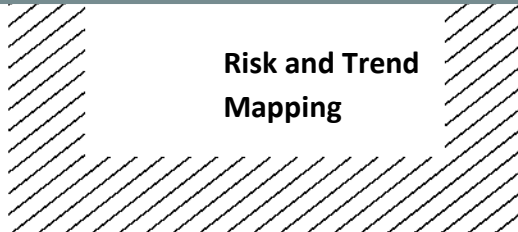




OCTOBER 2018

STUDY OF THE VOLATILITY OF FRENCH MONEY MARKET FUNDS

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Risk and Trend
Mapping

AUTORITÉ
DES MARCHÉS FINANCIERS



1. DATA AND COVERAGE

The objective of the study is to assess the volatility of French money market funds with variable net asset value compared to that of a relevant benchmark over a sufficiently long period (2006-2017) and under different market conditions.

Volatility provides an indication of the dispersion of fund returns around the average of its returns, that is, the standard deviation of changes in returns over a given period. For the purposes of the study, we rely on the calculation usually used to observe a change in the return of a security or a fund¹. We therefore use the annualised daily volatility².

Database and coverage: The data used for the money market funds comes from the Banque de France (monthly data collection from undertakings for collective investment, UCI inflow), Lipper and AMF data (BIO database). The combined use of these three databases makes it possible to ensure good coverage for the analysis (in terms of fund population), and reliability of the net asset values used³.

The analysis is performed at the level of the fund units, given some units may be more volatile than others within the same fund, and endeavours to ensure consistency throughout the period studied, which is marked by regulatory changes. Thus, the population covered consists of:

- 2006-2011: units of "Euro money market" and "International money market" funds (ECB classification in effect for the period); and
- since 2011, units of "Short-term money market" and "Classic or standard money market" funds.

Period of analysis: The 2006 to 2017 timeframe includes periods of stress (2008-2009 and 2011-2012) and a period of low interest rates and low volatility (observed since 2013), which allows us to assess the change of this volatility in different market configurations. This period is also marked by the implementation in 2011 of the CESR Guidelines imposing, for the first time, constraints on weighted average life (WAL) and weighted average maturity (WAM)⁴. Part of the study focuses on the latter period.

¹ See, for example, Rajgopala S. and Venkatachalam M. (2011), "Financial reporting quality and idiosyncratic return volatility", *Journal of Accounting and Economics*, Volume 51, Issues 1–2, February. In other research, some authors seek to complicate this calculation to take into account the correlation of returns over time or avoid normalisation (on an annualised or monthly basis) which does not take into account the distribution of returns, which is not necessarily symmetrical. However, the calculation chosen here has the merit of simplicity and comparability with other studies of this type.

² In order to ensure that this analysis does not have any bias related to the daily frequency of volatility, a full analysis of the distribution of volatilities and spreads to the EONIA rate by studying the annualised weekly volatility is also conducted. This does not, however, show any major difference with daily volatility: while the peaks seem to be smoothed in general, the distinction between short-term and standard fund units appears similar and the distribution of volatility differentials to EONIA is similar. It therefore seems that there is no bias related to the frequency considered. As a result, the proposed analysis uses annualised daily volatilities.

³ Lipper is the preferred provider of daily net asset values. The Bio database is used to correct duplications/absence of NAV in Lipper. The UCI database makes it possible to ensure the coherence of the scope studied. This collection is carried out on behalf of the European Central Bank. The ECB has defined money market UCIs since 2001 as "those UCIs of which the units are, in terms of liquidity, close substitutes for deposits and which primarily invest in money market instruments and/or in MMF shares/units and/or in other transferable debt instruments with a residual maturity of up to and including one year, and/or in bank deposits, and/or which pursue a rate of return that approaches the interest rates of money market instruments. The criteria applied in order to identify MMFs shall be derived from the public prospectus as well as fund rules, instruments of incorporation, established statutes or by-laws, subscription documents or investment contracts, marketing documents, or any other statement with similar effects, of the UCIs." Annex I – I(6) and (7) of Regulation (EC) No. 2423/2001 of the European Central Bank of 22 November 2001.

