APPENDIX 1: An Overview of the Input-Output Methodology

The reformation of the mutual interdependence and interactions (structural changes) between the structure of the economy and the units constituting this structure, along with various abstractions within a theoretical framework, to make it simpler and more comprehensible, constitutes the foundation of economic thought. By simplifying macro modeling with a series of assumptions and transforming it into the input-output (IO) model, Wassily Leontief pioneered in this field.

The IO methodology is a framework employed in economics to model and examine the connections between various sectors within an economy. The IO tables help model the economy, track sectoral dependencies, and assess the impact of changes in production, investment, and government policies. These tables are matrices illustrating the flows of goods and services among different sectors. IO tables present economic data in a matrix layout, with rows representing inputs (e.g., goods, services, or production factors) and columns representing outputs (final goods and services produced). Each cell in the matrix indicates the quantity of input required from each sector to generate one unit of output for another sector. This feature of the tables allows us to capture the interconnections among sectors by demonstrating how the output of one sector serves as input for others. This encompasses both direct input purchases and indirect relations through intermediary goods and services. More specifically, the columns of the input-output table display the intermediate goods that an industry must use from other industries to produce its own products, while the rows show which sectors utilize the products it generates. Each sector appears twice in the tables, once in a row and once in a column. Besides, the IO table consists of four main sections. The first section is the section named intermediate demand (intermediate consumption). This section is the main section where flows between industries are observed. In this section, the columns represent the intermediate goods and services inputs that each industry uses from other industries, while the rows show which industries and final demand components use the products produced by an industry. The second section includes the units named final demand, where the amount remains for final usage after the intermediate demands of both industry and other industries are met. Private and public consumption expenditures, private and public investments, stock changes, and exports are included in this section. The third section includes the inputs (such as labor, capital, and land), which are named value added. This section includes indirect taxes, subsidies, employee benefits, wear and tear, and other proofreading. The fourth section shows the revenues of the value added from the final demand expenditures.

In addition, IO analysis allows to calculate multiplier effects, which measure the total impact of an initial change in one sector on the entire economy. Multipliers can be used to assess the ripple effects of changes in production, consumption, investment, or government spending. Another crucial point for IO methodology is to enable detailed analysis of individual sectors within an economy, including their production processes, input requirements, and contributions to overall output and employment. In that sense, as these models evaluate the potential effects of economic policies, such as changes in taxes, subsidies, tariffs, or government spending, these models are used for deriving economic policies. By simulating the impacts of policy changes on IO tables, economists can assess how different sectors and regions of the economy may be affected. In summary, the IO methodology provides a comprehensive framework for understanding the structure and dynamics of an economy, as well as for analyzing the potential consequences of different economic policies and shocks.

The State Planning Organization (SPO) in Turkey created the first IO table in 1959 with 15 sectors followed by a new table in 1963. The Turkish Statistical Institute (TurkStat) created tables in 1968, 1973, 1979, 1985, 1990, 1996, 1998, 2002, and ultimately 2012. The IO table was developed with more information in 1968 and had 50 sectors, compared to the 37 sectors in the tables from 1963 and 1967. The tables were then constructed with 64 sectors and extra detail.

IO model has some fundamental assumptions. First, there is the assumption of linearity in relationships. According to this assumption, the relationships between the production of each industry and the inputs, will not change within a certain period. Another assumption is that industries have constant input coefficients (Leontief technology) which means each sector produces a single good and uses a single production technique to produce this good. In an economy with n sectors, the production of any i-th sector can be used by other sectors as inputs as well as for final demand purposes. Since there is a linear relationship between the input demand of each sector and the quantity of production, the input demand received by any j sector from the i sector is expressed as Xij. Therefore, the coefficients of aij input for each year, derived from the flow table known as Xij, are expressed as the ratio of the input demand of each sector to total production (Leontief 1951).

 (1)

Moving from the table (matrix) represented by input demands shown as Xij, it is possible to reach the table (matrix) of input coefficients expressed as aij. The matrix of input coefficients for each year reflects the flow of goods and services in that year, thereby revealing the production structure of the economy.

