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Assessing the Regional Economic Benefits of Public Investments

A Replicable Methodology and Case Study Application to the Dominican Republic

Pablo Anton
Nassim Alemany
Luis Schloeter

Inter-American Development Bank
Housing and Urban Development Division

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Ministerio de Turismo
REPÚBLICA DOMINICANA

GOBIERNO DE LA REPÚBLICA DOMINICANA
ECONOMÍA, PLANIFICACIÓN Y DESARROLLO

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We express our gratitude to our institutional partners across both public and private sectors for their invaluable contributions to this research. Special thanks go to the Ministry of Economy, Planning, and Development (MEPyD) for its crucial role in granting access to essential economic data at both national and regional levels within the Dominican Republic. Our appreciation also goes to the Tax Administration of the Dominican Republic (DGII) for providing anonymized firm-level data, which has been instrumental in enabling our analysis of economic interactions between firms and regions. Furthermore, we are grateful to the Ministry of Tourism (MITUR) for providing detailed data essential for our case study on the rehabilitation of the Colonial City of Santo Domingo, including disbursements and planned investments. This information has been vital in evaluating the program's economic benefits on the regional economy. Additionally, our research has benefited significantly from the participation of numerous Dominican companies that have anonymously contributed data through surveys. Their engagement has been crucial in enriching the depth and breadth of our study. We extend our thanks to everyone involved for their indispensable support in this project.

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FOREWORD

Assessing the economic effects of public investments offers compelling evidence of their social, economic, and financial benefits. At the Inter-American Development Bank (IDB), we consider the measurement of our programs' effectiveness as a core institutional commitment. It is a crucial step for evaluating the outcomes of our programs and gauging the extent of our success in meeting development goals for our member countries.

We are excited to introduce a groundbreaking tool, developed in collaboration with the Dominican Republic's Ministry of Economy, Planning, and Development. This tool is designed to assess the potential economic benefits of the IDB's operations and public investments at the subnational level. It empowers local and national governments to allocate public resources more effectively through informed decision making, vital in contexts where resources are limited and the need to ascertain the added value of investments is paramount.

To illustrate the capabilities to the tool, we have applied the methodology to the region of Ozama in the Dominican Republic. As exemplified by the Colonial City of Santo Domingo program, the tool allows to showcase how the benefits of urban regeneration investments could support a thriving local economy. The case study reveals that the investments under consideration could add USD 100 million (0.014% of GDP) in domestic value added (VA) during the project's lifespan (2021-2026), creating 1,250 jobs annually. Notably, 65% of the VA increase and 52% of the job creation are expected in the Ozama region (Greater Santo Domingo), attributed to its diverse production chain and superior productivity relative to the rest of the country. After the program's completion we anticipate a boost in tourist spending in the Historic Center by an additional USD 13 million, resulting in a potential GDP contribution of USD 21 million (0.015%) and the creation of approximately 1,990 jobs, nearly half of which will be in the Historic Center itself.

Finally, we have developed a detailed technical guide that simplifies the adoption of this tool in any other region. The potential to replicate this methodology across Latin America and the Caribbean marks a significant step forward in assessing the potential economic benefits of public investment programs to highlight their contributions to the local and region wide economy.