⁴ CESR/10-049.

Choice of benchmark: A comparable benchmark is chosen in order to compare the volatility of unit returns. Most of the money market fund units studied use EONIA or the capitalised EONIA as a benchmark (see Table 1). Published by the European Central Bank, the EONIA rate, which is the weighted average of all overnight unsecured lending transactions undertaken by the main European banks, represents a very short-term European risk-free rate.

The benchmark chosen is the capitalised EONIA (EONIA Capitalization Index 7D provided by Bloomberg), which corresponds to the value of EONIA reinvested each week. It is a relevant reference for comparing the volatility of the returns of money market fund units⁵.

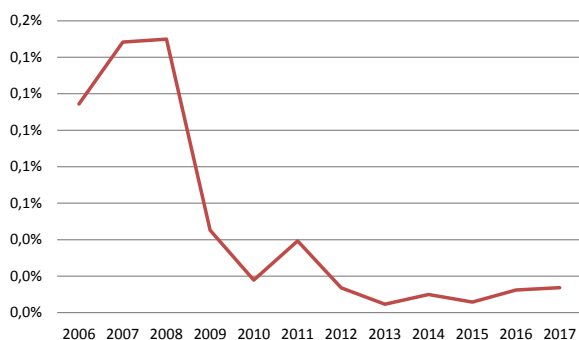
Table 1: Benchmarks used by the fund units studied

Benchmark	Number of units	% of total number of units
EONIA	437	55.0
Capitalised EONIA	282	35.5
Not available	28	3.5
Other benchmarks	47	5.9

Source: Lipper, AMF

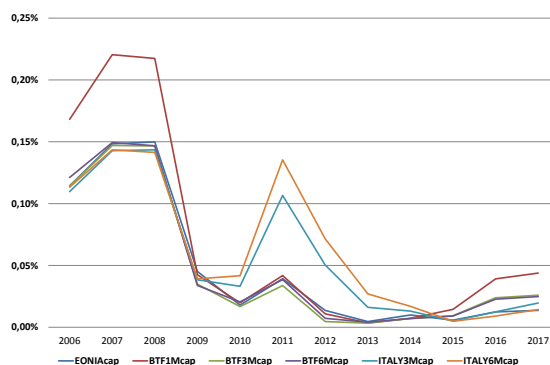
Other benchmarks are also studied, such as French, Italian or Greek treasury bills with different maturities. Calculating the annualised daily volatility of the capitalised returns of these sovereign bonds, presented in Chart 2, confirms that EONIA, a true "risk-free rate", is the least volatile index and therefore a conservative benchmark for the study.

Figure 1: Annualised daily volatility of the capitalised EONIA



Source: Bloomberg, AMF

Figure 2: Annualised daily volatility of the capitalised EONIA, and capitalised returns of French and Italian treasury bills with 1, 3 and 6-month maturities



Source: Bloomberg, AMF

2. RESULTS

The analysis is carried out here by studying the distribution of the volatility of the fund units, allowing us to observe the dispersion of the results, rather than via average calculations that do not enable a more precise assessment of the spectrum of the volatility of money market funds.

⁵ The capitalised index corresponds to an investment similar to that of a fund, unlike the pure EONIA index that is only a daily point which can change significantly.

We first consider the distribution of the annualised daily volatility of all French money market funds, then subsequently the distribution of spreads to the volatility of the EONIA capitalization index. In both cases, we consider successively all the funds, and then the short-term and standard funds separately.

2.1. Population studied

Detailed analysis of the trend in net asset values of the funds reveals several biases that lead to sudden drops or variations in NAV and consequently a mechanical and artificial increase in the volatility of these funds: the currency effect for non-euro funds, effects related to the distribution of dividends and changes in decimalisation, and effects related to the structure of funds (feeder funds and end-of-life money market formula funds)⁶.

The proposed analysis is conducted after funds concerned by these biases have been removed from the scope.

