# EMPLOYMENT POLICY BRIEF

International Labour Office

# INVESTMENT IN INFRASTRUCTURE – ASSESSMENT OF EMPLOYMENT OUTCOMES USING MACRO-LEVEL ANALYSIS: APPROACH AND INDICATORS


This policy paper presents an overview of the approach and indicators that were used to assess the impacts of investment in infrastructure using macro-level analysis. It is based on the analysis of 11 European Investment Bank (EIB)- financed investment projects in different infrastructure sectors in Jordan, Tunisia, Egypt and Morocco. Macro-level analysis were utilized to assess direct, indirect and induced effects on production, income and employment. It is based on accounting frameworks such as the latest Input-Output tables and Social Accounting Matrices.

The macro-level analyses were supported by project-level analyses that assessed direct employment outcomes, considering quantity and quality, during construction and operation and maintenance. The project-level analysis used structured interviews, site visits and document reviews to assess direct employment outcomes. There is another policy paper that presents the approach and indicators of the project-level analysis.

This policy paper presents the findings of the macro-level analysis for the 11 projects that were assessed in 2013. It describes the approach that was used, and the indicators that could be extracted using this approach.


## Background

Preceding the global economic crisis, most of the Mediterranean Partner Countries (MPC) supported by the European Investment Bank – Facility for Euro-Mediterranean Investment and Partnership (EIB-FEMIP), saw solid growth rates and economic reforms that were successful in many sectors including infrastructure. However, this growth did not translate into sufficient job creation. The countries suffered from the global recession in 2008 and, although there are encouraging signs of economic recovery worldwide, the ILO Global Employment Report of 2014 found that those economic improvements will not be sufficient to counterbalance the supply-demand gap in the labour market that built up in recent years. In fact, development policies did not generate sufficient employment opportunities for the fast-growing population and many workers ended up taking vulnerable jobs in the informal economy. This increased the concerns about the effects on wage levels, working conditions, child labour and increased labour market non-formalization.

As a result, the EIB and the ILO undertook a joint evaluation to analyse the employment outcomes of eleven EIB financed investment projects in four different infrastructure sectors; Transport, Energy, Sanitation and Environment. The main purpose of the ILO-EIB collaboration was to formulate policy recommendations on how to better assess and monitor employment outcomes in future investments, and put forward policy recommendations to the governments of the four countries covered in the evaluation on how to increase the employment opportunities, in a manner that could also be replicated in countries with similar challenges and opportunities.

## Sectors and Projects

The eleven projects were chosen to cover the different types of infrastructure investments funded by EIB in each country. The selection considered the geographic distribution of the projects within each country, the coverage of different sub-sectors per sector, the inclusion of projects in urban and rural areas, the stage of project completion, and the extent of project implementing agency's cooperation.

**Table 1: Projects and Sectors**

| | Project | Sector |
|---|---|---|
|  | – Amman Development Corridor | Transport |
| | – Tafila Wind Farm | Energy |
|  | – Second National Program of Rural Roads | Transport |
| | – Solar Energy Plant in Ourzazate | Energy |
| | – Sanitation in Oujda | Sanitation |
| | – Sanitation in Sebou Basin | Sanitation |
|  | – Urban Priority Roads V | Transport |
| | – Power Station Sousse C | Energy |
|  | – Giza North Power Generation Plant | Energy |
| | – Egyptian Power Transmission Project | Energy |
| | – Egyptian Pollution Abatement Project II | Environment |

The study covered the four main infrastructure sectors; transport, energy, sanitation and environment. As shown in the table above, two projects were assessed in Jordan and

Tunisia, three projects were assessed in Egypt and four projects were assessed in Morocco.

## Methodology and Approach

Macro-level analysis of investment in infrastructure utilizes multiplier analysis based on accounting frameworks such as the Input-Output Table (I-O Table) and Social Accounting Matric (SAM). This analysis allows the estimation of direct, indirect and induced effects of investment in infrastructure on production, income and employment. The ILO's guide for employment impact assessment[1] identifies three varieties of accounting frameworks that can be used in macro-level analysis: (1) Input-Output Model, (2) Static SAM, (3) Dynamic SAM (DySAM). These tools are suitable to assess and estimate short-term employment impact.

