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PUMA COOPERATION BETWEEN THE BANK OF ITALY AND THE INTERMEDIARIES FOR THE PRODUCTION OF STATISTICAL, SUPERVISORY AND RESOLUTION REPORTING

by Massimo Casa[*], Marco Carnevali[**], Silvia Giacinti[*] and Roberto Sabatini[*]

Abstract

The Bank of Italy collects a large amount of data — statistical, supervisory and resolution — from banks and other financial intermediaries in order to fulfil its institutional functions and meet the needs of other national and international authorities, in particular the ECB, the EBA and the SRB. Since the late 1980s, the Bank of Italy has been promoting intensive cooperation with the banking system through the PUMA procedure (Procedura Unificata Matrici Aziendali, Integrated Corporate Matrix Procedure), with the main objective of providing support to intermediaries in their reporting activities. The importance of this approach has been fully confirmed also in the context of the changes to the reporting framework that have been introduced over time at the European level. This paper aims to describe the characteristics of PUMA, discuss the main results achieved over the years, explain its role in inspiring similar initiatives undertaken at the European level, and investigate how this cooperation between the Bank of Italy and the financial system will remain central in the coming years. In an increasingly complex reporting system, PUMA has been instrumental in achieving an efficient balance between the need to support reporting agents, while pursuing objectives of data quality and cost containment, and maintaining the responsibilities for the production of the reporting flows with the reporting entities.

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Keywords: regulatory reporting, banking reporting, data model, data quality, information management, statistical production, information system, data dictionary, statistical integration.
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1. Introduction[1]

The regulatory reports that banking and financial intermediaries are required to send to the Bank of Italy on a regular basis have been subjected to profound changes over the last two decades: increasing amounts of information to be transmitted, quicker response time, and the growing complexity of the processing necessary to produce the reports. The international context has been the driving force behind this evolution: the single monetary policy, which requires analytical information to support its strategies, the launch of harmonized supervisory and resolution reports, and the need for increasingly granular data have led to profound changes in the reporting framework for central banks. The role of supranational authorities in defining reporting requirements has become predominant, as has the demand for increasingly high-quality data that is fully harmonized across countries, with a variety and a level of detail capable of capturing the increased complexity of the financial sector. Against this backdrop, it has become more and more difficult for reporting entities to address, in a timely and accurate manner, the numerous new requests for information received from multiple authorities and the frequent changes to the pre-existing reports, as well as the need for those authorities to have a dataset based on regulatory interpretations that are consistent among reporting entities.

In Italy, over the years, the initiative known as PUMA (*Procedura Unificata Matrici Aziendali*, Integrated Corporate Matrix Procedure), a structured cooperation between banking and financial intermediaries and the Bank of Italy, promoted and coordinated by the latter, has been a tangible and successful response to the growing complexity of the reporting framework. Started in the 1980s, in the midst of an extensive data processing automation process, PUMA has played a prominent role in promoting and facilitating the adoption of 'integrated approach' to the collection and processing of data that banks and other financial intermediaries are required to transmit to the Bank of Italy[2], helping to improve its quality and reduce production costs. Within the Bank of Italy, PUMA is the primary channel of contact with reporting entities for the organizational units that define the reporting regulations; it also constitutes a unique source of knowledge to deepen, in extreme detail, any interpretation and technical issues relating to the implementation of the reporting instructions. Similarly, for reporting entities, PUMA has become an essential component of the corporate approach to statistical reporting requirements, which is especially important when new collections of data are implemented.

In recent years, PUMA has been tested against a variety of experiences. First, it has become an international benchmark for similar cooperation initiatives with reporting entities. In particular, the ESCB's strategic statistical project, known as Banks' Integrated Reporting Dictionary (BIRD) and strongly supported by the Bank of Italy, directly mirrors PUMA, as it aims to build cooperation with the European banking industry to define standard rules for the production of data required by the authorities (in particular the European Central Bank – ECB, the European Banking Authority – EBA, and the Single Resolution Board - SRB). Second, PUMA's underlying principles can be recognized in alternative approaches, such as those based on RegTech or data-pull models.

[1] We would like to thank Francesco Cannata (Bank of Italy — Regulation and Macroprudential Analysis Directorate), Alessandro Carretta (Professor of Economics of Financial Intermediaries at the University of Rome Tor Vergata and Secretary General of the Italian Association for Factoring — Assifact), Bonifacio di Francescantonio (Executive Vice President and Head of Group Accounting & Regulatory Reporting of UniCredit) and Roberto Sabbatini (Bank of Italy — Statistical Data Collection and Processing Directorate) for their valuable comments. The opinions and concluding remarks are exclusively those of the authors and do not necessarily reflect the views of the Bank of Italy.

[2] '(…) the integrated approach favors the identification and exploitation of the synergies and relationships between different segments of the Bank's information assets. In so doing it aims to avoid, as far as possible, the duplication of data requests to reporters, thus helping to contain the reporting burden. Moreover, it increases the possibility of the cross-use of different information segments and, from a technological point of view, it also supports the application of significant economies of scale', Casa *et al.* (2022). See Paragraph 3.1 below.

This paper frames the experience of PUMA in the context of the evolution of the reports that banks are required to send to the Bank of Italy and other authorities (EBA, ECB, SRB). Section 2 provides a historical overview of all reporting — statistical, supervisory and resolution — highlighting its growing complexity. Section 3 describes the PUMA cooperation project and explains its contribution to the production of data. Section 4 illustrates other reporting cooperation experiences between central banks and reporting entities. Section 5 examines a number of innovative approaches to regulatory reporting that are either under assessment or that have already been adopted by the authorities. The conclusions outline the possible future scenario for PUMA in an increasingly harmonized reporting context at the European level.

2. The evolution of statistical, supervisory and resolution reporting

The evolution of the Bank of Italy's statistical and supervisory reporting since the first major reform of *matrice dei conti*[3] in 1989 can be regarded as a revolution in terms of regulatory framework, quantity and variety of data collected, approaches that are used. Over time, the main changes in the institutional set-up driving such evolution were the following:

- the gradual adoption of the 'integrated approach' by the Bank of Italy since the beginning of the 1990s (Casa *et al.*, 2022);
- the launch, at the beginning of 1999, of the last phase of Economic and Monetary Union (EMU), with the introduction of the single monetary policy;
- the responses to the global crisis of 2007-08, with the establishment in 2011 of the European Banking Authority, the introduction in 2014 of the Single Rulebook, the Single Supervisory Mechanism (SSM) and the Single Resolution Mechanism (SRM), the launch in 2018 of new highly granular harmonized statistical surveys within the Eurosystem.

In 2020-21, the revision of the Capital Requirements Regulation (CRR) and the COVID-19 pandemic revealed the need to face additional challenges with respect to data a central bank gathers form banking and other financial intermediaries.

2.1 The three historical phases of the banking and financial data collection

With reference to the evolution of the legislative framework concerning the statistical, supervisory and resolution reporting under the responsibility of the Bank of Italy, three periods can be identified.

In the first one, until 1998, the legal basis for collecting information from reporting agents (banks and financial companies) was the supervisory legislation, with the exception of data on usury, collected on the basis of Law No. 108 of 7 March 1996, and the decadal reporting, for which the collection takes place on a voluntary basis. The requests for information were mainly the expression of national needs that originated, with few exceptions, mainly from the purposes of banking and financial supervision and monetary policy, two institutional competences attributed to the Bank of Italy. The two main blocks of the reporting consisted of supervisory reports (merged in the *matrice dei conti*) and of those to the Central

[3] The *matrice dei conti* is a comprehensive reporting framework, which integrates the various information needs of different users.

Credit Register[4]. The latter provides information at the level of the individual debtor about its credit exposure to banks and financial corporations, useful both to the reporting agents themselves for the granting and monitoring of credits, and to the Bank of Italy for the activities of supervision, economic research and risk assessment of bank loans accepted as collateral in monetary policy operations. It is important to remark that supervisory reporting followed a multi-purpose approach, aimed at gathering aggregated accounting and statistical information (including that on payment and investment services), as well as information on the risks exposure by intermediaries (typically, credit and counterparty risk, market risks and large exposures).

Over time these requirements, which formed the original core of the reporting obligations imposed on intermediaries, have increased hand-in-hand with the new responsibilities assigned to the Bank of Italy and related to the oversight of the payment system and management of the banking crisis and resolution.

The integration of reporting regardless of the nature of the survey and the type of reporting entity has made it clear the importance of adopting the 'matrix model' (Del Vecchio *et al.*, 2007), on the basis of which the statistical dictionary containing all the definitions and related codifications of the Bank of Italy's information requests has been implemented (Casa *et al.*, 2022). The dictionary and the technical format for the exchange of data (for years the so-called 'PUMA format', then flanked by the more modern XML format) have been disclosed and updated over time through dedicated Bank of Italy circulars, in particular the No. 154 of 1991, 'Supervisory Reports of Credit and Financial Institutions. Reporting schemes and instructions for transmitting information flows'[5].

In the second phase, which can be positioned between 1999 and 2011, the Bank of Italy, as a member of the ESCB, started collecting information beyond that available at national level in order to carry out monetary policy and supervisory institutional functions, as well as payment system oversight and pursuing financial stability.

Article 5 of the ESCB Statute assigns to the ECB, assisted by the national central banks (NCBs), the power to collect the statistical information necessary for the performance of its tasks. Regulation (EC) No 2533/98 of 23 November 1998, 'Collection of statistical information by the European Central Bank', commonly referred to as the *Umbrella Regulation*, is a key component of the regulatory framework in support of the ECB's tasks of collecting statistical information. The Regulation lays down the types of economic operators in respect of which the ECB may exercise its power to collect statistical information, the nature of such power (e.g. in terms of imposing sanctions), the conditions for the protection and use of confidential data, data sharing with the European Statistical System (ESS) – Eurostat and national statistical institutes (NSIs), the authorities responsible for supervising financial institutions, markets, infrastructures and those responsible for safeguarding financial stability.

In this context, the ECB plays a key role in harmonizing the methods and the technical arrangements for the collection, compilation and dissemination of credit and financial statistics. On the basis of the Umbrella Regulation, the Governing Council of the ECB approves: (1) the regulations laying down, in particular, the statistical requirements for reporting agents and defining, for each case, the actual reporting population; (2) the guidelines addressed to the NCBs; (3) the decisions concerning, *inter alia*, the confidentiality of information and the measures to ensure its application. For the purpose of this work, an important aspect of Regulation 2533/98, which has remained unchanged in subsequent amendments, is that it allows NCBs to use confidential statistical information collected under the ECB statistical

[4] The additional data collections, sometimes initially carried out separately, have been progressively integrated into all the information managed according to the 'integrated approach'.

[5] The reports to the Central Credit Register, although integrated at the statistical dictionary level, have maintained specific technical arrangements for the exchange of information due to their peculiarities.

regulatory framework also for the exercise of the supervisory function as well as of other functions assigned to them which do not fall within the tasks of the ESCB.

The Bank of Italy, as well as other NCBs (Spain and Portugal from the outset, Croatia, Austria, Malta, Finland and, in part, France at a later stage), decided to continue to collect this new information within a national framework integrated with other banking data, by streamlining the existing *matrice dei conti*. To this end, in the secondary reporting legislation issued by the Bank of Italy, the ECB regulations are listed among the primary regulatory sources for imposition of the reporting requirements, normally alongside supervisory legislation, without distinguishing between what is collected for supervisory purposes or to meet the ECB's information requirements. It is worth mentioning that a clear separation is not possible, since most of the information requested from the banks fulfils both purposes.

The final step in the evolution of the reporting legislation occurred in response to the global crisis of 2007-08. It coincides with (i) the establishment of the Single Rulebook, which aims at ensuring a robust and uniform regulatory framework to facilitate the functioning of the internal market and prevent opportunities for regulatory arbitrage (Basel Committee on Banking Supervision, 2010a), (ii) the introduction of European banking supervision, i.e. the establishment of the EBA in 2011 and the SSM and the SRM in 2014, (iii) the launch, within the Eurosystem, in September 2018 of highly granular harmonized statistical surveys (AnaCredit and Securities Holdings Statistics Group, SHSG). These developments added a considerable burden and constraints to the NCBs statistical activity.

The main regulatory acts introduced for the implementation of the Single Rulebook are Directive (EU) 36/2013 on access to the activity of credit institutions and the prudential supervision of credit institutions and investment firms (CRD) and Regulation (EU) 575/2013 on capital requirements (CRR) which, from 1 January 2014, lays down prudential requirements directly applicable to credit institutions and investment firms (European Commission, 2013).

The CRR includes a number of articles with specific mandates for EBA to develop the Implementing Technical Standards (ITS) on supervisory reporting requirements, aimed at harmonizing reporting regulations in Europe, also with respect to formats, frequency and dates of reporting. Such harmonization is needed to ensure both a level playing field between comparable groups of credit institutions and investment firms and greater efficiency and convergence of supervisory practices. It also allows supervisory authorities to assess risks consistently across the EU and effectively compare banks and identify emerging systemic risks.

ITS shall set out the reporting requirements for own funds and own funds requirements, financial information, losses arising from loans secured by immovable property, large exposures, leverage ratios and liquidity ratios. As ITS follow the scope and level of application set out in CRR, they apply to credit institutions and investment firms, at (i) individual and (ii) consolidated levels, with the exception of financial information for which the scope is only consolidated.

ITS define the required data, expressed in the form of templates, and provide instructions for their compilation. In addition, the EBA publishes the technical documentation containing the Data Point Model and the data transmission format (XBRL), as well as the methodologies for verifying the quality of the information (the so-called 'validation rules').

