Extending ‘environment-risk weighted assets’: EU taxonomy and banking supervision

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ABSTRACT
Changing the economy to meet the goals posed by the Paris Agreement implies a financial system aligned to this end. This debate also involves a reconsideration of aims and tools of banking regulation although, for now, the discussion is still not very operational. In a previous work we introduced the ‘environment-risk weighted assets’ to internalize the pollution risk of the borrower that here we expand empirically to calculate the ‘external costs footprint’ of Italian corporate lending and to cover virtually every part of banks’ business. Moreover, we analyse whether our proposal is aligned to the European Union taxonomy on environmentally sustainable activities. We show that our framework can help to put on a working track the discussion on banking regulation for sustainable finance.

1. Introduction: social climate on climate change is changing

The biennium 2018–2019 marked a significant change in the mass perception on the need to tackle climate change. The world is becoming aware of how quickly and radically the economy must change to meet the goals posed by the Paris Agreement. It is also increasingly clear that financial system must be engaged in full to help the transition to the green economy. The relationship between banks and climate change is manifold. For instance, climate change has the potential to weight on banks and State revenues increasing the frequency of banking crises (Lamperti 2019), and there are hints that banks loans granted to firms depends negatively on their climate risk exposure (Faiella and Filippo 2019). More generally, what emerges is a strong connection between climate change and financial stability (Batten, Sowerbutts, and Tanaka 2016; Battiston 2017). The debate also involves the search for innovative financial regulation ideas, also because the ordinary economic policy tools (like Pigovian taxes) have many limits and a direct public intervention is limited by the precarious situation of public finances for the banking system bail-out after 2008.

Europe is at the forefront of the fight against climate change, having put sustainability at the core of its development strategy. Tools like the Capital Markets Union Action Plan, the EU 2050 long-term climate strategy (‘A clean planet for all’, EC 2018a) and the
Commission Action Plan on financing sustainable growth (EC 2018b) are examples of the efforts put up by European institutions.

Although multiplied in recent years, public proposals on the transition remain at an initial stage and the discussion remains at a very general level (EU 2018c). This is also true for changes in banking regulation that, for now, have been proposed in issues like transparency and governance but not on the ways to stimulate banks to reallocate their funding towards the green economy. The need for practical tools is felt. For instance, in a 2019 report of the Network for Greening the Financial System the first recommendation is: ‘Integrating climate-related risks into financial stability monitoring and micro-supervision’. From their parts, large financial conglomerates often tend to use green finance as a marketing device without real efforts to change their business model (so called ‘green-washing’; see for instance Warmerdam 2015). This also because they still do not have regulatory incentives for the change. For sure, the banks financing of brown sectors is huge: the European Banking Authority posed the EU banks total exposures towards these sectors at € 2,049 billion against CET1, the highest quality component of the banks’ own funds, of € 1,650 billion (EBA 2018). Moreover, the energy-related investments needed are also impressive, having been calculated at $830 billion annually for the period 2016–2050 (NGSF 2019).

All in all, political and institutional awareness is there, but practical proposals that can tackle climate change in the field of banking regulation are not. This is the goal of our work.

2. The ‘ERWA’

To push the discussion towards practical proposals, in Esposito, Mastromatteo, and Molocchi (2019, from now on, EMM) we recently suggested using a tool called ‘environment-risk weighted assets’ (ERWA) that can internalize the pollution risk of a borrower into the cost of capital of his/her lender. This is obtained using a correction for the environmental risk in the ordinary prudential weighting of the financial assets:

$$e_i = c_i r_i a_i$$

where $a$ is the book value of the asset; $r$ is the weight assigned to the asset according to the present framework for banking regulation; $c$ is the sectoral pollution coefficient representing the environmental impact (the negative externality) associated to the asset.

For enforceability reason, we suggested to put $c_i$ value between 0.5 and 1.5, with 1 being the sectoral average, taken as the threshold between brown and green activities, and where the minimum weight is only assigned to economic activities able to produce zero or positive environmental externalities, and so to reduce external costs. To take the example we made in EMM, a € 100 loan weighted 100% in the RWA framework to a firm that has a pollution coefficient of 0.9 means, for its bank, an ERWA of € 90.

We pointed out that, to be effective, the tool should be applied to the single credit line, but lacking these data, for now we suggested a sectoral ERWA, based on the statistical classification of economic activities in Europe (‘NACE system’). We suggested three ways to build ERWA at sectoral level (direct CO$_2$ emissions; direct external costs of all main air emissions types; direct and indirect emissions or external costs obtained with Input-Output Analysis, IOA), concluding that the most complete approach is combining
external costs with IOA, in order to consider both direct and indirect health and environmental impacts along the whole sectoral productive process to measure the supply-chain’s environmental efficiency.¹

We have made also a first tentative application of the ERWA proposal to Italy using the second and the third approach with the available environmental data, finding results that are compatible with a gradual shift of the banking system to the green economy (unfortunately, no data were available for external costs embodied in final demand).

This paper aims at expanding the ERWA concept in three main directions. The first is to complete their empirical application by adopting external cost calculation to estimate both direct and embodied (direct and indirect) external costs of air emissions of NACE sectors, in order to make a calculation of the ’external costs footprint’ of Italian corporate lending and to give a comparison of the pros and cons of the two methods. The second is to complete and refine our policy proposal, taking into account the policy developments in sustainable finance related to the EU taxonomy, and thirdly, to widen the proposal from corporate lending to cover virtually every part of banks’ activity so that its application could be the most business model-neutral possible.

3. Comparison of two different approaches to ERWA based on external cost approach and input-output analysis

This section is devoted to an empirical application of the external costs method, to calculate ERWA for Italy, to make a comparison between two alternative approaches: direct external costs related to the sectors’ activities (’DECSA’) and external costs embodied in the sectors of final demand (’ECFiD’). The first approach is a measure of the emissions directly connected to the underlying economic activities, while the second refers to emissions produced along the production chain: it represents the health and environmental costs ’embedded’ in a certain product when it is purchased by the final consumer.

