9	35,1	39,3
2011	43,4	42,6	34,1	38,7
2012	41,4	40,7	30,2	35,7
2013	40,5	42,2	27,4	33,9
2014	36,9	33,9	25,0	30,3
2015	35,5	30,7	24,5	29,4
2016	25,2	21,5	14,9	19,5
2017	27,3	26,0	17,4	22,3
2018	26,3	23,2	17,1	21,5
2019	22,6	17,5	14,8	18,1
2020	18,7	24,4	14,2	16,9
2021	10,9	17,1	12,0	11,9
Total	**35,7**	**35,4**	**27,9**	**31,8**

Source: Bank of Italy - Survey on International Tourism.

The analysis by volume of euro banknotes net flows by destination country shows that France, Spain, Austria, Germany, Switzerland, and the United Kingdom are at the top together accounting for half of the total outflows over the 2002-2021 period (Fig. 10), also reflecting the ranking of the top destination countries for tourist spending flows.

Figure 10

Cumulative net cash outflows in euros by destination country (period 2002-2021, million euros)



Source: Bank of Italy - Survey on International Tourism.

Finally, as to the balance between inflows and outflows of euro banknotes[21], over the entire period from 2002 to 2021 Germany ranks first for positive movement towards Italy, with a value fivefold exceeding the second country (United Kingdom); Austria and France follow (Table 5).

Italy records net outflows primarily towards Spain and Greece, followed by Slovenia, where net outflows have been concentrated in the last decade.

Table 5

Net movements by country of origin/destination – main countries

(billion euros)

	2002-2011	2012-2021	Total
	Top countries for inflow		
Germany	16.198	10.253	26.451
United Kingdom	3.453	2.214	5.667
Austria	2.798	2.004	4.802
France	1.230	2.718	3.949
Netherlands	2.511	1.199	3.709
Unites States	1.770	1.639	3.409
Switzerland	1.747	1.078	2.825
Poland	1.289	1.060	2.349
Belgium	1.414	859	2.272
Russia	292	939	1.231
Czech Rep.	622	553	1.176
Australia	648	489	1.137
Denmark	582	498	1.080
Canada	524	531	1.055
Slovakia	588	410	999
	Top countries for outflow		
Spain	-641	-1.507	-2.148
Greece	-1.006	-1.135	-2.141
Slovenia	-235	-913	-1.148
Thailand	-362	-626	-988
Morocco	-408	-409	-817
Egypt	-410	-339	-749
Cuba	-366	-310	-676
Tunisia	-226	-197	-423
China	-226	-164	-390
Dominican Rep.	-186	-158	-344
Portugal	-67	-158	-225
Romania	-373	156	-217
Mexico	-151	-58	-209
Kenya	-93	-105	-199
Indonesia	-37	-159	-196
	Other countries		
Others	1.932	2.244	4.176
	32.810	**22.606**	**55.417**

Source: Bank of Italy - Survey on International Tourism.

[21] For example, the net movement of euro banknotes for Germany is given by the offsetting of the net inflows generated by Germans visiting Italy, with the net outflows generated by Italians visiting Germany.

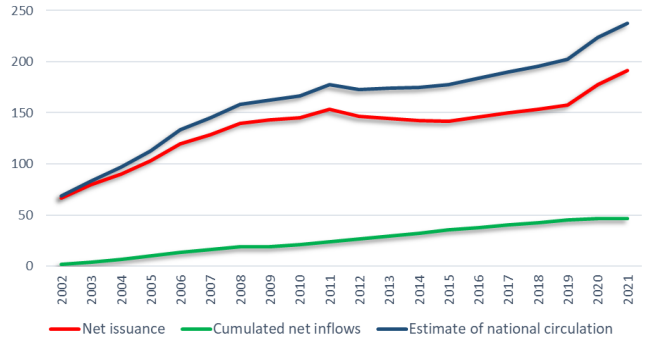
4. Banknote circulation in Italy and the contribution of net inflows from abroad

4.1 National circulation, net issuance and capital key-based circulation: trends and comparisons

Since 2015 Bank of Italy has been elaborating estimates of banknotes domestic circulation, in the context of the production of balance of payment statistics, by aggregating its own net issuance with estimates of net inflows worked out on the basis of the surveys described in the previous paragraph.[22]

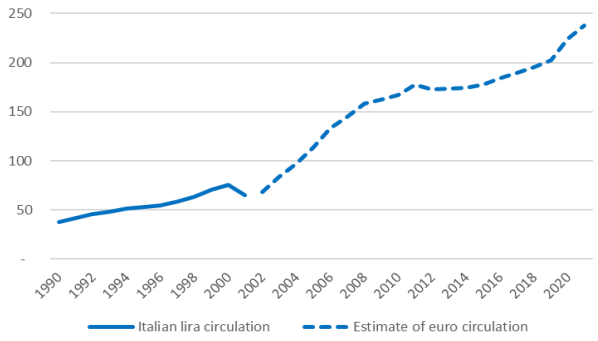
According to this estimate, national circulation increased from 68 billion euro in 2002 to 237.6 billion euro at end 2021. In the same period, net issuance - grown from 66 billion euro in 2002 to 191 billion euro at end 2021 – was always lower than national circulation (Fig. 11.a).

Figure 11.a
Estimate of national circulation
(2002-2021; billion €)



Source: Authors' elaboration on Bank of Italy data.

Figure 11.b
Banknote circulation in Italy from Italian lira to euro
(1990-2021; billion €)



Source: Authors' elaboration on Bank of Italy data.

The trend of domestic circulation has changed significantly over time. In this respect, five sub-periods may be identified (Table 6).

In the first sub-period (2002-2008) national circulation grew rapidly at an average annual growth rate of 15.1%, considerably higher than the average growth rate (6.9%) recorded in lira circulation last decade (from 1990 to 2000) (Fig. 11.b). Such an acceleration may be traced back, inter alia, to the lower holding costs of euro banknotes in comparison with lira notes thanks to lower interest rates and expected inflation rate but also to the new denomination structure which provides a wider range of high value denominations.

In the following sub-period (2009-2011) the dynamic of circulation slowed down to an average rate of 3.9%. This time span was characterized by the outburst of the international financial crisis triggered by the Lehman Brothers bankruptcy and the ensuing recession but also, at the domestic level, by the introduction of a more severe regulatory framework aimed at countering the use of cash for money laundering purposes (Legislative Decree no. 231/2007) and by the reduction of the limit on cash payments to 5,000 euro from the preceding level of 12.500 euro.

In sub-period 2012-2015, circulation dynamic further slowed down to an average growth rate close to zero; in particular, in 2012 national circulation decreased in absolute value. The slowing down of domestic circulation in these years may be traced back, on the one hand, to the recession which followed the

[22] Appendix A2 summarizes the various aggregates relating to cash circulation reported in Bank of Italy publications

sovereign debt crisis broken out in 2011 and, on the other hand, to a strengthening in Italy of anti-money laundering controls which went along with a further reduction of the limit on cash payments to as low as 1,000 euro.

National circulation rebounded between 2016 and 2019 at an average growth rate of 3.4%, in a context characterized by a slight GDP growth, low interest rates but also an increase to 3,000 euro of the limit on cash payments.

Lastly, national circulation sharply accelerated in 2020-2021 to an average growth rate of 8.3%. This period was affected by high uncertainty in relation to the Covid-19 pandemic,[23] which also resulted in higher implicit costs and inconveniences for end-users in withdrawing and depositing cash at bank branches and ATMs due to restrictions to mobility, contagion fears, operational limitations adopted by commercial banks for precautionary reasons.[24]

The ratio circulation/GDP, stable around 5%-6% in the last decade of Italian lira circulation almost doubled in the first decade from the changeover reaching 10.8% at end 2011. It was approximately stable from 2012 to 2015; then it started to grow again from 2016 attaining 11.3% at end 2019; lastly, at end 2021 it reached 13.3%.

Table 6

Comparison among National circulation, Net issuance and Legal circulation

Periods	Average growth rates *(percentage values)*			Share of GDP (*) *(percentage values)*			Share of Eurosystem Net issuance (*) *(percentage values)*		
	National Circulation	Net issuance	Capital key based circulation	National Circulation	Net issuance	Capital key based circulation	National Circulation	Net issuance	Capital key based circulation
2002-2008	15.1	13.3	13.1	9.7	8.5	7.7	20.7	18.3	16.5
2009-2011	3.9	3.3	5.0	10.8	9.4	8.9	20.0	17.3	16.4
2012-2015	0.0	-1.9	4.5	10.7	8.6	10.5	16.4	13.1	16.1
2016-2019	3.4	2.6	3.7	11.3	8.8	11.3	15.7	12.2	15.6
2020-2021	8.3	10.1	9.4	13.3	10.7	13.6	15.4	12.4	15.6

(*) Values referred to the last year of the period considered.
Source: Authors' elaboration on Bank of Italy and ECB data.

Until 2007, the growth of the Italian national circulation outpaced that of the capital key-based circulation, which closely approximated the dynamic of the Eurosystem net issuance.[25] Later on, the dynamic of the national circulation slowed down below that of capital key-based circulation. The gap between these two aggregates reached a peak of 32.7 billion euro at end 2007, afterwards it gradually decreased; from 2015 the two aggregates substantially aligned (Fig. 12.a and 12.b).

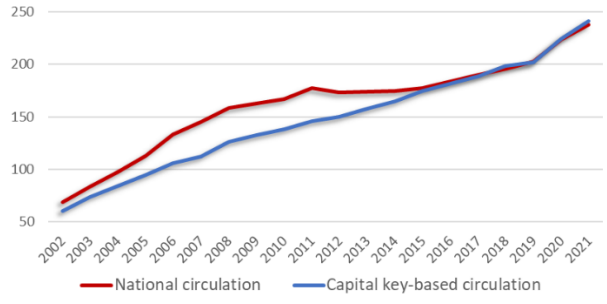
23 See Ardizzi *et al.* (2020).

24 The value limit on cash payments was lowered to 2,000 euro on 1 July 2020, then to 1,000 euro on 1 January 2022; later on it was increased to 2,000 on 1 March 2022 and lastly to 5,000 euro on 1 January 2023.

25 The dynamic of the Italian capital key-based circulation was affected by the gradual decline of the Italian capital key from 18.4% in 2002 to 16.99% in 2020, in relation to the reduction of the Italian shares of GDP (from 17.7% in 2002 to 15.0% in 2019) and population, out of total euro area GDP and population, but also to the accession of new countries to the euro area.

Figure 12.a

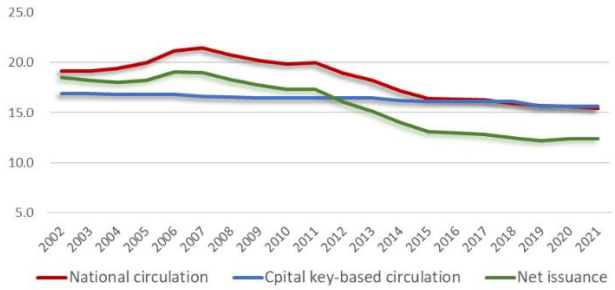
National circulation vs. capital key-based circulation
(billion €)



Source: Authors' elaboration on Bank of Italy data.