EBA, on the basis of the European legislation[6], introduced the principle of 'maximum harmonization' into the supervisory reporting[7] and imposed harmonized primary reporting in the EU, through the so-called Single Rulebook, which also includes the Technical Regulatory Standards (RTS), the Guidelines (EBA Guidelines) and the Questions & Answers (EBA Q&A).

In this context, national authorities are not allowed to draw a more detailed reporting scheme or to supplement harmonized information requests with data required for other purposes. This approach deviates from that followed by the ECB in 1998, when it left the NCBs the flexibility to decide how to translate the requirements of the statistical regulations into the national collection schemes. Initially, the new data necessary for the conduct of the European supervision were collected by the Bank of Italy on the basis of both the Community regulations and the national supervisory legislation[8]. In June 2016, the Bank of Italy opted for collecting harmonized supervisory reports referring exclusively to Community legislation and to the data representation model defined by the EBA[9]; the migration to the new collection mode - which represented for reporting entities an important discontinuity - was completed in September 2018.

As regards financial intermediaries, national reporting rules have established the application, with certain specific features, of the implementing regulation which adopted the EBA's ITS on own funds and own funds requirements, consolidated financial information and large exposures. These intermediaries, though not directly subject to European prudential and reporting rules, are in fact subject to a prudential supervision regime equivalent to that of banks, in compliance with the principle of proportionality.

Since the launch of the SSM, the ECB has been granted investigative powers, including the request for information, in order to carry out the new tasks. The framework is similar to that faced at national level by the authorities responsible for prudential supervision. The power to collect information can be exercised by the ECB either directly or through national authorities, in line with the delegated operational framework already provided for the statistical requirements of the ESCB. To carry out the new supervisory tasks, the ECB has mostly used the information already required by the EBA[10]. Moreover, since December 2015, the SSM has been imposing additional reporting obligations on banks under a specific regulation (Regulation 534/2015 , 'FINREP on an individual basis').

The launch of the SRM also led to the introduction of new reporting requirements for banks. The SRB, in cooperation with national resolution authorities, started collecting information in 2017 for the purpose of drawing up resolution plans and determining the minimum requirement for own funds and liabilities

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[6] The main regulatory sources governing the power to collect data are: Regulation (EU) No 575/2013 ('CRR'); EU Directive No 36/2013 (so-called 'CRD IV'); EU Directive No 59/2014 (so-called 'BRRD'); Regulation (EU) No 806/2014 (so-called 'SRM Regulation'). The implementing regulations that adopted the ITS are the following: Regulation (EU) No 680/2014 et seq. (so-called EBA-ITS Regulation), then replaced by Regulation (EU) 2021/451; Regulation (EU) 2070/2016 et seq. (with regard to Supervisory Benchmarking Exercise); Regulation (EU) 2018/1624 (information for resolution plans); Regulation (EU) 2021/453 (on Fundamental Review of Trading Book); Regulation 2021/763 (on MREL/TLAC). In addition, the guidelines published by the EBA, in particular the Guidelines on Funding Plans (EBA/GL/2019/05) should be taken into account.

[7] On the basis of that principle, national law cannot, at the stage of application of European legislation, depart from the terms and conditions laid down by the latter. The principle prohibits the so-called 'gold-plating' practices put in place by the Member States when transposing European legislation at national level.

[8] In Italy, in order to provide continuity to the tested pre-existing reporting system and limit the costs of the transition, European rules have been applied, through the exercise of an option provided for by Community legislation, by regulating primary reporting with the Bank of Italy's circulars, the approach of which has been kept firm on national data collection criteria (so-called 'matrix system'). To this end, the reporting instructions have been divided into two separate parts: a harmonized, with content coinciding with the European one, and a non-harmonized, including other supervisory information.

[9] The initial choice made by the Bank of Italy, described in the previous footnote, was abandoned in view of its costly nature, for intermediaries and for the Bank, and to avoid the related operational and legal risks.

[10] In the SSM, the information collected on the basis of the ITS is used by the ECB to carry out its supervisory tasks, together with additional information collected under the ECB's own legislation. Following the so-called 'sequential approach', harmonized supervisory reports are transmitted by banks to national supervisors, which in turn send them to the ECB. The latter shall forward to EBA reports collected under the implementing regulations adopting EBA ITS or EBA Guidelines, thereby avoiding double reporting.

eligible for write-down and conversion for major European banks. In addition to the information to be provided under the regulations issued under EBA's ITS, banks and banking groups under the responsibility of the SRB shall provide additional information on the structure of liabilities, critical functions and access to payment systems and market infrastructures. Finally, banks are required to report the data necessary for the calculation of the *ex-ante* contribution to the Single Resolution Fund.

In addition to the need to harmonize reporting regulations in Europe and close important information gaps for financial stability analyses (in particular those on liquidity and leverage), the global crisis highlighted the need for more granular statistics, for two main reasons. First, the crisis showed that different economic sectors, as well as individual businesses and households across euro area countries, reacted very differently to economic shocks. The main lesson was that for policy purposes, the ECB must analyse and monitor closely sectoral developments; this is all the more true if we consider that the ECB, but also the NCBs and other euro area authorities, since the end of the first decade of the current century have taken on new tasks in terms of macro-prudential supervision, which have required new tools and knowledge.

Aggregated statistics may prove not adequate for an in-depth assessment of certain economic phenomena. For example, the availability of granular information on individual firms on credits and balance sheets is of great use in order to identify the underlying drivers of funding and supporting policy decisions (De Bonis, Piazza, 2020). In addition, the increased granularity of the required information can also benefit reporting entities themselves, e.g. it can induce an improvement in data governance (Di Francescantonio, 2016).

In recent years, important results have been achieved in relation to the availability of granular databases. Since September 2018, with the launch of the granular survey AnaCredit[11], harmonized detailed information on individual bank loans (with a minimum threshold of EUR 25 000) granted in the euro area to counterparties identified as legal entities has been available for Eurosystem central banks. Granular information on the holding of securities on a global scale by all banking groups (SHSGs) under the direct supervision of the ECB is also available from the same date. Other new granular databases include (a) the Money Market Statistical Reporting (MMSR), launched in 2016, which collects transaction-by-transaction data on a daily basis for more than fifty large euro area banks in four different segments of the euro money market, (b) information on derivatives transactions (EMIR derivatives reporting) and (c) securities financing transactions (SFTRs).

The three phases described above are summarised in the table below:

Phase	Description	Characteristics
1- From 1989 to 1998	Adoption of the 'integrated approach' by the Bank of Italy	• The data model used across all reports has become the 'matrix model', on the basis of which the statistical dictionary containing all the definitions and related codifications of information requests has been implemented. • The requests for information were mainly the expression of national needs that originated mainly from the

[11] AnaCredit (analytical credit datasets) is a collection of detailed information on individual bank loans in the euro area. For more information see https://www.ecb.europa.eu/stats/money_credit_banking/anacredit/html/index.en.html.

		purposes of banking and financial supervision and economic analysis.
2- From 1999 to 2010	Start of the last stage of EMU, with the introduction of the single monetary policy	• The Bank of Italy, as a member of the ESCB, has initiated the collection of information additional to that available at national level for the performance of monetary policy, payment system oversight and the safeguarding of financial stability. • The ECB plays a key role in harmonizing the rules and arrangements for the collection, compilation and dissemination of credit and financial statistics.
3- From 2011 to the present	Responses to the 2007-2008 financial crisis	• Establishment of the Single Rulebook, aimed at ensuring a robust and uniform regulatory framework to facilitate the functioning of the internal market and prevent opportunities for regulatory arbitrage. • Introduction of European supervision, with the establishment of EBA in 2011 and of the SSM and SRM in 2014. • Launch within the Eurosystem in 2018 of some highly granular harmonized statistical reporting (AnaCredit and SHSG). • This resulted in additional burden and constraints in relation to the collection of the information requested by the said authorities.

2.2 CRR2 and the COVID-19 pandemic and their impacts on harmonized reporting

In 2019, two major changes were introduced to CRR, which affected supervisory reporting:

- amending Regulation (EU) 2019/876 'Capital Requirements Regulation II' (so-called CRR2) implemented a number of key measures in the EU for institutions covering different information areas, such as liquidity, leverage and large exposures;
- amending Regulation (EU) 2019/630 'Backstop Regulation' established uniform minimum levels of coverage to ensure that institutions have sufficient loss coverage for future non-performing exposures (NPE).

The main novelties of CRR2, which continued to be inspired to a 'proportionality principle' in order to contain the reporting burden related to supervisory obligations for smaller entities, are aimed at:

- deleveraging excessive leverage;
- addressing the risk of long-term financing;

- addressing market risks by increasing the risk sensitivity of existing requirements and enhancing the proportionality of the prudential framework;
- containing compliance costs for small and non-complex banks, without compromising their stability;
- improving banks' support of economic growth, in particular that devoted to SMEs;
- increasing the loss-absorbing and recapitalisation capacity of systemic banks (G-SIIs).

The Backstop Regulation introduced, as a first pillar measure, uniform minimum levels of loss coverage for non-performing exposures. In particular, the rule provided that where for each exposure the provisions made are not at least equal to that minimum level, institutions are required to deduct the relative difference from own funds.

In addition, to mitigate the negative economic consequences of the COVID-19 pandemic, the EU and its Member States have introduced a wide range of measures to support the real economy and the financial sector. In particular, a few countries laid down moratoria on repayments of existing loans by law, giving borrowers the possibility to suspend the scheduled payments in various ways. Other States introduced measures whose substance is similar, but implemented them as part of more general initiatives coordinated by the banking sector (non-legislative moratoria). In addition, various forms of public guarantees on new loans were introduced in several jurisdictions.

For supervisory purposes, in specific EBA Guidelines (GLs) the implications of such moratoria on payments in terms of compliance with prudential rules have been clarified, including the application of the rules on forbearance measures and the definition of default. Such clarifications, in particular, ensure that suspensions of payments applied on the basis of the GLs on moratoria are not to be regarded as forbearance measures and do not alter the pre-existing classification of exposures.

The lack of complete information on the application of the payment moratoria and public guarantees led EBA to introduce with the GLs additional, specific reporting and disclosure requirements from banks. The GLs are based on existing FINREP definitions; moreover, they follow the principle of proportionality and are flexibile enough to be adapted to the particular situations in each Member State. Indeed, the guidelines leave ample scope for the flexibility of supervision in the implementation of the general rules, with respect to both the population of the institutions involved and the data models that are applied. The GLs cover the following requirements: (1) information to monitor the use of payment moratoria and the evolution of the credit quality of exposures subject to those moratoria; (2) information on exposures subject to moratoria; (3) information on new loans suitable to receive specific public guarantees to mitigate the effects of the crisis induced by COVID-19; (4) information on other forbearance measures applied in response to the crisis.

The reporting and disclosure requirements in the context of the COVID-19 pandemic, initially foreseen until 31 December 2021, were subsequently extended until further notice. Reporting shall be carried out on a quarterly basis from the reference date of 30 June 2020. Disclosure is carried out every six months, on 30 June and 31 December.

Moreover, Regulation (EU) 873/2020 (so-called 'CRR quick fix') of the European Parliament and of the Council amended Regulation (EU) No 575/2013 and Regulation (EU) 2019/876 as regards certain adjustments in response to the COVID-19 pandemic (European Commission, 2020). The 'CRR quick fix' is part of a series of measures taken by the European institutions to mitigate the impact of the COVID-19 pandemic on banks in EU Member States. In addition to the flexibility that is already built-in in the existing rules, the quick-fix has introduced some adjustments to CRR, including temporary measures to strengthen credit flows to businesses and households, thus supporting the Union economy.

In addition, the 'CRR quick fix' provided for changes to regulatory requirements, which also have an impact on supervisory reporting, in particular on leverage ratio, own funds and credit risk modules. The EBA has published specific GLs to help banks to produce the reports and disclosures that are related to these regulatory measures (European Banking Authority, 2020b).

3. PUMA and the processes of data production within institutions

As described in the previous Section, in particular over the last decade the amount of statistical information that NCBs and NCAs collect from banks and other financial intermediaries as well as their granularity has been increasing substantially, hand-in-hand with the evolution of the economic and financial environment and the increased complexity of the regulatory framework. The ongoing process of harmonization of statistical requirements at the European level has only partly mitigated such trends. For instance, as far as supervisory reporting regulated by EBA is concerned it has been estimated for the period 2018-2020 that European banks overall bear an annual cost, including ongoing costs and implementation costs, of about EUR 5.5 billion (European Banking Authority, 2021a). Based on the results of a questionnaire addressed to institutions, the most prominent areas of concerns are complexity, the amount of information to be reported, internal data extraction and calculations and the stability of the EBA supervisory reporting framework.

The 'integrated approach' is the pillar of the strategy the Bank of Italy (Casa *et al.*, 2022; see below) has been pursuing over time in order to keep reporting costs down. Within such strategy, the PUMA cooperation is one of the main ingredients, to the extent that it supports reporting entities in developing appropriate solutions for the effective and efficient fulfilment of reporting obligations. The rest of this Section illustrates the underlying characteristics of the PUMA solution and its contribution to improving the quality of data and enhancing the efficiency of the whole data collection process.