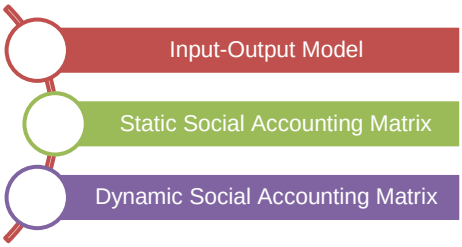


Figure 1: Varieties of Accounting Frameworks

Macro-level studies of the 11 infrastructure projects mentioned above used the latest I-O Table and SAM available in each country and estimated direct, indirect and induced effects on employment, production and income. This paper focuses on the employment outcomes that could be estimated using this approach, these are:

- Direct employment, which refers to employment created directly by the infrastructure investment project including all workers directly recruited by the main contractor and subcontracts, construction supervisor and project manager.
- Indirect employment, which refers to employment created in the backward-linked industries, supplying tools, materials, plant and equipment for the construction of the infrastructure project.
- Induced employment, which is the employment created through forward linkages as households benefitting from direct and indirect employment spend some of their additional income on goods and services in the economy.

[1] *The Employment Dimension of Infrastructure Investments, A Guide for Employment Impact Assessment, ILO, 2015.*

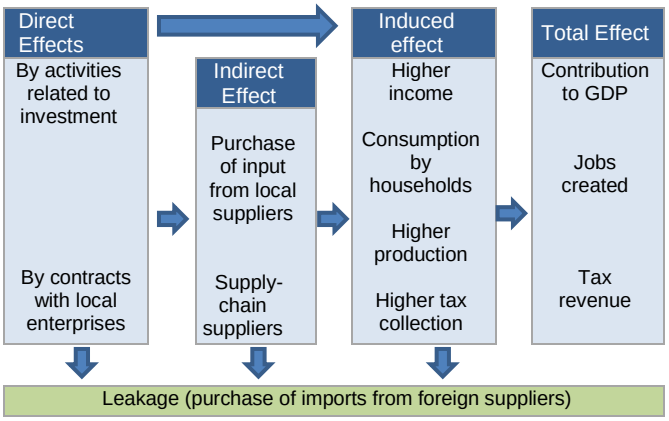


Figure 2: Direct, Indirect and Induced Effects[2]

The I-O model was originally introduced by Wassily Leontief in 1936, and is generally used to assess the impact of economic policy on productive sectors and economic agents such as households and the state. A basic I-O Table represents structural relationships between the various sectors of the economy in an interindustry matrix. Column entries typically represent inputs to an industrial sector, while row entries represent outputs from a given sector. It provides a static view of the structural relationships between the various sectors of an economy for a certain period of time.

I-O models with an employment module can be used to estimate direct and indirect employment effects of investment in infrastructure, while SAM can estimate induced effects of higher income through labour and the distributional impact of these investments. Dynamic SAM can help explain how some elements of price, productivity, behavioural changes, incentive structures and other elements affecting employment, impact change over time.

Consequently, the model could be used for analysis of employment impact, in addition to exploring policy options. All three varieties of the accounting frameworks mentioned above must be complemented by an employment satellite module or account. In addition to the assessment of employment impact, the employment satellite account can explain how employment impacts affect the different groups within the workforce.

## Indicators

Assessing employment impact of investment in infrastructure using macro-level analysis allows the estimation of a number of indicators related to direct, indirect and induced employment created by the project.

[2] *Source: Employment Impact of Infrastructure Investments in the Mediterranean Partner Countries, Study Summary Report. ILO. June, 2015*

Utilizing the findings of these 11 case studies, in addition to other studies conducted by the ILO, The Employment Impact Assessment (EmpIA) Indicators Guide identified eight key indicators that can be estimated using macro-level analysis.[3]. These indicators are:

1. Total employment in Full Time Equivalent (FTE) years per million USD which refers to the overall direct, indirect and induced employment created by each million USD of project cost. This indicator shows the full scale of employment created by the infrastructure project. Being standardized by cost allows the comparison between projects and programmes. It is calculated as: (Sum of direct, indirect and induced employment in FTE years/Total project cost in USD million).

