Methodology used to estimate the employment impact of CDP Social Bond

Methodological aspects. The approach used to analyze the 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.

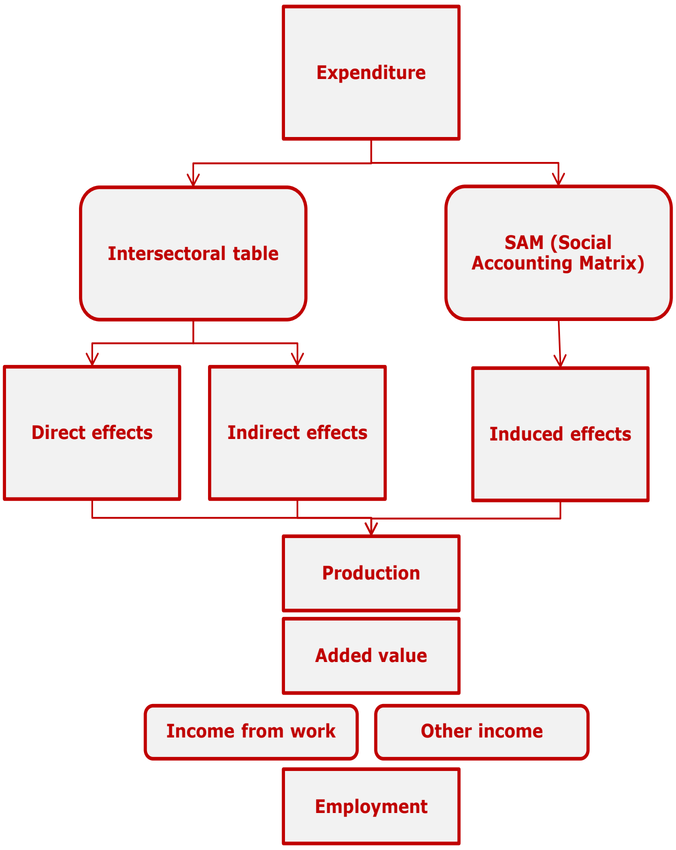
This takes account not just of how the sector in question is directly affected by the additional demand generated by the funds raised through the Social Bond, but also of all those effects caused when each sector relies on another for purchasing the intermediate and semifinished goods required in the 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 behaviour 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.

Flowchart of the input –output methodology



Source: CDP

The intersectoral table. 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 characterised by similar cost structures, production processes and products.

There are three sections (or sub-matrices) in an input-output table:

- the **production branches section**: this shows inter-industry transactions, i.e. transactions involving intermediate goods and services flowing from the branches of origin to the branches of use, where they are used as inputs for the respective production processes (the row total in this section will indicate the total intermediate uses in each sector, while the column total will indicate the total intermediate costs for each of the branches);
- the **final uses section**: this contains columns under headings of the individual components of final demand (public and private consumption, investments, exports). It shows the goods and services which, instead of being used in production, flow to end users for consumption, to the formation of capital and to exports;
- the **primary resources section**: this contains rows under headings of added value and its distribution to production factors. As such, it records the primary income paid to the production factors as remuneration for services rendered in the various production processes.

Therefore, by reading the rows of the table we can analyse production of the different types of products/services according to their destination, while by reading the columns, we can see the resource development process and the production costs structure for each product.

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.