Katharina Falkner-Olmedo
IDB Representative in the Dominican Republic

CONTENTS

LIST OF FIGURES

LIST OF TABLES

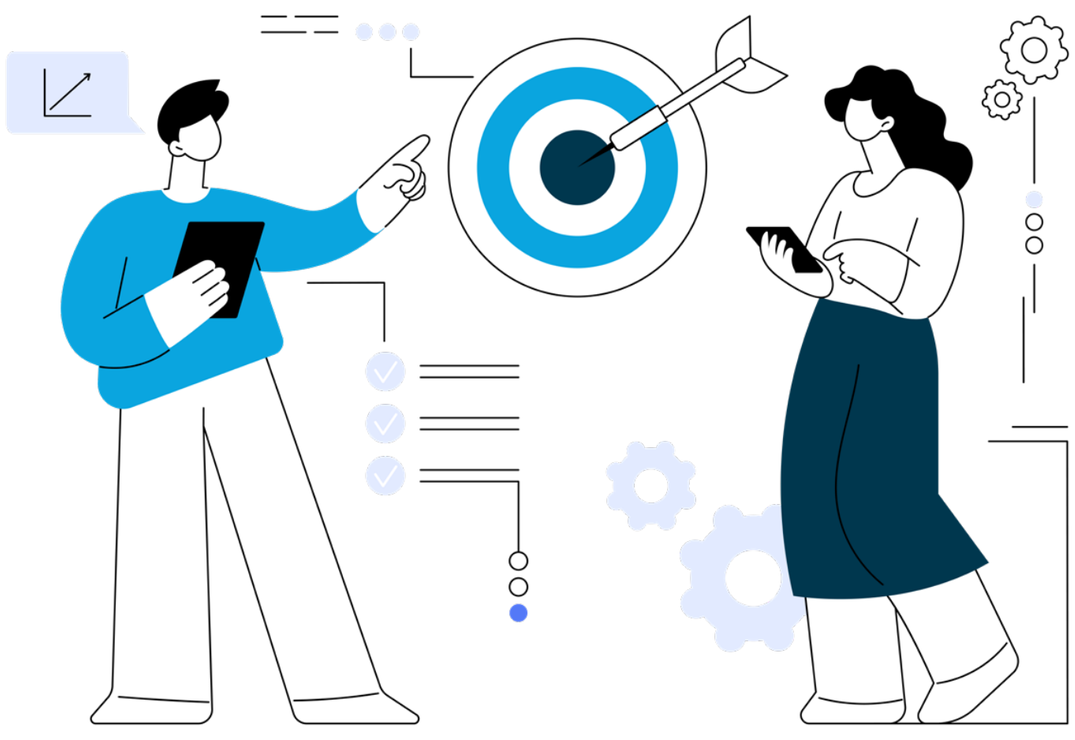
LIST OF BOXES

ABBREVIATIONS

ADB	Asian Development Bank.
ADN	Ayuntamiento del Distrito Nacional.
BCRD	Banco Central de la República Dominicana.
CBA	Cost Benefit Analysis.
CCSD	Colonial City of Santo Domingo.
CERF	Central Emergency Response Fund (United Nations).
DEBRIOT	Double-Entry Bi-Regional Input-Output Tables.
DEE	Directorio de Empresas y Establecimientos.
DGII	Dirección General de Impuestos Internos.
DR	Dominican Republic.
EBRD	European Bank for Reconstruction and Development.
EC	European Commission.
ECLAC	Economic Commission for Latin America and the Caribbean.
EIB	European Investment Bank.
ENAE	Encuesta Nacional de Actividades Económicas.
ENFCT	Encuesta Nacional Continua de Fuerza de Trabajo (BCRD).
ENGIH	Encuesta Nacional de Gastos e Ingresos de los Hogares (BCRD).
EPEC	European PPP Expertise Centre (European Investment Bank).
GDP	Gross Domestic Product.
GHG	Greenhouse Gases.
GTAP	Global Trade Analysis Project.
GVA	Gross Value Added.
IDB	Inter-American Development Bank.
IEG	Independent Evaluation Group (World Bank).
IMF	International Monetary Fund.
IO	Input-Output.
MDB	Multilateral Development Bank.
MEPyD	Ministerio de Economía Planificación y Desarrollo.
MINC	Ministerio de Cultura.
MITUR	Ministerio de Turismo.
MRIO	Multi Regional Input Output model.
ONE	Oficina Nacional de Estadística de República Dominicana.
OECD	Organization for Economic Co-operation and Development.
OPCS	Operations Policy and Country Services (World Bank).
SAM	Social Accounting Matrix.
SME	Small and medium-sized enterprise.
UN	United Nations.
UNDP	United Nations Development Program.
UNWTO	United Nations World Tourism Organization (UN Tourism).
WB	World Bank.
WBG	World Bank Group.

EXECUTIVE SUMMARY

This study presents and discusses a methodological framework to assess the benefits of public investments in the regional economy.



Assessing the regional benefits of an investment is a difficult task due to limited resources and data availability. This often leads stakeholders to overlook them when designing an intervention. In subnational governments this can be even more acute as resources tend to be more limited. Within this context, the objective of the work is to improve the operational efficiency at the early stages of any investment project by quickly providing an assessment of their potential benefits to the local economy. The framework aims to bring a data driven approach for better decision-making surrounding local public investments in a cost-effective way. The focus of the study is on the subnational level that we refer to as either regional or local.

The methodology develops an assessment tool that can be easily adapted to any region using frequently available economic statistics. Based on input-output analysis to derive the economic multipliers, we refine existing regional approaches to enhance our understanding of local economic linkages. The approach is adaptable to new regions in different countries once all the necessary data has been compiled for the geography of interest. Calibrating a new regional model requires following a 9-step framework with a minimal set of inputs from the end user.

In coordination with the MEPyD we applied the methodology to the region of Ozama in the Dominican Republic to build a pilot version of the tool. In the process we identified relevant sources to understand the Dominican supply chain, regional economic data covering the Ozama region and data gaps to be either estimated from primary data sources or collected via surveys. Most of the data needs were covered by primary data facilitated by the MEPyD and other Dominican administrations. In light of the lack of data on regional technology and inter-regional trade we conducted a specially designed survey of firms operating in Ozama across all sectors. The surveyed supply chain links between Ozama and the rest of the Dominican Republic are reflected in the resulting model across fifteen economic sectors.

We used the Ozama calibrated tool in a case study of a recent IDB program in the Colonial City of Santo Domingo (CCSD). The program was approved in 2016 to support the rehabilitation of the CCSD through the investment of USD 90 million. We modeled the different planned purchases of the investment program through the regional tool to derive the propagation of the benefits across the regional and national economy.

The CCSD case study found that 65% of all the potential GVA effects of the investment would materialize in Ozama. The planned investments could contribute 0.014% of GDP across the national supply chain during each year of investments and 0.015% afterwards on an annual basis. The GVA effects are concentrated in Ozama, thanks to a diversified regional supply chain that is able to respond to the changes in demand introduced by the intervention. When looking at employment, only 52% of the national effects would occur in Ozama, reflecting the specialization of the region into higher productivity sectors relative to the rest of the Dominican Republic.

The development of the methodology and its application to Ozama demonstrates the tool's potential to support decision making at the early stages of public investments. It can be particularly useful in the context of Cost-Benefit Analysis (CBA) to quantify the ex-ante economic benefits as they propagate through the supply chain and the national territory. This first version of the tool captures the potential short-term changes to GVA, employment, imports and fiscal receipts across both the region of interest and the national economy. While the tool is currently neither able to quantify long term effects nor their additionality, further developments will attempt to expand its functionalities to better account for them.

INTRODUCTION

Context and objectives of the study

Measuring economic effects is a powerful and persuasive approach for capturing evidence of the potential economic, social and financial benefits that can result from public investments. It not only allows to evaluate the economic return on investment, but also to demonstrate its potential to support the local economy and its development. In public finance, where contributing to economic development is a central success metric,[1] being able to quantify those benefits is important to justify the intervention. Using detailed appraisals to identify social, environmental and economic benefits can also help compare different investment options.[2]

At the national level, economic appraisals frequently rely on multiplier analysis based on input-output tables.[3] The analysis produced by input-output modeling is practical and quantitative.[4] The multiplier approach requires modeling policy interventions as changes to final demand to calculate how they translate into changes to the total output of the economy. Interventions can be positive shocks like an investment in the construction of infrastructure, or negative ones like factory closures or divestments. When used correctly, input-output models can allow businesses and governments to estimate the potential effects an economic shock may have in the short to medium term.[5] These models are designed to estimate all the ways that spending in one sector can propagate throughout the economy via supply chain interactions with the other sectors.[6] Input-output tables are usually compiled at the national level since getting granular data at regional or local level is infrequent.[7] For the decision maker, it is precisely at the most granular level that benefit analysis is most needed.