Figure 12.b

Ratios between different definitions of circulation and Eurosystem's net issuance
(percentage values)



Source: Authors' elaboration on Bank of Italy and ECB data.

The share of Italian domestic circulation on Eurosystem net issuance, amounting to 19.1% in 2002, increased until 2007 recording a peak of 21.4%, higher than the Italian capital key (18% at end 2007); later on, it gradually decreased to a minimum level of 15.4% in 2021, lower than the Italian capital key (16.99% in 2020). However, as pointed out in paragraph 1.1, a huge share of total euro banknote circulation, estimated at around 30% to 50%, is held at the external of the euro area.[26] Net of this component, the Italian share out of euro banknotes held within the euro area would grow to 20%-30%, above the weight of Italy in the euro area in terms of population and GDP. Also the ratio between Eurosystem net issuance and euro area GDP (12.5% in 2021) is lower than the one recorded for Italy (13.3% in 2021). This seems to confirm that demand for cash in Italy was higher than in the euro area as a whole.

4.2 Contribution of inflows from abroad to national circulation

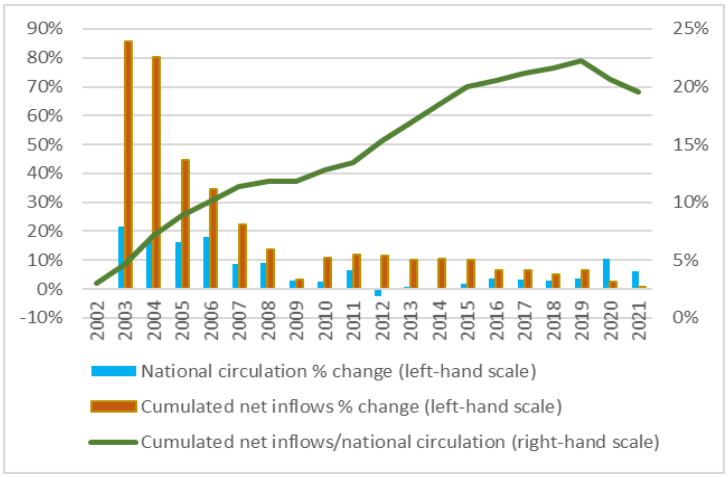
From 2002 to 2019 banknote cumulated net inflows from abroad grew more rapidly than national circulation (Fig. 13). The ratio between cumulated net inflows and national circulation, from 3% at end 2002, gradually increased to as much as 22.2% at end 2019; in the long term, the persistence of such a gap between the growth rates of these two aggregates would inevitably result in declining and eventually negative values of the Italian net issuance. However, in the period 2021-2022 net inflows decreased considerably whereas national circulation recorded an exceptional growth; the ratio between the two aggregates declined from 22.2% at end 2019 to 19.6% at end 2021.

[26] See Bartzch et. al. (2021).

Figure 13

Cumulated net inflows and National circulation

(yearly percentage changes)



Source: Authors' elaboration on Bank of Italy data.

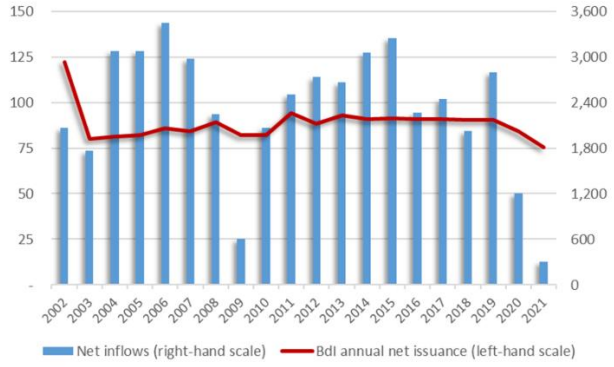
A measure of the contribution of net inflows from abroad to national circulation is provided by the ratio between net inflows and total banknotes put into circulation in Italy (withdrawals at Bank of Italy + net inflows). Over the period 2002-2021, net inflows, on average, accounted for 2.4 billion euro per year, with a strong decrease in 2020-2021 which can be traced back to the pandemic crisis (Fig. 14.a), whereas the value of banknotes issued by the Bank of Italy amounted on average to 88.4 billion per year. Therefore, net inflows from abroad represented, on average, 2.6% of total banknotes put into circulation.

Net inflows have always been lower than Bank of Italy net issuance but in period 2012-2015 when, given the slowing down in the demand for cash, net inflows from abroad allowed the banking system to meet the demand by reducing withdrawals from the Bank of Italy. By contrast, the sharp growth in the demand for cash recorded in years 2020-2021 was mainly met by an increase in Bank of Italy net issuance, given a significant drop in inflows from abroad(Fig. 14.b).

Figure 14.a

Banknotes yearly fed into circulation: Bank of Italy issuance vs. inflows from abroad

(billion €)

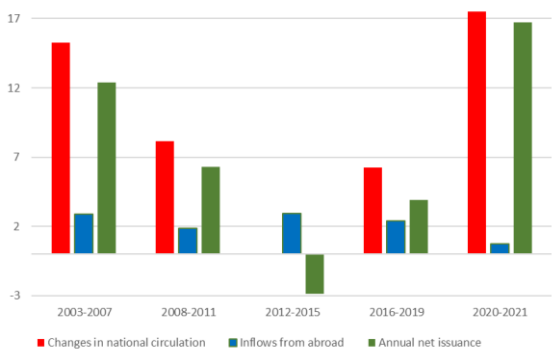


Source: Authors' elaboration on Bank of Italy data.

Figure 14.b

Changes in circulation, net issuance and net inflows by sub-periods

(billion €)



Source: Authors' elaboration on Bank of Italy data.

5. Migration and circulation broken down by denominations in Italy

Information on the composition of banknote circulation by individual denominations is available for the net issuance but not for the net inflows from abroad, as the Bank of Italy survey on tourism only collects aggregate data on the value of cash transactions. That is why, we are not able to estimate individual denominations' national circulation by adding net issuance to net inflows/outflows.

After a description of the trends of individual denominations' net issuance, also with regard to the Italian lira circulation before the changeover (par. 5.1), we will analyse migration and circulation on the basis of a number of indicators and empirical methods (par. 5.2, 5.3 e 5.4).

5.1 Individual denomination net issuance

In the period preceding the changeover, the Italian lira circulation consisted of the following denominations: 1,000, 5,000, 10,000, 50,000, 100,000 and 500,000 lira; this latter denomination was launched in 1997.

At end 2001, the highest denomination (500,000 lira) accounted for 16% of the total circulation (in terms of value) in comparison with 62% of the 100,000 lira note, 17% of the 50,000 one and of 5% of lower value denominations (mainly 10,000 and 2,000 lira). The two highest denominations (500,000 and 100,000 lira) accounted for 78% of total circulation.

The adoption of euro banknotes made it available a new denomination structure including a wider range of high value ones (€500, €200 e €100) suitable for meeting precautionary and store of value needs. Conversely, the range of low denominations shrinked; this resulted in a larger area, below the 5€ note (approximately 10,000 Italian lira), covered by coins ranging from a minimum of 1 euro cent (around 20 lira) to a maximum of 2€ (approximately 4,000 lira) (Table 7).

Table 7
Banknotes and coins denominated in Italian lira and euro: comparison between scales

High and apical denominations				*Medium denominations*		*Low denominations*		*Coins*							
€ 500		€ 200	€ 100	€ 50	€ 20	€ 10	€ 5	€ 2.00	€ 1.00	€ 0.50	€ 0.20	€ 0.10	€ 0.05	€ 0.02	€ 0.01
Lit. 968,135		*Lit. 387,254*	*Lit. 193,627*	*Lit. 96,814*	*Lit. 38,725*	*Lit. 19,363*	*Lit. 9,681*	*Lit. 3,873*	*Lit. 1,936*	*Lit. 968*	*Lit. 387*	*Lit. 194*	*Lit. 97*	*Lit. 39*	*Lit. 19*
	Lit. 500,000			**Lit. 100,000**	**Lit. 50,000**	**Lit. 20,000**	**Lit. 10,000**	**Lit. 5,000**	**Lit. 2,000**	**Lit. 1,000**	Lit. 500	Lit. 200	Lit. 100	Lit. 50	Lit. 20	Lit. 10
	€ 258.23			*€ 51.65*	*€ 25.82*	*€ 10.33*	*€ 5.16*	*€ 2.58*	*€ 1.03*	*€ 0.52*	*€ 0.26*	*€ 0.10*	*€ 0.05*	*€ 0.03*	*€ 0.01*	*€ 0.005*

At end 2002, first year of circulation of the euro cash, the composition of Italian net issuance was the following: the apical denominations (€200 e €500) accounted for 14.6%; the €100 for 24.6%; the medium denominations (€20 and €50) for 54.7%; the low denominations (€5 and €10) for 6.1%. At that time, the impact of migration from abroad was still limited; that is why, it seems reasonable to assume that the composition of net issuance was close to that of national circulation (Table 8).

Table 8

Breakdown of net issuance by denominations: lira in 2000 vs euro in 2002-2021

	Lira		Euro						
	denomin.	2000	*denomin.*	2002	2007	2011	2015	2019	2021
apical denomin.	*500,000*	15.1%	*500* *200*	14.6%	17.8%	7.8%	**-22.7%**	**-39.0%**	**-34.9%**
high denomin.	-	-	*100*	24.6%	24.5%	23.2%	15.8%	4.4%	**-0.6%**
mediun denomin.	*100,000* *50,000*	79.9%	*50* *20*	54.7%	55.0%	67.7%	**106.9%**	**135.8%**	**136.4%**
low denomin.	*20,000* *10,000* *5,000* *2,000* *1,000*	5.0%	*10* *5*	6.1%	2.7%	1.3%	0.0%	**-1.2%**	**-0.9%**

Source: Authors' elaboration on Bank of Italy data.

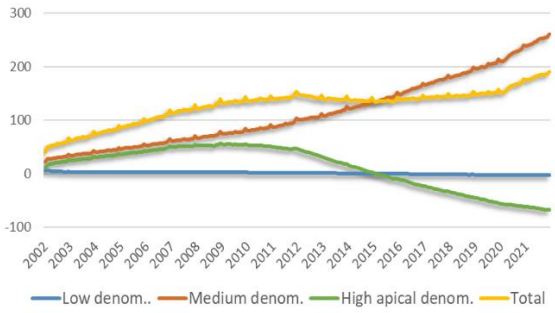
Later on, until end 2007, the apical notes represented the most dynamic component of the net issuance with average growth rates around 19%; they increased from 9 billion euro at end 2002 to a peak of 22.9 billion euro at end 2007. However, since 2008, in relation inter alia to more severe anti-money laundering controls and limits on cash payments, the apical denominations' net issuance declined and took on negative values from 2013; at end 2021 it amounted to -66.6 billion euro (Fig. 15.a e 15.b).

