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Methodology for estimating the impact of the Social Bond 2019

The impact assessment of the CDP's 2019 Social Bond is based on four specific targets:

1) employment impact;
2) number of students benefiting from school and university building interventions;
3) number of inhabitants benefiting from urban regeneration measures

1. Methodology used to estimate the employment impact of CDP Social Bond

Methodological aspects. The approach used to analyze the employment impact of the CDP's financing linked to the Social Bond involves input-output models that measure the effects generated in terms of added value and employment by changes in one or more components of the final demand.

This takes account not just of how the sector in question is directly affected by the additional demand

generated by the funds raised through the Social Bond, but also of all those effects caused when each sector relies on another for purchasing the intermediate and semi-finished goods required in the production process.

Using this method, the estimated impact is the result of three types of effects:

- **direct effects**, i.e. those impacting only the sector affected by the change in demand and its first intermediate inputs;
- **indirect effects**, i.e. those arising when each sector relies on another (the Leontief multiplier);
- **induced effects**, i.e. those deriving from the additional income flows that stimulate greater spending by end consumers (the Keynesian multiplier).

As this is a simple mechanical description of how the different sections of an economy are connected, it does not provide any explanation regarding the economic behavior of operators but it does take into account how external factors affect the economy, especially in the short term and assuming like-for-like conditions. It does not make spending distinctions based on who is doing the spending (there is no difference, for example, if the outlay comes from the private or the public sector), nor does it allow us to assess how the impact is affected by changes in the short-term economic environment.

Conceived by Wassily Leontief, input-output analysis is an economic statistics technique involving analysis of the relationships resulting from the production and circulation of goods and services between the different economic sectors. The main feature of input-output analysis is the double-entry intersectoral table, in which you can imagine the national economy as a set of sectors, each of which carries out two types of transaction:

- purchases from other sectors of goods and services that they use for their own production activity (branches of use);
- sales of goods they produce to other sectors and end consumers (branches of origin).

The sectors are grouped in branches, i.e. groupings of production units characterized by similar cost structures, production processes and products.

The input-output table makes it possible to quantify the many effects that a change in demand (consumption, investments, public spending, exports) can have on domestic production, added value and foreign-trade accounts in the country in question. This is possible by providing an overview of inter-industry relationships and the economic structure of a country and by determining the value of the intermediate goods and services produced by one sector and used by another.

By establishing the output that each sector must produce in order to satisfy a given sectoral demand, the input-output model makes it possible to estimate how particular economic policy decisions affect the future performance of the economy, especially in the short term (which is when the assumptions of the input-output model are more realistic). In this static model, the technological relationships remain fixed at a given moment in time, assuming a linear production technology and with fixed coefficients, so that the quantities requested adapt to the demand and not to the prices.

The input-output table is a system of equations that describe the relationships between production and respective usage. These relationships are subject to several constraints, the first of which envisages that the total production value generated in the *i-th* sector is equal to the sum of the intermediate uses and final uses (**balance equation**).

$$X_i = \sum_{k=1}^{n} \chi_{ik} + D_i \qquad (1)$$

Where X is the production, χ and D the intermediate and final uses, respectively, i and k are the index related to the final uses and the primary resources branches, respectively.

The second constraint envisages that the production value of an *i-th* sector is equal to the cost of the inputs and the overall income paid to carry out the production activities (**costs equation**).

$$X_i = \sum_{k=1}^{n} \chi_{ki} + V_i \qquad (2)$$

Where V is the income.

Finally, the **equilibrium equation** establishes the constraint that the total uses of the *i-th* sector be equal to the total resources of the same sector (equal values by row and by column).

$$\sum_{k=1}^{n} \chi_{ik} + D_i = \sum_{k=1}^{n} \chi_{ki} + V_i \qquad (3)$$

Using the input-output table, it is possible to construct the matrix of technical coefficients, which in turn calculates the impact in terms of production, added value, imports and jobs of a change in demand. The model's underlying assumptions used to analyze the impact are:

- linear production technology. In other words, it is assumed that in each production activity the input quantity required is directly proportional to the output volume achievable;

- fixed economies of scale in all the production sectors. The unit input need is assumed to be constant regardless of changes in production volumes;
- absence of external factors. The effect of an entity's economic activity outside the market transactions is not considered;
- fixed-coefficient production technology. There are no input substitutions for production, meaning that the quantities requested adapt only to the demand and not to price variations;
- imports as a share of the total product are assumed to constant regardless of changes in the final demand.

The technical coefficient matrix values are given by the ratio of the values in the intersectoral table to the row total or to the production of each sector (column total). These coefficients therefore show the contribution each sector makes to the value created in the other sectors.

$$\alpha_{ij} = \frac{\chi_{ij}}{X_J} \qquad (4)$$

The technical coefficient α_{ij} indicates how many units of the asset coming from branch *i* are necessary for producing one asset unit in branch j. The matrix of technical coefficients can be calculated not only for the internal production inputs but also for the imported inputs and the primary inputs (wages and salaries, added value, etc.).

