Federal Planning Bureau
Economic analyses and forecasts

Multipliers 2020: User's guide

Final demand multipliers are a standard application of Leontief's traditional input-output model. They measure the response of an economy to an exogenous shock and allow to estimate the effect of changes in final demand components (change in government expenditure, investment, exports…) on industry-level output, employment or income.

The underlying model for estimating these effects is based on the input-output table for domestic output (table 10 of the input-output tables 2020 database). This table summarises the use of domestically produced goods and services as well as the cost structure of their production.

Deriving multipliers from Leontief's input-output model

Leontief's input-output model is a demand-pull model based on the assumptions that output is determined by the final demand and that there is no constraint regarding the volume of production. Final demand is made up of consumption expenditures by households and the government, investment and exports. In this setting, an exogenous shock on final demand triggers a series of upstream effects in the economy. First, based on the model assumptions the industry affected by the exogenous shock raises its output accordingly. This is the **initial effect on production** of the change in final demand. For this additional production, the industry needs inputs from its direct domestic suppliers[1], which themselves need additional inputs from their domestic suppliers, which, in turn, need inputs from their suppliers… All effects on the direct domestic suppliers make up the **direct effect on production**, and the upstream effects on the direct suppliers' domestic suppliers and their suppliers make up the **indirect effect on production**. The sum of the initial, direct and indirect effects is the **total effect on production** of the change in final demand for the industry's output. It corresponds to the total change in domestic output in the entire economy that originates directly and indirectly from the change in final demand.

The model also allows to calculate these effects in terms of economy-wide generated income (referred to as "primary inputs", i.e. value added plus taxes less subsidies on intermediate consumption) and in terms of economy-wide generated employment. For this purpose, industry-level primary input coefficients (primary inputs per unit of output) and employment coefficients (hours worked per unit of output) are used to convert the effects on production into effects in terms of income or employment. Hence, the **initial effect on primary inputs** of a change in final demand (also referred to as initial primary inputs) corresponds to the primary inputs that are generated within the industry affected by the exogenous shock, through the increase in its output. The **total effect on primary inputs**

[1] Note that the industry also sources inputs from foreign suppliers. However, these direct intermediate imports are not taken into account in the multiplier calculation as they are leaks from the country's production cycle.

corresponds to the total economy-wide primary inputs generated in all production stages by this change in final demand (this is its net contribution to GDP). By the same token, the **initial effect on employment** (also referred to as initial employment) corresponds to employment that is generated (measured in number of hours) within the industry affected by the change in final demand through the increase in its output. The **total effect on employment** corresponds to the total economy-wide employment that is generated (measured in number of hours) in all production stages by this change in final demand.

The output, income and employment multipliers in this database have been computed at the level of disaggregation of the work format of the input-output tables, i.e. 127 SUT products. The results are reported at this level of detail as well as at the more aggregated level of 64 CPA 2.1 product categories (P64).

Multiplier definitions

All ***multipliers*** are calculated by **dividing the total effect** of a change in final demand by the **initial effect** of this change. Two alternative measures of the initial effect are used in the literature: the *exogenous final demand shock in monetary terms* or the *initial effect of this exogenous shock on respectively output, income or employment*. This leads to two types of multipliers: absolute multipliers, called ***simple multipliers***, and relative multipliers, called ***type I multipliers***.

Note: in the case of output multipliers, simple and type I multipliers are identical since the initial effect on production of the change in final demand is by assumption equal to the change in final demand.

Output multiplier

The output multiplier of a product category is the ratio between the **total effect on production** of a change in final demand for domestic output of this product category and the **initial effect on production** of this change (i.e. the change in final demand). It is expressed *as millions euros of total output per million euros of final demand*.

Simple income multiplier

The simple income multiplier of a product category is the ratio between the ***total effect on primary inputs*** of a change in final demand for domestic output of this product category and the ***exogenous shock***, i.e. the change in final demand. It is expressed as *millions euros of total primary inputs per million euros of final demand*.

Type I income multiplier

The type I income multiplier of a product category is the ratio *between the* ***total effect on primary inputs*** of a change in final demand for domestic output of this product category and the **initial effect on primary inputs** of this change. It is expressed as *millions of euros of total primary inputs per million euros of initial primary inputs*.

Simple employment multiplier

The simple employment multiplier of a product category is the ratio between the ***total effect on employment*** of a change in final demand for domestic output of this product category and the ***exogenous shock***, i.e. the change in final demand. It is expressed in *thousands of hours worked per million euros of final demand.*

Type I employment multiplier

The type I employment multiplier of a product category is the ratio between the ***total effect on employment*** of a change in final demand for domestic output of this product category and the ***initial effect on employment*** of this change. It is expressed as the *total amount of hours worked per initial hour worked*.

How to use these multipliers

The aim of the examples below is to provide guidance for the user in choosing the appropriate multiplier to answer a specific research question and in interpreting results.