3.1 The PUMA experience within the strategy of the Bank of Italy for data integration

At the Bank of Italy statistical information is a strategic resource, crucial for meeting the needs of a variety of users:

- its institutional functions (banking and financial supervision, market and payment system oversight, economic research, monetary policy, financial stability, etc.);
- other national authorities (Consob, Istat, etc.) and supranational authorities (ECB, EBA, FSB, etc.);
- external users (research institutions and universities, financial institutions, etc.);
- reporting agents, which receive feedback loops and thus, in their internal analyses, can rely on homogeneous and shared information.

As already mentioned, the management of the statistical resource takes place according to the integrated approach. It is based on the idea of managing the different information needs as parts of a unitary system; this contrasts with the so-called 'silo approach', where information areas of interest to different users are treated independently from each other, leading to a fragmentation of reporting regulations, statistical dictionaries and technical infrastructures. It is worth remarking that in the context of the silo approach, despite the fact that authorities collect the information separately for the various purposes, they try to

reconciliate the information areas that are related to similar phenomena, so following a sort of '*ex post* integration'.

Instead, the '*ex ante* integration' followed by the Bank of Italy is based on a single data definition and classification system. Information needs are therefore merged in a single data collection structure, which considers the possibility of using the same information for different purposes. It is not just a matter of sharing or reusing information, but rather of looking at the data from the unitary perspective of a common statistical system. In terms of its governance, within the Bank of Italy such system is governed by the Statistics Committee, chaired by a member of the Board, with the participation of all the main users, data managers and IT experts for statistical applications. This Committee ensures a strong coordination between the various stakeholders and the evaluation of new surveys by all potential data users.

In particular, new information requests are identified through a single process in order to prevent the risk of redundancy, and are described using a single information model. A common statistical dictionary contains information on data and concepts and, thus, allows to have a consistent view of the whole information system. The statistical applications are specific to each step of the whole production process (acquisition, processing, dissemination) but independent of the data that are processed[12]. Metadata, which describe statistical concepts, data and transformation rules, are 'active', i.e. they guide the software functions (Del Vecchio, 2001); in other words, the definitions given by users are directly interpreted and executed by the processing system[13]. Users access information through a common statistical data warehouse (DWH), according to rules and a governance set by the Statistics Committee.

As mentioned above, within the Bank of Italy the PUMA plays a prominent role in the context of the integrated approach to the management of the statistical data collection. It is important to remark that PUMA is not a software but rather a documentation, which describes, in logical terms, the process that takes place within the reporting entities in order to compile the data flows requested by the Bank of Italy and the EU authorities. PUMA is aimed at supporting intermediaries in the integration of their data systems and at optimising the overall reporting process in order to contain the reporting burden as well as to improve the consistency and the quality of the information transmitted. Ultimately, it represents the *trait d'union* between the information required by the authorities and the data available within the reporting agents.

The basic assumption underlying this approach is that the quality and the timeliness of the data made available to end-users are strictly related to the properties of the data initially received from reporting agents, which, in turn, are influenced by the presence of a well documented and highly standardized and automated process to produce the statistical flows. This is why the Authority has an interest in investing also in the internal processes of reporting agents to produce the required statistical data, although such processes remain under the responsibility of the institutions themselves.

In general, Italian banks and other financial intermediaries have adopted this approach to the extent that the source of the information resides in an upstream system, which is fed with all the data necessary to

[12] Under this strategy, which focuses on the re-use of generalised components, a new need for statistical information can be met without the writing of new software, but through the integrated use of a part or all of the available components, by defining appropriate metadata that customise the specific processing.

[13] An information system based on active metadata has the following advantages:

- it is self-documentary (active metadata are intrinsically correct and up-to-date and document the operations of the information system for users, data definers and IT staff);
- user autonomy (data definers can prepare and modify survey definitions and related processing with minimal involvement of the IT function, as well as end-users can search and consult data without the help of the data definers or IT function);
- time to market and cost reduction (the implementation and modification of applications mainly involves interventions on definitions and to a much lesser extent on software, making it easier to manage complexity).

meet the reporting needs (but also the statutory financial statement, etc.) and which consistently feeds all downstream processes, without the need for further reconciliations.

3.2 The contribution of PUMA and the main factors underlying its success

In order to understand how PUMA affects the process of generating statistical data to be sent to the authorities, it is important to investigate in some detail the processes typically followed by the reporting entities.

In order to produce the required data, intermediaries start from the information contained in their systems, which we can call 'primary data'. The actual internal organization can differ across reporting agents: for example, the information system can be divided into a number of application procedures, each dedicated to specific product areas (e.g. loans, securities, derivatives, etc.), or it can comprise different components based on a specific use of data (e.g. risk management, accounting, etc.) and in some cases it can have a comprehensive archive where all elementary information potentially useful for reporting is collected. In general, primary information consists of granular data, such as individual loans disbursed, with their elementary information (maturity date, currency, etc.). Therefore, institutions must ensure that they have at their disposal the data that are necessary to meet the information requests of the authorities; then, they have to extract them in an organized manner; finally, a process of transformation of the elementary data must be implemented in order to produce the reports.

The internal processes of reporting entities to produce statistical data may be defined according to different organizational criteria and arrangements in relation to the level of integration that is adopted.

In processes based on a silo approach, for each survey to be produced the bank extracts the information from its operating systems and produces the final files on the basis of *ad hoc* IT applications. Hence, it is likely that in order to produce the data flows for each survey, the same elementary information might be extracted several times. For example, harmonized supervisory reporting data can be extracted from business records and processed separately from similar information for monetary policy purposes despite the two areas overlap substantially.

On the contrary, in the context of an integrated approach, the production of the individual reports is obtained through the processing of data from an input database, defined logically in a unitary manner, the contents of which are extracted only once from the different information subsystems and by the same IT application. In other words, the extraction of all the necessary primary information, which is then used for the preparation of the various reports, logically takes place only once.

In the Bank of Italy's experience, the latter approach, which is considerably more efficient from the point of view of the data quality standards, was also dominant in relation to the action carried out by PUMA cooperation since the 1980s. Indeed, for the structuring of input data and for the definition of transformation rules, all reporting agents can rely on the documentation produced by the cooperation — the so-called 'dictionary' (see Paragraph 3.4), the key instrument to be used in reporting, especially important for small and medium-sized banks for which the implementation of an autonomous solution could be very costly.

The PUMA solution has been developed precisely with the twofold goal, shared by the Bank of Italy and the reporting entities, of increasing the quality of data and containing the costs of their production[14]. In order to mitigate the apparent conflict between these two objectives, the model is based on a documentation supporting institutions in the extraction of primary data and the implementation of data transformation procedures and rules to produce statistical information in an automated manner. A permanent working group, coordinated by the Bank of Italy, is in charge of the definition of these rules in a structured dictionary (see Paragraphs 3.3 and 3.4).

It is important to point out that the PUMA documentation is a public good, i.e. it is made available to all interested entities, independently on their direct participation to the PUMA cooperation. Other important beneficiaries of this documentation are the software companies that assist intermediaries in defining the procedures to prepare the information flows to be transmitted to the authorities, which use it to update their application packages.

The timely updating of the PUMA documentation has made it possible to cope with the numerous changes in reporting regulations and the continuous enrichment of the information processed. Thus, such documentation has become an essential reference for the production of reports, although the actual choice of how to organize the reporting systems within each institution as well as the responsibility for the quality of the data transmitted to the Bank of Italy remain of the individual reporting agents.

Several factors contributed to the success of the cooperation.

1) Firstly, when PUMA was launched, the possibility of following a common 'system approach' in the production of reports, based on a shared documentation developed in cooperation with the Authority, was regarded as well-suited to address reporting innovations; this induced a significant number of intermediaries (in terms of total asset) to participate from the very beginning to the project launched by the Bank of Italy, bearing then the related, internal sunk costs. Over time, the valuable role it played in the processing of a significant amount of information encouraged the banks to use and invest in the PUMA. Initially, the cooperation activities concerned essentially the *matrice dei conti*, the Central Credit Register, the Risk and Reporting Archives[15] and the Currency Matrix (*matrice valutaria*)[16]; subsequently, it included, *inter alia*, prudential information, statutory financial statement, reporting by non-bank financial intermediaries, decadal statistics and, in recent years, harmonized supervisory reporting, analytical information on loans (AnaCredit) and securities held (SHS) and resolution reports (see Section 1).

2) Secondly, the relevance of the PUMA for the banking and financial system is also due to its importance the for internal users other than those engaged in reporting obligations. As the Deputy Director General of the Bank of Italy Tommaso Padoa Schioppa pointed out at the beginning of the 1990s, PUMA is much more than a tool to produce reports to the Central Bank. In fact, 'in order to generate those reports, it makes a selection from the archives of the banking company and builds a wide database, which remains available to the company itself'; from this database, banks can draw information that 'provides elements of evaluation and support for planning and management control' (Padoa-Schioppa, 1993).

3) Thirdly, the governance of the cooperation, though only recently formalised (see Paragraph 3.6), has always been inclusive, with clearly defined roles on an equal basis. This approach has been

[14] A preliminary experience had been conducted, in a simplified form, during the seventies within the *Convenzione Interbancaria Per l'Automazione* (CIPA) and resulted in the development of software for the production of only the information contained in the newly created *matrice dei conti*.
[15] Set of data provided to support on-site inspections in the context of banking supervision.
[16] The *matrice valutaria* was a survey covering the foreign exchange operations of banks.

one of the main reasons for the strong support received from all the stakeholders. Several actors contribute to the activities:

- the Bank of Italy coordinates the initiative, playing a leading role in the analysis of reporting issues[17] and being responsible of the operational activities for updating and publishing the PUMA documentation;
- banks and financial intermediaries are directly involved in the planning of activities and in the analysis of the various issues, as well as in the identification of solutions;
- software companies, to which intermediaries usually entrust the development of software to process the data to be transmitted to the authorities, also play an important role in the PUMA cooperation to the extent that they provide *ex ante* any input for identifying critical issues for the production of specific information sets.

4) Finally, a number of strategic choices relating to the content of the PUMA dictionary (see Paragraph 3.4) have made it easy to adapt over time to new information requirements, in particular: the definition of a highly granular input (primary data); the development of an important set of checks on the consistency, coherence and validity of data carried out from the outset when the information is processed; the decision to include highly complex transformations (such as the mechanism for allocating a credit line to one or more exposures backed by it) and their accurate description; the possibility to update timely. The input information defined in the PUMA solution is very close to the operating systems of the reporting entities and, consequently, the processing rules developed within it include a wide range of transformations necessary to integrate the original information and produce the data requested by the Authority. The process is supplemented by data checks (executed, as mentioned, at each stage of the transformation process) and strict logical rules, which allow the quality of the information to be monitored before the reports produced are sent to the authorities.

3.3 PUMA as a metadata-driven procedure

The PUMA solution is aimed at stimulating the reporting entities to adopt a metadata-driven process[18] whose key ingredients are the following:

- a dictionary of metadata, and
- a generalised software, i.e. based on components dedicated to the automation of a particular aspect of the process but capable of managing any statistical information.

The realisation of the software is left to the market: PUMA defines the logic of the process, but it is not intended to provide a centralised application package suitable for all reporters. Each of them independently selects the preferred software solution from those available on the market.

The PUMA dictionary is the set of metadata guiding banks' internal systems. In order to assume the role of 'active dictionary' (see Paragraph 3.1) it is necessary that the dictionary is described in a language as formal as possible, i.e. that it can be read by software more or less automatically.

The metadata representation uses a relational database, whose data model is the so-called 'matrix model' (Del Vecchio *et al.*, 2007). The language is largely formalised and able to describe complex

[17] To this end, the support provided by the regulators for possible interpretative clarifications is of great importance (see Paragraph 3.5.1).
[18] Applied to data management disciplines, a metadata-driven approach consists of piloting the functioning of the data management system through a governance model consisting of a set of entities, attributes, relationships, rules.

transformations; at the same time it is user-friendly enough to be managed independently by business analysts, i.e. not necessarily by IT experts. The use of formal language makes it possible to describe the data production process more precisely and document statistical concepts and calculation algorithms more rigorously. The PUMA documentation is complemented by instructions and processing rules described in an unstructured language, i.e. not suitable to be automatically executed by a software[19].

However, some elements of evolution in the internal organization of reporting entities for information management and in the role of PUMA should be highlighted:

- the specialisation between the reporting environment and other internal data marts has gradually expanded;
- the PUMA dictionary is becoming less and less 'active' from a technical point of view, given that the software solutions adopted by most institutions do not use it directly as a set of metadata, but rather as a documentary reference;
- the data contained in PUMA's intermediate archives (in the sense of not yet compacted and configured for the production of expected final reports) is a source of growing importance for the production of information both for internal use and for third parties (including market and authorities).

3.4 The definition of the PUMA dictionary

This paragraph describes the dictionary developed by PUMA, which is the heart of the initiative. As already noted, the production of statistical data is a process that starts from the company information system and ends with the final reports to be sent to the authorities. It therefore begins with an input, which consists of the basic data in the intermediaries' archives (primary data), and it generates an output, the reporting flows, by a sequence of transformations that ensure compliance with the provisions of the reference reporting regulation. Although this process takes place in each institution separately, the PUMA dictionary aims to help govern it by establishing common definitions and rules, which are therefore applicable by all reporting entities[20].

The PUMA dictionary consists of:

- input information;
- transformation rules;
- output information.

There are also validation rules aimed at monitoring the quality of the data at each stage of the process (therefore, not only at the end).

Whereas the definition of the output contained in the PUMA documentation corresponds, as mentioned, to the information requests described by the authorities in their reporting regulations, the definition of input and transformations requires an in-depth analysis.