2.2. Distribution of the volatility of the funds

This first section presents the distribution of annualised daily volatility of the funds and that of EONIA. For comfortable readability, only the 25th, 50th and 75th percentiles of the distribution are shown.

Figure 3: Distribution of the volatility of French money market fund units

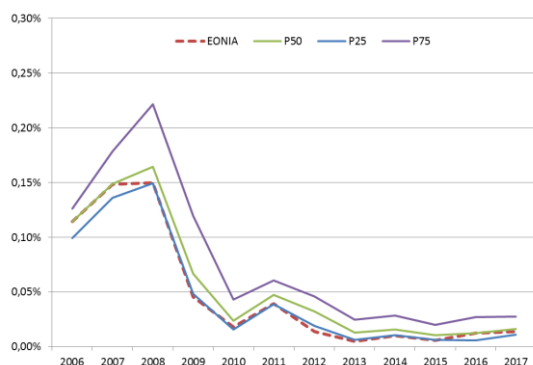
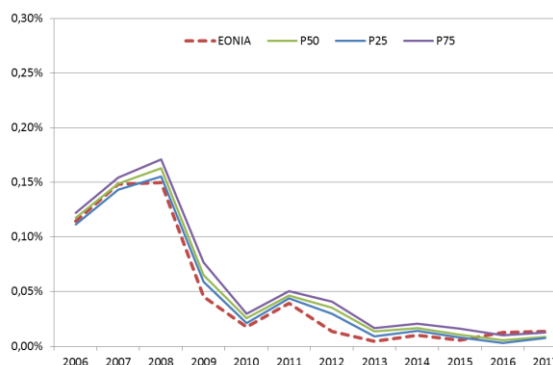


Figure 4: Asset-weighted distribution of the volatility of French money market fund units



Source: AMF

The first quartile of French money market funds with volatility of up to 15 basis points (bps) during the crisis shows volatility of less than 5 bps in the post-crisis period. Moreover, this volatility does not exceed that of EONIA by more than 0.6 bp over the entire period studied and even shows lower volatility for 7 of the 12 years considered. In terms of value, the median annualised daily volatility of the French funds ranges from 1 bp (minimum reached in 2015, a period of very low macroeconomic volatility) to 16.4 bps, the maximum value reached in 2007, when the financial crisis occurred. It does not exceed that of the EONIA performance index by more than 2 bps for the entire period. Finally, for the third quartile (75% of the funds), after sharp volatility in 2008 (22 bps), this falls to settle around 3 bps since 2014. In terms of the spread, the third quartile has volatility that tends to be closer to that of the benchmark since 2010, and not deviating by more than 3 bps.

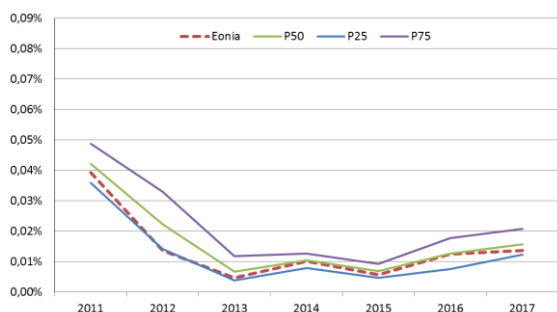
⁶ See Annex 1 for more detailed explanations.

When we take into account the assets under management of the funds considered, it appears that the distribution of the volatility of the money market funds is very close to that of the benchmark and never deviates by more than 3 bps for the first three quartiles including in times of crisis.

The volatility does not exceed 6 bps after 2009 for more than 75% of the funds. If we take into account the size of the funds, the volatility does not exceed 5 bps over the same period.

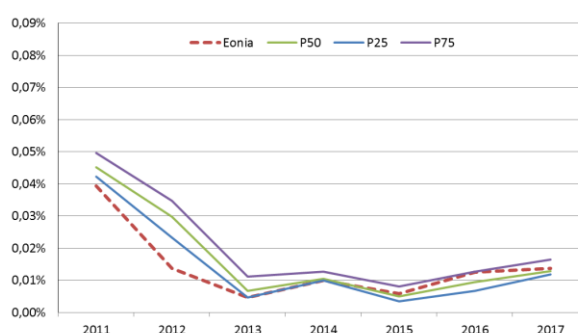
The distinction between short-term funds and standard funds was only made in 2011, so these results are presented for the period 2011-2017 only.