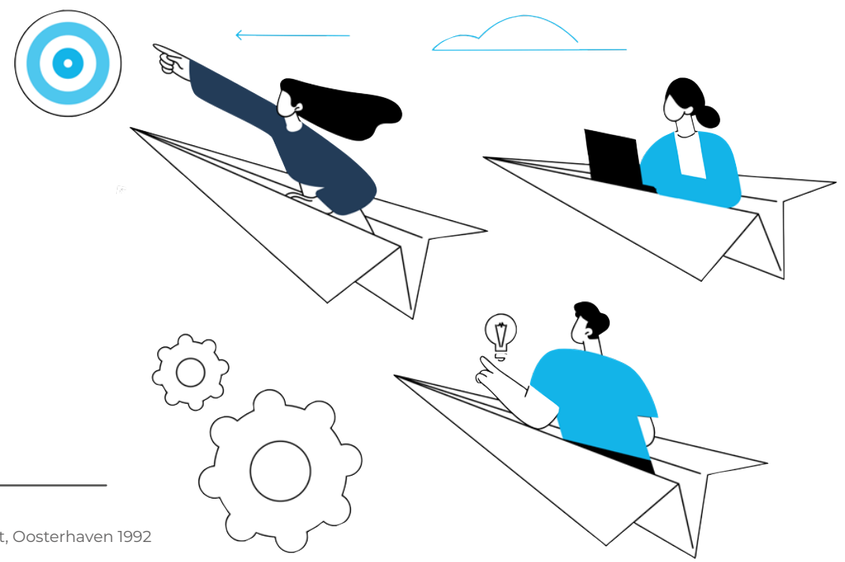
In the subnational context, the lack of ready to use data and limited resources for investment appraisal can pose a challenge to the assessment of economic benefits.[8] The subnational economy refers to the economic activities within a specific region or administrative division within a country. Subnational entities typically include provinces and regions, or other similar administrative units below the national level. Throughout this study, we use the term "regional" to describe economic dynamics on a localized scale within a country. When planning a regional investment, it is important to understand the different

[1] UN 2009
[2] OECD 2014
[3] ADB 2014
[4] van Leeuwen, Piet 2005
[5] Koks, E. E., Carrera, L., Jonkeren, O., Aerts, J. C., Husby, T. G., Thissen, M., Standardi, G., Mysiak, J. 2016
[6] Scandizzo P., Pierleoni M. 2020
[7] Hall, K. 2012
[8] IMF 2024 - Data for Development
[9] OCDE 2019

benefits it will have across the whole economy.[9] Focusing only on the region receiving the investment might be too restrictive in a tightly integrated economy as other regions are likely to also benefit through supply chain interactions. This type of comprehensive assessments can be costly. National planners are advised to consult the local administrations as they may have valuable information on the local context and opportunities that they would otherwise miss.[10] On the other hand, the regional administrations will struggle to contextualize the regional benefits within the whole national effect. Due to incomplete information and the complexity of gathering trusted data, many institutions do not fully assess the potential socioeconomic benefits of their investments for promoting regional economic development. Having a simple way to reconcile the two dimensions of the regional and national benefits within a single framework would provide both local and national administrations with a powerful tool to conduct comprehensive benefit assessments.

The objective of this work is to present a replicable methodology for a tool to assess the regional benefits of public investments. The methodology allows to build and calibrate a regional input-output model for regional economic analyses based on the DEBRIOT approach.[11] The tool improves decision making in investment allocation by quickly informing benefit assessments during early design or implementation phases. The approach is scalable to new regions in different countries once all the necessary data has been compiled for the geography of interest. We envisioned this as an easy-to-use approach where the user is required to provide a minimal set of inputs to adapt it to any new region. Once calibrated, the main inputs required to assess the economic benefits of an intervention are information of what the investment consists of and the purchases it will finance, broken down by sector of economic activity.

After discussing the methodology, we demonstrate the use case of the tool in a pilot application in the region of Ozama in the Dominican Republic. The calibrated bi-regional model captures the supply chain links between Ozama and the rest of the Dominican Republic. It can model shocks to any of the fifteen sectors considered in either region. Using a recent IDB program to support the rehabilitation of the CCSD[12] as a case study, we show how the tool can be used for assessing the ex-ante economic benefits of projects at early implementation stages throughout the regional and national supply chains.



[10] OECD 2022
[11] Boomsma, Piet, Oosterhaven 1992
[12] IDB 2016

Outline summary

CHAPTER 1

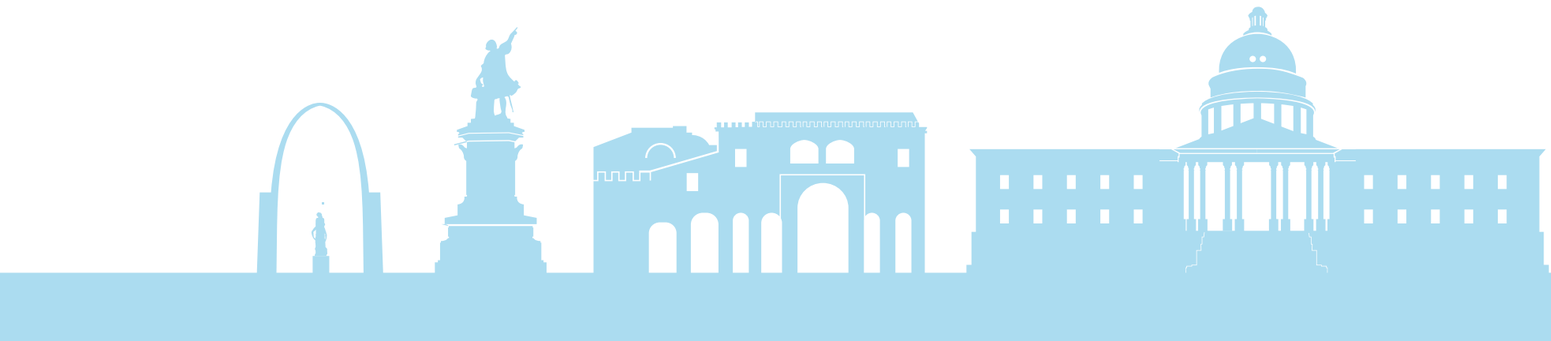
Presents the background and discusses the justification to develop a tool to assess the regional economic benefits of public investments.

We discuss the concept of impact and the difficulty of estimating it, especially in the context of public finance. In the presence of limited resources, it becomes especially difficult to conduct an assessment of the intervention's impacts when appraising the investment. We discuss the need for a functional collaboration between national and local governments to better assess economic benefits through ex-ante cost-benefit analysis. Understanding how investments will support the economy allows stakeholders to best channel funds towards the opportunities with the highest benefits. We will also emphasize the importance to focus on the localized effect in the region where the intervention occurs as it will witness the main source of benefit at the expense of other areas.