[19] In the activity carried out by the PUMA functional groups, different skills and experiences (personal and business) of the participants come together in a joint analysis, combining financial and accounting issues with problems of data management and transformation, in order to obtain a unitary product.

[20] The approach based on a common dictionary also responds to the Basel Committee's 'Principles for effective aggregation and reporting of risk data' (so-called BCBS 239) concerning risk data aggregation: 'As a precondition, a bank should have a "dictionary" of the concepts used, such that data is defined consistently across an organization'. PUMA has gone further because it not only promotes an approach within each institution but it also aims to have a common dictionary among banks.

3.4.1 Input information

The PUMA documentation identifies the data to be extracted from the operating systems of the banks in order to meet all information requests. The input consists of a database containing information at a high level of granularity, which directly derives from the operating procedures of the intermediary. The level of detail is so analytical that, as a rule, each observation refers to a particular transaction (e.g. granting a credit line to a counterparty), to which the relevant attributes are associated (e.g. currency, maturity, and so on). For loans and deposits, data are generally referred to the counterparty, whereas securities transactions refer to the security code (ISIN); then, the registers of entities and securities provide wide information on the characteristics of each counterparty and of each security. This granularity allows the reporting entity to cope with additional requests for information by adding new variables that enrich the database but without the need to modify the observation unit.

As reporting entities may structure their operating systems in different ways, it is necessary to define a taxonomy to organize the primary information of intermediary's internal databases in a standardized manner. However, a logical profile, which is intrinsic in phenomena, makes it easier to create this starting point; and, on this basis — as a conclusion of sometimes even in-depth and complex analyses — the minimum information needs necessary to fully meet information requirements laid down by the reporting regulation are objectively defined. Therefore, PUMA defines a common structure applicable to all reporting entities in its scope; every institution willing to adopt the PUMA solution should logically map its primary data into this structure. Nevertheless, the method used for this mapping can be adapted to the specific characteristics of the information system of each reporting entity; this flexibility has greatly contributed to the spread of the PUMA approach.

The definition of input information follows the common rules for correct data modelling (Codd, 1970). For example, the set of elementary codes that make up a domain must be separated (codes should not overlap) and complete (all codes must cover the entire domain of interest) and input information must be non-redundant (every piece of information must be present only once, but it can be used in many transformations).

Therefore, input information is a common structure of all data that are necessary to fulfil reporting obligations.

It is worth noting that for reporting agents — in addition to its technical-functional value —the input is also a reference model, which can be used to identify the information capacity that corporate systems must possess in order to properly manage a given financial product. This feature — which can be taken for granted for more traditional products — is particularly appreciated by institutions for the most complex and/or innovative products, for example those recently introduced into the market or affected by a significant change of the regulatory framework.

3.4.2 Transformation rules

The second key component of the integrated approach is the definition of transformation rules. In this regard, the PUMA documentation indicates how the elementary input data shall be processed in order to generate the reporting flows required by the authorities. More specifically, these transformations consist of aggregations, which can be more or less complex, and checks, as outlined below.

As regards checks, a first type verifies the presence of an observed value expressing the measure or qualitative characteristic of a certain phenomenon (so-called 'presence checks'). A second class of checks aims to verify that a variable assumes values within a given domain (so-called 'domain checks'). A domain can consist of a specified set of items, either specifically listed or contained in an external table (e.g. the table containing detailed information on each security, identified by the ISIN code), or it can be defined by a rule (e.g. an identification code of a certain length and composed of numeric and alphabetic characters in a predefined order). Finally, some checks ensure consistency between different variables; they are based on an analysis that may refer, *inter alia*, to regulatory constraints (accounting principles, prudential rules, etc.), to concepts of financial technique or to statistical classification criteria ('coherence checks').

In addition to the need to execute such checks, granular input information must undergo various transformations in order to become output statistical data. As already noted, the degree of complexity of such processing may vary greatly. Some examples of simple transformations are the aggregation of granular information on loans in order to have the total amount for a particular type of instrument, or the calculation of time intervals from the precise indication of dates. However, there are many transformations of considerable complexity and it is mainly in these cases that PUMA provides a decisive contribution. In fact, transformation rules respond efficiently and effectively to two basic needs. The first one is to connect different operating systems of the bank, i.e. to integrate data that the intermediary's information system treats separately (an example is the treatment of credit lines granted and guarantees received, which includes the rules of connection with the loans and the related allocation mechanisms — see Box 1). The second need is to have a uniform application of reporting regulations (e.g. asset classes and risk weights for credit risk are determined by complex algorithms that, on the basis of prudential rules, combine information on the type of asset, the characteristics of the counterparty, the availability of a credit rating, the currency of the transaction, its maturity and so on).

In line with the overall objectives of transparency and traceability, each transformation is documented in such a way that the data obtained progressively in the various steps of the process, which keep a very high level of granularity and breadth, can be used for further purposes, other than the final reports.

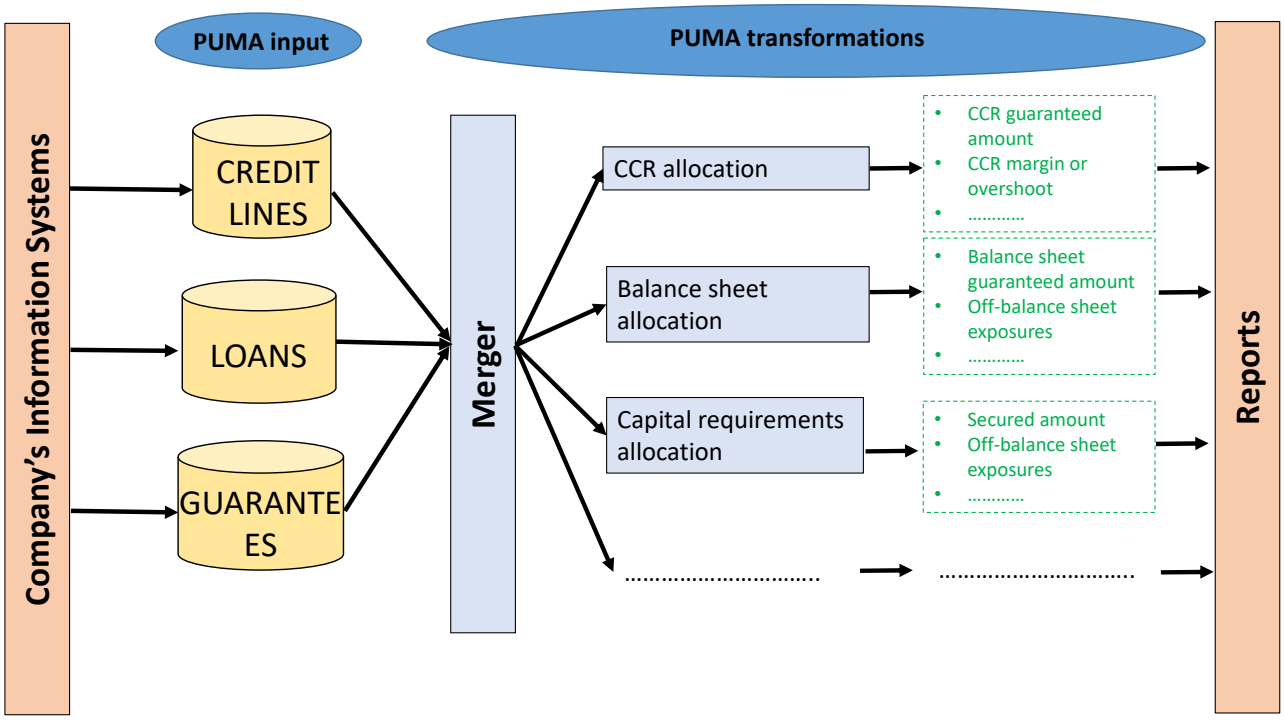
Box 1 — An example of complex transformations: the treatment of credit lines and guarantees

Information on loans, credit lines and guarantees/collateral is provided separately in the PUMA input. The numerous kinds of transaction are represented in their complexity, with the details useful for subsequent processing. In particular, credit lines and guarantees/collateral are distinguished according to whether they relate to a single customer or to several entities ('multiple') and by reference to the relationship with the loans ('specific' if linked to a single loan, 'promiscuous' if linked to several loans, 'generic' if linked to all the loans of a customer). PUMA transformation rules define the treatment of this information, which includes the following steps:

1) the loans, credit lines and guarantees/collateral are matched (the so-called 'merger' function), based, for example, on a company unique matching code or on an allocation code consisting of a range of values associated with all customer exposures;
2) credit lines are allocated to the loans in order to calculate additional information, such as margins and overshoots;
3) guarantees/collateral are allocated to the loans and the credit lines in order to calculate additional information, such as the guaranteed amount.

The execution of the calculations referred to in points (2) and (3) requires the definition of the criteria for making the so-called 'allocation of credit lines and guarantees/collateral', by identifying, *inter alia*, the credit lines and guarantees/collateral to be considered and establishing the order to be followed for their treatment and the rules for comparing the amounts. These criteria are differentiated according to the relevant regulation (Central Credit Register, accounting, credit risk, etc.) and thus give rise to separate calculations.

The presence in PUMA of this treatment has allowed institutions to produce the results of an extremely complex processing through rules defined in a standardized way within an integrated process. The strategic choice of PUMA cooperation has been to include in the procedure a wide range of transformations, even those less easy, with very sensitive effects (e.g. the allocation of credit lines and guarantees/collateral made for the Central Credit Register, which has a direct effect on the representation of the debtor's exposure) and potentially controversial. The well-established experience over thirty years shows how, given the complexity of the plant and the initial effort needed to rationalize and document it, it has been possible to significantly improve the stability and quality of the data obtained. A different choice would have led to the need for each bank to feed directly into input the information required by the various reporting regulations (margins/overshoots and guaranteed amounts for Central Credit Register, accounting, credit risk, etc.).



3.5 The role of PUMA cooperation in the process of reporting innovation

The involvement of PUMA cooperation in defining and implementing new data collections or in modifying existing data starts from the planning of new statistical needs.

Every year, a meeting is organized during which representatives of the Bank of Italy's organizational units responsible for reporting regulations explain the innovations planned for the next two years to the participants in PUMA cooperation. The work programme of PUMA Functional Groups is then drawn up on the basis of the planned initiatives; PUMA groups, besides preparing the update of the documentation, also play an important (informal) role of technical consultants to the regulator in the definition phase of new or amended reporting regulations. It follows that PUMA cooperation is an integral part of the process of implementing reporting innovations, by providing a key contribution to the clear specification of such innovations and facilitating their correct and timely transposition, while respecting their respective roles. This function is detailed in the following paragraphs.

3.5.1 Interaction with the regulator

As already noted, the work of PUMA cooperation is mainly aimed at producing the documentation that can be used on a voluntary basis by all reporting entities to produce the required information. In this context, the interaction with the Bank of Italy's organizational units responsible for reporting regulations is essential both *ex ante*, in relation to that informal advisory activity in the drafting of the regulations referred to above, and *ex post* in order to avoid that the rules defined by the PUMA Functional Groups are not in line with the correct interpretation of the regulations.

With regard to the *ex ante* dimension of the comparison between regulators and reporting agents, i.e. when the reporting regulations are being drawn up, it is important to point out in advance that it does not in the least affect their mutual powers and responsibilities. Rather, it is a valuable collaboration, mainly from the point of view of the regulator, who benefits from the expertise of representatives of banks and other financial intermediaries to refine the description of the phenomena of interest and make the regulations closer to the actual business of the institutions. An evaluation by the PUMA groups is normally requested and taken into account well before the publication of documents for the public consultation[21]. From the point of view of reporting agents, they have the opportunity to go into the substance of the requests that will be addressed to them; in this way, they can assess their implications and take the necessary steps for timely transposition.

With reference to the *ex post* interaction, its value and its necessity stem from the consideration that in the complex and articulated area of regulatory reporting, where accounting, prudential, statistical, statutory and sometimes even management criteria overlap, the concrete implementation of a reporting innovation, although clearly and precisely illustrated in the related instructions, then requires to go down to a high level of detail, which no regulation can reasonably reach. The need for this interaction has been reinforced by the progressive shift in regulatory power at supranational level, which has increased the difficulties to examine the details of the regulations and define the operational arrangements for their implementation[22].

The increased complexity of the reference context, combined with a growing granularity of the data requested by users, has made this activity more and more important. In particular, in presence of unforeseen events associated to extemporary and urgent information needs, it is necessary to know what information is available and can be quickly retrieved. PUMA cooperation experts are able to carry out this verification in a short time, by referring to the wide input database built within the regulatory data production process and already defined from a multi-purpose perspective. An important recent example that illustrates the value of this action carried out by PUMA is the additional information needs requested by the authorities in connection with the COVID-19 pandemic. The Bank of Italy has implemented several initiatives aimed at gathering information, in particular to assess the impact of specific measures taken by the Government regarding the moratoria on certain loans and the availability of new state-guaranteed finance (Casa, D'Alessio, 2020); on this occasion, the preliminary discussion carried out within the PUMA groups was essential in order to make available to policy makers the data necessary for their evaluations in a timely manner.

[21] This practice was adopted in Italy well before the principles of better regulation were laid down in the European Union.

[22] In particular, according to the participants in the PUMA cooperation, among the most relevant factors the following are highlighted: 1) the heterogeneous audience of the addressees of European regulations, belonging to countries with different legal and financial systems, which makes it necessary to draw up provisions of a general nature and therefore more distant from national specificities; 2) a technique of writing the reporting instructions characterised by a lower degree of detail and fewer examples of application than the circulars of the Bank of Italy; 3) a less direct dialogue with industry on reporting issues outside the formal processes of public consultations and Q&A.