For both approaches, we take data from Molocchi 2019, that estimated the air emissions external costs related to NACE sectors by applying NAMEA air emissions account calculated by ISTAT in 2018,² and the Italian official guidelines for the evaluation of external costs related to green-house gases and air emissions (MIT 2017); the work then estimated the external costs embodied in sectors of final demand by using IOA and OECD input-output tables for Italy.³

Table 1 shows the list of NACE sectors covered by the analysis⁴ (first column), the external costs data used for the two approaches⁵ (second and third column), the results for the two types of ERWA (fourth and fifth) and the sectoral loans at the end of 2015 (last column) that allows the calculation of the ‘external costs footprint of lending’ measured as the average of sectoral external costs weighted by the sectoral share of loans.

These data show many interesting points. In particular:

(a) Most economic sectors are light green (i.e. external costs are lower than the economy-wide average): 24 with DECSA ERWA and 19 with ECFiD ERWA on a total of 33 sectors (we put in yellow the sectors that are brown in the ECFiD measurement but light green in the DECSA one). Light green sectors represent almost 80% of total corporate loans with the DECSA measurement and 55% with the ECFiD one.
Table 1. DECSA and ECFiD ERWA, Italy 2015.

| NACE sectors                                          | Direct external costs related to 1 euro of sector’s value added | Demand embodied external costs related to total production activated by 1 euro of sector’s final demand | DECSA ERWA | ECFID ERWA | Loans | DECSA nature | ECFID nature |
|-------------------------------------------------------|----------------------------------------------------------------|-------------------------------------------------------------------------------------------------|------------|------------|-------|--------------|--------------|
|                                                       | €/€, 2015                                                        | 2015                                                                                             | 2015       | Million, 31/12/2015 |       |              |              |
| D01T03: Agriculture, forestry and fishing             | 0,320                                                           | 0,217                                                                                            | 1,142      | 1,179      | 44.347,52 | Brown        | Brown        |
| D579: Mining and quarrying                            | 0,118                                                           | 0,079                                                                                            | 1,042      | 1,041      | 3.177,91  | Brown        | Brown        |
| D10T12: Food products, beverages and tobacco (*)      | 0,035                                                           | 0,077                                                                                            | 0,990      | 1,039      | 31.355,50 | Brown        | Brown        |
| D13T15: Textiles, wearing apparel, leather            | 0,014                                                           | 0,032                                                                                            | 0,697      | 0,916      | 22.156,64 | Green        | Green        |
| D15: Wood and products of wood and cork               | 0,033                                                           | 0,053                                                                                            | 0,973      | 1,015      | *        | 3        | *            |
| D17T18: Paper products and printing                   | 0,071                                                           | 0,062                                                                                            | 1,018      | 1,024      | 9.703,68  | Brown        | Brown        |
| D19: Coke and refined petroleum products               | 0,971                                                           | 0,123                                                                                            | 1,468      | 1,085      | 5.630,30  | Brown        | Brown        |
| D20T21: Chemicals and pharmaceutical products         | 0,173                                                           | 0,066                                                                                            | 1,069      | 1,028      | 10.374,19 | Brown        | Brown        |
| D22: Rubber and plastic products (*)                  | 0,014                                                           | 0,041                                                                                            | 0,700      | 1,004      | 11.116,88 | Green        | Brown        |
| D23: Other non-metallic mineral products              | 0,457                                                           | 0,205                                                                                            | 1,211      | 1,167      | 12.255,60 | Brown        | Brown        |
| D24: Basic metals                                     | 0,280                                                           | 0,107                                                                                            | 1,122      | 1,069      | 14.728,49 | Brown        | Brown        |
| D25: Fabricated metal products (*)                    | 0,007                                                           | 0,040                                                                                            | 0,603      | 1,002      | 27.793,66 | Green        | Brown        |
| D26: Computer, electronic and optical products        | 0,008                                                           | 0,027                                                                                            | 0,610      | 0,855      | 4.925,46  | Green        | Green        |
| D27: Electrical equipment                             | 0,008                                                           | 0,037                                                                                            | 0,610      | 0,991      | 7.360,55  | Green        | Green        |
| D28: Machinery and equipment, nec                     | 0,006                                                           | 0,035                                                                                            | 0,582      | 0,957      | 22.341,53 | Green        | Green        |
| D29: Motor vehicles, trailers and semi-trailers       | 0,008                                                           | 0,029                                                                                            | 0,610      | 0,888      | 9.097,63  | Green        | Green        |
| D30: Other transport equipment                        | 0,006                                                           | 0,030                                                                                            | 0,582      | 0,894      | **        | 2        | *            |
| D31T33: Other manufacturing                           | 0,013                                                           | 0,033                                                                                            | 0,679      | 0,933      | 22.613,86 | Green        | Brown        |
| D35T39: Electricity, gas, water supply, sewerage, waste | 0,424                                                          | 0,160                                                                                            | 1,194      | 1,122      | 37.651,71 | Brown        | Brown        |
| D41T43: Construction (*)                              | 0,015                                                           | 0,040                                                                                            | 0,717      | 1,004      | 147.338,37 | Green        | Brown        |
| D45T47: Wholesale and retail trade; repair of vehicles | 0,008                                                           | 0,022                                                                                            | 0,615      | 0,793      | 143.199,42 | Green        | Brown        |
| D49T53: Transportation and storage                    | 0,128                                                           | 0,081                                                                                            | 1,046      | 1,044      | 40.620,32 | Brown        | Brown        |
| D5756: Accomodation and food services                 | 0,004                                                           | 0,030                                                                                            | 0,561      | 0,890      | 36.773,20 | Green        | Green        |
| D58T60: Publishing, audiovisual and broadcasting       | 0,001                                                           | 0,021                                                                                            | 0,509      | 0,774      | ***       | 3        | 3            |
| D61: Telecommunications                               | 0,000                                                           | 0,013                                                                                            | 0,502      | 0,674      | 3.768,99  | Green        | Green        |
| D62T63: IT and other information services             | 0,001                                                           | 0,011                                                                                            | 0,511      | 0,647      | 13.026,21 | Green        | Green        |

(Continued)
Table 1. Continued.