CHAPTER 2

Introduces the technical framework and methodology to build the tool while taking into account the most frequent data limitations found by practitioners.

The chapter starts with a general introduction section to the foundations of multiplier analysis and its building blocks. We focus on the structure and interpretation of the input-output table to set the ground for the inner workings of multiplier analysis. A full section is dedicated to how the regional dimension can be embedded in multiplier analysis in the absence of a ready to use regional table through a dedicated regionalization methodology. We give a detailed account of the approach to combine a national table with regional economic statistics to build the regional input-output model.



CHAPTER 3

Discusses the process required to apply the theoretical regionalization methodology to the region of Ozama in the Dominican Republic.

We start with data scoping and the identification of data gaps to be plugged using ad-hoc firm level surveys. A special emphasis is given to the compilation of the surveys that were conducted in Ozama stressing the main challenges and lessons derived from the collection process. The resulting bi-regional model captures the supply chain links between Ozama and the rest of the Dominican Republic.

CHAPTER 4

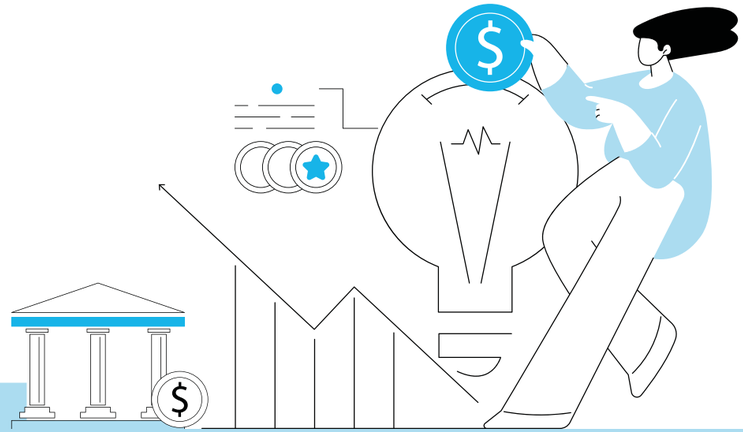
Presents the findings from applying the Ozama regional tool to assess the benefits of the IDB rehabilitation program of the CCSD.

The revitalization program used as a case study aims to enhance the CCSD touristic potential while strengthening the local economy through investments to foster its infrastructure. We modeled all components of the investment in CCSD through the Ozama calibrated tool to assess its potential economic benefits. We further discuss how the IDB estimated effects after program completion on the touristic sector of the Colonial City could translate into a sustained increase in the regional supply chain's activity.

CHAPTER 5

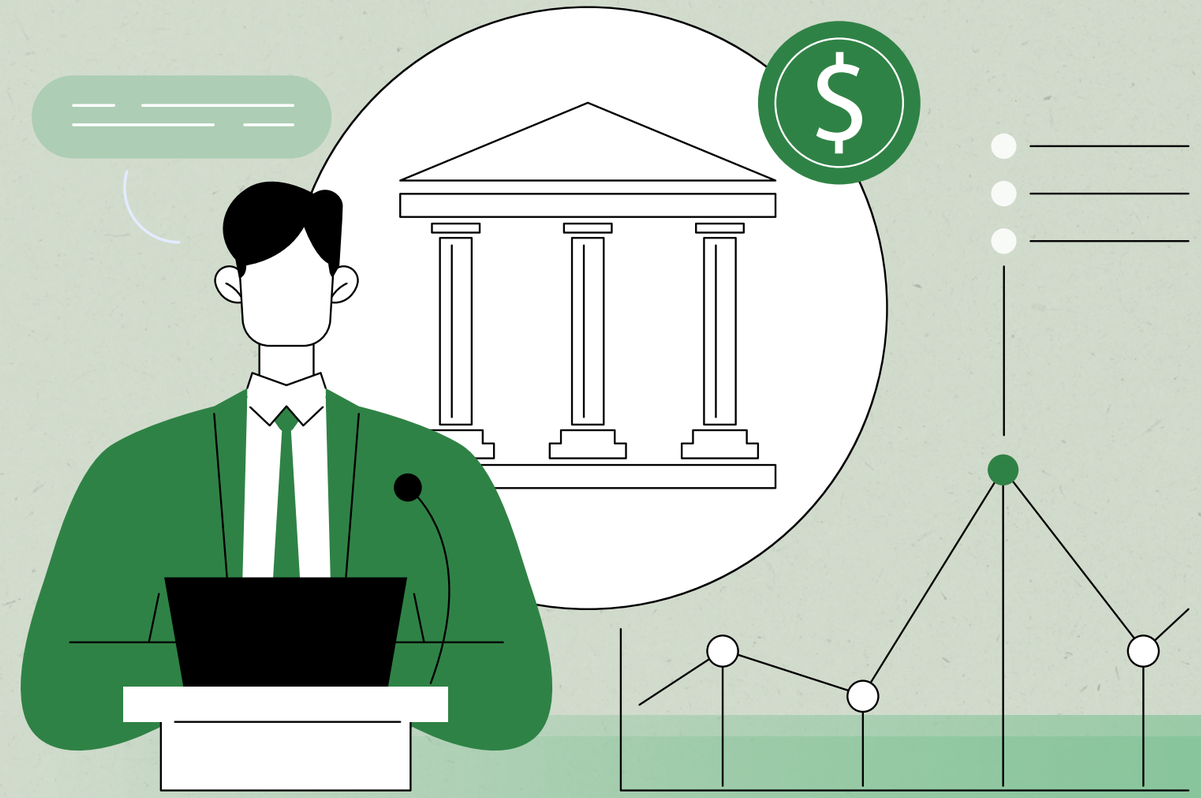
Discusses the replicability of the methodology and its potential application to any region.

Throughout the study we have ensured that the developed methodology is simple to apply and replicable. We provide a nine-step detailed framework for practitioners that would like to apply it to build the regional tool to any region where they may be interested in assessing the benefits of a public investment. To implement the methodology in Ozama, we built a software package that allows calibration of the regional model to any region and use it in a simple way to run shocks and evaluate their benefit. We finally discuss potential improvements to the tool to address its current limitations.