The €100 net issuance tended to replicate the trend of the apical notes with some lags and more gradually: until 2007 it grew at a 14% rate; from 2008 to 2011 it slowed to 3.2%; then, since 2012 it decreased in absolute value until reaching negative values in 2021 (-1,1 billion euro at end 2021) (Fig. 15.a e 15.b).

Figure 15.a

Net issuance broken down by denominations

(billion €)



Source: Bank of Italy.

Figure 15.b

Net issuance: high and apical denominations

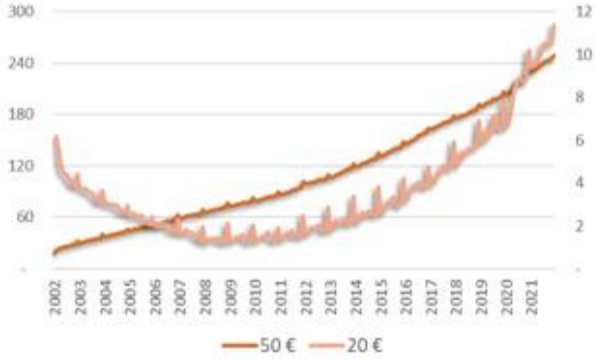
(billion €)

Source: Bank of Italy.

Figure 15.c

Net issuance: medium denominations

(billion €)

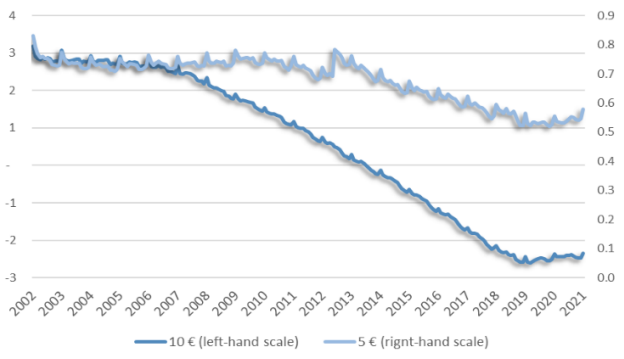


Source: Bank of Italy.

Figure 15.d

Net issuance: low denominations

(billion €)



Source: Bank of Italy.

By contrast, ever since 2002 the medium denominations' net issuance increased until becoming, from 2008, the most dynamic component of the total net issuance. In particular, the €50 net issuance exceeded both the total Bank of Italy net issuance (from 2015) and the estimate of national circulation (from 2019): at end 2021 it amounted to almost 250 billion euro as compared to 190 billion euro of net issuance and almost 238 billion euro of national circulation. Diversely, the €20 note declined from 2002 to 2010 (from 4.4 to 1,9 billion euro); ever since it steadily increased until reaching 11.4 billion euro at end 2021 (Fig. 15.a e 15.c).

Lastly, low notes' net issuance gradually declined from 4 billion euro at end 2002 to -1.7 billion euro at end 2021. In particular, the €5 net issuance decreased from 830 million euro in 2002 to 580 million euro in 2021 remaining in positive area; diversely, the €10 net issuance, amounting to 3.2 billion euro at end 2002, took on negative values from 2014 and amounted to -2,4 billion euro at end 2021 (Fig. 15.a e 15.d).

In the period 2020-2021, characterized by a strong increase in circulation and a sharp reduction in banknote net inflows from abroad, the dynamic of net issuance for all denominations partly deviated from the previous trends: the medium denominations growth rates accelerated; low denominations' net issuance increased, in contrast with its traditional declining trend; the decline of high and apical denominations slowed down (Fig. 15.a, 15.b, 15.c e 15.d).

Correlation indexes among individual denominations' net issuances highlight substitution relationships between low and medium notes but also between medium and the higher denominations (both €100 and apical denominations) (Table 9).

Table 9

Correlation coefficients among individual denominations' net issuance (*)

	5 €	10 €	20 €	50 €	100 €	200 €	500 €
5 €	1.00	0.26	-0.12	-0.29	0.22	0.23	0.13
10 €	0.26	1.00	-0.81	-0.68	0.81	0.78	0.84
20 €	-0.12	-0.81	1.00	0.85	-0.90	-0.80	-0.77
50 €	-0.29	-0.68	0.85	1.00	-0.81	-0.78	-0.72
100 €	0.22	0.81	-0.90	-0.81	1.00	0.94	0.88
200 €	0.23	0.78	-0.80	-0.78	0.94	1.00	0.96
500 €	0.13	0.84	-0.77	-0.72	0.88	0.96	1.00

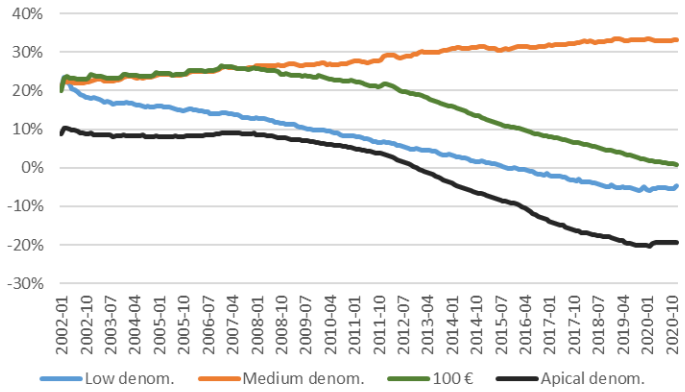
(*) Monthly net issuances cumulated over 12 months (from June 2003 to December 2019) are considered.
Source: Authors' elaboration on Bank of Italy data.

In comparison with the Eurosystem net issuance, the share of Italian medium denominations increased from 22.5% at end 2002 to 33.5% at end 2021, when only the German net issuance share exceeded the Italian one. Diversely, the Italian share of high and apical denominations, relatively high in the initial period from the changeover (almost 15%), later on decreased to as low as a negative share of -9,3% at end 2021, much lower than other countries also recording negative shares such as the Netherlands (-1,5%), Portugal (-1,4%) and France (-1,3%). Lastly, the Italian share of low notes decreased from 18% at end 2002 to –5% at end 2019, rebounding at –4,5% at end 2021; in this case, much lower negative shares emerged for Spain (-42.8%) and Greece (-11.2%) (Fig. 16).

Figure 16

Bank of Italy net issuance by denominations: shares of Eurosystem net issuance

(percentage values)



Source: Authors' elaboration on Bank of Italy and ECB data.

As shown in paragraph 3.2, banknote net inflows into Italy mainly came from Germany, Austria and France. The sum of German, Austrian and French net issuances for all denomination, but 50€, exceeded or was very close to 100% of total Eurosystem net issuance; this suggest that such notes tended to outflow from this group of countries. This group's composition of net issuance tends to be a mirror image of the Italian one; this may contribute to explain the denomination mix of banknote migration from/to Italy (Table 10).

Table 10

Net issuance of main countries originating banknotes inflows into Italy: share of Eurosystem's net issuance

(percentage values)

	Low denomin.	20 €	50 €	High and apical denomin.
Germany	127.1%	68.8%	36.6%	71.4%
Austria	8.7%	-20.0%	-26.3%	28.3%
France	31.2%	80.9%	15.6%	-1.3%
Total	*167.0%*	*129.7%*	*25.9%*	*98.4%*
Italy	-4.5%	12.3%	36.4%	-9.3%

Source: Authors' elaboration on Bank of Italy and ECB data.

5.2 Banknote migration by denomination

Individual denominations' migration may be estimated on the basis of two methods focusing on incongruous values respectively of: (i) net issuance of 1st series euro banknotes after the launch of 2nd series euro banknotes; (ii) net issuance of individual denominations (without distinguishing by series) at end 2021.

The 2nd series euro banknotes were launched between May 2013 and May 2019 at different times for each denomination. After such a launch, the 2nd series notes gradually replaced the 1st series ones. As a consequence, the Eurosystem net issuance for the 1st series notes decreased and, in the case of lower denominations - mainly demanded for transactional purposes – tended to stabilize at modest levels signaling that most of 1st series notes had been withdrawn from circulation by the Eurosystem; for higher

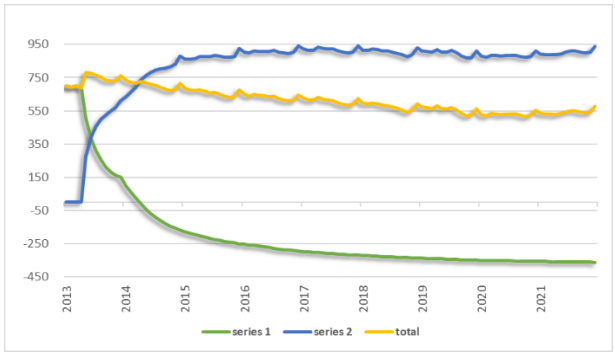
denominations, such a process took place more gradually. As Eurosystem net issuances stabilized at low values, individual NCBs' net issuances stabilized, for some NCBs, at relatively high values whereas for other NCBs at negative values. Such values approximate the size of the migration of 1st series banknotes to/from abroad which had taken place since the changeover in individual euro area countries.

In the Italian case, at end 2021 the net issuances of 1st series €5, €10 and €20 denominations stabilized at negative levels (Fig. 17.a, 17.b and 17.c). This is not a surprise for the 10€ note which had recorded negative net issuance values from 2014. Diversely, the net issuances of 5€ and 20€ had always been in positive area; in such cases, the negative values of the 1st series component reveal that Italy had been receiving inflows whose size was modest in comparison with domestic circulation.

Figure 17.a

Bank of Italy net issuance of €5 notes broken down by series

(million €)

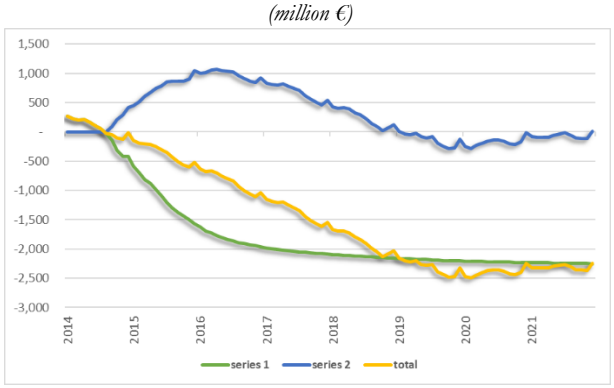


Source: Authors' elaboration on Bank of Italy and ECB data.