Layout of the input-output table

		Branches of use											Final sectors				
	Branches of origin	**1**	**.**	**.**	**i**	**.**	**.**	**j**	**.**	**.**	**n**	**Intermediate uses**	**C**	**I**	**E**	**Final uses**	**Total uses**
Production branches	1	x_{11}	.	.	x_{1i}	.	.	x_{1j}	.	.	x_{1n}	$\sum_{k=1}^{n} x_{1k}$	C_1	I_1	E_1	D_1	X_1
	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	i	x_{i1}	.	.	x_{ii}	.	.	x_{ij}	.	.	x_{in}	$\sum_{k=1}^{n} x_{ik}$	C_i	I_i	E_i	D_i	X_i
	.	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.
	.	.	.	.	.	.	.	.	.	.	.		.	.	.	.	.
	j	x_{j1}	.	.	x_{ji}	.	.	x_{jj}	.	.	x_{jn}	$\sum_{k=1}^{n} x_{jk}$	C_j	I_j	E_j	D_j	X_j
	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	n	x_{n1}	.	.	x_{ni}	.	.	x_{nj}	.	.	x_{nn}	$\sum_{k=1}^{n} x_{nk}$	C_n	I_n	E_n	D_n	X_n
	Intermediate costs	$\sum_{k=1}^{n} x_{k1}$	.	.	$\sum_{k=1}^{n} x_{ki}$	.	.	$\sum_{k=1}^{n} x_{kj}$	.	.	$\sum_{k=1}^{n} x_{kn}$	$\sum_{k=1}^{n} x_{kk}$	C_T	I_T	E_T	D_T	X_T
Primary resources	Wages and salaries	W_1	.	.	W_i	.	.	W_j	.	.	W_n	W_T	Final uses				
	Social welfare contributions	S_1	.	.	S_i	.	.	S_j	.	.	S_n	S_T					
	Other income	K_1	.	.	K_i	.	.	K_j	.	.	K_n	K_T					
	Added value	V_1	.	.	V_i	.	.	V_j	.	.	V_n	V_T					
	Domestic production	$_P X_1$	.	.	$_P X_i$	.	.	$_P X_j$	.	.	$_P X_n$	$_P X_T$					
	Imports	$_M X_1$	.	.	$_M X_i$	.	.	$_M X_j$	.	.	$_M X_n$	$_M X_T$					
	Total resources	X_1	.	.	X_i	.	.	X_j	.	.	X_n	X_T					

Source: CDP

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**).

$$\mathbf{X_i} = \sum_{k=1}^{n} x_{ik} + \mathbf{D_i} \qquad \textbf{[1]}$$

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**).

$$X_i = \sum_{k=1}^{n} x_{ki} + V_i \qquad [2]$$

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).

$$\sum_{k=1}^{n} x_{ik} + D_i = \sum_{k=1}^{n} x_{ki} + V_i \qquad [3]$$

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.

$$\alpha_{ij} = x_{ij} / X_j$$

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 [1] can therefore be rewritten:

$$X_i = \sum_{k=1}^{n} \alpha_{ik} X_k + D_i \qquad [4]$$

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:

$$X = AX + D \Rightarrow D = X - AX \Rightarrow D = (I - A)X \Rightarrow X = (I - A)^{-1} D \qquad [5]$$

where:

X = Production vector
A = Matrix of the production coefficients
D = Final demand vector
I = 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.

Social accounting matrix. The SAM (social accounting matrix)[1] is a tool that represents the economic process and highlights its circular nature. It can be viewed as an extension of the Leontief input-output table that shows not only the links that exist within the production system, but also the relationships between the production and distribution of income towards production factors (work and capital) and institutional sectors (families, businesses, public administration). The SAM is a simple and effective way of representing the fundamental economic law according to which an expense or outlay corresponds to every income item. The distribution of the income is inserted into the economic process and becomes a simultaneous cause and effect of the economic activation processes.

In the SAM layout, an increase in aggregate demand therefore triggers a double circuit of effects:
- the first determined by the **direct and indirect effects** of inter-industry links on the production level (**Leontief multiplier**);
- the second determined by how increased income in the institutional sectors affects consumption, the so-called **Keynesian-type induced effect**.

Furthermore, the SAM is a flexible tool that makes it possible to disaggregate accounting flows on the basis of different classification criteria depending on the objective of the analysis or availability of the data (for example, the family sector can in turn be broken down by income distribution or professional position).

[1] Pyatt, G. (1988), A SAM approach to modeling.

The structure of the Social Accounting Matrix

	Production	Production factors	Institutional sectors	Rest of the world
Production	Matrix of intermediate uses (T_{11})		Use of disposable income (consumption and investments) (T_{13})	Exports
Production factors	First passage of primary distribution (T_{21})			Income from abroad
Institutional sectors		Second passage of primary distribution (T_{32})	Secondary distribution (T_{33})	Transfers from abroad
Rest of the world	Imports for production	Income sent abroad	Imports for consumption and investments	

An SAM takes the form of a squared block matrix in which every account is represented in both the rows and columns. The rows constitute the inflows (takings) and the columns the outflows (payments) of the various economic frameworks and parties, and the sum of the items in a row must equal the sum of the items in the corresponding column[2].

- Matrix T_{11}, referring to the **production process**, coincides with the production branches section in the input-output table and represents all the intermediate production flows.
- The T_{21} matrix is already present in the input-output table and represents the **first passage in income distribution**. This is the transfer of resources from the production branches to the institutional sectors and represents the added value creation phase, i.e. the increased profits generated during the production process.