CHAPTER 1

ASSESSING THE BENEFITS OF PUBLIC INVESTMENTS IN THE REGIONAL ECONOMY



1.1

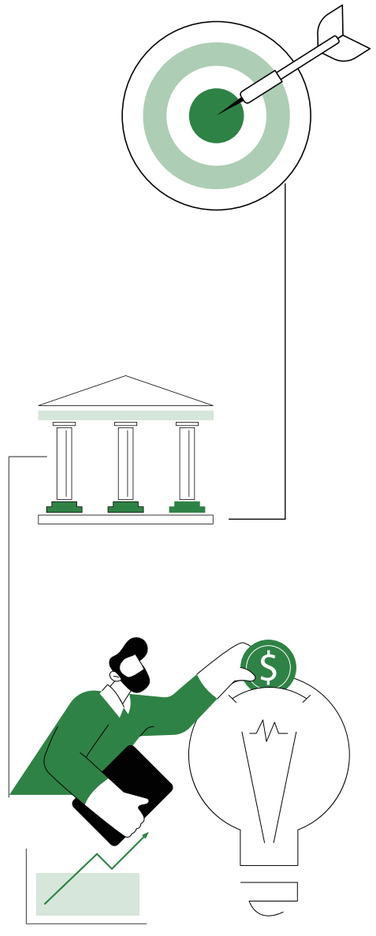
THE CHALLENGES OF QUANTIFYING THE BENEFITS OF A POLICY INTERVENTION

Public investments require clear socio-economic objectives beyond sound financial planning. They are often motivated by political goals aiming to solve a market failure and should be assessed according to their capacity to reach them.[13] According to the IDB these targeted objectives tend to focus on the promotion of economic development, the reduction of inequalities and the provision of infrastructure.[14] Partly due to their long-term horizon, these goals are hard to measure and quantify. A weak institutional environment as those sometimes found in Latin America can pose further challenges in clearly defining these objectives while adversely affecting the achievement of the desired socioeconomic outcomes.[15]

Assessing the potential outcomes of public investments can facilitate the efficient mobilization of public funds. It is important to ensure that scarce resources are used in a way that maximizes public value through the achievement of the widest possible benefits at minimal cost.[16] The OECD emphasizes the need to evaluate the social, environmental and economic benefits of any project as the only way to justify the use of public funds.[17] In the context of MDBs, the concept of additionality further requires that investments make a contribution 'that is beyond what is available from the market'.[18] The additionality requirement is meant to avoid crowding out private sector investments that would have happened anyway to focus attention on addressing market failures and better development outcomes. In light of the constraints surrounding public investments, justifying how they would achieve their social outcomes is a vital aspect to their mobilization.[19]

Despite the need to understand outcomes there is a tendency to focus on investment outputs when assessing the benefits of an investment. A useful approach is to think of outputs as tangible goods and services provided by the investment activity, like the number of kilometers of roads built.[20] Over time, those outputs are expected to lead to outcomes which correspond to the effects produced by the delivery of the investment's outputs in the target population - for example an increased level of economic activity and trade thanks to better road connectivity.[21] The main complexity in linking outputs to outcomes lies in the problem of identifying causality and the difficulty to rule out that external factors may also explain the observed outcomes. It may well be that the observed increase in trade is driven by strong global demand that would have happened without the improved roads. Measuring impact requires an understanding of the counterfactual situation where no intervention happens. The core challenge lies in the construction of a control group to make a credible counterfactual. In the absence of an experimental setup where this group can be purposely constructed as a baseline scenario, observational data will not allow us to assess causal outcomes.[22] Although experimental designs may be desirable for impact assessment, their large cost often makes them infeasible. They frequently need long timeframes to set up - sometimes several years - making them poor tools for stakeholders to execute medium term objectives. In some cases, like for infrastructure projects aimed at targeted areas, the fact that only one such region exists makes the very design of a sensible control group impossible.

Given the theoretical complexities and high cost associated with measuring impacts, focusing on the potential benefits of an intervention can provide a practical understanding of the anticipated outcome. The idea is to approximate the outcomes in a feasible way beyond the investment's outputs. As suggested by the WB, the approach to impact assessment needs to be pragmatic rather than dogmatic, and adjusted to the operational context.[23] For example, in many developing countries systematic data collection for impact assessment can be very costly as electronic data management systems and institutional capacity are not prepared for it.[24] This implies that simpler approaches to approximate the outcomes become critical as measuring impact is likely not feasible. In practice it translates to focusing on the potential benefits of an intervention and its partial equilibrium outcomes. In light of these challenges to estimate impact, we suggest focusing on the potential benefits as a cost-effective way to provide insights about the likely outcomes of an investment.



[13] OECD 2019
[14] IDB 2020
[15] IMF 2023
[16] EPEC 2015
[17] OECD 2015
[18] EBRD 2012
[19] WB 2017
[20] IEG 2012
[21] OPCS 2007
[22] WBG, IDB 2016
[23] WB 2011
[24] IMF 2024

1.2

IMPROVING DECISION MAKING THROUGH EX-ANTE ASSESSMENT

Assessing the benefits of public investments allows stakeholders to better support economic development. The main challenge in managing public investment lies in inadequate or deficient planning due to poor project appraisal based on unreliable data. In particular, the risk of investing in "white elephants" or unproductive but trendy projects can be substantially mitigated through rigorous ex-ante appraisals.[25] Analyzing the potential benefits of an investment at the initial design stage more than doubles its likelihood of achieving the intended outcomes. About 80% of projects that went through initial assessment while being designed achieved their objectives, compared with only 35% for those that were designed without a benefit analysis.[26] Early assessment becomes a clear contributor to the effective design of an investment by clarifying potential effects upfront.