Figure 17.b

Bank of Italy net issuance of €10 notes broken down by series

(million €)

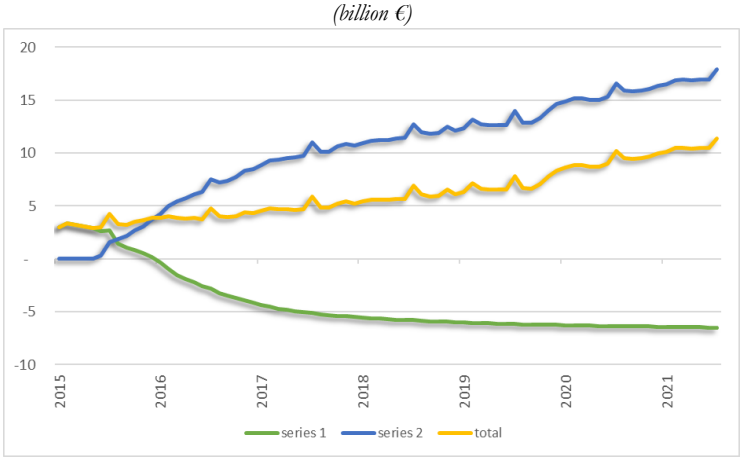


Source: Authors' elaboration on Bank of Italy and ECB data..

Figure 17.c

Bank of Italy net issuance of €20 notes broken down by series

(billion €)



Source: Authors' elaboration on Bank of Italy and ECB data

On the basis of the 1st series net issuances, it can be estimated (see Appendix A1, par. 4) that, from 2002 to the month preceding the launch of 2nd series banknotes,[27] cumulated net inflows amounted approximately to: 320 million euro for the €5 denomination, 2 billion euro for the €10 note, 4.5 billion euro for the €20 one, summing up approximately to 6.8 billion euro (Table 11).

[27] April 2013 for 5 euro, August 2014 for 10 euro, October 2015 for 20 euro.

We estimate that the net inflows from abroad represented shares of 3.9% for the €5 and the €10 notes, and of 2.4% for the €20 one, out of the total notes (for the respective denominations) put into circulation in Italy. Moreover, such inflows accounted for modest shares (between 0.1% and 0.2%) of the Eurosystem net issuances for the concerned denominations.

Furthermore, over the 2002-2015 period, the €5, €10 and €20 inflows as a whole (almost 7 billion euro) accounted approximately for 20% of total migration from abroad (approximately 35.5 billion euro), estimated on the basis of the Bank of Italy survey on tourism. Therefore, the net inflows from abroad, from 2002 to 2015, mainly consisted of higher value notes (in terms of value).

Table 11

Banknote inflows and outflows to/from Italy by denomination

Denom.	Cumulated net inflows		Cumulated net outflows		Share of total banknotes fed into circulation (*)	Share of Eurosystem net issuance (BdI excluded)
	billion €	from changeover to:	billion €	from changeover to:		
500 €	≥ 51.7	end 2021			≥ 39%	≥ 3%
200 €	≥ 15	end 2021			≥ 52%	≥ 2,5%
100 €	≥ 1.1	end 2021			≥ 0,5%	≥ 0,05%
50 €			≥ 28	end 2021		≥ 0,3%
20 €	4.5 (**)	October 2015			2.40%	0.2%
10 €	2 (**)	August 2014			3.9%	0.2%
	≥ 2.4	end 2021			≥ 2,2%	≥ 0,1%
5 €	0.32 (**)	April 2013			3.9%	0.1%

(*) The total amount of banknotes fed into circulation is calculated by summing cumulated net inflows to cumulated withdrawals at Bank of Italy. (**) Estimates based on lodgments of 1st series euro banknotes at Bank of Italy.

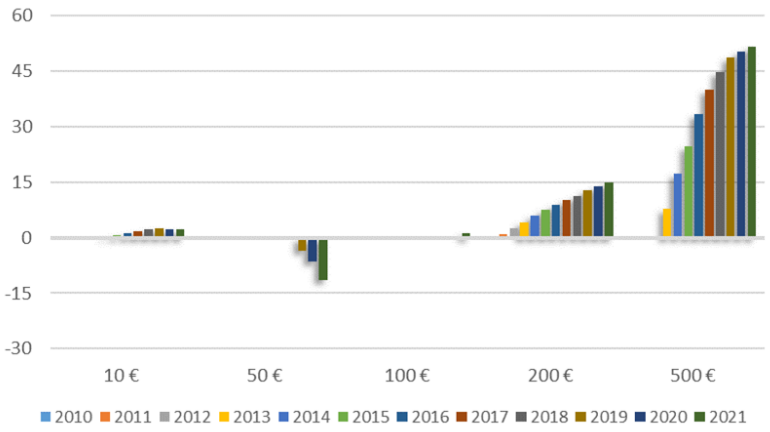
Source: Authors' elaboration on Bank of Italy and ECB data.

The second method aims at extracting indications on banknote migration from incongruous net issuance values at end 2021 without distinguishing by series. On that date, negative net issuance values were recorded for the €10, €100, €200 and €500 denominations, amounting as a whole to –70.1 billion euro. This means that, from 2002 to 2021, cumulated net inflows for such denominations amounted at least to 70.1 billion euro (Fig. 18). The largest inflows concerned the apical denominations (at least 15 billion euro for €200 and 51.7 billion euro for €500). In the case of €10, cumulated net inflows amounted at least to 2.4 billion euro, as compared to the above mentioned estimate of 2 billion euro referred to the period from the changeover to launch date of the 2nd 10€ series (August 2014). With regard to the €100 note, the negative net issuance first emerged only in 2021 (-1.1 billion euro); this value seems destined to grow significantly (in absolute terms) in the coming years (Fig. 18).

Figure 18

Incongruous net issuance values by denominations(*)

(billion €)



(*) *Negative net issuance taken with positive sign or, in case of positive net issuance exceeding the estimate of national circulation for overall denominations, difference between net issuance and the estimate of national circulation.*

Source: Authors' elaboration on Bank of Italy.

The size of inflows was remarkable for the apical denominations: out of total apical denominations put into circulation in Italy, net inflows from abroad accounted for at least 52% for the €200 note and 39% for the €500 one; the analogous shares for the €10 denomination (at least 2.2%) and the €100 one (at least 0,5%) were much lower. In comparison with the overall Eurosystem net issuance, net inflows accounted for at least 3%, 2,5%, 0,05% and 0,2% respectively for the €500, €200, €100 and €10 notes.

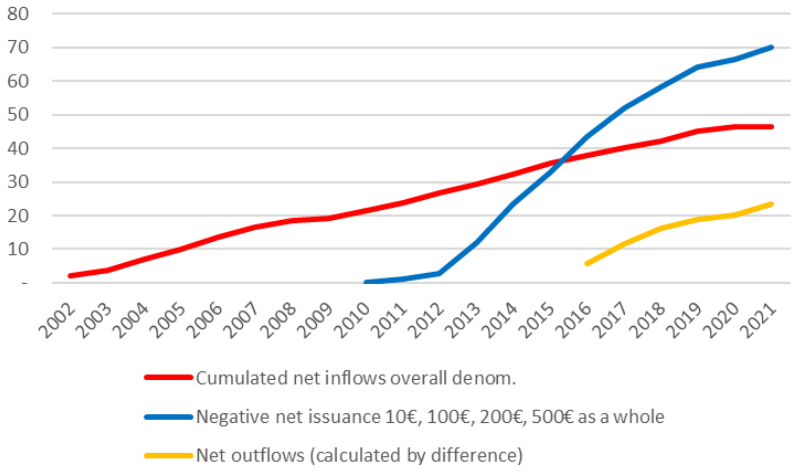
Also the 50€ net issuance took on incongruous values at end 2021: its value (249 billion euro) was higher than the estimated national circulation for overall denominations (237.6 billion euro). The difference between 50€ net issuance and national circulation, amounting to 11.4 billion euro, had necessarily flown out abroad.

Indications on outflows may also be drawn from a comparison between the estimate of migration from abroad based on negative net issuance (at least 70.1 billion euro at end 2021) and that of migration for overall denominations taken from the surveys on tourism and the statistics on net shipments (around 46.6 billion euro at end 2021). The first aggregate, which underestimates migration from abroad, exceeds by approximately 23.5 billion euro the estimate of migration for overall denominations (Fig. 19). Such a difference may derive from net outflows towards abroad for denominations recording positive net issuance at end 2021 (i.e., in principle €5, €20 and €50 notes). However, as above mentioned, inflows from abroad prevailed also for the €5 and the €20. Therefore, net outflows essentially concerned the €50 denomination and – taking into account the above mentioned estimates of €5 and €20 inflows - would have amounted at least to 28.3 billion euro.

Figure 19

Net inflows for overall denominations (from survey on tourism) vs net lodgments at BdI for denominations with negative net issuance

(billion €)



Source: Authors' elaboration on Bank of Italy data

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As already mentioned, in the coming years the €100 net issuance, negative from 2021, is expected to decline remarkably, in line with the trends observed for other denominations with negative net issuance.

If the incongruous net issuance values help identifying minimum levels of migration, maximum limits may be deduced from the estimates of gross cumulated inflows and outflows for overall denominations which, as already mentioned, amounted respectively to 144.5 and 98 billion euro at end 2021. With regard to inflows of high and apical notes, the minimum limit (66.7 billion euro at end 2021) may be compared with a maximum limit of 135 billion euro, obtained by detracting inflows estimated for lower denominations (€5, €10, €20) from the estimate of gross inflows for total denominations. As regards €50 outflows, the minimum level of 28.5 billion euro can be compared with a maximum one of 98 billion euro. The hypotheses underlying the maximum limits are extreme: it is assumed that foreigners coming to Italy held exclusively denominations other than 50€ and that Italian residents held only the 50€ notes in their travels abroad. Realistically, both inflows of high and apical denominations and €50 outflows were significantly lower than such maximum limits.

5.3 National circulation of individual denominations

The estimates of migration provided in the previous paragraph may be added to the net issuance in order to obtain estimates of the national circulation.

Accordingly, estimates of the national circulation of low denominations and the €20 note are elaborated by taking into account the estimate of migration from the changeover to the launch dates of 2nd series.

According to such estimates, the circulation of the low denomination notes (€5 and €10) in the years 2013-2014 amounted to almost 3 billion euro, accounting approximately for 2% of national circulation, as compared to 6% in 2002.[28] Moreover, since the changeover and 2013-2014, the €5 circulation increased

[28] The share of low denominations in 2002 is calculated on the basis of their net issuance. In fact, net issuance at end 2002 was likely affected only to a limited extent by migration and therefore its divergence from national circulation was likely limited.

at an average yearly rate of approximately 2% whereas the €10 circulation decreased at an average rate of -4.6%.

We estimate that the €20 circulation increased at an average annual rate of 4.5% from 2002 to 2015 when it represented around 5.2% of national circulation (as compared to 6.7% at end 2002).

Table 12

Estimates of national circulation of low denominations and €20 between 2013 and 2015
(*billion €)*

Denomin.	Cumulated net inflows		Net issuance	Estimates of national circulation (*)	Share of national circulation (**)
	million €	from changeover to:			
5 €	0.3	April 2013	0.6	0.9	0.6%
10 €	2	August 2014	- 0.1	1.9	1.3%
20 €	4.5	October 2015	2.9	7.4	5.2%

(*) Referred to the month before the launch of 2° series euro banknotes. (**) Referred to the average circulation over the period 2013-2015.

Source: Authors' elaboration on Bank of Italy data.

