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# Technical note for input-output analysis

Documentation for the economic-wide  
employment impact of the Femern Belt  
tunnel construction

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## Preface

This is a technical note about the Input-Output model (IO) used to assess the economy-wide employment impact of Femern Belt fixed link (tunnel) construction. It describes the IO methodology as well as data sources used. Section 1 provides a general description of the input-output analysis. Section 2 explains the two steps that we follow to integrate project budget into an IO table. Section 3 deals with data that has been used as an input in the IO analysis.

## 1 Introduction to input-output analysis

*"Input-output analysis describes the analytical approach developed by Professor Wassily Leontief in the late 1930s - for which he was awarded the Nobel Prize in economics in 1973. The Input-output analysis' main purpose is to analyse the interdependence of industries in an economy and is one of the most used methods in economics."*<sup>1</sup>

The basis of an input-output analysis is the so-called input-output table. The table in each row shows how goods and services are sold to different sectors and final consumers; while in each column it describes how goods and services are purchased from different sectors, wages and salaries paid etc.

The indirect impact of industry X is calculated by estimating the value added of its sub-suppliers, which is attributed by the industry X 's input consumption. Multiplier are calculated to capture that when the sub-suppliers again purchase goods and services from others sub-suppliers, this tells us how much industry X is contributing to the value added created by its suppliers.

Induced impact of industry X is calculated by quantifying the value added generated through its employees' spending (i.e. through spending the wages and salaries paid out by industry X). This induced impact exists due to the fact that the wages and salaries will be spent in an economy, which will further generate additional value added in different sectors.

Using the same principles as above, the impact in terms of employment is calculated by using wage per employee in each sector.

The total employment contribution of an industry (direct + indirect+ induced), can be compressed into three multipliers which tell us how big the total contribution is rela-

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<sup>1</sup> Taken from introduction section of the book entitled as "Input-output Analysis- Foundations and Extensions", Second Edition, R.E. Miller og P.D Blair, 2009

tive to the value of production in the industry. Such standard multipliers can be calculated on the basis of the input-output table.<sup>2</sup>

In general, the total contribution (direct + indirect+ induced) of an industry, inter alia, depends on its share of input purchases from domestic sectors versus imports, and the amount of its primary factor payments. For example, the higher the share of purchases from domestic suppliers the higher the total contribution (through indirect effects will be and vice versa. Hence, before analysing economic impact of a given industry using IO model, a precise distribution of its revenue into purchases of goods and service across sectors and remuneration of primary factors is a very essential exercise.

The next section explains how the total construction budget for the Femern Belt project has been dealt with in the input-output analysis.

## 2 Integrating Femern A/S into the Danish IO table

So as to calculate the three multipliers (direct + indirect+ induced), the Femern Belt construction has to be integrated into the most current Danish IO table. We distributed Femern's total projected budget for the construction of the tunnel as well as its distribution into purchases of goods and services and payment of primary factors.

The total construction budget is projected to be DKK 43.9 billion in 2011 prices and 77 per cent of which is assumed to be spent on Danish economy and the rest to be spent on German and other countries economy, cf. Table 1.

**Table 1 Femern A/S' construction budget spending**

Construction budget spending	Construction budget, bill. dkk in 2011* price	Share of total budget
Danish economy	33.8	77%
German economy	6.6	15%
Other countries economy	3.5	8%
<b>Total budget</b>	<b>43.9</b>	<b>100%</b>

Note: \*The construction period is between 2015-2021, and hence we use internal discount factor of (2.56%) from Femern A/S investment plan to calculate the total budget in 2011 price.

Source: Femern A/S "Vurderinger af de beskæftigelsesmæssige effekter af byggeriet af Femern Bælt forbindelse".

We use data from Statistics Denmark on how "Anlæg af veje og jernbaner-421000" sector in the Danish economy distributes its budget into purchases of goods and service and payment of wages. We have used this data to split Femern's total budget into consumption of goods and services and payment of wages and salaries. To further split the total consumption of goods and services across supplier sectors, we make an assump-

<sup>2</sup> For detail explanation of methods of calculating the multipliers see see "Input-output Analysis- Foundations and Extensions", Second Edition, R.E. Miller and P.D Blair, 2009, Chapter 6- Multipliers in the Input-Output model

tion that, on average, Femern A/S's purchase will be similar to that of the Danish *civil engineering sector*.<sup>3</sup> A split based on this assumption is shown in Table 2 below.

**Table 2 Distribution of Femern A/S's total construction budget**

Total budget split into:	Spending, billion dkk, 2011 price	Per cent of total budget
Purchases of goods and services, domestic suppliers	18.8	56
Purchases of goods and services, Imports	6.3	19
Payments of wages and salaries	8.5	25
Gross value surplus income (return to capital)	0.3	1
Total	33.8	100

Source: Copenhagen Economics based on Input-Output data

In practice, we have added the Femern Belt project as an individual "industry" (i.e. as a separate column in the IO table) due to the fact that the tunnel construction is a future event (the construction period is 2015-2021). As the whole construction budget is integrated into the IO table, which will be spent over the construction period, the economic impact that comes out of the IO analysis will be a cumulative one.

### 3 Input-output data from Denmark Statistics

Denmark Statistics publishes the detailed input-output table with a breakdown of 117 branches every 2-3 years, while national accounts data at a less detailed level are published (38 branches) every year. Structures in the overall economy, and thus the input-output table typically do not change much from year to year.

To calculate the economic impact of Femern Belt tunnel construction on the Danish economy, we undertake an IO analysis based on 2011 data. However, the latest available detailed input-output table from Denmark Statistics is for the year 2009.<sup>4</sup> Therefore, the more aggregated production side (with 38 branches), which highlights the consumption of goods and services, production value, value added, etc. has been split into more disaggregate level (with 117 branches) based on the latest national accounts, i.e. 2011. Such process ensures that the calculations are done on the best possible basis used and the input-output table at all levels in line with the latest available national accounts data.

<sup>3</sup> 420000- (civil engineering) DST sectorial classification. Note that this sector includes a sub sector called (Anlæg af veje og jernbaner-421000).

<sup>4</sup> <http://www.statistikbanken.dk/NATIO1N>.