The consultancy activity takes on a formal aspect in the so-called 'impact analysis', provided for by Law 262/2005 on the protection of savings. The request for new information normally requires an assessment of the costs and benefits associated with it. When the responsibility for regulations lies with the supranational authorities, the latter usually conduct this analysis, sometimes assisted by national authorities. On the other hand, if the Bank of Italy expresses the need to collect new information, it is required to conduct an impact analysis according to a pre-defined process, which takes into account the difficulty of objectively measuring costs and benefits and of comparing them. If the reporting innovation affects the categories of entities participating in the PUMA cooperation, the role of PUMA is crucial in carrying out the cost assessment. As a rule, PUMA members are formally involved in the pre-consultation phase of the regulation with the request to provide an ordinal quantification of set-up and recurrent costs associated with each new information detail. Different options are sometimes compared and institutions can express their view on feasibility and costs.

In short, PUMA cooperation is a privileged interlocutor for the regulator and is an added value compared to the normal procedures for dialogue and consultation. In fact, the knowledge of the company's business and its information systems, combined with the ability and the necessity to analyse in depth the methods of production of information, allow PUMA experts to assess the consequences of a regulatory choice and anticipate its criticalities. In turn, thanks to this collaboration, the regulator can better specify the contents of the reports, it can reduce their costs and increase their compliance with users' expectations.

3.5.2 The update of the PUMA documentation

In the event of new data requests defined by the regulator, PUMA shall promptly update the documentation supporting the reporting agents in order to make it available in time for the necessary adaptation of the respective information systems. The coordination between the regulatory production and the activity of PUMA, in terms of both content and timing, makes it possible to satisfy the information needs according to the deadlines set. The introduction of new reporting requirements by the regulations activates a consolidated update process consisting of the following steps.

The first activity to be carried out concerns the assessment of the impact on input data (see Paragraph 3.4.1), i.e. the precise identification of new information to be found in intermediary information systems in order to meet the new requirements. In this context, the contribution of the representatives of reporting intermediaries is crucial, since, thanks to their knowledge in detail of banking and financial business, they are able to accurately identify the input data to be integrated by analysing in depth the new information requirements introduced by the regulation. As a rule, the impact on input is disseminated in a draft PUMA documentation well before the entry into force of the regulation, in order to give the institutions the time needed to retrieve the new data in the corporate information sub-systems.

Subsequently, the work on the adaptation of transformation rules begins. Even at this stage, the dialogue with the Authority is of fundamental importance for the correct application of the regulation, by translating general instructions into precise data processing algorithms. In this regard, although the PUMA documentation is not an official interpretation of the regulation (and therefore the reporting agents retain full responsibility for the production of the flows to be transmitted), banks and financial intermediaries consider this documentation to be a fundamental tool, which, through the logical definition of the data production process, helps them to be compliant with the reporting regulations, which is particularly useful in case of controversial issues. In this respect, the PUMA documentation differs significantly from the use of modern RegTech technologies for the production and management of supervisory regulations (see Paragraph 5.1).

Once the analysis carried out by the PUMA groups has been completed, the new documentation is updated and made available to all intermediaries; it includes:

- the PUMA dictionary in database form, separate for banks and financial intermediaries[23];
- the functional technical manual, which contains, *inter alia*, a description of the model used for the representation of metadata, instructions for compiling input data and particularly complex transformation steps that cannot be included in the database;
- the technical notes, which describe, with reference to a certain area of information, the analysis carried out to update the PUMA documentation, normally linked to significant reporting innovations;
- codifications of output data, when the regulation does not contain them (e.g. for the statutory financial statement) or when, to document them in PUMA, a recoding is required (as for the supervisory and resolution reports described in the EBA Data Point Model).

The complexity of this activity emerges from some numbers. At present, the PUMA documentation covers 29 banks' surveys and 7 for non-bank financial intermediaries (in 2011 there were 14 and 4 respectively). During 2021, 49 releases of the PUMA database were published, with 235.255 metadata changes, 23 updates to the Manual, 18 technical notes and 11 output codification updates.

3.5.3 Dissemination of PUMA documentation: website and training activities

The PUMA documentation is disseminated through the cooperation website (https://www.cooperazionepuma.org/), within the 'Products' section. The use of a separate website, created in 2020, makes it possible to configure PUMA cooperation as an autonomous entity, even if it has no legal personality, both from the Bank of Italy and from the institutions participating in the initiative. The site is used to publish the PUMA documentation, by making it available to all intermediaries including those who do not participate in PUMA groups, and present the cooperation initiative and its activities. A periodic newsletter highlights the events and topics of particular interest.

A less well-known but increasingly important channel for the dissemination of PUMA content is that of training professionals in the sector (exponents of the banking and financial world involved in reporting, experts in risk management, representatives of software companies and service centers that implement innovations in reporting). The publication of the documentation is in fact accompanied by training initiatives aimed at promoting the understanding of reporting innovations and related PUMA adaptations and their timely transposition. These initiatives normally have a high level of participation[24], especially in the current context characterised by a sharp increase in the volume of statistical data required and the increased complexity of reporting regulations.

In addition, PUMA cooperation organizes on its own regular, annual or half-yearly meetings with software companies and service centers in case of significant reporting innovations. Thanks to the informal collaboration with these companies, which represent the first users of the documentation produced, it's possible to identify any problem arising from the concrete execution of the PUMA rules and thus to be able to improve the solutions adopted. In these meetings, the interventions made to the

[23] The implementation of separate PUMA dictionaries for banks and other financial intermediaries reflects their differences in terms of both operations performed and reporting requirements.

[24] Among the most consolidated initiatives over time we can mention the seminars that ABIFormazione (a division of ABIServizi SpA, a private stock company owned by the Italian Banking Association) organizes in response to important innovations in reporting regulations. The structure of these seminars includes an initial part of the regulatory framework, generally carried out by the experts of the supervisory function of the Bank of Italy, followed by the detailed description of the interventions carried out on the PUMA documentation, by the team of the Bank of Italy that coordinates the activities of the cooperation, and by the witness, by the banks and the participating financial intermediaries, of the main problems encountered in the implementation of the new information requests.

documentation are presented and the underlying logics are clarified, while leaving autonomy in the definition of the various application solutions.

Recently, the PUMA team of the Bank of Italy has organized training courses on the data model used to describe the PUMA dictionary and on the relational database where PUMA metadata are contained. This training activity accompanied the transition, in mid-2020, to new ways of representing PUMA documentation, with the adoption of a more technologically modern product that has made it possible to overcome the constraints and rigidities of previous instruments.

3.6 The organization of cooperation

PUMA cooperation is based on the willingness of all actors to work together to pursue the shared objectives of high quality data and lower costs for intermediaries. A clear identification of roles and responsibilities is therefore essential for the successful performance of the activities.

In December 2018, the participants in the initiative entered into an Agreement (https://www.cooperazionepuma.org/chi-siamo/Accordo_di_cooperazione.pdf) defining the subject, the participants, the governing bodies and the rules of cooperation. According to the Agreement, the objective is 'the creation and maintenance of reference documentation for the production of information flows by intermediaries'. The following institutions may join the agreement:

a) the banks registered under Article 13 of the Consolidated Banking Act;
b) the financial intermediaries registered under Article 106 of the Consolidated Banking Act;
c) trade associations and consortia of banks and/or financial intermediaries.

In June 2022, 26 institutions were members of the cooperation (https://www.cooperazionepuma.org/chi-siamo/Elenco_degli_aderenti.pdf), in addition to the Bank of Italy, representing large and medium-sized banks, cooperative credit and financial intermediaries carrying out the various types of financial lending.

The governance of the cooperation is ensured by the Strategic Committee, which is chaired by a representative of the Bank of Italy and it is composed of one member for each institution participating in the initiative and of the coordinator of the Functional Groups (see below). The Committee approves the planning of activities, it identifies the resources to be allocated to projects and it defines their priorities, it decides on requests for membership and possible exclusion, and it approves amendments to the Agreement. In view of the extreme importance for PUMA activities of collaboration with the organizational units responsible for regulatory production in the Bank of Italy, the latter are also expected to participate in the meetings of the Strategic Committee, as observers.

The analysis of the reporting regulations and the definition of interventions on the PUMA documentation are carried out by the Interbank and Interfinancial Functional Groups, which are coordinated by a representative of the Bank of Italy. Each participant is required to have adequate knowledge of banking and financial operations and experience in compiling reports. Software or consultancy companies operating in the accounting/regulatory field may also be invited to attend the meetings of the Functional Groups.

The Technical Secretariat of the initiative is entrusted to the Bank of Italy, which also provides the logistical and technological resources to carry out the activities. In particular, for the quality of the products disseminated it is crucial to have an IT solution that allows high levels of efficiency and that

guarantees the completeness, correctness and integrity of the PUMA dictionary, thanks to a comprehensive system of controls [25].

3.7 The advantages of the PUMA solution

The experience of PUMA cooperation has helped to increase the quality of reporting and facilitate the task of banks and other financial intermediaries in the production of statistical information, effectively containing reporting costs. The spirit of cooperation between the participants and the frequent interactions with the Bank of Italy over time have also enabled the Bank of Italy to become more sensitive to the specific issues of reporting entities, which in turn have become an active part in the process of defining and producing regulatory reporting (see Box 2). A number of areas where benefits are more evident are described below.

Consistency — First, the PUMA solution ensures consistency between the statistical data produced by the individual institution with reference to the different reports that are transmitted to the authorities, since the flows originate from the processing of the same set of primary data extracted from the various databases of the intermediary.

Standardization — The solution also favours a higher degree of sistem-wide harmonization, as the data are produced by reporting entities that follow the same rules. The analysis carried out by the PUMA Functional Groups at a centralised level, which is supported by a constant interaction with the experts of the Bank of Italy, reduces the risk of misinterpretation or non-uniform interpretation of reporting regulations across intermediaries.

Correctness — Although internal consistency of flows transmitted by a certain reporting agent and across reporting agents is a key element for the quality of the information transmitted, it by itself does not assure that the data are correct. PUMA cooperation contributes to the correctness of information in various ways: first, the documentation includes input data control rules that allow institutions to detect errors at source; furthermore, since the processing rules are defined centrally, each reporting entity can focus on the correct extraction of input data, which is the predominant factor for the quality of reporting. In any case, it should be remembered that the application of the PUMA rules does not eliminate the risk of errors in the data, the correctness of which remains under the full responsibility of the institution that produces them.

Time-to-market — In view of the unique process underlying data production, intermediaries have margins of efficiency and are potentially able to shorten reporting time without upheaval. For example, this approach has helped banks to reduce the timeframe for the transmission of harmonized supervisory reporting, which has been shortened to T+42 with respect to the reference date since 2014.

Flexibility — An additional advantage of the PUMA solution is its flexibility. The documentation is defined in a set of tables external to the application programs and it can be managed by staff without particular IT skills. Consequently, in a context where information needs vary frequently, it is possible to adapt quickly to changes. In fact, most of the adjustments concern the metadata composing the PUMA documentation, which can therefore be updated by participants in the Functional Groups and for the benefit of the whole system, with limited impact on software and low costs for reporting entities. In addition, the extreme granularity and richness of the input database reduces the impact of new

[25] In particular, the application used for this purpose allows to carry out checks on the metadata entered, enrich the input with new elements derived from the logic of the process, conduct further consistency checks and produce the database containing the PUMA dictionary.

information requests, which could be met by updating the rules of transformation of already available elementary input information.

Reporting burden — From the point of view of the reporting entity, the PUMA approach promotes greater efficiency of reporting processes through the re-use of basic data and the sharing of part of the costs of analysis and implementation. In addition, it allows institutions to adopt internal procedures that consider the different information requests together and that standardize and centralise certain activities. It should also be pointed out that such an approach, which is documented in a structured and formal way, facilitates the development of IT applications for reporting while remaining absolutely non-binding.

Data lineage — Finally, we highlight the importance of the process traceability (so-called 'audit trail') and the possibility for reporting entities to drill down to micro data from aggregates. This feature makes it possible, *inter alia*, to identify more easily the reporting errors detected by the Authority by means of the control procedures, which in part refer to aggregated data, and respond promptly to the related requests for clarification.

These characteristics make the PUMA solution extremely beneficial, also considering the possible risks associated with it, such as: a) an incorrect interpretation of the reporting regulation widespread throughout the system; b) failure to respect the time for software adaptations due to the late availability of PUMA documentation; c) the erroneous perception in some of the involved parties of a (although obviously unfounded) de-responsibility of intermediaries, despite the clear disclaimer published on the cooperation website[26].