As for the €50 and the high and apical denominations circulation, the estimates of migration provided in the previous paragraph allow us to propose the following estimates by interval at end 2021:

- the €50 circulation would be included between a minimum of around 150 billion euro (64% of national circulation) and a maximum of approximately 220 billion euro (more than 90% of national circulation);
- the circulation of high and apical denominations would be included between 0 and 67 billion euro (28% of national circulation). However, a zero value does not appear realistic. It can be hypothesized that national circulation of such denominations amounts at least to transactional balances estimated on the basis of their lodgments at the Bank of Italy in 2021.[29]

The intervals indicated for the €50 and the high and apical denominations are extremely wide. In any case, with regard to high and apical denominations, even if we consider the maximum level, their share out of national circulation declined noticeably as compared to 2002 (almost 40%); conversely, the share of medium denominations greatly increased as compared to their level in 2002 (around 55%).

However, some considerations, set out in the following paragraph, lead to believe that, at end 2021, the circulation of high and apical denominations was at the lower end of the estimated range whereas the medium denominations circulation was at the higher end of the respective interval.

[29] Transaction holdings were estimated on the basis of the method of the most transactional denomination (€20), mentioned in paragraph 6, by assuming that the return rate of €20 estimated for 2015 remains substantially valid in 2021.

Table 13

Estimates of national circulation of €50 and high and apical denominations in 2021
(*billion €*)

Denomin.	Cumulated net inflows (+) / outflows (-)		Net issuance at end 2021	Estimate of national circulation at end 2021		Share of national circulation at end 2021	
	min	max (*)		min	max	min	max
50 €	-28.3	-98 (*)	249.2	151.2	220.9	63.6%	93.0%
high and apical denomin.	67.8	135 (**)	-67.8	3.5 (***)	67.2	1.5%	28.3%

(*) Gross cumulated outflows of overall denominations estimated by the Bank of Italy survey on tourism. (**) Gross cumulated inflows for overall denominations estimated by Bank of Italy survey on tourism minus estimates of 5€, 10€ and 20€ cumulated net inflows. (***) Estimates of transaction balances.
Source: Authors' elaboration on Bank of Italy data.

5.4 Trends of high and apical denominations

As already mentioned, from 2002 to 2007 the net issuance of high and apical denominations increased significantly; then, from 2008 to 2011 it declined gradually. The estimates available on inflows from abroad in this period do not allow to highlight how the circulation of such denominations evolved.

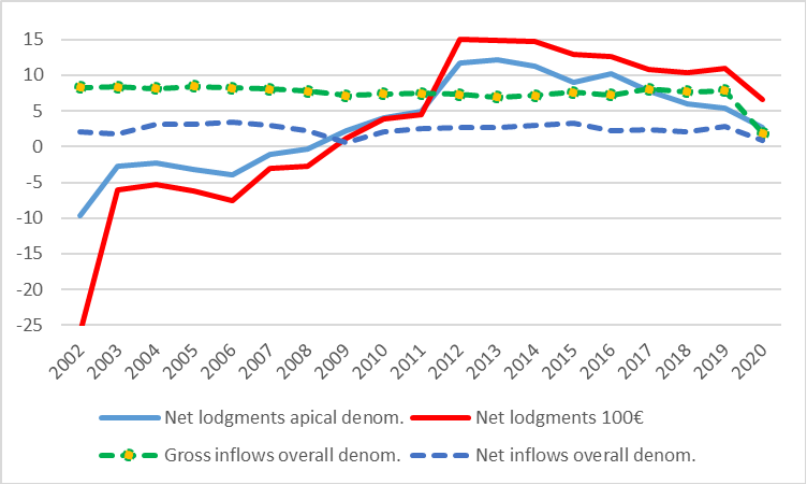
Since 2012, *net* lodgments (equal to lodgments minus withdrawals) of high and apical notes at Bank of Italy recorded a sudden increase. What's more, from 2012 to 2021 high and apical denominations' *net* lodgments were always higher than the total *gross* inflows from abroad (referred to all denominations), estimated on the basis of the surveys on tourism. Therefore, in this period, a dramatic reduction in the net issuance of the high and apical notes was not compensated by net inflows from abroad; this resulted in a decline of national circulation of such denominations. In particular, from 2012 to 2021 *net* lodgments of high and apical denominations amounted to 115.4 billion euro whereas *gross* inflows from abroad for all denominations were estimated at 65.2 billion euro (Fig. 20). Under the extreme hypothesis that inflows from abroad consisted exclusively of high and apical denominations, the reduction in their circulation would have amounted to approximately 50 billion euro; if, as it appears realistic, inflows consisted also of other denominations, the decline in circulation of such denominations would have been be higher.

Further considerations may be made on apical denominations, whose net issuance was close to zero at end 2012 and took on negative values from 2013. From 2013 to 2021 *net* lodgments of apical denominations amounted to 67 billion euro, higher than the value of *gross* inflows for all denominations (58 billion euro). The difference between such aggregates (approximately 9 billion euro) indicates that, at end 2012, national circulation of apical denominations was sensibly higher than net issuance and that such an additional banknote stock necessarily had to be traced back, in part, to banknotes flown into Italy and hoarded by residents in previous years. Therefore, before 2012 the circulation of apical denominations was higher than the value indicated by net issuance.

Figure 20

High and apical denominations' net lodgments vs. estimates of overall denominations' gross and net inflows

(billion €)



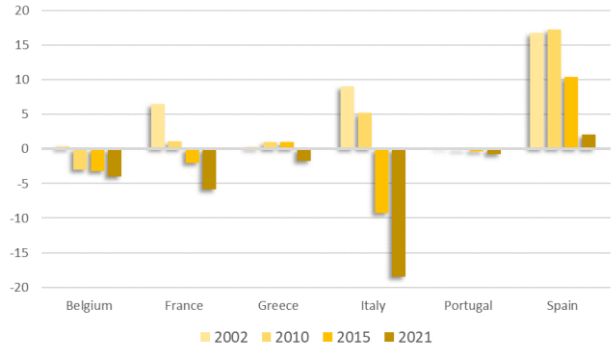
Source: Authors' elaboration on Bank of Italy data.

The collapse in the demand for apical denominations in Italy appears peculiar as compared with other euro-area countries: in 2002 the Italian share of apical denominations out of Eurosystem net issuance amounted to 9% and was exceeded only by the shares of Germany (44.1%) and Spain (16.8%); conversely, at end 2021, the Italian share (-18.5%) was the lowest in the euro area (Fig. 21.a).

Figure 21.a

Apical denominations net issuance in selected countries: shares of Eurosystem net issuance

(percentage values)

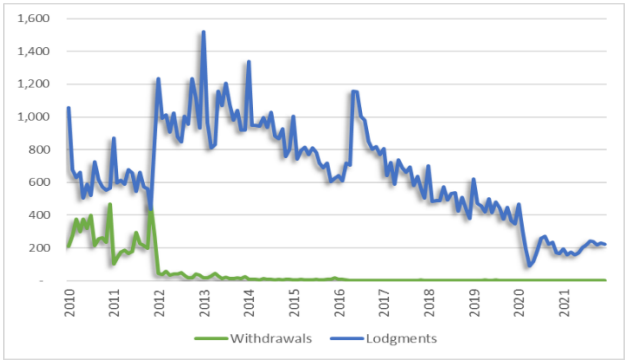


Source: Authors' elaboration on ECB data

Figure 21.b

Monthly withdrawals and lodgments of apical denominations in Italy (2010-2021)

(billion €)



Source: Bank of Italy.

As pointed out in various contributions,[30] the collapse in apical denominations net issuance in Italy (Fig. 21.b) may be traced back, inter alia, to the reductions in the limit on cash payments, in particular the reduction to 1,000 euro introduced at end 2011. However, stringent limits (equal or lower than 3,000 euro) on cash payments were also introduced in other euro area countries (Table 14) which, diversely

[30] See Baldo *et al.* (2021), op. cit.

from Italy, experienced more gradual reductions in the demand for apical denominations, as shown by the trend of the ratio withdrawals/lodgments at NCBs (Fig. 22).

Table 14

Countries with limits to cash payments
Equal or lower than 3,000 €

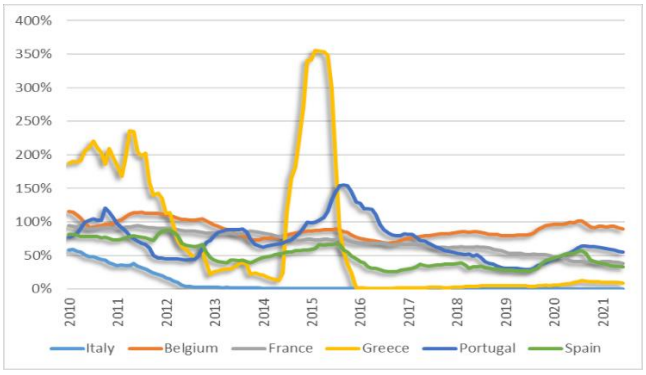
Countries	Limits (year of introduction)
Belgium	5,000€ (2012)
	3,000€ (2014)
France	3,000€ (2014)
	1,000€ (2016)
Greece	3,000€ (2011)
	1,500€ (2012)
	500€ (2017)
Italy	5,000€ (2007); 12,500€ (2008; 5,000€ (2010); 2,500 (2011); 1,000 (Dec 2011); 3,000 (2016); 2,000€ (2020); 1,000€ (2021)
Spain	2,500€ (2012)

Source: Ecorys-CEPS (2017).

Figure 22

Ratio withdrawals/lodgments for apical denominations
in countries with limits equal or lower than 3,000 €

(withdrawals and lodgments over 12 months; percentage values)



Source: Authors' elaboration on ECB data.

In this respect, an Italian peculiarity relates to the particular severity in controls on cash payments for anti-money laundering purposes,[31] which specifically focus on the use of apical denominations.[32] The costs for commercial banks stemming from anti-money laundering controls are therefore higher in the case of operations involving apical denominations; this may have induced a stiffening in the supply of such denominations thereby inducing customers to demand alternative denominations. Actually, from 2012 Italian banks tended to reduce the recirculation of apical denominations, that is the rate of re-issuing of banknotes deposited by their customers: from 2012 to 2020 the recirculation rate of apical denominations declined from 30% to around 10% whereas the recirculation rate of medium notes remained stable at 60%. (Fig. 23).

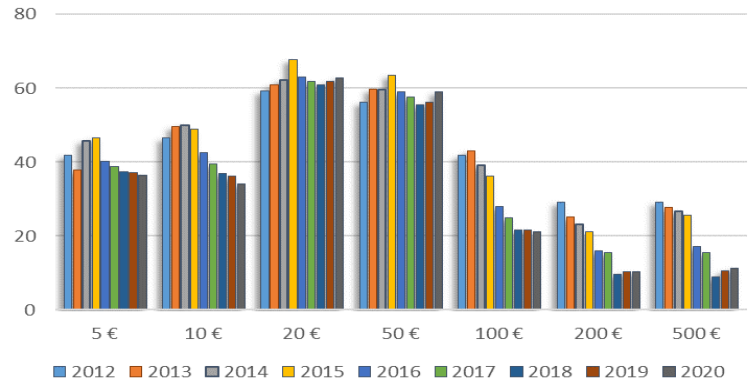
31 Borrello *et al.* (2021) highlight how Italian anti-money-laundering regulations also aims at preventing fiscal evasion, and takes into account the high propensity to use cash typical of Italy.