2. Direct employment in Full Time Equivalent (FTE) years per million USD. Direct employment includes direct jobs created during the construction phase and for Operation and Maintenance (O&M) of the infrastructure once the construction is completed. This is a good indicator for the cost of generating jobs which can be compared between projects and programmes. This indicator is calculated as: FTE years of direct employment from construction / Construction cost in USD million.

3. Indirect employment in FTE years per million USD. Indirect employment includes jobs created through the backward linkages created due to the investment, mostly through suppliers of materials, tools and services. This is a good indicator for the cost of generating jobs which can be compared between projects and programmes. This indicator is calculated as: FTE years of indirect employment from construction / Construction cost in USD million.

4. Induced employment in FTE years per million USD. Induced employment is created in the economy as a result of consumption effects on goods and services generated by the households benefitting from direct and indirect employment. This indicator is calculated as: FTE years of induced employment from construction / Construction cost in USD million.

5. T1 multiplier. This indicator refers to Type I Leontief multiplier, and it shows the size of employment generated by investment in infrastructure when including indirect employment effects. It is calculated as: Sum of direct and indirect employment in FTE years/Direct employment in FTE years.

6. T2 multiplier. This indicator refers to Type II Leontief multiplier, and it shows the size of employment generated by investment in infrastructure when including indirect and induced employment effects. It is calculated as: Sum of direct, indirect and induced employment in FTE year/Direct employment in FTE year.

7. Cost per FTE year of total employment. This indicator is very similar to indicator 1 above, but presented to show the cost per job created. It is simpler, and can be interpreted more intuitively. It is calculated as: Total project in USD/Total employment (direct, indirect and induces) in FTE year.

8. Cost per FTE year of direct employment. This indicator is very similar to indicator 2 above but presented to show the cost per job created. It is simpler, and is calculated as: Total project cost in USD/Direct employment in FTE year.

The following tables list some of the main indicators calculated in the study for the 11 projects mentioned above. Table 3 includes additional indicators that allow the comparison between the three types of employment created (direct, indirect and induced).

A close look at these tables provides some key indicative conclusions. First, in Egypt and Morocco, the indirect employment effect is considerable, and even higher than the direct effect, especially in the energy sector. This was driven by the large backward and forward linkages between the public utilities sector and the construction sector.

Second, the induced effects usually compromise the smallest share of the overall employment, yet it remains significant. The large number of workers employed on the projects, and by the suppliers, generate induced employment through local consumption.

There are a number of important inputs that are required to enable the use of I-O models to assess employment impacts of investment in infrastructure. The investment level (cost of the project) is needed, in addition to cost breakdown to specify the quantities and costs of the various inputs required, and to match them to model structure. Data regarding the investment level are in principal available at the government agency implementing the project, however, obtaining this information might not be straightforward. Allocation of overhead costs, for example, is not necessarily transparent and uniform across all government agencies to individual projects. Additionally, cost breakdowns available in these agencies might not be comparable to that used for EmpIA simulation.

In some cases as well, cost related information is not available at the relevant central ministry but rather with a government agency that is tasked with overseeing project implementation. In some cases, where a project is composed of a number of sub-projects, each sub-project is implemented by a local sub-

[3] *The indicators were extracted from ILO Indicator Guide for Infrastructure employment Impact Assessment, 2015 (p.5-6, 22-23).*

agency in a different geographical location. This means that critical data required needs to be collected at the lower level rather than the central level.

Substantial differences between planned expenditures and actual expenditures should also be taken into consideration when using I-O models. Although funding may become available in a certain year, certain investments are usually implemented over a number of years. This also requires attention during the analysis of employment impacts.