Figure 5: Distribution of the volatility of short-term money market fund units



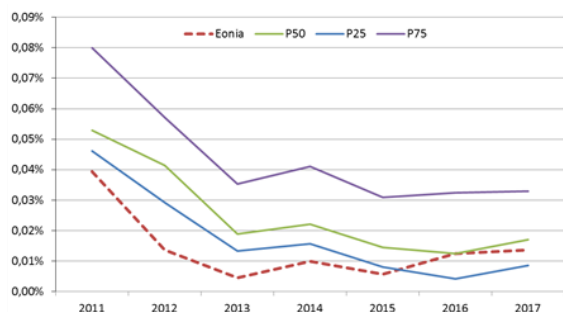
Source: AMF

Figure 6: Asset-weighted distribution of the volatility of short-term money market fund units



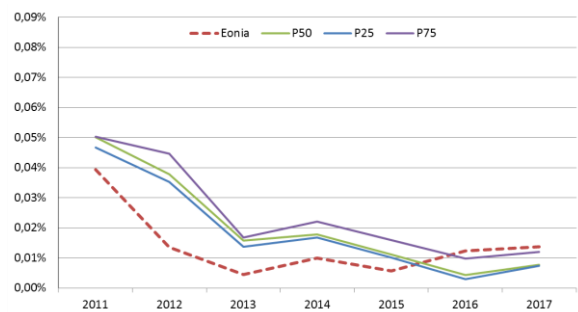
In the case of the short-term funds, the volatility never exceeds 5 bps over the entire period for more than 75% of the funds. In detail, the first quartile shows lower volatility than the EONIA capitalization index over the entire period studied. 50% of the funds have volatility that does not exceed that of the benchmark by more than 0.3 bp, except in 2012 where the value of the median exceeds that of the EONIA by 0.9 bp. If we look at the third quartile (75% of the funds), the latter does not exceed the benchmark by more than 1 bp over the entire 2011-2017 period, except in 2012 when it exceeds it by 1.9 bps. Taking into account assets under management highlights a narrowing of spreads to the volatility of EONIA since 2014.

Figure 7: Distribution of the volatility of standard fund units



Source: AMF

Figure 8: Asset-weighted distribution of the volatility of standard fund units



In the case of standard funds, volatility for the first quartile is lower than that of the EONIA performance index over the last two years of the study. For the other years, its value is higher than the benchmark but, apart from

2012, it does not deviate by more than 0.9 bp. The 50th percentile shows a similar trend to the 25th percentile: its differential to the volatility of the EONIA's performance index only exceeds 2 bps once in 2012. Finally, the 75th percentile has a value that fluctuates between 2 bps and 4 bps more than the benchmark.

Thus the volatility of short-term fund units is lower compared to that of standard fund units, since:

- **For short-term funds: the median volatility fluctuates between a minimum of 0.7 bp in 2013 and 2015 and a maximum of 4.2 bps in 2011, while:**
- **For standard funds, the median minimum and maximum values are reached, respectively, in 2015 (1.5 bps) and in 2011 (5.3 bps).**

Volatility levels decrease for both fund categories when assets under management are taken into account. Thus, across all fund categories, 75% of the funds' assets under management have volatility of between 1 bp and 5 bps over the entire period, including during the crisis.