Box 2 — The experience of a reporting agent in the context of PUMA cooperation[1]

The production of regulatory reporting represents — as a well-established experience shows — a demanding challenge for all reporting entities (regardless of their nature, size, market placement, organizational model, etc.).
In fact, it is a matter of periodically producing, according to pre-established and non-derogable timetables and schemes, an intrinsically sensitive set of information (for the content that characterises it and for the attention they are destined to have with the authorities). In this, the contribution made by PUMA has historically been and is still fundamental: it was initially, when in an exclusively national context it was meant to give a decisive impetus to automation and standardization, and it is today, in a predominantly European context, in which it is necessary to deal with a progressively more articulated and complex reporting.
The availability of PUMA documentation has facilitated the regular and standardized production (that is, obtained not with an appreciable *ad hoc* effort, but with a documented and almost fully automated process) of reporting. It may seem an obvious consideration, given the mandatory nature of reporting, but in reality it is not. In fact, it is one thing to have information produced on the basis of a fully individual interpretation and application of the rules; quite another thing is to define a reporting flow that — without prejudice to the mandatory individual responsibility of each reporting agent — results from a shared functional interpretation of the rules and from a concrete application carried out by software freely selected on the market but also in fact shared (at least in use) by an important number of institutions. On this point, it may be useful to point out that such an approach does not conflict with the requirement that the regulations themselves (as is clearly the case with European regulations) are thus not the subject of an interpretation (in the technical and legal sense of the term) which would be *contra legem*. They are, in fact, directly applicable and possibly assisted in their application by well-known and clearly defined procedures (e.g. Q&A) with which the cooperation does not in any way conflict, since it produces technical and functional documentation.
PUMA support has facilitated important and complex transitions. By way of example (because in reality they were really numerous and significant), it is worth mentioning among others:

[26] The disclaimer states, *inter alia*, that 'PUMA documentation shall not affect, modify or replace the responsibilities of intermediaries vis-à-vis competent authorities'. Furthermore, 'reporting intermediaries shall remain fully responsible for the organization of their internal reporting systems and for the correctness of their data vis-à-vis the authorities'.

— the application of Legislative Decree No 87 of 27 January 1992, adopted in implementation of Directive 86/365/EEC on the annual accounts and consolidated accounts of banks and other financial institutions (first experience of standardizing activities relating to statutory financial statements in accordance with European criteria);
— the establishment of prudential reports (since the so-called 'Basel 1': solvency ratio, market risks and large exposures), which are progressively assisted in their development even in particularly complex implementations such as those linked to the calculation of the effects of *gamma* and *vega* risk factors for trading derivative contracts;
— the reform of the Central Credit Register in 1997, with which the data production process was significantly innovated in the contents and methodology of data representation;
— the reforms of the *matrice dei conti* in 1998 (characterized by the introduction of information necessary to meet the needs of the ECB for the launch of the single monetary policy and by tighter deadlines for data transmission by banks) and in 2008 (the year of introduction of the rules for compiling national supervisory reports, on an individual basis, which Italian banks and Italian branches of foreign banks still transmit to the Bank of Italy);
— the first application of International Accounting Standards / International Financial Reporting Standards (IAS/IFRS) to the statutory financial statements and related supervisory reporting of banks and supervised financial intermediaries (2005-2006);
— EBA templates on prudential reporting (large exposures, asset encumbrance, leverage ratio, Liquidity Coverage Requirement — LCR, Net Stable Funding Ratio — NSFR, Additional Liquidity Monitoring Metrics — ALMM included) between 2015 and 2016;
— AnaCredit and SHS (Securities Holdings Statistics) granular reports in 2018.
This list demonstrates not only the work carried out, but rather the ability of PUMA to achieve the new objectives in a timely manner, which will inevitably continue to be set in the future, both in terms of producing new reports and possible bridging to similar ongoing initiatives at the European level (in particular the BIRD).
The qualitative support has also proved to be a (no less significant and appreciable) cost containment factor. PUMA makes it possible to produce new reports and adapt existing reports at a significantly lower cost since the progressively consolidated availability of a very rich and granular input database allows for an incremental approach, which consists in integrating this database with the necessary information from time to time without having to prepare a fully *ad hoc* one. Moreover, the changes that originate exclusively from a different representation of phenomena imply costs only for the final production, i.e. the development of the rules of transformation internal to the procedure, but they do not require a real implementation and, above all, the creation of new input information, which is often the most expensive and delicate component of updates.
PUMA is not only a factor of reporting facilitation and cost containment but it has also a — no less significant — intangible value as it contributes significantly to make all those involved in various ways in the activity of regulatory reporting aware that such involvement does not constitute a mere fulfilment (although mandatory and assisted, in case of inadequate compliance, by a specific penalty regime). Rather, it represents an active partnership in a delicate and complex process aimed at putting data users — the authorities, above all, but also the reporting agents themselves, trade associations, analysts, etc. — in the condition that they are properly and adequately informed to carry out the tasks assigned to them.
This contributes to a process that thus becomes more involved and cooperative and creates, from the point of view of reporting agents, a mutual benefit. More specialised or simply larger intermediaries can act as 'specific knowledge carriers' (particularly on more complex and/or innovative transactions) for the benefit of even smaller ones. The latter, for their part, carry out — precisely because of their characteristics — an extremely accurate and effective monitoring of the effects of the documentation even on aspects that — in large numbers — would be objectively more difficult to identify; in many cases, they return valuable feedback to perfect the available documentation, for everyone's benefit.
For the sake of completeness of information, it is also worth highlighting the role in some cases played by PUMA documentation in facilitating access to products or initiatives of great interest in the system, for which being able to rely on processing within the PUMA protocol has allowed all types of intermediaries to be promptly (and happily, as experience has actually shown) in a position to access it. As an example, there are two common knowledge initiatives: 1) the production of information related to participation in the first *Targeted longer-term refinancing operations (TLTRO)* programme, which was obtained in a very short time, with a really minimal impact on the input required of banks; 2) the documentation of synthetic securitisations, a necessary condition for joining recent initiatives approved by the European Commission under the European rules on 'State aid' (such as the

introduction of a new product under the European Guarantee Fund managed by the EIB Group – European Investment Bank, in the form of guarantees on synthetic securitisation segments for the benefit of non-financial corporations affected by the coronavirus outbreak).
What we want to emphasise more generally is that the availability of knowledge on the organization of the information necessary for the treatment of certain cases (which is one of the results offered by the PUMA documentation, freely accessible to all interested parties) is sometimes a critical factor of success for the actual execution of certain operations, with extremely significant effects not only for the intermediary who is able to implement them in this way but for the system as a whole.
Looking ahead, PUMA's extensively demonstrated ability to contribute effectively and flexibly to the evolution of regulatory reporting allows the Bank of Italy and institutions' representatives to be confident that they will be able to integrate PUMA with similar ongoing European initiatives (the BIRD) and, irrespective of this, to continue to support the production of new reporting frameworks.

(1) By Marco Carnevali.

4. Other experiences of central bank-industry cooperation

In the European landscape, structured cooperation between industry and authorities similar to PUMA to support the management of statistical reporting has been launched in recent years in Austria and in the ESCB with the *Banks' Integrated Reporting Dictionary* (BIRD). These initiatives, taking inspiration from the Italian experience, have the common objective of making the regulatory reporting process of intermediaries more efficient.

4.1 Austria

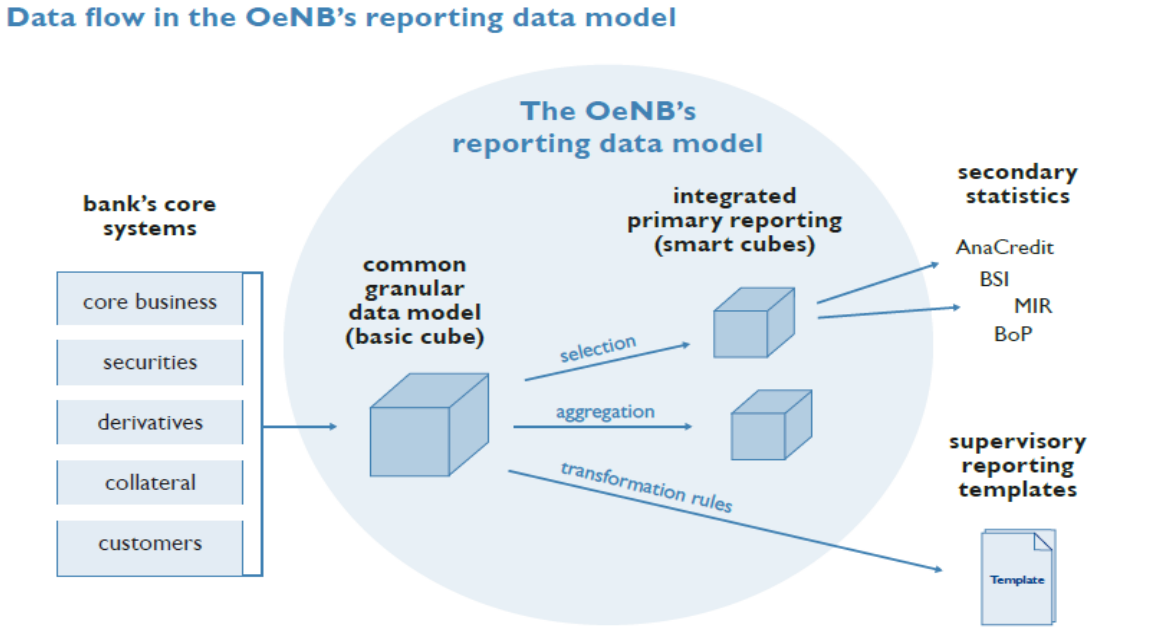
The Austrian central bank (OeNB) started in 2013 a cooperation with supervised entities to harmonize and integrate data. Several banks and companies providing financial services participated in the project. The project aims to simplify regulatory reporting and improve data quality through the reorganization of the reporting system of the Austrian central bank (Kienecker *et al.*, 2018). The intermediaries participating in the initiative send granular data, according to a scheme prepared by the central bank, to a shared platform, where the transformations are carried out, through a single software, for the generation of aggregated flows (according to a data model predefined and prepared by the OeNB), which are then transmitted to the central bank[27].

[27] This solution has been analysed in Luxembourg where members of the *Association des Banques et Banquiers Luxembourg* (ABBL) have launched a feasibility study to quantify costs and benefits arising from the possible creation of a hub that manages, on the basis of a cooperative logic, the reporting required by the reporting regulations for the banking sector. The project aimed to provide regulatory reporting services, with the objective of ensuring transparency of reporting processes, higher data quality and greater flexibility in the reporting system, avoiding data redundancy and reducing costs for reporting entities. Like the Austrian solution, such a system would have made it possible to achieve economies of scale in the reporting of individual participating banks. In fact, the hub would have made it possible to process the raw data on a common platform with shared calculation tools and in line with the information requests provided by the reporting regulations, thus avoiding to implement the same solution in each individual reporting bank. However, after the investigation phase the project has not entered the implementation phase.

Austrian Reporting Services GmbH (AuRep), a statistical reporting service provider that has set up and operates a Common Reporting Platform dedicated to the production of reports, has been set up to implement this initiative.

AuRep supports the banks that use the service in converting the data present in the respective information systems into one based on the so-called 'cubes'. More specifically, for each reporting entity, the data extracted from the corporate databases are provided in a single 'basic cube' from which the information is then extracted to be reorganized into the 'smart cubes', each of which describes the structure of the information to be transmitted to the OeNB. The details of the information model are given in Figure 1.

Figure 1 — OeNB data flow



Source: OeNB.

Note: AnaCredit = analytical credit datasets, BSI = balance sheet items, MIR = monetary financial institution interest rates, BoP = balance of payments.

For each reporting entity, all flows for submission to the Austrian central bank are processed and prepared through software available on the Common Reporting Platform. The existence of a single platform that is used by the different reporting entities in place of individual IT solutions allows for a reduction in the costs of preparing and sending reports at the system level. In addition, the adoption of a single data model (basic cube and smart cube) allows the same knowledge to be shared among the different operators and it promotes, through unique and shared definitions, a higher quality of information regardless of the reporting entities that produces the specific data.

The platform's objective is to formally describe, collect and send the reporting data to the OeNB. The data entering the Common Reporting Platform is described according to a granular entity-relationship model (ER model), which contains the information (with a high level of granularity) necessary to meet the reporting requirements of the OeNB, avoiding redundancy. Cubes and processing rules are jointly defined by the OeNB and Austrian banks.

The data flow described in Figure 1 requires banks to feed basic cubes by extracting information from their information systems; subsequently, the basic cubes are subjected to various transformations, expressed in a pseudo-formal language. The transformations can include enrichment of the basic cubes,

filters and, aggregations that lead in some cases to the final reports in other cases to the creation of the smart cubes or cubes enriched with new information from which the final reports are then extracted.

It is important to note that the OeNB cannot access granular input data, but only reports which are mostly aggregated.

This solution has been adopted by most Austrian banks and financial service providers.

Similar to the PUMA solution, the ultimate benefit of the Austrian solution is the increased ability of the system to meet the information requirements effectively and efficiently, where computation rules and input data are shared by the reporting entities and defined in cooperation with the central bank. This generates greater consistency of the data sent and leads to a higher quality of the data itself. In addition, the system is more flexible, thanks to its large and integrated input database. It's able to respond more quickly to changes in reporting regulations, having more possibilities to cover new information requests compared to the case of non-integrated systems. At the same time, the involvement of the central bank in the analysis of reporting regulations promotes a higher quality of data thanks to a single computation process. Finally, the solution adopted also leads to a reduction in IT costs, as a result of sharing the statistical production platform by the participating banks. The pros and cons of this approach to the PUMA solution will be discussed in Paragraph 4.3.