Equation [4] can therefore be rewritten

$$X_i = \sum_{k=1}^{n} \alpha_{ij} X_k + D_i \qquad (5)$$

This system of equations expresses the internal production flow of the product as the value of the intermediate goods and services supplied to all productions plus the value of the goods and services that satisfy the final demand. The basic input-output model can thus be represented as follows in matrix form:

$$X = AX + D \rightarrow D = X - AX \rightarrow D = (I - A)X \rightarrow X = (I - A)^{-1} D \quad (6)$$

Where X is the production vector, A is the production coefficient matrix, D is the final demand vector and I is the Identity matrix.

In this way, production broken down by production branch is expressed as a function of the final demand addressed to each single branch. The elements of the (I – A)-1 matrix, known as the Leontief matrix, indicate the overall need for goods and services generated internally by the product of the *i-th* row required for directly and indirectly satisfying a final unit demand for the product j, thereby enabling the impact of a change in external demand on production, intermediate import inputs and primary resources inputs to be estimated.

Starting for this matrix, it is possible to compute the demand multipliers used for estimate the overall (direct, indirect and induced) employment impact (considering both created and maintained jobs) of the investment supported.

Construction of the matrix activation vector. The ability of the model to assess properly the effects of the funds raised through the Social Bond on national employment is clearly related to the proper split of the financing flows to the different product items in the classification of the input-output matrix. This reallocation inevitably contains a degree of subjectivity.

In this specific analysis, investments financed through the Bond emission are considered as investment able to activate production in the construction sector.

Data The database for the analysis of the employment impact multipliers is represented by the system of input/output tables provided by Istat[1] appropriately calibrated on 2019 data with reference to the employment dimension.

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[1] Cfr. https://www.istat.it/it/archivio/225665

2. Number of students benefiting from school and university building interventions

For the identification of the number of students[2] benefiting from school and university building interventions, different approaches were used depending on data availability[3].
For 64% of the school and university building portfolio, it was possible to directly allocate the number of students for each school, based on the database of the Ministry of Education, University and Research (MIUR)[4].

For 29 % of the same portfolio for which the exact figure was not present, the average number of students in the schools, in the same municipality and of the same order[5], was used as a proxy for the students of the school benefiting from the intervention, following the formula:

$$Students_i^{(k)} = \frac{\sum_{j=1}^{n} Students_j^{(k)}}{n}, where\ i \neq j \ldots\ldots\ldots\ldots \text{(7)}$$

Where (k) is the type of school: k=primary school, secondary school, high school, and (j) are the j-existing schools in the same municipality as school i.

For the remaining 7%, represented by kindergartens and childhood schools for which it is not possible to track the number of schoolchildren enrolled by official MIUR data (neither at the level of a single structure nor at the level of a municipality), the regional average of the schoolchildren enrolled by type of structure was used as proxy:

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[2] Cfr. Handbook – Harmonized Framework for Impact Reporting, Social Bond (2019), Access to Essential Services.
[3] For 0.4% of the portfolio no type of allocation was possible.
[4] Students enrolled in the school year 2019-2020.
[5] Students enrolled in the school year 2019-2020.

$$Schoolchildren_i^{(l)} = \frac{Schoolchildern_r^{(l)}}{Structures_r^{(l)}} \ldots\ldots\ldots\ldots\ldots\ldots (8)$$[6]

Where (l) is the type of structure: l=kindergartens, childhood school and R are the Italian regions.

3.Number of inhabitants benefiting from urban regeneration measures

The social impact and effectiveness of funding for urban regeneration have been assessed in terms of the number of beneficiaries reached[7]. Considering, in fact, the nature of the investments financed, aimed at the redevelopment and safety of public buildings, sports, recreational and children's facilities, public parks and cycling, the benefits resulting from this type of intervention extend to the entire population in the municipalities reached. The allocation of beneficiaries was made on the basis of data on the population present in Italian municipalities provided by Istat[8] and updated to 2019.

Further information about the methodology and data used is available on request, by contacting sostenibilita@cdp.it

[6] For the reference of the data in the right side of the equation (8), concerning the number of schoolchildren, see: (i) for childhood schools www.dati.istat.it, school year 2018-19; (ii) for kindergartens https://www.istat.it/it/archivio/asili+nido, school year 2017-2018.

[7] Cfr. Handbook – Harmonized Framework for Impact Reporting (2019), both Social and Green Bond published by ICMA, Social and Economic Empowerment and Clean Transportation.

[8] Cfr. http://dati.istat.it/Index.aspx?DataSetCode=DCIS_POPRES1