There are two ways to obtain the inputs required for simulation using I-O models. First, a desk study to give an initial indication of the level of investment and cost breakdown. Second, a field visit to collect data from implementing agencies and relevant stakeholders including the implementing government agency, contractors, sub-contractors and construction supervisors. This step results in collecting more accurate data on the level of investment and the cost breakdown.

**Table 2: Employment Main Indicators Using Macro-Level Analysis for 11 Projects**

| Project | Sector | Total employment per million USD* | Direct employment per million USD* | Indirect employment per million USD* | Induced employment per million USD* | T1** | T2*** |
|---|---|---|---|---|---|---|---|
| – Amman Development Corridor | Transport | 46.2 | 17.1 | 15.2 | 14.0 | 1.87 | 2.67 |
| – Tafila Wind Farm | Energy | 52.4 | 21.5 | 18.9 | 12.0 | 1.87 | 2.42 |
| – Second National Program of Rural Roads | Transport | 76.2 | 19.9 | 31.3 | 25.0 | 2.58 | 3.83 |
| – Solar Energy Plant in Ourzazate | Energy | 39.9 | 8.2 | 28.0 | 4.0 | 4.41 | 4.86 |
| – Sanitation in Oujda | Sanitation | 82.6 | 28.7 | 42.6 | 11.0 | 2.48 | 2.88 |
| – Sanitation in Sebou Basin | Sanitation | 79.3 | 29.6 | 38.2 | 12.0 | 2.29 | 2.68 |
| – Urban Priority Roads V | Transport | 54.0 | 34.3 | 11.6 | 8.0 | 1.34 | 1.57 |
| – Power Station Sousse C | Energy | 10.9 | 6.8 | 2.4 | 2.0 | 1.35 | 1.61 |
| – Giza North Power Generation Plant | Energy | 30.5 | 5.1 | 20.3 | 5.0 | 4.97 | 5.97 |
| – Egyptian Power Transmission Project | Energy | 5.0 | 0.9 | 3.0 | 1.0 | 4.19 | 5.32 |
| – Egyptian Pollution Abatement Project II | Environment | 40.9 | 7.7 | 14.5 | 9.0 | 4.18 | 5.32 |

* Employment in FTE year.

** T1 is type I Leontief multiplier.T1=Sum(direct+indirect)/direct.
*** T2 is type II Leontief multiplier. T2=Sum(direct+indirect+induced)/direct.

**Table 3: Additional Employment Indicators Captured Using Macro-Level Analysis for 11 Projects**

| Project | Sector | Total Employment* | Direct (%) | Indirect (%) | Induced (%) |
|---|---|---|---|---|---|
| – Amman Development Corridor | Transport | 10,327 | 37 | 33 | 30 |
| – Tafila Wind Farm | Energy | 13,131 | 41 | 36 | 23 |
| – Second National Program of Rural Roads | Transport | 49,529 | 26 | 41 | 33 |
| – Solar Energy Plant in Ourzazate | Energy | 39,854 | 21 | 70 | 9 |
| – Sanitation in Oujda | Sanitation | 5,854 | 35 | 51 | 14 |
| – Sanitation in Sebou Basin | Sanitation | 7,523 | 37 | 48 | 15 |
| – Urban Priority Roads V | Transport | 8,464 | 63 | 21 | 15 |
| – Power Station Sousse C | Energy | 4,622 | 62 | 22 | 16 |
| – Giza North Power Generation Plant | Energy | 67,107 | 17 | 66 | 17 |
| – Egyptian Power Transmission Project | Energy | 3,473 | 19 | 60 | 21 |
| – Egyptian Pollution Abatement Project II | Environment | 6,132 | 19 | 60 | 21 |

* Direct, indirect and induced employment in FTE year.

## Strengths and Limitations

**Assessing employment outcomes using macro-level analysis can be implemented in many countries for EmpIA studies**. Since many countries already have recent I-O models, EmpIA studies could use these models to simulate the impact of infrastructure investments on direct, indirect and induced employment. Furthermore, the models are usually easy to use, update, calibrate, resolve and interpret and normally use readily available spreadsheet software.