4.2 Banks' Integrated Reporting Dictionary (BIRD)

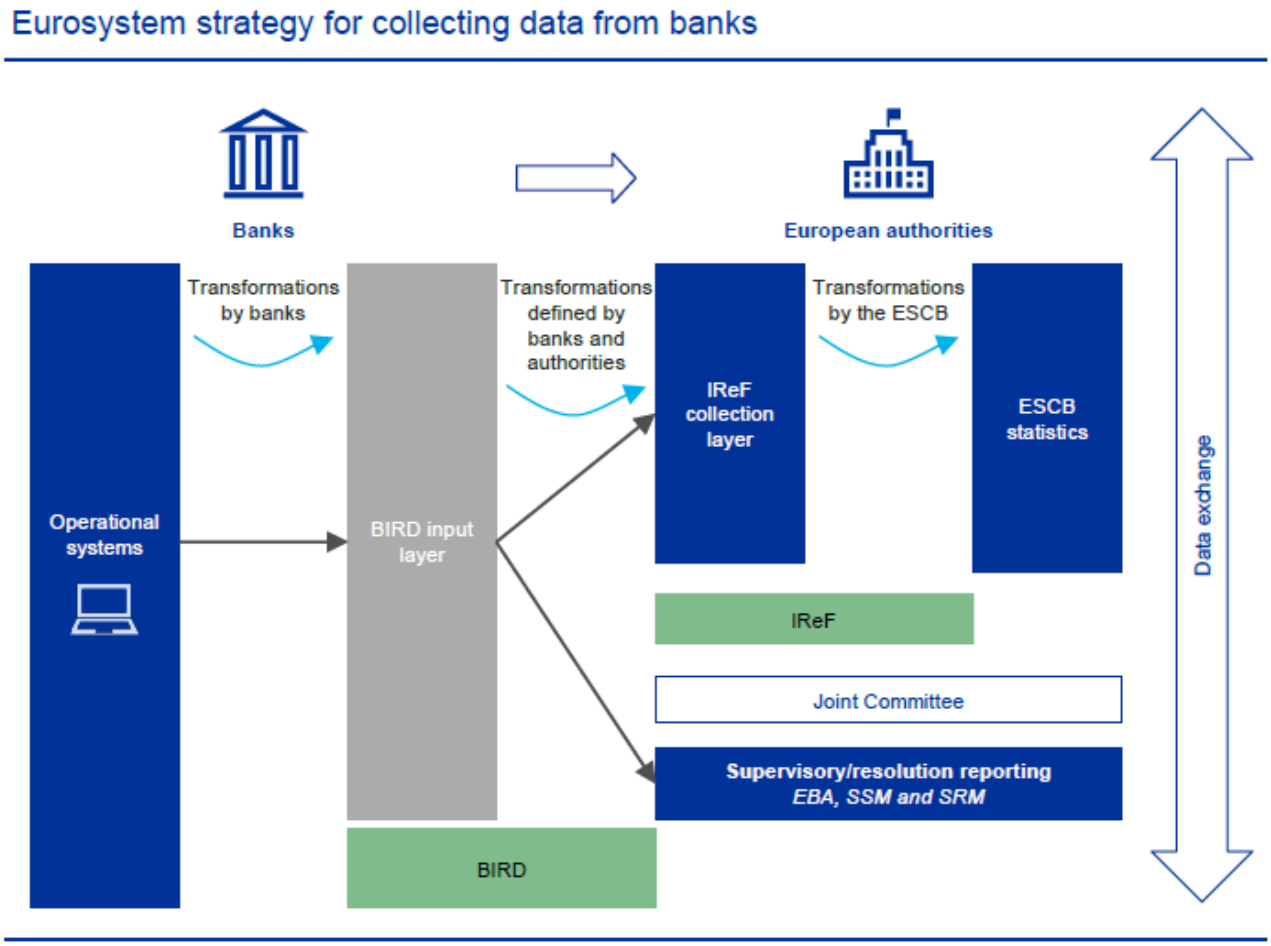
In 2015, the ECB launched the strategic statistical project called *Banks' Integrated Reporting Dictionary* (BIRD)[28], with the dual purpose of increasing the quality of reported data and reducing the reporting burden.

The basic characteristics of the BIRD are directly inspired by those of the Italian PUMA: the project is based on a harmonized data model specifying what should be extracted from banks' internal information systems to generate the reports requested by the authorities. In addition, the transformation rules to be applied to basic information to produce a specific final regulatory report are clearly defined. Industry cooperation is on a voluntary basis: about thirty European commercial banks from nine EU countries and the central banks of Austria, Finland, France, Germany, Italy, the Netherlands and Spain are currently participating in the BIRD[29].

The BIRD consists of the input data, which consist of the basic information necessary to meet the reporting requirements, the output data, i.e. the information flows to be transmitted to the authorities, and the transformation rules, which describe in a formal language the various stages of aggregation and computation that banks must perform to generate output data from input data. Figure 2 represents the BIRD within the more general banking and financial data reporting system.

[28] https://www.ecb.europa.eu/stats/ecb_statistics/co-operation_and_standards/reporting/html/bird_dedicated.en.html
[29] The list of participating commercial banks and central banks can be found at https://www.ecb.europa.eu/stats/ecb_statistics/co-operation_and_standards/reporting/html/bird_Expert_group.en.html.

Figure 2 — The BIRD in the Eurosystem's strategy for collecting data from banks



Notes: EBA stands for European Banking Authority, SSM for Single Supervisory Mechanism and SRM for Single Resolution Mechanism.

The input is divided into the following two components:

The Logical Data Model (LDM) is a highly normalized data model[30], which describes the business domain, i.e. information (metadata) and logical relationships between data that are relevant to meet reporting requirements.

The Input Layer (IL) is a less normalized model than the LDM. It is designed to support the effective physical implementation of BIRD by banks. The IL is derived directly from the LDM through a process known as 'forward engineering'.

The language so far used to describe transformations is the Validation and Transformation Language (VTL) developed by the SDMX community[31]. It is a standard language to define validation and transformation rules (set of operators, their syntax and semantics) for any type of statistical data (SDMX Technical Working Group — VTL Task Force, 2018[32]). The adoption of the VTL guarantees a unique description of the transformations (SDMX, 2021) and the possibility of easily translating this formal language into any of the IT languages used in the banking information systems for the possible

[30] In the context of database management, normalization can be defined as 'the process of organizing data in a database. This process includes creating tables and defining relationships between them on the basis of rules designed to protect data and make the database more flexible by eliminating redundancy and inconsistent dependencies' (https://docs.microsoft.com/it-it/office/troubleshoot/access/database-normalization-description).
[31] The Task Force for the Validation and Transformation Language (VTL) was established in 2013 in the SDMX community.
[32] See in particular the chapter 'General Characteristics of the VTL'.

implementation of the BIRD. In recent years, a successful testing activity has been carried out to verify the syntactic correctness of the BIRD transformation rules defined in VTL[33].

The BIRD, like PUMA, is comparable to a public good, i.e. it aims to provide a service to all banking intermediaries, irrespective of their participation in the cooperation initiative, which, as mentioned above, is exclusively on a voluntary basis; it follows that the BIRD documentation is freely accessible on the ECB's website[34]. The implementation of an IT solution using the BIRD also remains an autonomous choice of the intermediary.

At the end of 2021, the BIRD Steering Group, which *inter alia* defines the project's priorities and work program, refined its key objectives. Shortly the project will focus on the production of the data defined in the Integrated Reporting Framework (IReF), the Eurosystem project aimed at creating an integrated reporting framework for the collection of banking and financial data for statistical purposes across the euro area[35]. In particular, activities will focus on updating the input layer to align it with the needs of the IReF.

The implementation of the IReF project will also help to overcome one of the main factors that has so far hindered the full affirmation of the BIRD with regard to data collection for statistical purposes. The BIRD refers directly to the ECB's statistical regulations; in their implementation, intermediaries are required to transmit data to the central bank of their jurisdiction (primary reporting), which then sends them to the ECB (secondary reporting). Primary reporting, however, is based on requirements set at national level by the respective central bank, which are not harmonized at the European level and therefore do not necessarily coincide with the requirements set out in the BIRD. In essence, for statistical reporting requirements, banks need to adapt the content of the BIRD to national requirements, as the harmonization of primary reporting will only take place with the IReF.

The situation is much simpler for harmonized supervisory reporting (EBA ITS), since in this case primary reporting is the same between jurisdictions (being established by the EBA according to the principle of maximum harmonization described in Paragraph 2.1) and the direct application of the BIRD by intermediaries is straightforward.

4.3 Comparison with PUMA

The two cooperation projects between intermediaries and authorities summarised in the previous sub-paragraphs share some important aspects with the PUMA approach. In particular, on the one hand they are based on the awareness that the reporting is important for the system as a whole (i.e. not as the sum of the isolated needs, roles, powers and responsibilities of the involved parties) and its overall management cannot be reduced to the (mere) configuration of an obligation (which also exists) on reporting entities. On the other hand, cooperation between all those involved parties in their respective roles is important, albeit not sufficient, precondition for ensuring efficiency and effectiveness of the process, even though the responsibilities assigned to each party remain unaffected. The approach

[33] It should be noted, however, that development activities of the BIRD methodology are underway and they include the adoption of a logical / semantic language for transformation rules, in order to support non-IT users and give the business perspective in a still formal but simpler language.

[34] https://www.ecb.europa.eu/stats/ecb_statistics/co-operation_and_standards/reporting/html/bird_content.en.html

[35] The IReF project aims to integrate European statistics into a single standardized reporting framework at the European level. This project together with the BIRD is part of the ESCB's long-term strategy for reporting (https://www.ecb.europa.eu/stats/ecb_statistics/co-operation_and_standards/reporting/html/index.en.html) and aims to standardize, harmonize and integrate ESCB statistics as much as possible when they are collected from banks. For more details, see https://www.ecb.europa.eu/stats/ecb_statistics/co-operation_and_standards/reporting/html/index.en.html#IReF.

described shows the sensitivity of supporting the reporting entities in a reporting eco system where requirements are constantly increasing, as the volume and variety of data that are exchanged between the banking system and the various European regulatory authorities.

Regarding the perimeter of application a significant difference is the following: in the BIRD, as well as in PUMA, the focus is exclusively on the business aspects of data modeling and the rules of validation and transformation thereof; in the Austrian case, a common IT support is also provided.

Under the organizational point of view, the IT solution adopted by Austria, based on the development of a single software, could bring inflexibility in contexts where intermediaries have heterogeneous characteristics. At the operational level there is a risk of unavailability of the common platform, as a consequence there can be a general stop of the reporting activities of all intermediaries. However, these potential problems are not present in PUMA, nor in the BIRD. Both the solutions define the documentation that must then be translated by different operators into many IT solutions, which can be modelled according to the needs of individual intermediaries; against this advantage, it is clear that there may be additional costs resulting from non-standardization of software.

In Italy, the launch of the BIRD was an opportunity to bring up to date the PUMA. In this respect, a first phase of migration of PUMA content to a database has already been completed, right now the PUMA database is very similar to the BIRD database structure. This process allowed two main results: first of all, PUMA got closer to the BIRD model without losing its original content; second, the transition to the new DB has moved the PUMA content towards a modern and efficient technology compared to the one previously used. Under the technological prospective the two solutions are very similar today.

Regarding the content, PUMA largely covers the reporting of Italian banks, while the BIRD, in relation to the relatively recent start, contains few reporting frameworks. An important difference that should be noted relates to the scope of use of the two documents in the industry, which depends on the strategic choices of the intermediaries, as membership in both cases is on a voluntary basis: the BIRD is not yet established in the European banking industry as a key tool to support reporting; by contrast, in Italy the PUMA solution has been widely used for over three decades by banks and financial companies to provide reporting to the Bank of Italy.

Looking ahead, the technological proximity and conceptual affinity between the two solutions will allow a complete link between them. In particular, the highly granular PUMA input data, using transformations defined *ad hoc*, can be connected to the information contained in the BIRD input layer. In this way, on the one hand, the processes of extraction of company data developed for PUMA by Italian banks (the modification of which would entail very significant costs) can be safeguarded and, on the other hand, Italian banks can be allowed to exploit the contents of the BIRD documentation developed at the European level for harmonized reporting. It will essentially involve making a logical connection between the two documents.

For Italian intermediaries, this is an important advantage over banks in other European countries, which is likely to guarantee them a significant reduction in the costs of implementing the new standardized reporting framework IReF when it is integrated into the BIRD.

5. Possible alternative regulatory developments

The experiences described in the previous paragraph are mainly based on the cooperation of industry with the authorities in order to jointly develop solutions to meet the reporting requirements defined by the authorities. To sum up, the key ingredients of this approach are:

- the definition of a highly granular input layer;
- the definition of transformation rules to link this input layer to the different reports requested by the authorities;
- the decisive role of the authorities in promoting and coordinating the cooperation initiative;
- the voluntary adoption of such solutions by reporting entities.

This paragraph focuses on the ongoing consideration, which is still mainly methodological, on new regulatory reporting solutions focusing on (a) greater granularity of information requests from regulatory authorities and (b) giving regulatory authorities the responsibility to carry out the transformations of primary data into the aggregated information necessary for their analyses, thereby overcoming the responsibility currently placed on reporting entities[36]. The discussion essentially regards two types of solutions: the approach known as Regulatory Technology (RegTech) and the data-pull models.

In general terms, both approaches presuppose the indispensable presence of a single data dictionary, which allows data standardization and must be shared and applied by all parties involved in to implement these solutions. In the case of RegTech authorities use the dictionary to regulate in detail input data and their transformations to calculate aggregated information ('instructions as code'). Substantially the authorities describe the transformations as a machine-executable code that reporting entities can perform directly to calculate the required reports from input data. In the case of data-pull models, authorities shall describe in the dictionary the data that reporters must deliver in a staging database, i.e. an information storage area that the authorities will access in order to carry out the necessary processing for their own purposes; in this approach, therefore, the responsibility for processing granular data to obtain regulatory aggregates is left to the authorities. In addition, the concept of predefined reporting frequency is overcome, as an Authority can access available data at any time.