[2] The capital account is missing in this simplified description as it is considered external to the system; in this way, the model takes on a typically Keynesian form in which the savings adapt to the level of investments. If the capital account were to be added, we would have a neoclassical model assuming a market in which the interest rate balances the investment demand with the savings supply.

- The **second passage in the primary distribution** of income, i.e. the transfer from the production factors to the institutional sectors (proprietary) of the remuneration for participation in the production activities, is represented by matrix T_{32}.
- The income that the institutional sectors receive for their participation in the production activities cannot be used in full because there are other transactions between the institutional sectors that, while not affecting the overall income produced in the economic system, nevertheless modify its distribution. As such, these are transfers made not as consideration for some service but which derive from the need to remunerate the financial capital and redistribute the income (remuneration of own securities, taxes, welfare contributions, insurance, etc.). This set of transfers generates a **secondary distribution** (matrix T_{33}) that determines the disposable income.
- The disposable income is then used by every institutional sector for consumption or savings. Resources that are not set aside for savings will therefore be used for individual consumption, collective consumption or investments, and will enter the **income utilisation matrix** (T_{13}).
- Finally, the accounts headed **Rest of the World** include all the structures that are outside the economic system being analysed. The inflows for the rest of the world are entered by row, representing an outflow for the economic system in question. Vice versa, the outflows for the rest of the world are recorded by column, representing inflows for the economic system in question.

As an extension of the input-output model, the SAM analyses the impact of the exogenous variables by calculating the multipliers. In order to use the social accounting matrix as a model for calculating the impact, a distinction should be made between the endogenous accounts and the exogenous ones. The selection criteria depend on the aim of the analysis; in our example, the endogenous accounts are those in which changes in expenditure directly follow every income change (families, businesses), while the exogenous accounts are those for which expenditure is assumed to be established regardless of income (public administration, rest of the word). The layout shown above can therefore be reproduced, this time distinguishing the exogenous accounts from the endogenous ones.

The structure of the Social Accounting Matrix – endogenous and exogenous counts

	Production	Production factors	Institutional sectors (families and businesses)	Exogenous accounts (Public Administration and the Rest of the World)	Total
Production	T_{11}		T_{13}	F_1	X_1
Production factors	T_{21}			F_2	X_2
Institutional sectors (families and businesses)		T_{32}	T_{33}	F_3	X_3
Exogenous accounts (Public Administration and the Rest of the World)	L_1	L_2	L_3	G	X_4
Total	X_1	X_2	X_3	X_4	

The same method used for deriving the inverse Leontief matrix is followed for calculating the accounting multipliers, except that this time the matrix of the multipliers also contains the circular effect of income in the economy. It is therefore possible to construct a matrix of expenditure coefficients aij by dividing each element of the Tij matrix by the corresponding element of the sum vector of column Xj. In matrix form, we will therefore have:

$$A = T\left[\bar{X}\right]^{-1} \qquad \textbf{[6]}$$

where $\bar{X}$ is the diagonal matrix featuring as elements the total payments of the endogenous operators. In this way, a system of SAM equations can be expressed in compact form as follows:

$$X = AX + F \Rightarrow F = X - AX \Rightarrow F = (I - A)X \Rightarrow X = (I - A)^{-1}F \Rightarrow X = MF \quad [7]$$

$M = (I - A)^{-1}$ is the global accounting multipliers matrix and measures not only the direct and indirect effects of a change in exogenous demand on the production sectors, but also the effects of an increase in the earnings of those institutional sectors that are deemed to be endogenous (families and businesses) in terms of greater end consumption (matrix T_{13}). Unlike the inverse Lontief matrix, the M matrix is closed vìs-a-vìs income distribution and consumption, and is therefore able to describe the circular effect of income in the economy.

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.

The analysis is definitely biased by the purpose of the loan and the economic destination of the investment.

There are two type of investment financed by the bond funding. A first kind of investment concerns productive investments related to the purchase of property, plants and equipment. This kind of investment has the main goal to increase the production of the company receiving the financing and it counts for the 65% of the total amount.

A second kind of loans has the aim to finance working capital that is supposed to grant the regular activity of the enterprise, that otherwise could have been forced to reduce the number of employees (the outstanding 35%).

All that considering, there are two different categories of additional demand affecting the valuation. The first one, concerning the productive investments, activates demand in the specific sector of construction or manufacturing or real estate services. The second kind of loans, financing working capital, increased demand in the enterprise's sector of activities. In the first case the amount of job estimated is considered jobs created, in the second one the estimated amount of job can be considered as retained.