NAM-based Multipliers: User's guide

The multipliers presented here are derived from a model based on a National Accounting Matrix (NAM). This matrix provides a framework for endogenous income formation, making it possible to derive multipliers which, in addition to upstream effects through the purchase of intermediate inputs, include induced effects of an exogenous final demand shock through household income and consumption.

The National Accounting Matrix

A NAM is a presentation of ESA-accounts in a matrix, which shows in detail the linkages between institutional sector accounts and a supply and use table or an input-output table.

While supply and use tables and input-output tables only contain information on the production and use of products, NAMs record **all transactions** taking place in an economy during a given period. In particular, they capture the relationship between the structure of production and household income formation, by adding two sub-matrices to the input-output table: one that allocates factor income to institutional sectors and another one that reports transfers between institutional sectors.

A NAM thus provides a framework in which the **full circular flow of income** is illustrated. It shows that:

❖ *The production of goods and services generates incomes accruing to the different factors involved in the* production process (labour and capital). Factor income is made up of the compensation of employees (including from abroad), taxes less subsidies on production, mixed income (income of self-employed) and gross operating surplus (capital income).

❖ *Factor income* is allocated to the different *institutional sectors* (financial and non-financial corporations, government, households, non-profit institutions serving households (NPISHs) and the rest of the world) to which the factors belong: labour income (compensation of employees and mixed income) to households and the rest of the world, net taxes on production to government and capital income (gross operating surplus) to all domestic institutional sectors.

❖ *The disposable income of the domestic institutional sectors* is obtained by adding/subtracting several property incomes as well as current transfers between institutional sectors (including with the rest of the world) to/from factor income.

❖ Part of the disposable income of households is spent on domestically produced goods and services *(final consumption expenditure for domestic output),* leading to additional *production* and hence *factor income.*

The multipliers in this database are derived from a national accounting matrix for 2010, consistent with the 2010 input-output tables for Belgium published in December 2013 (ESA 1995). This NAM covers 64 products, 4 production factors and 4 institutional sectors (households, government, corporations and NPISHs, and the rest of the world). Six accounts are provided for the Belgian economy (production account, generation of income account, allocation of primary income and distribution of secondary income account, use of disposable income account, accumulation account) as well as two accounts for the transactions with the rest of the world (current and capital accounts).

The NAM-based model

The NAM multipliers presented here are derived from a model based on the assumption that the corporations account, the government account, the capital account and the rest of the world account are exogenous, while the accounts for production, factors of production and households are endogenous.

The NAM framework then allows to jointly determine **output** by product, **factor income** by type of factor and **household income,** for an *exogenous injection into the system* and taking into account the *leakages from the system*.

Injections from exogenous accounts can be classified in three categories depending on where they occur in the system (in the production account, the factors of production account or the households account). The first category represents *changes in exogenous final demand for domestic output* (which in this case corresponds to final consumption expenditure by government and NPISHs, gross capital formation and exports). The second category represents *compensation of employees received from abroad* and the last category, *property incomes and current transfers* received by households from other institutional sectors (for example, interest, dividends, rents, social benefits, non-life insurance claims). The multipliers presented in this database belong to the first category of injections.

Imports, compensation of employees paid abroad, direct and indirect taxes, households' payments to other institutional sectors and households' savings are *leakages from the system* and are not taken into account in the NAM multipliers calculation.

NAM multipliers

The NAM-based multipliers database presents output, factor income, household income and employment multipliers arising from a change in *exogenous final demand for domestic output of a product*. These multipliers have been computed at a level of disaggregation of 64 CPA 2008 product categories (P64).

Output, factor income and household income multipliers

The NAM provides a coherent framework with endogenous household income formation, allowing to *jointly* measure the impact of a change in exogenous final demand on economy-wide output, factor income and household income. Therefore, output multipliers include not only upstream supply chain effects but also the effects induced by household income and consumption.

To illustrate this, let us take the example of a change in exogenous final demand for domestic output of a product and see how this shock is transmitted through the economy.

First, under the model assumption of no production constraint, the industry receiving the additional demand increases its output accordingly. 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... **The additional output resulting from this mechanism** is equal to the *output multiplier derived from the standard Leontief input-output model*. The additional effects induced through household income are not taken into account.

Furthermore, for this increase in output, the industry and its supply chain need additional production factors (the model assumes that these are underemployed). In turn, this raises factor income and the income of the households to which these factors belong. As households spend part of this additional income on domestic goods and services, a new round of income generation starts. There is a further increase in production which generates extra income. Through this mechanism, the model captures the **additional multiplier effects on output,** i.e. the **induced** effects **from the circular flow of income** (output, production factors and households). The calculation of the effects on output yields at the same time the **total effects** of the change **on both factor income and household income**.