Table 2: Comparative analysis of the volatility of the funds and that of EONIA

Year	Quartile from which the volatility of funds studied exceeds:			Value of the volatility for the quartile identified when this volatility exceeds:		
	Volatility of EONIA	Volatility of EONIA + 25 bps	Volatility of EONIA + 50 bps	Volatility of EONIA	Volatility of EONIA + 25 bps	Volatility of EONIA + 50 bps
2006	P49	P97	P98	0.11399%	0.35835%	0.49867%
2007	P49	P92	P97	0.14801%	0.38010%	0.53886%
2008	P25	P82	P85	0.14902%	0.39675%	0.52826%
2009	P19	P85	P90	0.04505%	0.29339%	0.44615%
2010	P31	P93	P95	0.01778%	0.19599%	0.46803%
2011	P26	P95	P97	0.03890%	0.19258%	0.53093%
2012	P15	P99	P99	0.01343%	0.14208%	0.14208%
2013	P16	P97	P97	0.00458%	0.08668%	0.08668%
2014	P23	P96	P97	0.00987%	0.08655%	0.37298%
2015	P21	P100	P100	0.00569%	0.10169%	0.10169%
2016	P49	P99	P99	0.01127%	0.11938%	0.11938%
2017	P42	P98	P99	0.01307%	0.10410%	0.30760%

Note: The first three columns of this table allow us to identify the percentile from which the volatility of the fund units considered exceeds, respectively, the volatility of EONIA, the volatility of EONIA + 25 bps and the volatility of EONIA + 50 bps. The following three columns give the level of annualised daily volatility of the percentile identified in the three scenarios.

Thus, for 2017, 42% of the funds studied have annualised daily volatility that is lower than that of EONIA. 98% of the funds have lower volatility than EONIA + 25 bps and 99% less than EONIA + 50 bps.

Source: AMF

The comparative analysis of volatilities shows that French money market fund units exceed EONIA from the 28th percentile on average since 2011 (Table 2)⁷. Particular consideration must be given to this tail distribution.

To this end, an exhaustive analysis of cases where the volatility of the funds exceeds that of EONIA + 25 bps is conducted; this concerns 148 fund units for the entire period studied, including 125 fund units before 2011⁸. This

⁷ This value is the same when we take into account the assets under management.

analysis shows that, for 75 of these units, their sudden drops can be explained by the reasons identified above (see section 2.1 supplemented by Annex 1), which a detailed analysis of the fund's documentation allows us to observe: (i) units of funds denominated in euros but invested in assets in foreign currencies, for which EONIA is therefore not the good benchmark; (ii) units of funds of funds or end-of-life formula funds. A further 17 of these units correspond to "dynamic" type management with investments in assets that will no longer be authorised by the MMF Regulation. Lastly, out of the remaining 56 cases whose volatility movements cannot be explained, 54 occurred before 2010, even before the entry into force of the CESR Guidelines, which introduced, in particular, the first constraints in terms of WAM and WAL. **In the end, only two fund units showing higher volatility levels than EONIA + 25 bps since 2010 cannot be explained.**

2.3. Distribution of spreads

In order to have a more precise idea of the behaviour of funds whose volatility exceeds that of EONIA, only "fund unit/year" couplets whose volatility exceeds that of the index are studied. For example, if a unit has higher volatility than the EONIA capitalization index in 2011, it is included in the scope of the study for this year only. The number of units thus studied for each year is shown in the table below.

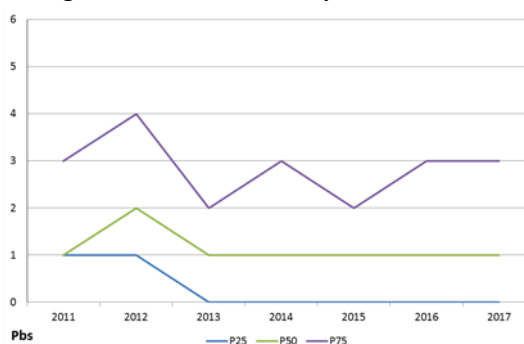
Table 3: Population of units exceeding the volatility of the EONIA Capitalization Index

Year	2011	2012	2013	2014	2015	2016	2017
Total No. of units	210	192	168	146	133	134	128
No. of units with higher volatility than EONIA	154	163	141	111	105	68	73
<i>o/w short-term fund units</i>	50	64	52	32	32	23	27
<i>o/w standard fund units</i>	93	99	89	79	73	45	46

Source: AMF

The first quartile stands at a value below 1 bp. This means that every year, a quarter of fund units whose volatility in their net asset value is higher than EONIA have a volatility differential of less than or equal to 1 basis point. This differential is even reduced to 0 from 2013 for these same funds. The 50th percentile is below 2 bps. The 75th percentile shows deviations greater than 2 bps, with a maximum (reached once) of 4 bps.