5.1 RegTech Solutions

RegTech consists, for the profiles that are most relevant in this work, in the use by financial companies and, more generally, those operating in regulated sectors, of innovative technologies to support compliance procedures and regulatory implementation processes, with the aim of simultaneously pursuing results in terms of efficiency and cost containment.

As a rule, the reporting instructions provided by the authorities are mainly expressed in a natural language, which therefore requires an interpretation by reporting entities. RegTech aims to facilitate the interpretation of natural language instructions to reduce errors and make data production processes more efficient. In fact, there are technological options to check whether the rules of natural language comply with existing standards for writing regulations. Standardization of drafting would not necessarily make the instructions shorter, but it could make their understanding and use easier. Moreover, the most technologically advanced solutions also provide 'notes' to reporting instructions, which may include specific tags (metadata) that allow for automated extraction of information (Bank of England, 2020).

[36] Similar considerations are contained in *A reporting system for the future* (2022), the recent feasibility study on 'Redesign Options for Regulatory Reporting' carried out by BaFin, also supported by the consultancy firm Accenture, together with the Deutsche Bundesbank, credit institutions, service providers and industry associations.

This general context of application of technology to regulations and reporting obligations could evolve towards a more extreme approach in which rules — as well as in common legislative language — would also be published in the form of a code[37]. The disclosure of a code should lead to a greater level of detail, accuracy and consistency than can be found in the publication in natural language, thereby reducing the interpretative burden and facilitating the implementation of rules in reporting processes internal to reporting intermediaries. In particular, in such a scenario reporting software could incorporate an already written code, without having to carry out the activities normally necessary for a regulation to be translated into digital language. This approach would also benefit those authorities which, if they had to prepare a coded version of the rules, could also engage in a test activity prior to their publication.

From a purely methodological point of view, it is quite intuitive that the objective of writing a code with the characteristics of detail and accuracy described above implies the prior definition of a common and shared input, all the detailed elementary (univocally defined) information required. If this condition is not met, the instructions - even if drafted in the form of a code - would not be directly deployable. In this case an effort would be needed to interpret (which the solution in question aims instead to eliminate or limit) and develop a connection between the input data identified in the published code and the information recorded in the company's information systems.

Although the issue of how to draft regulations following RegTech-type solutions is very topical, even in the European authorities, it is still an area subject to analysis and comparison of ideas and perspectives and there are currently few cases in which these solutions have actually been implemented. An interesting example of development in this direction is the pilot project Digital Regulatory Reporting (DRR) developed in the UK in 2018-19 jointly by the Financial Conduct Authority (FCA) and the Bank of England, in partnership with a limited number of banking intermediaries. The objective of the project to make the regulatory reporting process more accurate, efficient and consistent is pursued through:

a) the definition of a reporting regulation immediately readable by a software (Machine Readable Regulation - MRR);
b) its conversion, by means of a compiler, into code for execution on an external dataset (Machine Executable Regulation - MER);
c) the definition of a common data model to be adopted by reporting agents in order to execute the regulation.

In this way, the production of the reports sent to the authorities is entrusted directly into a software, without any human intervention. It eliminates all the activities that, in the traditional approach, are necessary to implement the reporting requirements in a software able to extract the necessary data and process them to obtain the flow of data to be sent. In summary, the core of the reporting burden containment is the writing of instructions in a language directly readable and executable by a computer (PA Consulting, 2020).

The project, which is still ongoing, has fed into the new FCA strategy (Data Strategy), in which automation and data-driven systems are an essential part of the data approach. The results are promising but there are large areas that need to be deepened and the testing has shown how in any case this is a very complex innovation, which requires significant investments by reporting entities as well as authorities.

[37] Encyclopedia Treccani, definition of 'source code': 'Version of an algorithm written in a high-level programming language (i.e. closer to human language, typically in pseudo English), the instructions of which are then executed by the machine by means of specific programs (compilers, assemblers or interpreters). The use of a source code shall be aimed at performing, on all input data, actions defined in the chosen programming language by means of a limited number of instructions'.

5.2 Data-pull models

Other initiatives go in the direction of allowing authorities to move from regulatory reporting to data sharing. In the latter framework, the authorities would extract the information they need directly from the databases of financial institutions (data-pull); this approach would therefore replace the periodic transmission of information by reporting entities (data-push approach). The implementation of the data-pull approach would help the authorities in the on-demand monitoring of the conditions of individual financial institutions and it would allow them to act quickly if the situation requires it, to the benefit of the pursuit of financial stability (Crisanto *et al.*, 2020).

These solutions go beyond data standardization and the improvement of reporting instructions. In fact, they need to intervene even invasively on the overall architecture of the reporting system and on the responsibilities of the individual actors in its governance. For example, reporting entities could make their data available, with a common and predefined input level, through an application programming interface (API) to which competent authorities would directly connect. The API could limit access to potentially extractable data only to data to which they have a right of access and it could also set constraints on requests, such as the amount of data and the minimum level of aggregation.

This approach allows for greater flexibility for authorities, which can easily adapt their decision-making processes and methodologies by having a granular database available, while the different information needs can be met by a different processing of the same databases available in the information storage area.

A concrete application of this model in the field of reporting is that of the National Bank of Rwanda (NBR), where an electronic data warehouse (EDW) system was set up in 2020 to automate reporting processes in order to provide data to supervisory authorities (National Bank of Rwanda, 2017). Starting from a situation in which there was no statistical reporting to the authorities, a complete standardization of data and the implementation of a very innovative system could be carried out without having to bear any costs related to a paradigm shift. The EDW allows the NBR to extract data automatically from participating intermediaries' IT systems. This approach reduces the need for data compilers in these institutions to draw up and send reports manually, as well as the errors and inconsistencies often associated with this process. To this end, a data dictionary was developed and each financial institution was asked to write scripts that could map the data of their IT systems to this dictionary. This information is then stored in a 'parking area' where the NBR can extract the data it needs. This approach has also led to an improvement in the internal use of this information by intermediaries, for example in the field of risk management.

5.3 Comments on alternative approaches to reporting

The main feature of RegTech and data-pull solutions is that in both cases the authorities are responsible for describing the input data layer, which, in an integrated reporting system for statistical, supervisory and resolution data, tends to assume an extremely high level of granularity of information.

The issue of the possible assumption by authorities of the responsibility for direct production of regulatory aggregates from granular data was also discussed during the work that led to the publication of the *EBA report on a feasibility study of an integrated reporting system under article 430c CRR*. The discussion starts from the consideration that statistical, prudential and resolution reporting requirements are defined at a relatively aggregate level and in several cases they have overlaps between similar concepts, which

obliges reporters to repeat substantially similar processing several times. This inefficiency could be avoided if the authorities directly had the primary (granular) data in order to carry out the necessary processing for their own purposes.

The feedback collected in the context of the public consultation on the EBA Report revealed many concerns about the possibility of requiring a single highly granular dataset from reporting entities, in particular for the preparation of resolution and prudential information. For the purposes of the analysis carried out in this work, these considerations are relevant as they can be extended to the granularity of RegTech-type solutions and to those of data-pull.

Firstly, one aspect to be taken into account when considering greater granularity relates to the underlying legal framework, which defines the limits of granular data collection and the definition and application of processing rules. Although the current framework may, in principle, be subject to change by the legislator, important issues need to be explored, in particular with regard to responsibility for the data produced. Reporting entities must remain responsible for all corporate data (granular and aggregated), in particular in the prudential and resolution frameworks, as it is on them that decisions to intervene by the authorities and institutions themselves are based. This means that institutions must be responsible not only for all granular data produced, but also for the aggregates that are calculated from them. This could limit the possible efficiency gains for institutions resulting from a more granular solution.

Secondly, requiring greater granularity at the consolidated level (banking group), for the component of intermediaries resident in non-EU countries, may not be feasible, in particular as a result of legal constraints relating to the exchange of granular data with EU competent authorities.

In addition, there is a whole area of aggregated information for which the subjective judgement of experts is required and therefore their derivation from high granularity data is not automatic. For example, the following two aspects are mentioned:

- granular reporting is considered more feasible at the level of individual intermediaries, less at consolidated level as it requires expert judgement in the application of accounting and prudential standards; therefore, the data consolidation process is not likely to be delegated to third parties;
- the existence of internal models and rules based on principles allow institutions to follow different approaches, making it impossible to define a standard transformation rule for the calculation of data.

Finally, reporting entities need to develop appropriate tools and processes for aggregating risk data and reporting risks that are assessed as part of their internal governance under the SREP (e.g. compliance with BCBS 239; Basel Committee on Banking Supervision, 2013a).

6. Conclusions

Over the past two decades, Italian banks and other financial intermediaries have had to meet the authorities' regulatory reporting requirements in an increasingly complex and challenging context, also in light of the much more intense pace of regulatory innovations which is at the root of the constantly growing volume and variety of data required from intermediaries. The fact that reporting obligations can be imposed not only by the Bank of Italy but also by international authorities is an additional element of complexity.

The current landscape of reports collected from EU banking and financial intermediaries consists of several non-integrated domains (statistical, prudential supervision, and resolution) for which different authorities are responsible. This leads to potential inefficiencies in the information collection process and to a risk of data duplication. In this respect, discussions and initiatives have been underway for a number of years to establish an integrated reporting system aimed at simplifying the whole statistical data production and management process for reporting intermediaries and authorities. The core principle should be *define data once and report once*, as requested by the European Banking Federation (2018); such a system would also facilitate the sharing of information among authorities through shared governance. In compliance with Article 430c of the CRR, the EBA conducted a feasibility study of the system, which was published on 16 December 2021 (European Banking Authority, 2021b).

Alongside the harmonization of reporting regulations at the European level, national information requirements complicate the system further, with additional costs for reporting entities.

Finally, the numerous shocks recorded in recent years have undoubtedly contributed to the frequent reporting innovations, as a result of which national and international authorities have identified information gaps, from time to time, and planned new initiatives to acquire an even more comprehensive set of data to monitor the stability of the financial system and prevent future crises or limit their effects.

These factors make the reporting framework increasingly articulated and complex, making it more and more difficult for reporting entities to respond to these challenges within the required timeframe. In Italy, the Bank of Italy launched a strategy aimed at making reporting processes more effective and efficient. This strategy, based on a structured and voluntary collaboration with reporting entities, has been producing tangible results for over thirty years. In particular, as shown through this paper, the value of this collaboration is two-fold: *ex ante*, it makes it possible to carefully scrutinize new proposals for reporting regulations in order to identify options that favour the production of high-quality data while containing their costs; *ex post*, through the preparation of the PUMA documentation, it describes the calculation logic from banks' input data to the outputs requested by the authorities, combining participants' regulatory knowledge and operational experience with regulators' fundamental contribution to clearing any interpretation doubts. The longevity of the PUMA cooperation project demonstrates its contribution towards improving the quality of reporting and supporting banks and other financial intermediaries in the production of statistical information. Furthermore, the spirit of cooperation and frequent interactions with the regulator have enabled the Bank of Italy to become more aware of the costs borne and challenges faced by reporting entities.

Italy's PUMA project has been an example for other authorities in Europe: first, Austria and, a few years later, the ECB started a similar cooperation programme with their respective banking systems. Austria, although with some organizational differences, replicated the Italian experience on a national scale; as a result of the progressive harmonization of reporting at the European level, the ECB launched the BIRD cooperation initiative, involving a significant number of European NCBs and commercial banks. These experiences are based on the assumption that, with few exceptions, primary reporting remains aggregated (both in the statistical field, e.g. AnaCredit and SHSG, and in the supervisory field, e.g. large exposures) and that the calculation processes and related responsibilities for the preparation of information flows to be transmitted to the authorities remain a prerogative of reporting entities.

However, there is an ongoing debate at the European level on the value of granular data for the authorities and the possibility of transferring onto them the processing complexity for the production of aggregated indicators. Against this background, the debate has focused in particular on two approaches to regulatory reporting: the first one, known as 'RegTech', is based on the production of digital regulation that guides aggregated data processing from a highly granular standardized input scheme; with the second

approach, called 'data-pull model', information is extracted directly by the authorities from a highly granular input scheme made available by the intermediaries and processed according to their specific needs.

Among all the cooperation solutions available, we believe PUMA and BIRD are preferable to those based on mandatory and highly granular input schemes, such as RegTech and data-pull, for a number of reasons.

First of all, the authorities do not replace reporting agents in the processing of granular information. Besides computational burden and complexity (an example of which is the huge problem of banking group data consolidation, which is especially critical for the collection of data from non-European legal entities), the most important aspect is that reporting entities must remain aware of and accountable for the figures produced, as these are not only a statistical reporting obligation vis-à-vis the authorities, but must also be used to guide strategic corporate choices.

A second aspect to be taken into account when considering greater granularity of reporting obligations is the underlying legal framework, which defines the limits of granular data collection and the identification and enforcement of transformation rules to obtain the prudential and resolution aggregates that the authorities need.

Even in light of the BIRD cooperation initiative, we believe that in Italy PUMA will continue to be an essential point of reference for data producers, though some action will be necessary to ensure full integration between the two solutions. However, successful integration will depend on the degree of maturity achieved by the BIRD project, which is currently far from consolidated, and on its ability to become a benchmark for reporting entities, in the same way that PUMA has been for years.

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