Ex-ante assessment can help differentiate between different investment options and intervention designs. Such techniques can be particularly useful in understanding the anticipated effects of an intervention despite not relying on observed measurements of the actual impacts of a program.[27] Ex-ante evaluation offers strategic insights into the implications of a given investment design through a broad initial assessment identifying its potential benefits. A good framework for assessing economic benefits can support decision making at all the stages of public investment. When faced with multiple investment options, ex-ante evaluation becomes a central input to support stakeholders' understanding of the best alternatives available to reach the stated goals.[28]

[25] OECD 2019
[26] WB 1994
[27] WB 2011
[28] OECD 2014

1.3

UNDERSTANDING REGIONAL INTERVENTIONS

The assessment of public investment benefits is particularly challenging for regional and local governments. In Latin American and Caribbean (LAC) countries, 35.2% of all public investment in 2017 was carried out by local and regional governments, going as high as 40% in Colombia and Peru. This reflects an upward trend in LAC, where the share of public investments conducted by local administrations has increased 5.4 percentage points since 2007.[29] A 2017 EIB survey revealed that only 50% of subnational governments conducted independent ex ante assessments of the social benefits of infrastructure investments. Of those that do, 60% do not incorporate the assessment results into their decision-making processes, often due to lack of capacity to coordinate with the necessary bodies.[30] This challenge is more pronounced for the local governments where the absence of the necessary technical expertise, macro vision, and resources for these assessments is more acute.[31]

Regional and local administrations can benefit the most from ex-ante analysis of an intervention's regional effect. When there is a lack of capacity to formulate and execute investment strategies, policies may fall short of reaching their intended goals. This is particularly important at the local level where the correlation between the quality of government capacity and the outcomes of public investment and growth is strongest.[32] In formulating strategies tailored to specific locations, the successful involvement of regional and local governments is crucial. Their firsthand knowledge of policy complementarities and trade-offs within the region often surpasses that of central governments.[33] Better capacity to assess the regional benefits of investments could enhance their pivotal role in discerning local needs and examining synergies among investment priorities. Moreover, when national governments seek regional knowledge from local administrations it is important they are able to provide the requested technical assistance to adapt the investment to their region's needs.[34]

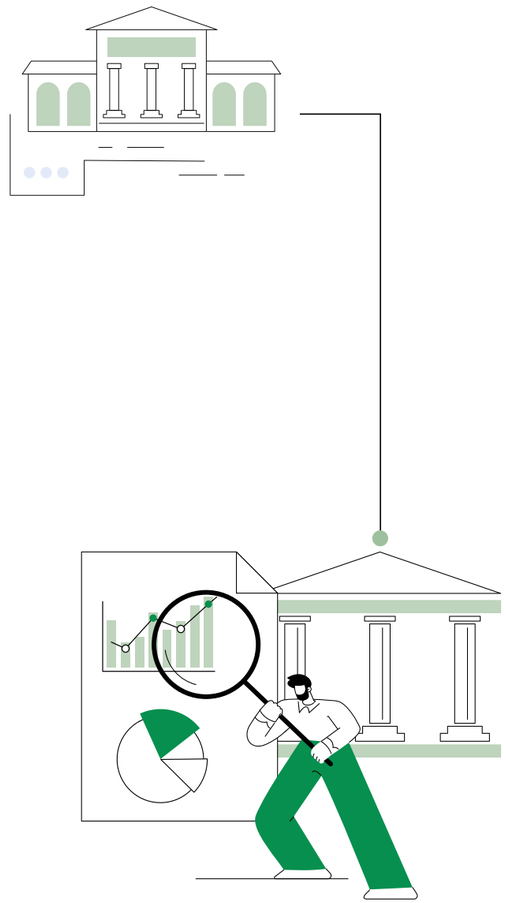
Assessing regional effects is also useful for national governments to quantify how localized investments may have spillover effects across the whole economy. Understanding how regional investments will fit within longer term objectives as they spillover to other regions via supply chain linkages can contribute to define the direction of national strategies. Crucially, it will provide a common ground for better coordination between national and local governments to increase synergies among regional investment policies.[35]

[29] OECD 2020
[30] EIB 2017
[31] OECD 2014
[32] OECD 2019
[33] OECD 2018
[34] Ter-Minassian 2017
[35] OECD 2014

1.4

A TOOL TO COMPLEMENT CBA

CBA is the most frequent approach for investment appraisals. The official policy of many MDBs like the IDB[36] and the WB[37] is to apply CBA to all relevant projects. Despite this policy, it has become increasingly common to omit cost-benefit analysis during project appraisal in recent years. While in 1970 more than 70% of projects were appraised through CBA, the share fell to 40% by 2008. The most cited reason for omitting CBA at an early stage was the difficulty to make economic analysis in the face of inadequate data.[38]



The regional tool discussed in this study provides a quantitative assessment of the potential benefits of an investment at regional and national levels. The IEG argues that CBA remains a relevant and useful tool for most investment projects. Although its practice may need to be revisited to enhance rigorous benefits assessment, it should not be abandoned.[39] The goal of economic analysis is to bring together all the benefits across all sectors and agents to provide a unified measure of value and feed into the estimation of the project Economic Rate of Return.[40] To approximate economy-wide benefits, input-output methods offer a simple and effective way to trace the direct and indirect effects of the intervention across all sectors of the economy.[41] In this context, the tool presented in the next chapter facilitates the local benefits assessment by incorporating a regional economic dimension into an IO framework.

[36] IDB Project evaluation for development effectiveness
[37] WB Cost-Benefit Analysis
[38] WB 2010
[39] WB 2010
[40] ADB 2013
[41] EC 2014