Example 1 - What is the impact on output, employment and income of an increase of 30 million euros in the exports of prefabricated wooden buildings manufactured in Belgium?

Impact on output

In response to this additional demand from abroad, the Belgian wood industry (SUT product category 16A) increases its production by 30 million euros. This additional production of the wood industry affects the production of other industries through the wood industry's intermediate input purchases. Its main suppliers are forestry (for unprocessed wood), the wood industry itself (e.g. for lumber used in prefabricated wooden buildings), wholesale trade, road transport services and the chemical industry (for glue and other chemical products).

The **total effect on production** is calculated by multiplying the increase in exports by the corresponding industry's *output multiplier*. The total impact on domestic production of a 30 million euros rise in the exports of prefabricated wooden buildings is:

€ **1.68** million of output per € 1 million of final demand for the domestically produced wood products* € 30 million of exports of prefabricated wooden buildings

= € **50 million of output** in Belgium.

Impact on employment

The rise in exports of prefabricated wooden houses also affects employment. In this example, the exogenous shock is expressed in terms of change in final demand for domestically produced wood products. Therefore, total effect on employment can be calculated using the *simple employment multiplier* (number of hours worked per million euros of final demand).

Thus, **the total effect on employment** of a 30 million euros rise in the exports of prefabricated wooden buildings is:

11.48 thousands of hours worked per € 1 million of final demand for domestically produced wood products

* € 30 million of exports of prefabricated wooden buildings

= **344,000** hours worked in Belgium.

Moreover, the *type I employment multiplier* for wood products (which amounts to **1.74** total hours worked per initial hour worked) can be used **to split the total employment effect into the initial employment effect and the direct and indirect employment effects**. Hence, the total effect of 344,000 hours worked is made up of an initial effect of 198,000 hours (= 344,000/1.74) worked in the wood industry and 146,000 extra hours generated through intermediate input purchases from domestic suppliers (direct and indirect employment).

Impact on income

The rise in exports of wood also generates income. Since the exogenous shock is expressed in terms of the change in final demand for domestically produced wood products, the total effect on primary inputs must be calculated using the *simple income multiplier* (million euros of primary inputs per million euros of final demand).

Thus, **the total effect on primary inputs** of a 30 million euros rise in the exports of prefabricated wooden buildings is:

€ **0.50** million of primary inputs per € 1 million of final demand for domestically produced wood products * € 30 million of exports of prefabricated wooden buildings

= € **15 million of primary inputs** generated in Belgium.

Moreover, the *type I income multiplier* for wood products (which amounts to € **2.13** millions of primary inputs per € millions of initial primary income) can be used **to split the total income effect into the initial income effect and the direct and indirect income effects**. Hence, the initial effect in the wood industry is € 7 million of primary inputs (= 15/2.13). The remaining € 8 million of primary inputs are generated directly and indirectly through intermediate input purchases from domestic suppliers.

Example 2 - What is the impact on employment of a rise in the output capacity of a company producing alcoholic beverages?

A producer of alcoholic beverages (SUT product category 11A) raises its output capacity and announces the creation of new jobs (120,000 extra hours worked).

Impact on employment

In this example, the exogenous shock is expressed in terms of employment generated in the alcoholic beverages industry. Hence, the total effect on employment must be calculated using the *type I employment multiplier* (total hours worked per initial hour worked).

The type I employment multiplier in the alcoholic beverages industry is 2.02. Thus, the rise in output capacity – that has an initial employment effect of 120,000 hours in the alcoholic beverages industry – generates overall:

2.02 * 120,000 initial hours = **242,034 hours** in the Belgian economy

In other words, 242,034 – 120,000 = 122,034 additional (direct and indirect) hours worked in the industries that are part of the supply chain of the alcoholic beverages industry.

Caveats

- The input-output tables for Belgium compiled by the Federal Planning Bureau are product x product tables. All multipliers presented above should therefore be interpreted in terms of product categories (or homogeneous industries).
- Leontief's traditional input-output model, from which these multipliers are derived, is based on of the following main assumptions: there is no constraint regarding the volume of production in the economy; it is a demand-pull model, i.e. production is determined by exogenous final demand; there is a fixed relationship between output and the inputs used in the production process.
- The multiplier values should be interpreted as averages. They are calculated with data on total annual output. Therefore, it is advisable to be particularly cautious when using these average multipliers to compute the effects from a marginal increase in final demand. For example, the model does not take into account possible production bottlenecks such as the lack of skilled workers.
- Multipliers are static measures that do not reflect possible changes in behaviour or strategy by companies (e.g. product or market diversification).
- The multipliers in this database only capture effects that occur upstream through supply chain links. Effects induced by changes in wages and household consumption are not taken into account.
- Type I multipliers are relative measures. They show to what extent the effect of a change in final demand on employment or primary inputs increases when direct and indirect effects are taken into account. A higher multiplier value can be driven by a stronger total effect (numerator) or a weaker initial effect (denominator).