**Estimation of employment impact using this approach is highly reliable.** The model is based on concrete relationships between economic sectors, which means that the results of the simulation are highly reliable. Additionally, it allows the assessment of direct, indirect and induced effects on other economic activities, and the economy as a whole.

**Adjusting the model and simulating the impact of investment does not require a vast amount of data.** Consequently, desk reviews, in addition to field visits to collect data on investment breakdown from relevant government agencies and project implementation partners, would provide sufficient data to run the simulation.

**Using I-O models allows comparison between different policy options.** This could be used to compare investments in different sectors, but also assessing the foreseeable consequences of two different technologies such as labour or capital-based construction technology. It also allows the simulation of alternative infrastructure projects such as maintenance, rehabilitation, or construction.

**I-O models are static and are based on a series of core assumptions that should be considered.** There is no perfect model to assess employment impact, and although using I-O models can provide a vast amount of relevant information for EmpIA and policy analysis, consideration should be given to the limitations of this approach. These limitations include[4]:

- An I-O model is static and uses fixed prices, so the time factor could not be taken into account. Behaviour of enterprises or consumers, in particular, cannot be taken into consideration. The model does not take into account the changes in technical coefficients such as labour productivities or possible substitution between labour and capital.
- The model describes the production and consumption sides of the economy (truncated economic cycle). Consequently, distributional and social effects cannot be analysed.

[4] *The Employment Dimension of Infrastructure Investments, A Guide for Employment Impact Assessment, ILO, 2015.*

## Policy Recommendations

EmpIA studies raise awareness on the employment impacts of infrastructure investments. In addition to informing policy makers about the employment dimensions of such investments, they support the development of employment related and wider policies and strategies appropriate to the labour market context and employment creation priorities.

The use of macro-level analysis to assess direct, indirect and induced employment of investment in infrastructure provides a relatively simple and reliable approach for EmpIA studies. It provides quantitative data on the overall employment generation, and the effects of the investment on the economy as a whole. Furthermore, it allows the calculation of a number of principle indicators that describe different dimensions of employment. In order to expand the use of macro-level analysis to assess employment of investment in infrastructure, below are some practical recommendations.

- Improve monitoring of employment in infrastructure projects. Recording of employment data on regular basis using simple spreadsheets or Management Information Systems (MIS) can significantly improve the data available for EmpIA studies. Employment data should include categories of staff, hours worked by each and average wages for each category. This data should be disaggregated by sex and age group, and supported by sufficient details on other cost elements of the project.
- Ensure that project/investment expenditures are broken down with precision according to the structure of the I-O model. This will increase the reliability and accuracy of the study findings.
- Conduct analysis of completed projects to capture the employment impact of investment in infrastructure. This will facilitate future decision making, and particularly allows the assessment of trade-offs with other investment alternatives in which employment can outweigh other criteria.
- Staff from government agencies and research institutes could be trained on standardized macro-assessment methods to create a pool of local competent experts that could undertake the assessment of completed project or simulation of alternative policy options.

## Key ILO resources

1. Macroeconomic Employment Impact of EIB Infrastructure investment in Jordan. Final Report – Jordan. October, 2014.
2. Macroeconomic Employment Impact of EIB Infrastructure investment in Tunisia. Final Report – 2014.
3. Macroeconomic Employment Impact of EIB Infrastructure Investments in Egypt. Final Report – September, 2015.
4. Macroeconomic Employment Impact of EIB Infrastructure investment in Morocco. Final Report – October, 2014.
5. ILO Data Guide for Infrastructure Employment Impact Assessment, 2016.
6. Employment Impact of Infrastructure Investments in the Mediterranean Partner Countries, Study Summary Report. June, 2015.
7. The Employment Dimension of Infrastructure Investments, A Guide for Employment Impact Assessment. 2015.

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For more information on links between infrastructure investment and employment creation, visit the website of the Employment Intensive Investment Programme:

http://www.ilo.org/global/topics/employment-intensive-investment/lang--en/index.htm