| NACE sectors | Direct external costs related to 1 euro of sector’s value added | Demand embodied external costs related to total production activated by 1 euro of sector’s final demand | DECSA ERWA | ECFID | Loans | DECSA nature | ECFID nature |
|---------------|---------------------------------------------------------------|------------------------------------------------------------------------------------------------|------------|-------|-------|---------------|--------------|
| D64T66: Financial and insurance activities                   | 0.001                                                         | 0.008                                                                                       | 0.510     | 0.604 | 9.211|84            | Green        | Green        |
| D68: Real estate activities                                  | 0.000                                                         | 0.005                                                                                       | 0.503     | 0.560 | 114.629|78               | Green        | Green        |
| D69T82: Other business sector services                       | 0.003                                                         | 0.015                                                                                       | 0.536     | 0.700 | 57.118|96               | Green        | Green        |
| D84: Public admin. and defence; comp. social security        | 0.003                                                         | 0.011                                                                                       | 0.545     | 0.645 | ***** |****          | Green        | Green        |
| D85: Education                                              | 0.000                                                         | 0.007                                                                                       | 0.503     | 0.589 | 23.134|71               | Green        | Green        |
| D86T88: Human health and social work                        | 0.002                                                         | 0.015                                                                                       | 0.530     | 0.700 | ***** |****          | Green        | Green        |
| D90T96: Arts, entertainment, recreation and other            | 0.003                                                         | 0.019                                                                                       | 0.544     | 0.757 |       |               |              |              |
| **Total loans**                                             | **0.035**                                                     | **0.038**                                                                                    | **1,000** | **1,000** | **885.452,89** |              |              |

* Loan data on D16 is included in D31T33 ‘other manufacturing’, ** loan data on D30 ‘other transport equipment’ is included in D29 ‘motor vehicles’, *** loan data on D57T60 ‘Publishing …’ is included in D62T63 ‘Telecommunications …’, **** loan data on D84 ‘Public administration …’ is excluded from data, ***** loan data refers to all sectors D85T96. (*) sectors green with DECSA and brown ECFID.

Source: Bank of Italy for loans, Molocchi (2019) for external costs estimates.
(b) For both ERWA approaches, lending tends to be allocated to sectors with higher external costs than the average (in fact the average external costs are € 67/1,000 for lending compared to € 35/1,000 for economic activities with the direct external cost approach; they are € 50/1,000 for lending compared to € 38/1,000 for economic activities with the embodied external cost approach). In the second approach this difference shrinks, because the IOA allows to take into account the external costs related to the sector’s supply chain, therefore external costs of non-primary industrial sectors and of tertiary sectors are higher with the IOA.

(c) Finally, even if with ECfiD ERWA more sectors appear to be brown due to the supply chain contribution to each sector’s external costs (13 sectors against 9 in the DECSA approach), their ERWA values are in most cases slightly higher than 1, and for only three sectors with values beyond 10% (18% agriculture, 17% mineral products, 12% electricity production). In the DECSA approach, that is focused on the direct emissions of each sector, some sectors show much higher discouraging factors (oil refining 1.468, mineral products 1.211, electricity production 1.194).

All in all, the high proportion of corporate loans provided to light green sectors in the DECSA approach and the overall low ERWA values of the brown sectors in the ECfiD approach (with the exception of three sectors) confirm what we concluded in EMM: the application of ERWA would not be disruptive for banking and for the economic system.

4. The EU taxonomy approach for environmental sustainability

The implementation of the EC Action Plan ‘Financing Sustainable Growth’ (EC 2018b) will deeply innovate European policies for sustainable finance, starting from financial products such as bonds and mutual funds, but affecting credit activity as well. In summary, there are three parallel European regulatory streams aimed at building up policy proposals concerning environment-related financial risk reduction tools:

(a) the Taxonomy stream, mainly represented by the Commission legislative proposal for a Regulation to establish a framework to facilitate sustainable investment (EC 2018c) and the two Technical Expert Group (TEG) reports on taxonomy published on June 2019 (TEG 2019a; TEG 2019b).

(b) the Non-financial information stream, related to Directive 2014/95/EU, particularly the new Supplement on climate related information of Guidelines on non-financial reporting published in the Official Journal of the European Union of 20th June 2019 (EC 2019).

(c) the Financial Product disclosure stream, represented by the EU Regulation on Disclosure relating to Sustainability Risks and Sustainable Investments, that has been approved by the Trilogue in May 2019.

This section will describe the essential features of these regulatory developments to analyse their main implications for lending and financing in general.

The taxonomy regulation proposal (EC 2018c) states that an economic activity is environmentally sustainable if it complies with a number of criteria based on environmental
objectives and connected to technical screening criteria established by the Commission. For now, the experts’ reports on taxonomy (TEG 2019a, 2019b) covered activities that make a substantial contribution to climate change mitigation and adaptation. Since the taxonomy applies to economic activities, TEG adopted the NACE classification that is also used for credit reporting. TEG report on taxonomy distinguishes among activities on the basis of their ‘substantial contribution’ to climate change mitigation.9

The new Commission guidelines on disclosure of climate related information (EC 2019) introduced some provisions specifically related to the taxonomy, creating a link with the reporting duties of large listed companies,10 with the aim of improving reporting on activities that provide a substantial contribution to climate mitigation. Specific key performance indicators have been proposed for activities such as asset management and lending.

The regulation proposal for environmental taxonomy was intended to be aligned with the requirements of the ‘Proposal for a regulation on disclosure relating to sustainability risks and sustainable investments’ of 24th May 2018,11 that has been approved by the Triilogue in May 2019. Under this regulation, financial market participants offering a ‘green’ financial product must disclose the objectives and the methodologies used to assess measure and monitor progress against the sustainability objectives, as well as the results of the sustainability impact of the product. Investors offering products associated with the environmental taxonomy must disclose how and to what extent the product is aligned with the taxonomy.12

Even if the taxonomy has been conceived to be applied to green financial products (‘green bonds’), it can be also applied to credit activity, especially for corporate banking (Table 2).