32 From 2010, Bank of Italy started monitoring commercial banks' withdrawals and lodgments with a view to detecting anomalies to be traced back to money-laundering by commercial banks' customers; this seems to be an Italian peculiarity not shared by other euro area countries. Furthermore, the above mentioned Decree Law.231/2007, inter alia, provided for the definition, by Bank of Italy, of indicators of anomalies to be used by financial intermediaries in the assessment of customers' operations for anti-money laundering purposes. In this respect, in 2013 Bank of Italy issued a Provision on customer operations assessment establishing that, in case of deposits, withdrawals or payment operations for amounts higher than 2,500 euro, involving apical notes, the intermediaries must conduct a more in-depth assessment (so called "strengthened assessment"). Moreover, the Bank of Italy Provision of July 2019 provides that the strengthened assessment must be applied in the presence of risk factors such as an "high and unwarranted frequence of cash operations with the use of high value denominations". An analysis of the possible use of high denomination banknotes for money-laundering purposes is provided in Cassetta *et al.* (2016).

Figure 23

Shares of banknotes recirculated by commercial banks

(percentage values)



Source: Authors' elaboration on Bank of Italy.

In the Italian case, therefore, from 2012 apical denominations put into circulation derived almost exclusively from inflows from abroad. Ever since, commercial banks issued such notes to a negligible extent: residents received them in transactions with foreigners and/or with residents who were de-hoarding stocks accumulated in previous years. Once deposited at banks, most of such denominations were returned to Bank of Italy which, as a rule, withdrew them from circulation. This resulted in the marginalization of apical denominations whose circulation in Italy dropped to modest levels.

Diversely, the €100 note circulation might be higher. It has been declining since around 2010; however, we are not able to infer the size of inflows as the €100 net issuance took on negative value only from 2021. In the coming years, we expect a significant increase of negative net issuance values, in line with what we observed for other denominations, which may provide further elements of evaluation.

6. The motives underlying demand for cash in Italy

The growth of national circulation since the changeover (Fig. 24.a) went along with a change in the weight of the motives underlying the demand for cash in Italy. Baldo *et al* (2021), on the basis of the seasonal method, estimated share of national circulation demanded for transaction purposes at 30-43% in 2002, then at 13%-25% in 2019 and lastly at 12%-21% in 2020. Conversely, the component demanded for precautionary and hoarding purposes would have been increasing.

Further indications may be obtained from an analysis of the evolution of the return rate of the national circulation also with regard to individual denominations.

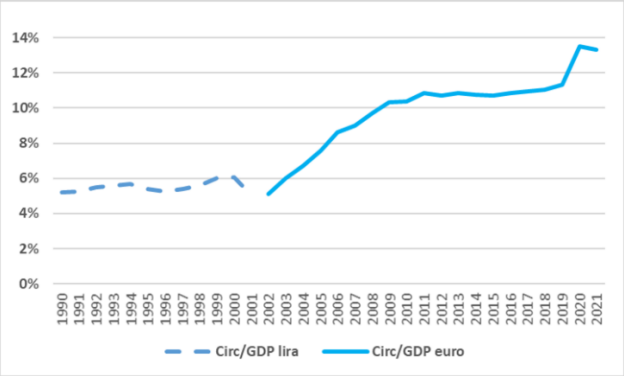
In the years 1998-2000 the rate of return of the circulation of lira banknotes amounted approximately to 90%. Since the changeover, such a rate declined to around 50% between 2008 and 2010; then, it slightly increased in the years 2011-2012 characterized by the collapse in the demand for apical denominations; afterwards, the return rate started to decline again until they reached a minimum of 30% in the years

2020-2021, in which the precautionary demand for cash increased significantly in relation to the Covid-19 pandemic (Fig. 24.b).[33]

Figure 24.a

National circulation/GDP: 1990-2021

(percentage values)

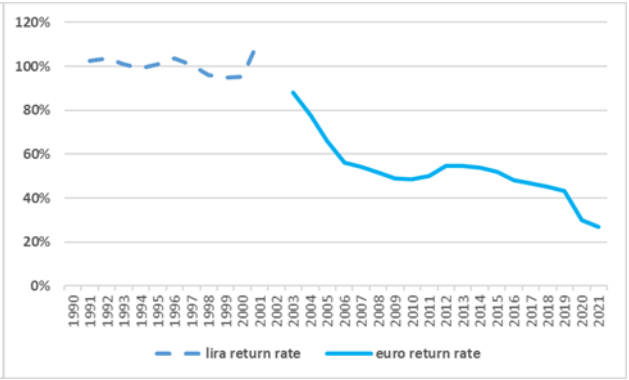


Source: Authors' elaboration on Bank of Italy data.

Figure 24.b

Circulation return rate: 1990-2021

(percentage values)



Source: Authors' elaboration on Bank of Italy data.

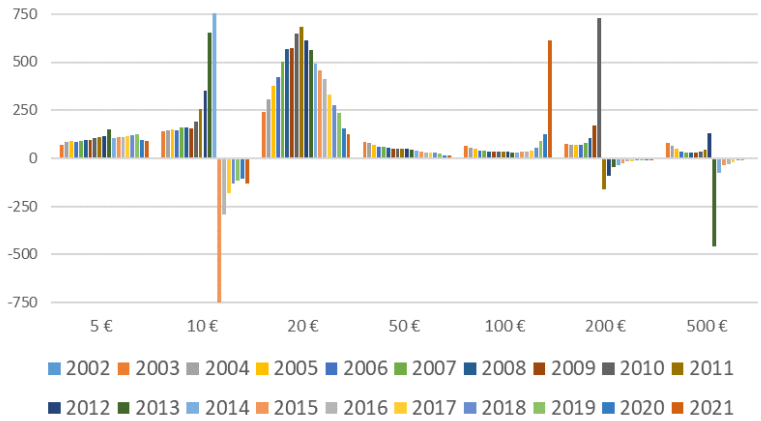
In the last years of Italian lira circulation, the highest return rate was recorded for the 50,000 lira note (around 145%). According to the method of the "most transactional denomination", lodgments of different denominations were divided by such a rate in order to estimate the transactional balances accounting for almost 60% of total circulation in 2000.

Since the changeover, the calculation of return rates for individual notes becomes problematic as the data available relate to net issuance which diverges from actual circulation. In the case of banknotes interested by high inflows, the return rates tend to positively diverge to infinite as the net issuance approaches zero; then, once net issuance takes on negative values, the return rates negatively diverges to minus infinite (Fig. 25).

Figure 25

Return rates by denomination

(Percentage values)



Source: Authors' elaboration on Bank of Italy data.

[33] The banknote return rate may also be affected by structural changes in the cash cycle such as agreements among commercial banks aimed at netting among themselves surpluses and shortages which result in a reduction in lodgments and withdrawals at the central bank. In Italy the Multibanca scheme, launched in 2018, operates according to such logics.

However, for lower denominations we dispose of estimates of cumulated net inflows from 2002 to the launch dates of 2nd series banknotes. By linearly distributing such inflows over such a period, it is possible to correct net issuance in the initial years from the changeover in order to obtain better approximations of actual circulation and, therefore, of return rates. On the basis of such a correction, at end 2002 the €20 denomination showed the highest return rate (around 220%) followed by €10 (130%) and €5 (67%); these two latter denominations were returned less frequently to Bank of Italy as retailers tended to hold them in order to manage changes in retail transactions. Return rates of €50 and higher denominations are lower than the €20 one.

With regard to 2002-2003, by applying the €20 return rate to the various denominations, transactional balances are estimated at 32 billion euro, accounting for almost 40% of domestic circulation (Table 13), lower than the 60% share estimated for the last period of lira circulation.

Furthermore, the estimates of low denomination and €20 circulation close to the launch of the 2nd series (from 2013 to 2015) allow us to update return rates relating to such years. We estimate the €20 return rate at 250%, the €10 one at 150%, the €5 one at less than 100%. Therefore, even in this period, the €20 was the denomination most intensely used in transactions; estimates of return rates of the remaining notes are not available but it seems realistic to assume that they were lower than the €20 one.

Then, estimates of transaction balances over 2013-2015 were obtained by dividing the average yearly lodgments over such a period by the €20 return rate. They would have amounted to almost 40 billion euro, accounting for 22% of national circulation (Tav. 15).

Table 15

Estimates of transaction balances in 2013-2015

(million €)

	€ 5	€ 10	€ 20	€ 50	€ 100	€ 200	€ 500	Total
Transaction balances 2003	823	3,356	4,495	14,306	5,349	953	3,103	32,386
Composition by denominations	*2.5%*	*10.4%*	*13.9%*	*44.2%*	*16.5%*	*2.9%*	*9.6%*	*100.0%*
Share of net issuance 2003	*1.0%*	*4.2%*	*5.7%*	*18.0%*	*6.7%*	*1.2%*	*3.9%*	*40.7%*
Transaction balances 2013-2015	1,014	1,912	7,485	20,847	3,729	667	3,810	39,463
Composition by denominations	*2.6%*	*4.8%*	*19.0%*	*52.8%*	*9.4%*	*1.7%*	*9.7%*	*100.0%*
Share of average circulation 2013/2015	*0.6%*	*1.1%*	*4.3%*	*11.9%*	*2.1%*	*0.4%*	*2.2%*	*22.5%*

Source: Authors' elaboration on Bank of Italy data.

The estimate of transaction balances in years 2013-2015 in Italy appears comparable to those relating to transaction balances in Germany in 2015 elaborated by the Bundesbank, equal to 35 billion euro, accounting for 15%-30% of German circulation (Deutsche Bundesbank, 2018); by contrast, it is higher than the one relating to transaction balances in France in 2015 equal to 20 billion euro (Politronacci *et al.*, 2017).

In the Italian case, medium denominations accounted for the major share of transaction balances (70%-80%). Low denominations accounted for around 7%-8%, a lower level than those estimated for Germania (16.8%) and France (around 20%).

The reduction in the share of transaction balances out of total circulation in Italy, analogously to other countries, may be related, inter alia, to the decline in the share of retail transactions settled by cash. According to surveys on the use of cash and alternative payment instruments conducted by the ECB, in Italy the share of transactions settled by cash out of total transactions at points of sale declined, from 2016 to 2022, from 86% to 69% in terms of volumes and from 68% to 49% in terms of value.

7. Conclusions

Since the changeover to euro cash, the analysis of banknote circulation in individual euro-area countries has become increasingly difficult due to distortions affecting the NCBs' net issuance, which can be traced back to euro banknote migration.

