

Jobs Supported by Exports Methodology

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I. Introduction

The estimates of export related employment are produced using an Input-Output (IO) modeling framework. The IO framework traces the activities of industries that both produce goods and that consume the production of other industries as inputs into the production of their outputs. The use of the IO framework thus enables us to estimate the totality of labor embodied in exports and not just the labor used in the production of the final product that is then exported.

The IO data used in the Jobs Supported analysis are from the Annual IO accounts published by the Bureau of Economic Analysis (BEA) available at https://www.bea.gov/industry/io_annual.htm. The annual accounts contain data on 73 commodities and 71 industries.

II. Deriving a Domestic Total Requirements Table

IO modeling starts with two tables, the Use table and the Make table. The Make Table shows the value of commodities produced by each industry, while the Use Table shows the values of the inputs used in each industry's production and the values of commodities consumed by final users. The Make and Use tables are used to derive requirements tables. A total requirements table shows the production that is required directly and indirectly to deliver a given dollar value (typically one million) of a commodity to final users.

If we let¹

U = the intermediate portion of the use matrix less imports of intermediate inputs² ;

\hat{g} = a diagonal matrix with industry output along the main diagonal and zeros elsewhere;

V = the make matrix;

\hat{q} = a diagonal matrix with the total output of each along the main diagonal and zeroes elsewhere;

\hat{p} = a matrix with the proportion of an industry's total output comprised by scrap along the main diagonal and zeroes elsewhere, then following two matrices can be derived:

$$D = V\hat{q}^{-1}$$

$$W = (I - \hat{p})^{-1}D$$

¹ The derivation and notation employed here are based on the Appendix to Chapter 12 in Horowitz & Planting.

² Estimates of the use of imported intermediate inputs by industries are published by BEA in the Import Matrix which can be downloaded from BEA's Annual Industrial Accounts.

$$B=Ug^{-1}$$

B is a commodity by industry matrix which shows the amount of each commodity used by an industry per dollar of industry output. W is an industry by commodity matrix which shows, for each commodity, the share of the total output of a given commodity that is produced by in each industry. I is the identity matrix.³

From the matrices B and W we can calculate an Industry by Commodity Domestic Total Requirements Table⁴ :

$$W(I-BW)^{-1}$$

The Domestic Total Requirement Table shows the industry output required from each industry i per dollar of each commodity j delivered to final users.

III. Creating the Employment Requirements Table

The next step is to calculate the Employment Requirements Table using information on employment by industry from the National Income and Product Accounts.⁵ The measure of employment used is Persons Engaged in Production, which consists of fulltime-equivalent and self-employed. If we let E be an industry by industry diagonal matrix, in which the value of the (i,i) element is employment in industry i divided by the total output of industry i, then the domestic employment requirements table is given by

$$L= EW(I-BW)^{-1}$$

This is an industry by commodity table that shows for each commodity the amount of labor required from each industry to produce a million dollars' worth of output of each commodity.

IV. Calculating Jobs Supported by Exports

The final step in calculating jobs supported by exports is to apply the domestic employment requirements table to exports to determine the total amount of labor embodied in those exports. The bulk of the export data used in the analysis is taken directly from the BEA IO Tables. However, we make several adjustments to some of the exports in the IO Tables using data from other BEA accounts and additional sources. First, the BEA export data for trade and transportation services include the value of margins used to facilitate the movement of products from factory to port. We remove estimates of the values of those margins from the export data for margin services in the IO tables as we consider the

³ B is known as the Direct Coefficients Matrix and W is known as the Transformation Matrix.

⁴ Two additional Total Requirements Table can also be calculated, the Industry by Industry Total Requirements Table and the Commodity by Commodity Total Requirements Table. Since employment is given industry and exports are given by commodity, we use an Industry by Commodity Total Requirements Table in the jobs supported by exports calculation.

⁵ Employment by industry data is contained in Section 6 of the [National Income and Product Accounts](#). Data is available on both a Full-time/Part-time employment basis and a Full-time Equivalent (FTE) basis.

employment embodied in those margins as being jobs supported by the export of the products using those services.⁶

Second, the export data in the Use table includes the values of exports of two commodities that are not associated with an industry: the rest-of-world adjustment, and scrap, used and secondhand goods. For scrap, used and secondhand goods we consider only the labor embodied in the margins used to facilitate the export of those goods as jobs supported by the export of scrap and secondhand goods.

The value of exports of the commodity rest-of-world adjustment is an adjustment that BEA makes so that the total value of exports in the Use table will match the total value of exports contained in the National Income and Product Accounts. The rest-of-world adjustment includes the value of values of goods and services sold to foreigners in the United States which we wish to treat as exports. To estimate the employment embodied in those sales we need to determine the industry which produced the good or service being sold. We use data from several supplemental sources to associate the value of these exports with a BEA IO industry/commodity. As an example, the sale of accommodation services value of exports sold to foreign visitors is part of the value of the rest-of-world adjustment and thus the value of exports of the IO commodity accommodations is given as zero in the Use table. For a value of sales of accommodations to foreigners in the U.S. we use BEA's [Travel and Tourism Satellite Accounts](#) which has estimates of such sales.

Finally, data from the [National Center for Education Statistics](#) and the [Institute of International Education](#) to estimate tuition expenditures by foreign students studying in the U.S.

If we let X be the matrix of our adjusted commodity export values, we calculate the matrix of the employment needed to produce U.S. exports as:

$$J=LX$$

J is an industry by commodity matrix in which the value of the element (i,j) is the amount of labor from industry j embodied in the exports of commodity i. The value of the sum of all the entries in column i is the total number of jobs supported throughout the economy by the export of commodity i. Summing across all columns yields the total number of jobs supported by exports.

⁶ For example, in this approach the labor embodied in truck transportation services used to move farm products to port are counted as jobs within the truck transportation industry supported by the export of farm products.

Bibliography

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