Other comments on the taxonomy and other related regulatory streams can be summarized as follows:

(a) Even if the environmental taxonomy has been developed by TEG starting from economic activities (‘mitigation activities’ normally related to energy standards in the use phase of a product, ‘enabling activities’ related to energy efficient or low carbon products) the taxonomy allows the classification of green products as well, such as low carbon cars or high efficient heating systems, expanding its original scope.

(b) Both the TEG (2019b) and the EC guidelines on climate related information recommend an environmental life cycle approach or, at least, an approach that considers

### Table 2. Uses and users of the taxonomy.

| Users                        | Compliance with disclosure obligations                                                                 | Optional additional uses                    |
|------------------------------|--------------------------------------------------------------------------------------------------------|---------------------------------------------|
| Asset management             | UCITS, Alternative Investment Funds, Individual Wealth Management                                      | - Insurance                                  |
| Insurance                    | Insurance-based investment products (IBIP)                                                            | - Securitisation                             |
| Corporate & investment       | • Securitisation funds, ABS                                                                         | - Venture capital and private equity         |
| banking                      | • Venture capital and private equity funds                                                             | - Individual Wealth Management               |
|                              | • Individual Wealth Management                                                                     | - Project finance and corporate financing    |
| Retail banking               | • Indices funds                                                                                     | - Mortgages                                 |
|                              |                                                                                                       | - Commercial building loans                  |
|                              |                                                                                                       | - Car loans                                  |
|                              |                                                                                                       | - Home equity loans                          |

Source: TEG (2019b), page 9.
the whole supply chain, including upstream and downstream activities that are not
directly under the company control. This means a preference for the ECFiD
ERWA that include the external costs related to emissions of intermediate sectors.
(c) The EU taxonomy has been designed to identify green activities only. However, to
reach full consistency with target 2.1.c of the Paris Agreement (‘to make finance flows
consistent with a pathway towards low greenhouse gas emissions and climate-resilient
development’), it needs to be complemented with other approaches, in order to
involve also non-green activities and products towards the transition.

5. How to extend ERWA in the context of the EU taxonomy: the product
ERWA

As we said, to make ERWA a business model-neutral tool, they should be applicable to
every part of banks’ balance sheet. This means, basically, loans and securities. We describe
these assets using Italy as an example. As for loans, we can sum up their destination in the
following Table 3.

Let’s discuss the options for the different recipients (Figure 1 summarizes the various
cases). In EMM we excluded loans to government from the ERWA. We will see how to
include them in some cases later on. As for the other recipients (firms and households)
that make the vast majority of loans, we first describe the main types of loans and then
we propose how to treat them into the ERWA framework.

In the case of households, we can divide loans into three categories. The main part is
constituted by house mortgages (almost €345 billion). The second component is made
by loans for cars, durable goods, etc. (so called finalized loans) whose main part is
given by car loans (about €18 billion). The last part is made by generic consumer
lending (personal loans, loans secured by pledge of salary, credit cards, etc.) that
amounts to around €90 billion. The first two categories can derive their weighting from
the environmental indicator or energy consumption class of the product they are
funding (for instance, the energy consumption class related to a building, or the CO2/
km emissions of a car). Therefore, to include these lending categories, we propose to
use product ERWA consistent with the technical screening criteria of the EU taxonomy.
As for ordinary consumer lending, that is not linked to any particular good or service
neither entails financial risks specifically connected to environmental issues, we think
that it is premature to include it in ERWA application, until specific consumer lending
products will make it possible to establish such a link. The ERWA logic will incentivize
market operators in this direction.

In the case of corporate lending, we can also distinguish between general corporate
loans and loans that have a specific destination (for instance, leasing). The data con
firm that the latter is the bulk of the total (Table 4).

While some types of credit, such as current accounts, cannot be easily linked to a
specific activity of the firm, other types are more connected to a product or a project.
In the first case, when the bank is giving a general corporate loan, we suggest to apply
the sectoral ECFiD ERWA related to the sector of activity of the recipient firm, unless
the latter can demonstrate that its activities are compliant with the EU taxonomy. For
example, if the borrowing firm can demonstrate that 30% of its output is related to activi-
ties that are aligned with the taxonomy, we suggest to apply the minimum ERWA value
proportionally i.e. 0.5 for the 30% of the lending, and the sectoral ERWA, let’s say 0.9, for the remaining 70% of its activities, so to produce a mixed ERWA (0.78 in the example) related to both (taxonomy) compliant and non-compliant activities; in this way all the activities of a certain firm would be covered.

For loans with a specific destination, we suggest to use product ERWA consistent with the technical screening criteria of EU taxonomy. In particular, we suggest to apply the minimum ERWA value of 0.5 for loans aimed at investing in a product that is compliant with the technical screening threshold of the taxonomy, and ERWA values in the range between 0.5 and 1.5 (depending from the energy efficiency class or the value of the emission intensity indicator of the product) if the product does not satisfy the threshold of the taxonomy. Section 5 will provide examples of this approach.

From the point of view of technology adoption, literature suggest that a more specific policy tool (i.e. the product ERWA) is more useful when new technologies are available and ready to substitute less efficient technologies; if the choice is left to the market it will tend to stick to the older and more known technology (Polzin 2019). Therefore, broadly speaking, we can conclude that product ERWA can be a more precise and stronger incentive to the transition than sectoral ERWA and, when it is possible, it is better to use the former.

**Table 3.** Composition of lending by counterparty, Italy, 2018.

| Counterparty                                    | Amount   | Percentage |
|------------------------------------------------|----------|------------|
| General government                             | 264,382  | 14.8%      |
| Financial companies (excluding Monetary Financial Institutions) | 220,537  | 12.4%      |
| Non-financial companies and producer households | 758,915  | 42.6%      |
| Consumer households                            | 537,704  | 30.2%      |

Source: Bank of Italy 2019a, 11 and following. Data in millions of Euro.
An example of how the two types of ERWA can be applied is the following. If a construction firm approaches a bank for a loan, when assessing the connected capital absorption, the bank has two options: (a) weighting the loan for the environmental risk of the company sector using the construction sector ERWA or, (b) if the loan is related to something green, like a renovation project of an existing building, weighting the loan using the product ERWA related to the targeted energy efficiency class of the project. Of course, the latter option can be given to the bank only if it can prove that the project does comply with the relevant taxonomy technical screening criteria.