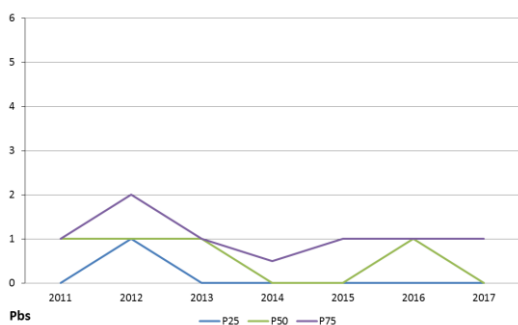
Figure 9: Distribution of spreads, all funds



Source: AMF

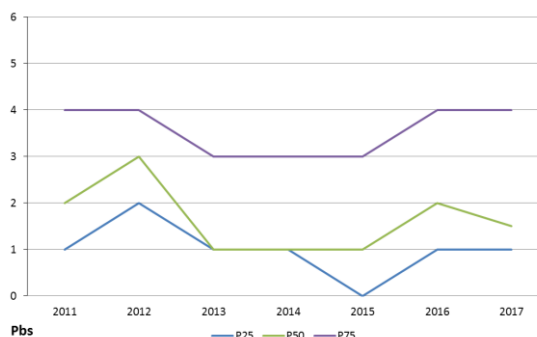
⁸ Among the population studied, 148 funds show volatility higher than that of EONIA + 25 bps at least once between 2006 and 2017.

Figure 10: Distribution of spreads, short-term funds



Source: AMF

Figure 11: Distribution of spreads, standard funds

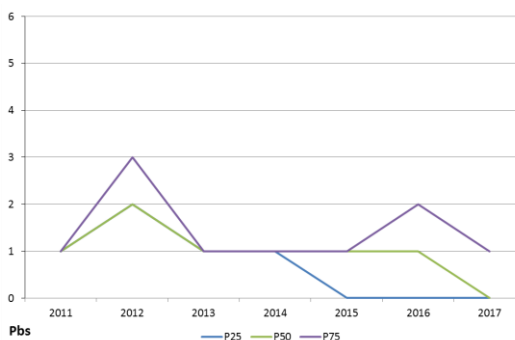


Looking at short-term fund units only, the 50th percentile is always below 1 bp. The 75th percentile is lower than or equal to 1 bp in 2011 and between 2013 and 2015 and reaches a maximum of 2 bps in 2012. For standard fund units, the 25th percentile is below 1bp apart from 2012 when it reaches 2 bps. The 50th percentile has values of between 1 bp and 3 bps. Lastly, the 75th percentile fluctuates between 3 bps and 4 bps.

In order to complete this numbers picture, an analysis of the asset-weighted distributions is carried out. The population studied is the same as before, i.e., only fund units that are more volatile than EONIA.

The assets under management view confirms that 50% of the assets of money market fund units that are more volatile than EONIA are at a differential less than or equal to 2 bps over the period. 75% of assets are below 3 bps. Volatility differentials at EONIA exceeding 5 bps are only observed starting from the 90th percentile, that is, on 10% of the fund unit assets.