The output, factor income and households income multipliers respectively correspond to the **ratio between the total effects** of the change in exogenous final demand **and the exogenous change** itself. They are expressed *in millions of euros per million euros of exogenous final demand*.

Employment multipliers

The model also allows to calculate the total effect of a change in exogenous final demand on economy-wide employment by converting the output change resulting from the change in final demand into a change in terms of employment. This conversion is made at each production stage by multiplying by the industry-level employment coefficient, i.e. the number of jobs (number of persons) per million euros of output.

The NAM-based multipliers database contains two different employment multipliers. The first one is an ***absolute employment multiplier*** and is obtained by dividing the ***total effect on employment*** of a change in exogenous final demand by the **change in exogenous final demand**. This multiplier is expressed in the total number of jobs *per million euros of exogenous final demand*. The second is a ***relative employment multiplier***, which corresponds to the ratio between the ***total effect on employment*** of a change in exogenous final demand and the **employment** that is immediately generated by the industry when it raises its output to satisfy the exogenous final demand (initial jobs). This multiplier is expressed as the total number of jobs per initial job.

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[1]   As a reminder, the intermediate imports are not taken into account in the multiplier calculation as they are leaks from the country's production cycle.

How to use these multipliers

> ### Example - What is the impact on output, factor income, household income, and employment of a 30 million euros increase in the exports of prefabricated wooden buildings manufactured in Belgium?
>
> #### Impact on output, factor income and household income
>
> In order to meet this additional demand from abroad, the Belgian wood industry (SUT product category 16A) increases its production accordingly (30 million euros). There are direct and indirect effects of this additional production on the output of the domestic industries belonging to the wood industry's supply chain (for example, forestry, the wood industry itself, wholesale trade and the chemical industry). In parallel, additional employment and capital is required for this extra production, leading to a rise in factor income, household income and household final consumption expenditure, which in turn induces new output, etc.
>
> The **total effect** on economy-wide **output** of a change in the exports of prefabricated wooden buildings is calculated by multiplying the change in exogenous final demand by the corresponding industry's *NAM output multiplier*, which is 2.02. Hence:
>
>> **2.02** million euros of output per million euros of exogenous final demand for domestically produced wood products * 30 million euros of exports of wood products
>>
>> = **61 million euros of output**, including 8 million euros of induced effects on output by the circular flow of income.
>
> The induced effect on output is calculated by multiplying the exogenous shock by the difference between the *NAM output multiplier* and the *IO output multiplier* (derived from the standard Leontief IO model, 1.75), i.e. 30 * (2.02 – 1.75) = 8.
>
> **The total effect on factor income** is equal to the *NAM factor income multiplier* for wood products multiplied by the change in exports of wood products, i.e.
>
>> **0.64** million euros of factor income per million euros of exogenous final demand for domestically produced wood products * 30 million euros of exports of wood products
>>
>> = **19 million euros of factor income**
>
> **The total effect on household income** is equal to the *NAM household income multiplier* for wood products multiplied by the change in exports of wood products, i.e.
>
>> **0.44** million euros of household income per million euros of exogenous final demand for domestically produced wood products * 30 million euros of exports of wood products
>>
>> = **13 million euros of household income**
>
> The increase in exports of prefabricated wooden buildings by 30 million euros leads to an additional factor income of 19 million euros in Belgium and an increase in the income of Belgian households of 13 million euros.

Impact on employment

The increase of 30 million euros of exports of prefabricated wooden houses also affects employment in Belgium. In our example, the shock is expressed in terms of a change in exogenous final demand for domestically produced wood products. Consequently, the *NAM absolute employment multiplier* (number of jobs per million euros of exogenous final demand) must be used to determine the total effect on employment.

Thus, **the total effect on employment** is equal to the absolute employment multiplier for wood multiplied by the change in exports of wood products, i.e.

   9.94 jobs per million euros of exogenous final demand for domestically produced wood products

     * 30 million euros of exports of wood products

       = **298 jobs** generated in the Belgian economy by the 30 million euro increase in exports of prefabricated wooden buildings manufactured in Belgium, of which 52 jobs induced by the circular flow of income

The induced effect on employment is calculated by multiplying the exogenous shock by the difference between the *NAM absolute employment multiplier* and the *IO simple employment multiplier* (derived from the standard Leontief IO model, 8.19), i.e. 30 * (9.94 – 8.19) = 52.