As for bonds, in the following table we synthetize their weight on the Italian banks’ balance sheet (Table 5).

Data shows that corporate bonds are a minor part of Italian banks’ assets (as for most EU countries: EBA 2018). Anyway, ERWA can and should be used for these assets too. Apart from their allocation into the different regulatory portfolios (under the prevailing accounting and prudential standards), we can classify securities considering whether they are used to finance either the general activity or a specific project of a firm. In the first case, sectoral ERWA can be applied to them, in the second one a mix of sectoral and product ERWA can be applied, depending from the availability of energy efficiency standards of equipment and products. The same method can be used for every asset. For instance, asset backed securities (ABS) can be divided between sectoral ABS (that can be weighed with sectoral ERWA) and specific investment ABS (that can be weighed with product ERWA or a mix of sectoral and product ERWA).

With the combined utilization of sectoral and product ERWA, the tool is basically neutral vis-à-vis the composition of the assets of the banks: capital requirements will depend from the direct emissions or also the indirect external costs (more complex and complete) related to the activity that has been funded, not from the funding source.

The last loan recipients we mention are the financial companies. Given that they embed a very limited quantity of direct external costs, in EMM we excluded them from the application. However, as they are important borrowers, ERWA can be applied to them too. It can be done either using their direct sectoral ERWA or a more complex option applying the ERWA weighted average of their lending portfolio. In this scenario, a bank’s lending footprint would be the basis for its ERWA. We suggest a step-by-step approach, starting with the average emissions related to the sector, as proposed in EMM. A growing list of

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**Table 4. Composition of corporate lending, Italy 2018.**

| Description            | Amount   | Percentage |
|------------------------|----------|------------|
| Current accounts       | 93,277   |            |
| Mortgage loans         | 358,163  |            |
| Factoring              | 16,880   |            |
| Financial leasing      | 32,365   |            |

Source: Bank of Italy 2019a, 20 and following. Data in millions of Euro. Counterparty: non-financial companies and produces households.

**Table 5. Loans and bonds, Italian banks, 2018.**

| Description            | Amount   | Percentage |
|------------------------|----------|------------|
| Loans                  | 1,640,263| 44.7%      |
| MFI bonds              | 56,699   | 1.5%       |
| Government bonds       | 375,573  | 10.2%      |
| Corporate bonds        | 235,331  | 6.4%       |

Source: Bank of Italy 2019b, 61. First column: data in millions of euro; second column as a percentage of total assets.
banks are internally experimenting this approach in Italy. Once extended to the entire sector, banks’ footprint could be adopted for ERWA in lending between banks.

6. How to create product ERWA: the case of energy efficient mortgages

In terms of dimension, the most important application of product ERWA by far is mortgage loans. In fact, ‘The volume of outstanding mortgage loans in the EU amounted to EUR 7 trillion at the end of 2016, representing 30% of total assets in the EU banking sector … and equalling 47% of EU GDP’ (EeMAP 2017a) and ‘Buildings account for 40 per cent of energy use in the European Union’ (EeMAP 2017b). The general structure of the initiative is akin to the design of ERWA inasmuch as it entails the idea that green mortgages are less risky for lenders: ‘One of the key premises of the EeMAP Initiative is that energy efficiency has a positive impact on credit risk’ (EeMAP 2017a). For now, scientific literature on the issue is sparse and almost all on U.S. market, anyway studies ‘find evidence of a significant reduction in default risk associated with energy efficiency. This effect is larger for houses that are more energy efficient’ (EeMAP 2019) and some studies are confirming that ‘buildings’ energy efficiency is associated with lower probability of default’ (Billio 2019). They are less risky also because green buildings have a higher value when they are sold, therefore they are a better collateral for the banks, ceteris paribus. The EU taxonomy is expected to deeply innovate current financial practices in the construction and real estate sector by introducing a regulatory framework for energy efficient activities related to buildings. Part F of the TEG report on taxonomy (TEG 2019a) provides a thorough taxonomy cards for buildings. To apply the framework is important the availability of the EPC rating. With the EPC is possible to create product ERWA consistent with the taxonomy. For instance: if the loan is related to a building activity that fulfils the taxonomy threshold, the assigned ERWA is the minimum value (0.5), if the connected EPC is from class C to G, ERWA values will be from 0.7 to 1.1, etc. Table 6 resumes our product ERWA proposal for the sector based on the taxonomy.

Research shows that green mortgages could be appealing to consumers (EeMAP 2018) and that bonds created to fund these mortgages would be also appealing for investors (EeMAP 2017a). Our proposal of product ERWA for the sector provides a differentiated premium according to the energy efficiency class in line with the ambitious taxonomy thresholds proposed by the TEG. To make these proposals effective, some problems related to the standard and its measurement need to be addressed, for instance in terms of EPC consistency among Member States due to different national transposition of the directive (EeMAP 2017b) and compliance with the directive EPBD (ICF International 2015).

In the following table we detailed our proposal of ERWA for house loans. Appendix provides additional examples on how to create product ERWA consistent with the taxonomy approach.