Therefore, the total production of sector i is expressed as:

 (2)

For the case of n sectors indexed over i, the material balance equations of the model are represented as follows:

 (3)

Here; X: n\*1 vectors of sectoral output, A: (aij): n\*n matrix of I\_O coefficients, and Y0: n\*1 vector of final demand. Given Y0, the X vector solving the system would be:

 (4)

where is Leontief inverse. I is n\*n identity matrix.

aij coefficient matrix is called a matrix that shows how the j. sector’s production needs direct i. good’s input coefficients. Since aij’s are fixed, Equation (4) shows how sectoral gross domestic outputs would change in response to an exogenous shock affecting Y0, the final demand for the output of sector j (Leontief 1951). While aij’s themselves are indicators of sectoral interdependence within this framework (Sayan and Demir 1998).

It is worth noting that IO analysis has some limitations. It captures only the demand side and assumes that there are no capacity constraints. Besides, it represents a static approach to modelling as they assume prices will be unaffected by changes in sectoral output. The IO model is static also because it only captures the short-run effects. Investing in care could have further medium- and long-run effects through its positive influence on labor productivity. Moreover, it characterizes output as a linear function of fixed inputs, excluding the possibility of increasing returns to scale. Additionally, this model cannot estimate the impact of care expenditures through expenditures of care workers, which would have additional effects on private investments. The care expenditures could also be subject to balance of payments constraints due to the expenditures of care workers. Moreover, given that the collection of IO data is cost-intensive, national statistics agencies update IO tables infrequently. Finally, the analysis of indirect employment effects is confined to backward linkages, excluding factors such as increased household consumption resulting from higher employment in the calculations.

For Turkey, the 2002 IO Table was updated in 2012 and to date, no other updates have been undertaken. In using the 2012 IO, to assess indirect employment creation of care services sectors in 2019, our estimates rest on the assumption that cross-sectoral input coefficients have remained constant over this period. To avoid some of these limitations, Ilkkaracan et al. (2015 and 2021) use the synthetic sector approach in the IO analysis of ECCE services, where the sector is inserted (synthetically) in the existing IO Table using data on its input and cost structure collected via a field survey of childcare centers and preschools in Istanbul in 2014-15. Nevertheless, this is a costly undertaking difficult to replicate within the confines of the present study.

The IO model used in this study analyzes the effects of output increases on different sectors. For example, it shows how increased output in sectors such as early childhood care and education (ECCE) or long-term care (LTC) causes changes in output in other sectors. This is done through backward linkages; these linkages emphasize the inputs that care services demand from other industries. Because IO tables capture flows of goods and services across sectors, they help estimate not only direct employment in care services but also indirect employment created in sectors that provide inputs to those services. This comprehensive view reveals the spillover effects of care investments in different areas of the economy.

The input-output model provides valuable information on the economic returns of care investments in Turkey. It highlights the direct and indirect employment impacts, revealing how care services can promote inclusive and gender-equal growth. However, the static nature of the model and the lack of incorporation of induced effects suggest that future research with more dynamic modeling approaches could allow us to more comprehensively understand the full economic potential of the care sector.

References:

**İlkkaracan I, Kim K and Kaya T (2015)** The Impact of Public Investment in Social Care on Employment, Gender Equality, and Poverty: The Turkish Case. İstanbul Technical University Women’s Studies Center in Science, Engineering, and Technology and the Levy Economics Institute of Bard College, August. Available at: https://www.ilo.org/wcmsp5/groups/public/---europe/---ro-geneva/---ilo-ankara/documents/publication/wcms\_409804.pdf (accessed 04 April 2020).

**İlkkaracan I, Kim K, Masterson T, Memiş E, and Zacharias A (2021)** The impact of investing in social care on employment generation, time-, income-poverty by gender: A macro-micro policy simulation for Turkey. World Development, 144, 105476, 1-11 <https://doi.org/10.1016/j.worlddev.2021.105476>.

**Leontief W (1951)** Domestic Production and Foreign Trade: The American Capital Position Reexamined, Economia Internazionale, 7, (Reprinted in American Economic Association (1968) Readings in International Economics, Homewood: Richard D. Irwin.

**Sayan S and Demir N (1998)** Measuring the degree of block interdependence between agricultural and non-agricultural sectors in Turkey. *Applied Economics Letter* 5(5), 329–332.