Looking at Italy, we were able to estimate national circulation (for all denominations collectively) and evaluate how the inflows of euro banknotes from abroad helped meet the internal demand for cash, by drawing on the information made available by the Bank of Italy through its survey on tourism expenditure and its statistics on net shipments.

For individual denominations, we proposed a method for analysing the information content of incongruous net issuance values, which allowed us to gauge the size of the migration phenomenon and to estimate the circulation of some denominations in specific years (close to the launch of the 2nd series of euro banknotes). Inflows from abroad of apical denominations are particularly substantial, as highlighted by their negative net issuance values, which far exceed those recorded in other euro-area countries. Such a phenomenon likely depends on a drop in the demand for apical denominations in Italy, rather than on the intensity of the migration of these notes to Italy. Inflows from abroad are also recorded for low denominations and the €20 note, though they are significantly smaller than those of higher denominations. The inflows of low value notes, of €20 notes and of higher value notes are partly offset by the outflows of €50 notes.

Italian banknote circulation has increased considerably since the changeover. Based on the estimates of euro banknotes held inside the euro area, Italian circulation accounted for between 20% and 30% of total euro-area internal circulation at the end of 2021, which is a larger share than that which Italy contributes to the euro area in terms of GDP, consumption or population.

In Italy, in line with the trends observable at euro-area level, the circulation of banknotes demanded for precautionary and store of value purposes has increased. The share of banknote circulation flowing back to the Bank of Italy on a yearly basis declined from 90%, in the last years of the Italian lira, to 30% in 2021. The share of banknote transaction balances declined from 60%, near the end of the legal tender status of the Italian lira, to 40% after the changeover and then to 20% in the years 2013-15; it has continued to decline in more recent years. This trend has gone alongside a gradual reduction in the share of payments settled in cash.

Looking at the evolution of circulation by denomination, one aspect is specific to Italy. In the period immediately following the changeover, the new denomination structure helped meet the increasing demand for cash for store of value purposes, thanks to the wider range of higher value notes. Later on, as a result of the anti-money laundering regulatory framework and of value limits on cash payments, the demand for apical value denominations dropped and circulation has progressively converged to medium denominations. As the use of the two highest denominations has become increasingly marginal, the €100 note has de facto taken on the role of highest denomination, though its demand has also been gradually declining. The share of low value notes out of total circulation also appears small compared with the euro area.

The evolution of circulation by denomination has been affected, among other things, by the cash distribution policies adopted by the banking system, which have been based on ATMs stocked mainly with medium value notes. This explains why the share of low denominations has continuously been eroded; however, it could also have contributed to the decline in the share of higher denominations.

In conclusion, the growth in the demand for cash in Italy, which is mainly ascribable to precautionary and store of value purposes, has been accompanied by an increasing shift of circulation towards medium

denominations. These trends, apparently not fully consistent, could adversely affect the ability to meet users' demand for cash and the efficiency of the cash cycle. Further research on cash circulation could focus on these issues.

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APPENDIX

A1. Indicators and empirical methods for migration and circulation analysis

1. *The relation between net issuance (NI), circulation and banknote migration*

As highlighted in paragraph 2, for importing countries, net issuance is equal to the difference between national circulation and cumulated net inflows from abroad:

$$NI_t = NAT\_CIRC_t - \sum_{i=1}^{t} (Inflows_i - Outflows_i)$$

Upward trends of net issuance may be traced back, in general, to circulation growth rates higher than inflows ones; the opposite holds true in case of downward trends of net issuance.

The relationship between net issuance and circulation, in the presence of migration from abroad, may behave differently, as shown below.

In Figure a.1, a stable circulation, in the presence of increasing cumulated net inflows at a constant rate, results in a linear decline of net issuance which is destined, in the long term, to drop to zero and then to take on negative values. In Figure a.2, a moderate increase in the demand for cash (e.g., 2%), in the presence of a higher growth of cumulated net inflows (e.g., +5%), results in a decline of net issuance at increasing rates and in the emergence of negative values more rapidly than in the preceding case.

Figure a.1

National circulation vs net issuance
Scenario: constant demand and inflows

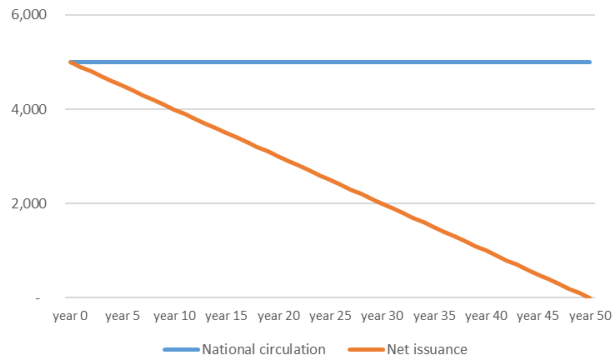
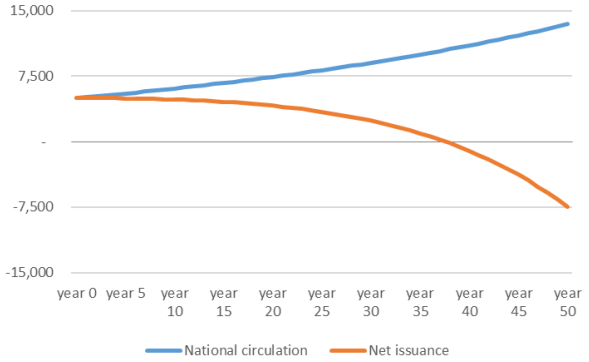


Figure a.2

National circulation vs net issuance
Scenario: increasing demand (+2%) and inflows (+5%)



In Figure a.3, the growth of both circulation and cumulated inflows, at rates higher for circulation (5%) than for inflows (e.g., 2%), results in the growth of net issuance at rates lower than those of circulation. Lastly, Figure a.4 replicates the hypotheses underlying Figure a.3 until year 10; then, from year 11, due to a shock affecting the demand for cash, domestic circulation becomes stationary; in such a case, the initial upward trend of net issuance turns later on in a downward trend resulting, in the long term, in the emergence of negative values.

Figure a.3

National circulation vs net issuance
Scenario: increasing demand +2% and inflows+ 5%

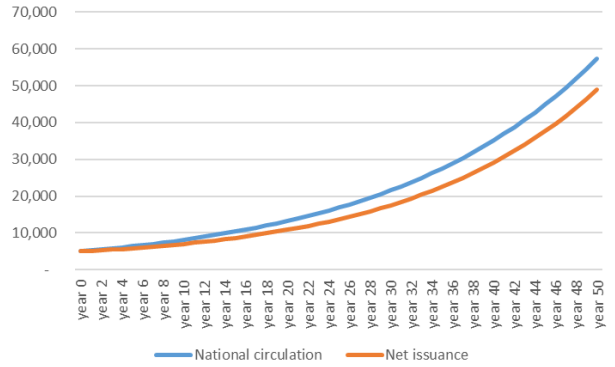
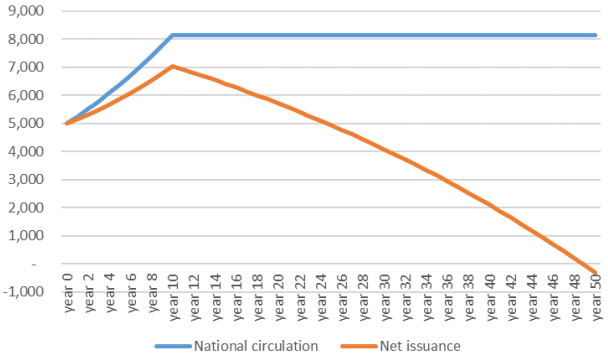


Figure a.4

National circulation vs net issuance
Scenario: increasing demand +5% until t10, 0% from t11: increasing inflows + 2%



2. *Comparison of individual denominations' net issuance and estimates of net inflows from abroad for overall denominations*

Negative net issuance emerges when cumulated net inflows exceed the amount, generally unknown, of national circulation. That is why negative net issuance measures the emerged part of cumulated net inflows, exceeding national circulation. Therefore, negative net issuance underestimates cumulated net inflows; however, the measure of underestimation is not known.

In the analysis of migration of individual denominations, when negative values of net issuance emerge, it may prove useful to compare such values with estimates of aggregate migration (referred to all denominations) taken from surveys on tourism.

Cumulated net inflows referred to all the denominations) are equal to the algebraic sum of cumulated net inflows of individual denominations, which may have different signs. If some denominations are imported while other ones are exported, cumulated net inflows of imported denominations exceed total cumulated net inflows referred to all denominations. In such a case, the difference between these two aggregates measures the cumulated net outflows relating to exported denominations.

3. *The rate of return of circulation (yearly lodgements/net issuance)*

Before the changeover to euro cash, the return rate of individual denominations, equal to the ratio between annual lodgments and net issuance, measured the share of banknotes in circulation annually returned to Bank of Italy. Such a ratio was higher for the notes mainly demanded for transactional purposes whereas was lower for the ones mainly demanded for precautionary or hoarding purposes. Variations in the return rates highlighted changes in the motives underlying the demand for different denominations.

Since the changeover, the net issuance no longer provides a correct measure of circulation, due to banknote migration which also impacts on lodgments. In such a context, an increase in the return rate may depend on a more intense use of a denomination for transactional purposes but also on inflows from abroad; conversely, a decrease in the return rate may depend on more intense hoarding of a denomination as well as on outflows. Therefore, the interpretation of return rates has become complex.

However, return rates provide clear indications when they positively diverge to infinite. Such a trend emerges when, in presence of relatively stable lodgments, net issuance declines getting closer to zero. This announces, with some advance, that the net issuance is going to take on negative values, which indisputably signals the phenomenon of migration from abroad.

Cases of divergence to infinity of return rates never emerged before the changeover. Also after the changeover, at February 2012 (final deadline for changing lira banknotes at Bank of Italy) the net issuance of Italian lira banknotes did not fall to zero as part of them was never returned to Bank of Italy, presumably because they had got destroyed or lost. From the changeover to February 2012, a gradual reduction of their return rates was observed.[34]

4. Information on migration and circulation deducible from the net issuance of 1st series euro banknotes

Since the launch of the 2nd series of euro banknotes, which took place from May 2013 to May 2019, the 1st series euro banknotes were gradually returned to the Eurosystem which, from the launch dates, met the demand for cash by issuing the new series notes and, only to a limited extent, residual stocks of the old ones.[35] Information on the two components of net issuance (i.e., 1st series and 2nd series) is available. From the launch date of the 2nd series, Eurosystem net issuance of 1st series banknotes declined and tended to stabilize at low levels; the residual net issuance of 1st series notes indicated the existence of stocks of notes hoarded and/or held abroad but also the missing return of notes which had got lost or destroyed. In the case of importing countries, the 1st series net issuance tended to stabilize at negative values which approximate the actual amount of 1st series banknote migration from abroad;[36] conversely in the case of exporting countries, net issuances tended to stabilize at positive values which approximate migration towards abroad.