7. Open issues and future research

The awareness of the need for a rapid transition towards a green economy is gaining traction. In order to achieve such a momentous goal, all the institutions and economic players
Table 6. Applying ERWA to the construction sector under the EU taxonomy.

| Cases | New building construction | Major renovation of existing building | Minor renovation of existing building | Individual energy renovation measure | Acquisitions of buildings – without energy renovation | Acquisitions of buildings – with minor renovation | Acquisitions of buildings – with major renovation |
|-------|---------------------------|---------------------------------------|--------------------------------------|------------------------------------|--------------------------------------------------|-------------------------------------------------|-------------------------------------------------|
| Taxonomy reference | | | | | | | |
| Borrower | | | | | | | |
| ERWA = 0.5 | | | | | | | |
| EU taxonomy compliant | | | | | | | |
| Construction companies | Construction companies | Construction companies, households | Construction companies, installation services, households | Compliant with energy performance standards set for NZEB in national legislation transposing EPBD and EPC ratings classes A1-A4, B (equivalent to the level of performance of the top 15% of the national building stock) | EPC ratings classes A1-A4, B | EPC ratings classes A1-A4, B or at least 30% primary energy saving in comparison to baseline before the renovation | EPC ratings classes A1-A4, B or at least 30% primary energy saving in comparison to baseline before the renovation |
| ERWA = 0.7 | | | | | | | |
| EPC class C or at least 20% energy saving | EPC class C or at least 20% energy saving | EPC class C or at least 20% energy saving | EPC class C | EPC class C or at least 20% energy saving | EPC class C or at least 20% energy saving | EPC class C or at least 20% energy saving |
| ERWA = 0.8 | | | | | | | |
| EPC class D or at least 15% energy saving | EPC class D or at least 15% energy saving | EPC class D or at least 15% energy saving | EPC class D | EPC class D or at least 15% energy saving | EPC class D or at least 15% energy saving | EPC class D or at least 15% energy saving |
| ERWA = 0.9 | | | | | | | |
| EPC class E or at least 10% energy saving | EPC class E or at least 10% energy saving | EPC class E or at least 10% energy saving | EPC class E | EPC class E or at least 10% energy saving | EPC class E or at least 10% energy saving | EPC class E or at least 10% energy saving |
| ERWA = 1.0 | | | | | | | |
| EPC class F | EPC class F | EPC class F | EPC class F | EPC class F | EPC class F | EPC class F |
| ERWA = 1.1 | | | | | | | |
| EPC class G | EPC class G | EPC class G | EPC class G | EPC class G | EPC class G | EPC class G |

The table presents more than four columns since each sheet of the taxonomy proposes different thresholds in the different situations (acquisition with or without renovation, etc).
must participate with an active role. The transition implies, *inter alia*, huge investment from public and private sources. This extraordinary funding need is at the root of the flourishing of sustainable finance that will be one of the main driver of the banking business in the coming years.

In EMM we proposed a tool to align the lending policies of the banks to the green transition goals. Particularly since 2018, a discussion on the links between prudential banking supervision and sustainable finance has thrived (Signorini 2019) but as far as the operational side is concerned, the debate remains at a very early stage.

In this paper, we extended the results of EMM confirming that the tool can be tailored to be a stimulus and not too penalizing for banks, to help the transition at the right pace. We proposed methods to extend ERWA to every part of banks’ assets, in particular adding *product* ERWA to the *sectoral* ERWA, so that the tool can also take into account the EU taxonomy that is developing in these months, and has already finalized many documents dealing with how to treat projects and products as far as the transition is concerned.

The EU Institutions Action Plan for sustainable growth is an important cornerstone and entails ambitious goals that, however, will remain wishful thinking without a proper operational set-up. This is particularly true for the financial system. In its Communication of 8th March 2018, the EC aptly pointed out:

> The financial system is being reformed to address the lessons of the financial crisis, and in this context it can be part of the solution towards a greener and more sustainable economy. Reorienting private capital to more sustainable investments requires a comprehensive shift in how the financial system works. This is necessary if the EU is to develop more sustainable economic growth, ensure the stability of the financial system, and foster more transparency and long-termism in the economy. (EC 2018b)

This is also what we suggested in EMM: using climate change to help the development of new banking business models.

It is also worth noting that the ERWA logic is completely in line with the three specific goals posed in the Communication for the financial sector:

1. reorient capital flows towards sustainable investment in order to achieve sustainable and inclusive growth; 2. manage financial risks stemming from climate change, resource depletion, environmental degradation and social issues; and 3. foster transparency and long-termism in financial and economic activity. (ivi)

We only insist that these goals need operational proposals to become real.

This pragmatic approach is also in line with the development in the field of banking regulation on a world scale, where the goals after 2008 crisis have been clearly specified, but they have not always been implemented coherently or completely on a national level (Trapanese 2019). In particular, a specific toolkit for the prudential treatment of sustainable finance related assets is paramount to prevent a new ‘race to the bottom’ in financial regulation. In Europe, the creation of the Banking Union has helped to improve the effectiveness of banking supervision (Altavilla 2020) but in many fields, national differences remain. Once again, our proposal is instrumental to develop an integrated framework for sustainable finance starting with the EU.

Besides the practical and political difficulties that must be overcome to implement the ERWA that we discussed in EMM (the main being the different energy mix of the different EU countries and hence different results of ERWA application on a European scale), an
important observation on their possible dynamic implementation is in order. ERWA logic is to give banks a positive/negative incentive on their capital requirements if they fund a green/brown sector, but sectoral external costs can vary every year. Can and must ERWA take into account this change? ERWA are built as a difference from an average. If a specific sector modifies its external costs in line with the average dynamic, its ERWA does not change. If a sector is reducing its external costs more rapidly than the average, its ERWA will decrease, thus giving the right incentive to the financial system that will be pushed to finance the more pro-active sectors in term of external costs reduction. These changes are sufficiently slow to allow banks to adjust their business at a reasonable speed (especially in terms of banking book composition). Moreover, to give stability to banks’ strategies, we propose to update ERWA in coherence with the TEG (2019a) suggested periodical update of the technical screening criteria for the ‘mitigation activities’ (and for the connected enabling activities), this means every five years, starting from 2020, so to match last year with the deadline of the targets of the current EU energy and climate policy (2030).

Finally, regulators should decide whether new ERWA should be applied to the existing banking book. If a bank has extended a loan with a given ERWA five years ago, in general the original ERWA should be used, because the investment or product presumably maintains the same external costs. However, while this is true for product ERWA (since they are related by definition to an energy efficiency class or to a specific value of an emission intensity indicator), this is not true for sectoral ERWA, because old measures cannot acknowledge the continuous technical improvements that reduce external costs of the sectors. In this case, instead of a five-year validity period, it would make sense to allow the banks to use yearly updated ERWA values also to weight old loans. We understand that there are pros and cons in these choices. For instance, a more stable weighting of financial assets can help creating markets standards, especially for green bonds. On the other hand, this lag does not help innovative investment in green technologies. These choices are part of the technical discussion on the best strategy to introduce ERWA or similar tools in banking regulation. We wish we were already at that stage! In reality, as we noted, the operational debate is still in an initial phase. To move things forward, EU and international institutions must take fully into their hands the issue of transition.