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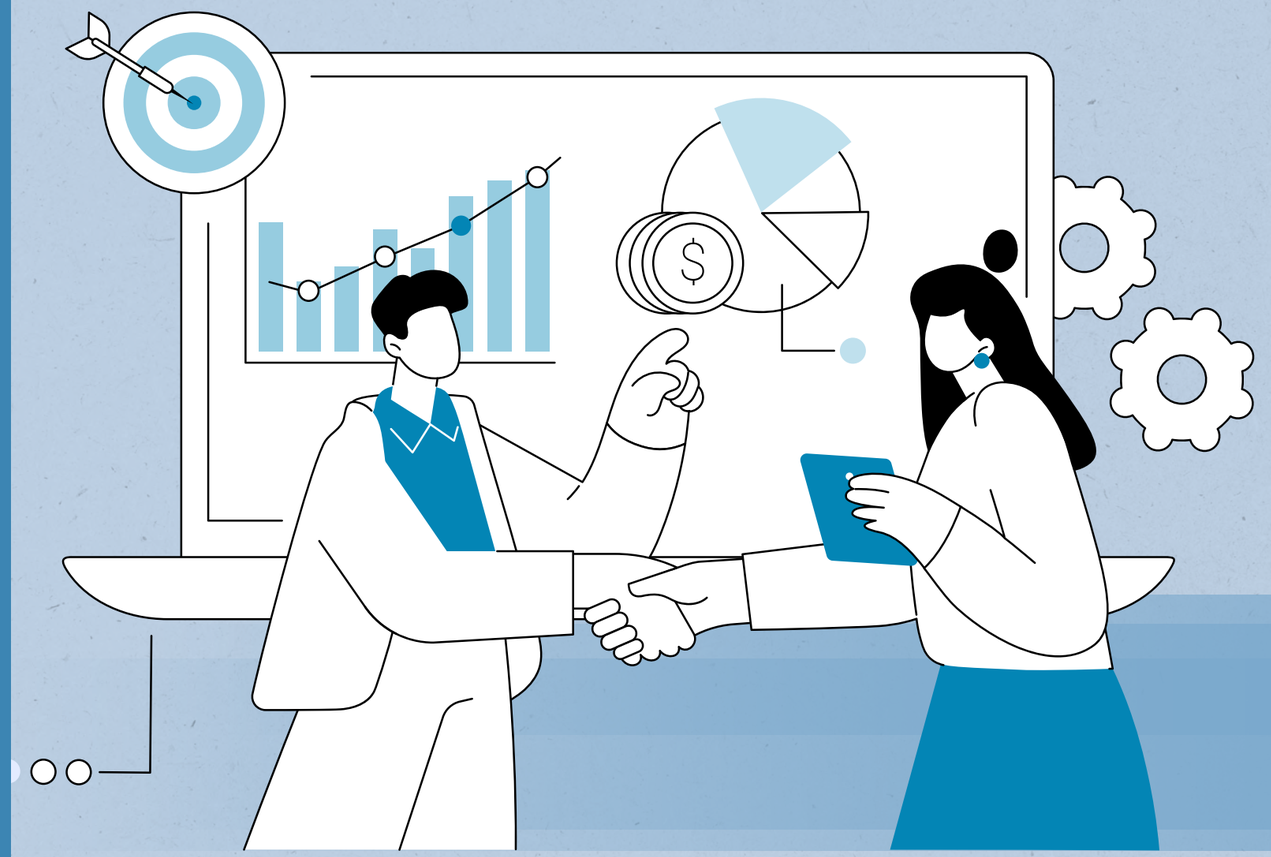
CHAPTER 2

A CONCEPTUAL FRAMEWORK FOR REGIONAL ECONOMIC ANALYSIS



2.1

FOUNDATIONS OF INPUT-OUTPUT MODELS

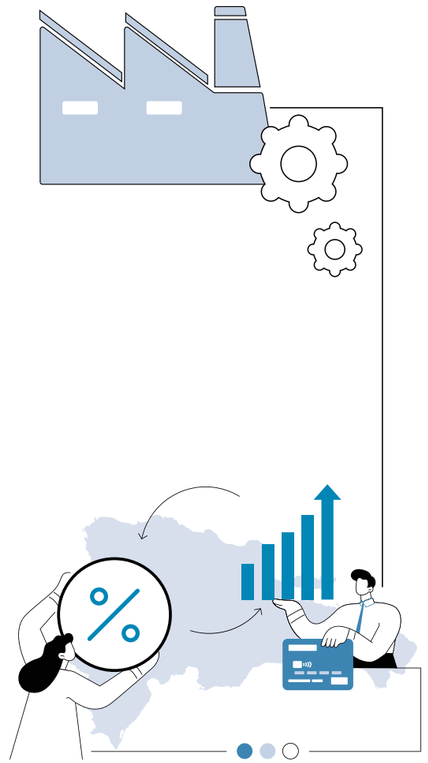
2.1.1 The Input Output table

Input-output analysis has been widely used to assess the economic benefits of investments, policy interventions and economic shocks. According to Baumol (2000), input – output analysis is one of the most widely applied methods in economics as it provides:

- A simple mathematical description of the observed economic data for a specific geographic region
- Intuitive interpretation of economic multipliers
- Fast computation and calibration

The nature of IO models is to capture the circular flow of income between the economic agents as they interact with each other. There are businesses that produce goods and services that consumers purchase from them. The households also own and work for the businesses thereby receiving income from them. The value of that income exactly equals the total value of their purchases. This is the cornerstone of the circular flow of income and expenditures where the total value of production can be measured either by the value of all goods and services delivered to consumers or by the payments for the factors of production to the households.

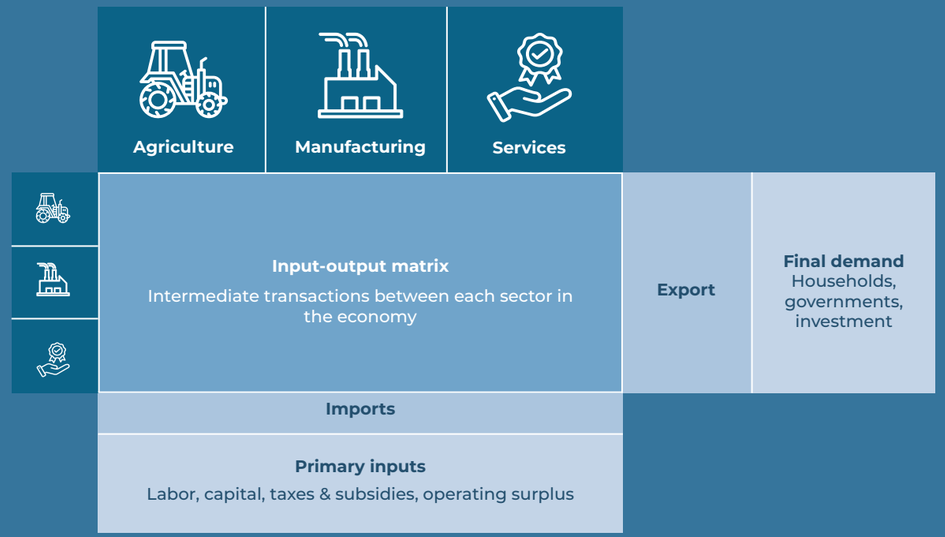
IO models are built on top of an IO table describing all economic transactions within an economy in a given year. The table quantifies all the interindustry relationships. It shows what goods and services each sector purchases, detailing the production and consumption flows across the production agents. An IO table is a square matrix where columns represent purchases and rows represent sales. The values in the table account for the monetary transactions between the row (seller) and the column (buyer).