The return to the Eurosystem of 1st series banknotes was faster for lower denominations (€5, €10, €20), mainly demanded for transactional purposes; at end 2021 the main part of these notes had been lodged at the Eurosystem.[37] The remaining denominations (from €50 to the higher ones) have been returning more slowly to the Eurosystem.[38]

As regards Italy, at end 2021 the 1st series net issuances stabilized at negative values not only for €10 (-2.2 billion euro), but also for €5 (-327 million euro) and €20 (-4.9 billion euro).

[34] The 20,000 lira note was withdrawn from circulation at the beginning of 1986; a significant share of banknotes in circulation (around 7%) was not returned to Bank of Italy; the return rate declined from approximately 280% in 1983 to 18% in 1986. During the changeover from lira to euro cash, lira banknotes could be used in payments until end March 2002; their convertibility at Bank of Italy was allowed until end-February 2012. Lira banknotes in circulation were changed into euro mostly in 2002, but partly also in the following years. At lira prescription date, 10,000 lira banknotes not returned to Bank of Italy still accounted for 8.4% of those in circulation at end 2000; the analogous percentage amounted to 1.3% for the 50,000 lira note and to 1.3% for the 100,000 lira one. The return rates recorded sharp one off increases in 2002 at the start of the changeover; later on, they continuously declined: the return rate of the 50,000 lira note, close to 150% in 2000, increased at 185% in 2002, then it declined to 10.6% in 2003 and to 2.3% in 2011; the one of the 100,000 lira denomination increased from 90% in 2000 to 3600% in 2002, afterwards it declined to 16.5% in 2003 and 3.5% in 2011.

[35] The Eurosystem defined "issuing scenarios" for the launch of the 2nd series notes also providing for the issuance of residual stocks of 1st series notes only in case of brand new ones; by contrast, recirculated 1st series notes were destroyed.

[36] Actually this method entails an underestimation of migration as part of banknotes in circulation tends not to be returned to the central bank (e.g. banknotes lost, destroyed, held abroad).

[37] At end 2020, out of total euro banknotes in circulation, the shares of 1st series denominations amounted to 11% for €5, 1.7% for €10, al 5.6% for €20.

[38] The 2nd series of the €50 and high and apical denominations were launched more recently as compared to lower denominations.

In order to estimate migration from abroad from 2002 to the launch date of 2nd series, it should be considered that part of the migration of 1st series notes took place after the launch dates of the new series, alongside 2nd series notes. The amount of banknotes migrated before the launch of the new series is equal to total migration of 1st series banknotes minus the part of such notes migrated after the launch of the new series. In this respect, it should be considered that, in the case of lower denominations, 1st series banknotes migrated to Italy accounted for shares from 0.15% to 0.21% of the Eurosystem net issuance (Bank of Italy excluded).[39] By applying such percentages to banknotes issued by the Eurosystem from the changeover to some months before the launch of the new series (Bank of Italy excluded), we obtain estimates of inflows from abroad[40] amounting approximately to: 320 million euro for the €5 note (from the changeover to April 2013), 2 billion euro for the €10 note (from the changeover to August 2014), 4.5 billion euro for the €20 one (form the changeover to October 2015), which add up to a total of almost 7 billion euro (Table a.1).

By summing such estimates to the net issuances of the concerned denominations, the following estimates of national circulation are obtained (Table a.1):

- for €5 at April 2013, 1 billion euro (as compared to net issuance amounting to 690 million euro);
- for €10 at September 2014, 1.9 billion euro (in comparison with net issuance amounting to -22 million euro);
- for €20 at October 2015, 7.5 billion euro (as compared to net issuance equal to 2.9 billion euro)[41].

Table a.1

Estimates of €5, €10 and €20 national circulation close to the launch of the 2nd series euro banknotes

(million €)

	5 €	10 €	20 €
BdI net issuance in the month before 2nd series launch (*) **(A)**	692	-136	2,939
Surplus 1st series notes lodged at BdI as compared to issued 2002-2021 **(B)**	327.1	2,202.2	4,872.3
1st series banknotes issued by Eurosystem (**) 2002-2021 **(C)**	223,608	1,051,574	2,646,339
1st series banknotes issued by Eurosystem (**) from 2002 to 6 monthes before launch of 2nd series **(D)**	220,560	977,643	2,469,331
Share 1st series banknotes flown from abroad into Italy out of Eurosystem issuance 2002-2020 **(B/C) = E**	0.15%	0.21%	0.18%
Estimates inflows before 2nd series launch **(E*D)=F**	323	2,047	4,546
Estimates inflows from abroad after 2nd series launch **(B-F)=G**	4	155	326
Estimate of national circulation in the month before the laucnh of 2nd series (*) (A+F)	**1,014**	**1,912**	**7,485**
BdI net issuance at end 2002	831	3,193	4,417
Circulation close to 2nd series launch/net issuance at end 2002	122.0%	59.9%	169.5%

Source: Authors' elaboration on Bank of Italy and BCE data.
(*) April 2013 for €5; August 2014 for €10; October 2015 for €20. (**) Excluding banknotes issued by Bank of Italy.

[39] As regards lower denominations, the amounts of 1st series banknotes issued and returned to the Eurosystem after the launch of the new series are rather limited amounting approximately to 2.5% -3% of total issuance and 5% of total lodgments of the concerned denominations.

[40] More precisely we considered the amount of banknotes issued by the Eurosystem (Bank of Italy excluded) from the changeover until 6 months before the launch of 2nd series notes, in order to account for the time from the issuance of banknotes by a foreign NCB and their influx in Italy.

[41] As regards the 20€ denomination, a change of direction of migration after 2011 cannot be excluded; in such a case, cumulated net inflows estimated at October 2015 would represent the algebraic sum of net inflows and net outflows recorded in different periods.

A2. Statistics on cash circulation published by the Bank of Italy[42]

In the statistics on cash circulation published by the Bank of Italy, several aggregates are available. They are calculated for different purposes and based, in some cases, on the conventional criterion of the *capital key*, in others on net issues.

Furthermore, some aggregates concern the overall circulation of banknotes (including stocks held by the banking system), others the circulating currency (banknotes and coins) held by the general public (net of depositis with the banking system). Lastly, some aggregates converge into broader items without autonomous evidence in the Bank of Italy's publications.

In detail, the aggregates are the following:

1) The "legal circulation" reported in the Bank of Italy's balance sheet, calculated applying the *capital key* to 92% of the net issues of the Eurosystem. This aggregate concerns the total banknotes in circulation, including those held by the banking system.

2) The "cash circulation", i.e. the net issues of banknotes of the Bank of Italy, equals the cumulative outflows minus the cumulative inflows since the changeover. It is reported in the chapter "Banknotes" of the annual *Report on Operations and Activities of the Bank of Italy*, in which the production and the circulation of banknotes are described. This aggregate also includes stocks held by the banking system.

3) The circulating currency in monetary aggregates, which includes the circulation of banknotes, calculated applying the *capital key* to 100% of the net issues of the Eurosystem, and the metal coins issued by the Ministry of Economy and Finance. This aggregate excludes the cash stocks held by commercial banks.

4) The circulating currency in financial accounts, calculated by adding the legal circulation, the metal coins issued by the Ministry of Economy and Finance and the net exports of the "rest of the world" sector, whose inflows (or outflows) contribute to modify the overall supply of banknotes in the way described in the section on the balance of payments (see point 5); the estimated circulating currency is then split among the holding sectors (households, enterprises, General government, financial companies, rest of the world) and included in the item "Currency and transferable deposits".

5) The circulation in the balance of payments and the international investment position. The aggregate is calculated by adding the cash circulation to the cash flows arising from the two main types of transactions underlying the migration of banknotes: international travel and shipments of banknotes abroad made by the central bank or the national banking system.

A3. Information on cash collected from the survey on international tourism

The sample survey, launched in 1997, is based on interviews and counts of resident and non-resident travellers transiting through Italian borders (road and rail passes, international ports and airports). The information collected through counting operations, together with data obtainable from administrative sources and, recently, from mobile phone data, allow the estimation of the reference universe, i.e. the number of international travellers – with details of country of residence/destination – who have crossed the Italian borders in a given month; the information collected through the questionnaires, aimed at collecting international tourism expenditure, is then expanded to the reference universe. The survey is conducted with the institutional objective of compiling the "Travel" and "International passenger transport" items of the balance of payments.

[42] See Bank of Italy (2020). In addition, a reconstruction of monetary aggregates from the Unification of Italy is provided in Barbiellini Amidei et al. (2016).

Until December 2015, the survey on international tourism collected information on euro cash expenditure without asking questions about the place of cash collection (whether carried with the traveller or withdrawn in the visited country). The estimate of euro banknotes flows to/from abroad was based on some assumptions, which allowed to determine the coefficients used to calculate the share of cash expenditure made using euro banknotes following the traveller [2]. Based on this approach, the information on foreign tourists gave rise exclusively to inflows of cash, whereas the information on Italian tourists generated only outflows.

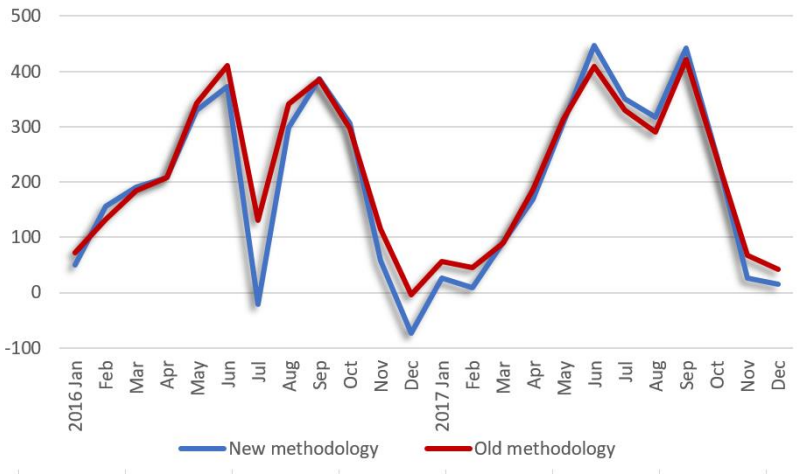
Since 2016, in order to more accurately detect the phenomenon, specific questions have been introduced in the questionnaires of the survey [3]. In particular, international travellers are now asked questions about the amount of euro cash carried with them at the time of departure and the amount of euro cash withdrawn in the visited country. Such information, together with the data already collected on cash expenditure, has allowed to improve the estimation methodologies.

In summary, the new procedure does not estimate the coefficients applied to the cash expenditure but directly calculates the movements of euro cash to and from Italy. An important consequence - as well as a change from the previous methodology - is that both foreigners and Italians can generate inflows and outflows of banknotes.

Comparing the new series with previously developed ones, the inflows and outflows of the new methodology are generally higher, since they take into account previously undetected phenomena. However, in the 2016-2017 biennium, the balance calculated with the new procedure was broadly in line with the previously estimated balance, with an overall difference of 7.8% (Fig. c.1).

Figure c.1

Balance comparison
(million euros)



Source: Bank of Italy

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