Notes

1. The main features of the external costs approach as compared to the one based on CO2 emissions only, are the following: (a) it covers a much wider set of pollutants (about twenty air pollutants, CO2 emission included); (b) it offers an aggregate monetary valuation of the various health and environmental risks related to the pollutants emitted by the borrower, due to its economic activity; (c) given that this approach is used also for establishing optimal environmental taxation levels (marginal external costs), the calculated sectoral external costs can be a good estimation of the so called ‘policy risks’ type of transition financial risks (costs related to a new environmental regulation, such as pollution taxes).

2. See http://dati.istat.it/Index.aspx?DataSetCode=DCCN_CONTIEMATMREV2. Air emissions NAMEA currently provides the time series starting from 1990 of yearly emissions of about twenty different types of harmful substances for all sectors of economic activity (NACE rev 2, disaggregation level of 63 branches) and for three households types of activity (transport, heating, other) following the residents principle. For each sector, NAMEA
aggregates data on emissions from production processes characteristic of the sector, from secondary activities and from ancillary activities.

3. See the OECD website: https://stats.oecd.org/Index.aspx?DataSetCode=IOTS.

4. The OECD input-output tables refer to 36 branches of economic activity according to ISIC rev. 4 (International Standard Industrial Classification of All Economic Activities), consistent with the European NACE rev.2 classification.

5. The external costs obtained using the two approaches cannot be compared, because in the first one the external costs are divided by the sector’s value added, while in the second one the external costs are divided by the sector’s value of final demand. The latter have been obtained by applying the Leontiev method of the ‘inverse matrix’, that is based on the direct external costs related to the value of production (as known, the values of a sector’s value added, production and demand are different, for example the value added does not include the value of intermediate goods used in the production of a certain sector).

6. The main initiatives of the plan are the 24 May 2018 package for new regulations of the EU Parliament and the Council and the June 2019 package, with the publication of the new Commission Guidelines on the disclosure of climate related information (EC2019), the TEG’s reports on taxonomy (TEG 2019a, 2019b), on green bonds (2019c) and carbon benchmarks (2019d).

7. Given that the approval process of taxonomy regulation is still ongoing in the EU Parliament and Council, we are referring here to the original legislative proposal by the Commission COM (2018) 353 final. As to the work by the Technical Expert Group (TEG) supporting the Commission on different issues of the Action Plan for the related technical issues, particularly on taxonomy, we refer to the ‘Taxonomy Technical Report’ (TEG 2019a) and to the TEG supplementary report ‘Using the Taxonomy’ (TEG 2019b) published the 18th of June 2019.

8. The directive lays down the rules on disclosure of non-financial and diversity information by large companies that are required to include non-financial statements in their annual reports from 2018 onwards. The directive applies only to public-interest companies with more than 500 employees (included banks and insurance companies). It covers approximately 6000 large companies and groups across the EU.

9. They are activities that are: already low carbon, contribute to a transition to a zero net emissions economy in 2050 but are not currently operating at that level and that enable the type 1 and 2 activities (see the decision three in TEG 2019a, figure 9). TEG (2019b, 21–25) provides the complete list of NACE sectors and activities included by the taxonomy on climate change mitigation. The part F of the Taxonomy document (TEG 2019a) provides the details of the technical screening criteria to be met by each activity in the list.

10. The Directive 2014/95/EU applies to large listed firms included banks and insurance companies. The non-binding Commission Guidelines aim to support companies to comply with the directive obligations. It is worth mentioning that Guidelines specify that financial companies should consider the impacts on climate of the activities that they support or facilitate (although this requires a system for detecting information not fully controlled by such companies).

11. Proposal for a regulation on disclosures relating to sustainable investments and sustainability risks and amending Directive (EU) 2016/2341 COM (2018) 354 final. 2018/0179 (COD).

12. The final text allows issuers to apply also other methods to comply with disclosure obligations, if the firms explain them.

13. According to TEG (2019a), the expected coverage of the taxonomy is about 5% of the overall value added of economic activities.

14. As we noted, the screening criteria of the taxonomy are aimed at selecting green activities only, excluding activities whose contribution to an environmental objective is considered not substantial or that are counterproductive to the objective.

15. Of the two approaches we suggested, in this case we recommend ERWA based on the embodied external cost in final demand (ECFID), since they take into account a life cycle approach
by including in the external cost calculation the contribution of the whole supply chain of each sector.

16. For an introduction, see the documentation of the Bank of Italy workshop held the 3th of July 2019 (https://www.bancaditalia.it/media/notizia/disponibili-gli-atti-del-convegno-sviluppo-sostenibile-finanza-e-rischi-climatici/).

17. The EeMAP Initiative (promoted by a consortium guided by the European Mortgage Federation and the European Covered Bond Council) aims to create a standardised 'energy efficient mortgage', able to incentivize owners to improve the energy efficiency of their buildings or to acquire an already energy efficient property thanks to preferential financing conditions (see the website: www.energyefficientmortgages.eu).

18. The activities are construction of new buildings (26.2), renovation of existing buildings (26.3), individual renovation measures (26.4), and acquisition of buildings (26.5).

19. The Energy Performance Certificate has been introduced by Directive 2002/91/EC. Many houses do not have an EPC, since it is required only when selling or renting a property and its validity is limited to 10 years. In 2014 no EU country had a building stock with more than 35% of EPC and only three countries had more than 10% (EeMAP 2017b), although these percentages increase gradually every year.

20. A Trilogue agreement on the new text revising Directive 2009/33/EC was reached on 11th February 2019. The Parliament adopted the text in the following April and the Council on 13th June 2019. The final act was signed on 20th June 2019. The revised directive links the definition of clean vehicle to Directive 2014/94/EU on alternative fuels infrastructure, allows the counting of retrofitted vehicles towards procurement targets and extends the scope of the directive to public service contracts for parcel and mail delivery services and urban and household waste collection.