Figure 12: Asset-weighted distribution of spreads, all funds



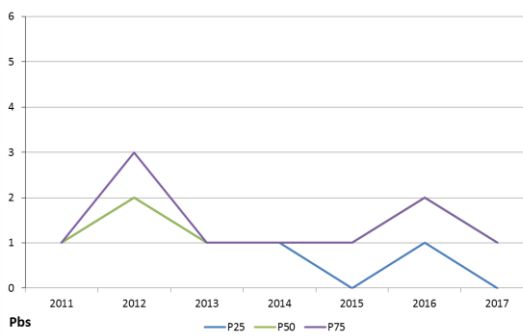
Source: AMF

Figure 13: Asset-weighted distribution of spreads, short-term funds



Source: AMF

Figure 14: Asset-weighted distribution of spreads, standard funds



Source: AMF

Looking only at the assets of short-term fund units, the volatility differentials to EONIA are below 2 bps over the entire period. Only the 95th percentile exceeds 3 bps over the period. This means that 95% of short-term fund unit assets that are more volatile than EONIA, have higher volatility than that of EONIA that is less than 3 bps over the period. Lastly, for standard fund units, 50% of assets that are more volatile than EONIA are below 2 bps, and 75% of assets below 3 bps. It is from the 85th percentile of assets that it exceeds 5 bps over the period .

The study shows that for more than 75% of the money market fund units, the volatility differential to EONIA is below 4 bps over the period studied. It is slightly higher for standard funds compared to short-term funds.

However, taking into account assets under management significantly reduces the volatility differential observed, which does not exceed 3 bps for more than 85% of assets, including for standard fund units.

ANNEX 1 QUALITATIVE ANALYSIS OF THE MOST VOLATILE FUND UNITS IN 2017

An individual analysis of the characteristics of fund units that are 5-basis points more volatile than EONIA was carried out in 2017 (34 fund units representing assets under management of approximately €8 billion, i.e. 2% of total assets for the population studied in 2017).

The individual analysis of each unit concerned shows the following explanations, in descending order of volatility:

- **Changes in decimalisation:** Asset management companies sometimes choose to change the price of the shares/units of their funds (for example to reduce the price of a unit from €100 to €10 to improve liquidity: the holders receive 10 "new" units for each "old" unit). In such cases, an artificial variation in the NAV of the unit is observed of (-90% in the example cited) concomitant with an increase in the number of units (by 10 in the example), without any overall impact on the fund's net assets.

- **Dollar-denominated fund units:** Volatility is due to (i) the higher volatility of US money market rates (the Libor 1M USD benchmark is most commonly used) and (ii) the euro countervalue effect. These funds have a consistent behaviour and do not call for any particular comment.

- **Units in formula funds with end-of-life money-market behaviour:** Formula funds are designed to transform themselves, once they have reached maturity, into money market classification funds in order to retain the assets under management the time needed to propose new investments to investors. The fund is then dissolved or merged with a money market fund. As a result, the fund unit appears very volatile during its "formula fund" period before becoming much less so during the "money market" period. This type of situation will no longer occur as the AMF's services have considered that these funds will not have to apply for MMF approval for their end of life (included in their initial purpose for this period, and lifespan limited to a few months).

- **Distribution effects:** The Lipper data used for this study do not consider the reinvestment of coupons detached by the funds. This results in artificially high volatility in the event of coupon detachment.

- **Feeder fund units:** These funds show higher volatility than the EONIA while the master fund does not. This can be explained in particular by side effects, such as different decimalisations between the master and the feeder, which can generate momentary jumps in the feeder's NAV. A technical alert on the NAV has also been reported for a fund. Note that this type of situation will no longer occur in the future as master-feeder structures are prohibited by the MMF Regulation, excluding employee savings funds.

In order to limit the impact of the above effects, which tend to artificially increase volatility, we again analysed the trend in volatility by keeping only units of euro funds and capitalization funds⁹ as well as units of non-feeder funds. In addition, all fund units with a volatility greater than 20% were excluded from the analysis in order to be exempted from the decimalisation effect. We note that the effect on certain units caused by a formula fund switching to a money market fund cannot be addressed specifically due to an inability to identify them in the databases used.

⁹ Unlike distributing funds, they do not pay any dividends to holders of shares or units and reinvest all the interest, dividends and capital gains linked to the composition and management of their assets.

The table below presents the final composition of the sample studied:

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
No. of units considered in the analysis	235	238	247	266	245	210	192	168	146	133	134	128
Total no. of units	497	502	508	519	483	417	378	334	272	243	231	219

Source: AMF