21. Also in this case, a Trilogue agreement on the new text revising Directive 2009/33/EC, was reached on 11th February 2019. The Parliament adopted the text in the following April and the Council on 13th June 2019. The final act was signed on 20th June 2019. The agreement sets a legally binding 30% reduction target for the average fleet emissions of new trucks by 2030 as compared to 2019 levels. Zero and low-emission vehicles should reach a 2% share of manufacturers sales by 2025. In 2022, the Commission will have to propose new post-2030 targets.

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**Appendix – Product ERWA for road transport vehicles**

**Passenger cars and light commercial vehicles**

In the case of passenger cars and light commercial vehicles (vans), the technical screening criteria of the taxonomy (zero tailpipe emission vehicles and – until 2025 – vehicles with tailpipe emission intensity of max50 gCO2/km) are aligned with the new definitions of ‘zero emissions vehicles’ and ‘clean vehicles’ provided by the recently approved EU legislation (Regulation 2019/631 setting CO2 emission performance standards for new passenger cars and vans in the EU for the period after 2020, and the revised Clean Vehicle Directive20 that aims to promote clean mobility solutions in public procurement tenders). To reward the compliance of the borrower with the above-mentioned threshold the ERWA value will be set at the minimum (0.5). Loans for the purchase of cars and vans slightly beyond 50 gCO2/km could obtain a premium too, if consistent with the EU 2030 targets. In fact, the new regulation (EU 2019/631) sets the following CO2 emission performance targets, intended as average for new EU-fleets of passenger cars and vans:

- Cars: 95 gCO2/km in year 2020; 15% reduction as compared to 2021 from year 2025 on and 37.5% reduction as compared to 2021 from year 2030 on.
- Vans: 147 gCO2/km in year 2020; 15% reduction as compared to 2021 from year 2025 on and 31% reduction as compared to 2021 from year 2030 on.

By calculating the above-mentioned reduction targets for 2025 starting from year 2020 (instead of 2021 to simplify), we obtain 80 gCO2/km for cars and 125 gCO2/km for vans. For vehicles with a carbon intensity beyond 50 g CO2/km, we assign the intermediate ERWA value of 1.0 to the 2025 targets in terms of carbon intensities.

**Heavy duty vehicles (HDVs)**

In the case of HDVs (freight transport services), TEG (2019a) proposes three optional technical screening criteria:

- zero tailpipe emission vehicles;
• low-emission vehicles with specific emissions of less than 50% of the reference/average emission of all vehicles in the same subgroup;
• vehicles using biofuels and renewable fuels in line with Directive 2018/2001.

The first two criteria take into account the policy framework established by two new EU regulations on HDVs CO₂ emissions (Regulation 2018/956 and the recently approved Regulation setting CO₂ emission performance levels for HDV<sup>21</sup>).

With the aim of aligning the ERWA proposal for HDV to the taxonomy, the new EU Regulation intermediate target of a 10% emission reduction for 2025 is assumed as a reference value for the neutral ERWA value of 1.0. Reductions between 50% (taxonomy) and 15% (2025 EU target) are allocated in the ERWA range 0.5-1.0, while new HDV achieving emissions reductions lower than 15% as compared to the CO₂ reference values at the subgroup level are given ERWA values higher than 1. We also propose that after 2025 the ERWA values are updated to the HDV target at 2030 (30% emissions reduction).

**Table A1.** Product ERWA – road transport vehicles (passenger and freight).

| ERWA | Tailpipe emission intensity (car) | Tailpipe emission intensity (LCV) | (Until 2025) specific direct CO₂ emissions of the reference CO₂ emission of all vehicles in the same sub-group |
|------|----------------------------------|----------------------------------|-------------------------------------------------------------------------------------------------------------|
| 0.5  | • Zero tailpipe emission vehicles; (Until 2025) Vehicles with tailpipe emission intensity of max 50 gCO₂/km | • Zero tailpipe emission vehicles; (Until 2025) Vehicles with tailpipe emission intensity of max 50 gCO₂/km | • Zero direct emission HDVs • Low emission HDVs with specific direct CO₂ emissions <50% of the reference CO₂ emission of all vehicles in the same sub-group • Dedicated vehicles solely using ‘advanced biofuels’, or ‘renewable liquid and gaseous transport of non-biological origin’, or certified low-ILUC biofuels in line with Directive 2018/2001 |
| 0.6  | 50 < gCO₂/km ≤ 60                | 50 < gCO₂/km ≤ 65               | ≥50% and <60%                                                                                                  |
| 0.7  | 60 < gCO₂/km ≤ 65                | 65 < gCO₂/km ≤ 80               | ≥60% and <70%                                                                                                  |
| 0.8  | 65 < gCO₂/km ≤ 70                | 80 < gCO₂/km ≤ 95               | ≥70% and <75%                                                                                                  |
| 0.9  | 70 < gCO₂/km ≤ 75                | 95 < gCO₂/km ≤ 110              | ≥75% and <80%                                                                                                  |
| 1.0  | 75 < gCO₂/km ≤ 80                | 110 < gCO₂/km ≤ 125             | ≥80% and <85%                                                                                                  |
| 1.1  | 80 < gCO₂/km ≤ 85                | 125 < gCO₂/km ≤ 140             | ≥85% and <90%                                                                                                  |
| 1.2  | 85 < gCO₂/km ≤ 90                | 140 < gCO₂/km ≤ 155             | ≥90% and <95%                                                                                                  |
| 1.3  | 90 < gCO₂/km ≤ 95                | 155 < gCO₂/km ≤ 170             | ≥95% and <100%                                                                                                |
| 1.4  | 95 < gCO₂/km ≤ 100               | 170 < gCO₂/km ≤ 185             | ≥100% and <110%                                                                                                |
| 1.5  | gCO₂/km > 100                    | 185 < gCO₂/km ≤ 200             | ≥110%                                                                                                           |

Taxonomy reference: for passenger cars and light commercial vehicles 24.5, for heavy duty vehicles 24.6; application to car mortgage, leasing and every other kind of product loan.