Box 1

The structure of the Social Accounting Matrix

A SAM is a more comprehensive framework than an IO table as it not only includes the interindustry transactions (or intermediary matrix, between firms) but also incorporates data on factors of production (i.e. labor and capital), income distribution, and various other economic agents such as households, government, and the rest of the world. SAMs can be thought of as an extended IO table accounting for the distribution of income between all factors of production, government, capital accounts and households. The figure below provides a schematic representation of a SAM. Just like an IO table, it reads as: 'agents in the columns buy from agents in the rows'.



Source: authors

2.1.2 Multiplier analysis

Multiplier analysis is the concept used to measure how a change in economic activity in one sector ripples through the economy via the supply chain interactions captured by IO tables. It quantifies the effect of an initial change in spending or investment by considering how it leads to subsequent rounds of increased production in the economy to satisfy that demand shock.[42] Depending on how the multipliers are constructed, they will be decomposed either as direct, indirect or induced effects:[43]

- **Direct effects** refer to the initial change in economic activity, representing the immediate consequences of a change in spending, production, or investment in a particular sector of the economy. For example, if a company decides to build a new factory, the direct effects would include the construction jobs created and the purchases of materials and equipment directly related to the factory's construction.
- **Indirect effects are** the secondary or downstream consequences of the initial change in activity. They result from the interdependencies between different sectors of the economy. When one sector experiences a change in activity, it affects the suppliers that provide goods and services to that sector. Continuing with the factory construction example, the indirect effects would include increased production and employment in industries supplying construction materials, such as steel, concrete, and machinery.
- **Induced effects** are the higher order consequences that arise from changes in household spending as a result of changes in income. When economic activity increases due to direct and indirect effects, households may experience changes in their incomes. This in turn affects their consumption. In our example, as the construction industry and its suppliers expand, more workers in these sectors earn an income. This increased income may lead to higher household spending on goods and services, such as groceries, healthcare, and entertainment.

The IO multipliers, also called Leontief coefficients, are derived from the IO table. They consist of a set of linear equations with the number of available sectors as unknowns. Solutions to the input–output equation system are mathematically straightforward, but interesting economic interpretations are found in the algebraic results. The Leontief coefficients have a clear economic interpretation as they capture all the effects on the supply chain from increasing final demand of a given sector's products. The shock filters through the economy to satisfy the increase of demand for inputs beyond the first order effect, until it is exhausted.

To derive the multipliers let's first define Z as the transaction matrix observed in the IO table[44]. The square matrix Z describes intermediate transactions between sectors for production, of dimension n – the number of sectors. Each element represents the inputs used by sector j from sector i for producing output j.

We defined d as the vector of final demand. Each component represents the final demand for good i, from households, government, investment and the foreign sector.

[42] Blair and Miller 2009, p.243
[43] Weisbrod, G. 1997
[44] Blair and Miller 2009, chapters 1 & 2

We define x as the vector containing the value of output. Each component is the total value of domestic production for good i, combining output for final demand and intermediate demand.

Assuming a 2-sector economy, the system can be described as follows:

$$z = \begin{bmatrix} z_{11} z_{12} \\ z_{21} z_{22} \end{bmatrix}, \quad d = \begin{bmatrix} d_1 \\ d_2 \end{bmatrix}, \quad x = \begin{bmatrix} z_{11} + z_{12} + d_1 \\ z_{21} + z_{22} + d_2 \end{bmatrix} = \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

Defining i as a column vector of 1's we can write the IO system in compact matrix form:

$$x = Zi + d \qquad (1)$$

The matrix form then allows us to compute the technical coefficients representing the production technology. Equation (1) links total sectoral output to its final use (i.e., intermediate inputs $\boldsymbol{Z}$ or final demand $\boldsymbol{d}$). For each sector's inputs and outputs, we can define the technical coefficient ratio $\boldsymbol{a_{ij}}$:

$$a_{ij} = \frac{z_{ij}}{x_j} = \frac{\textit{value of product i used as inputs by producers of product j}}{\textit{value of production of product j}}$$

Defining A as the matrix of technical coefficients, $A = \begin{bmatrix} a_{11} a_{12} \\ a_{21} a_{22} \end{bmatrix}$, we can describe the economy:

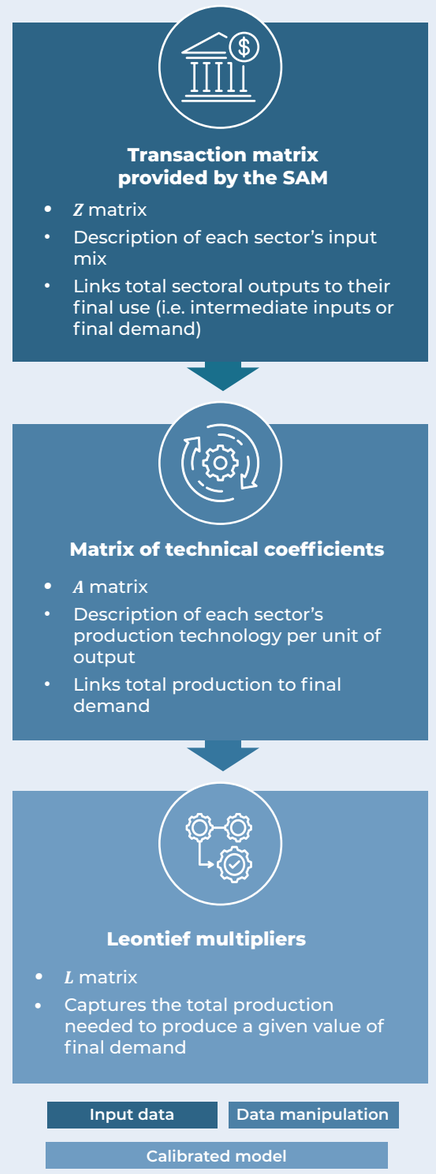
$$x = Ax + d \qquad (2)$$

Finally, the direct link between final demand and total sectoral production is captured by the Leontief coefficients. The $\boldsymbol{A}$ matrix provides a breakdown of the total sectoral outputs by end use such that $\boldsymbol{Ax}$ are the intermediate inputs and $\boldsymbol{d}$ is the final demand. Rearranging terms from equation (2):

$$x = (I - A)^{-1} d \qquad (3)$$

From the last step we derive the matrix of Leontief multipliers as $L = (I - A)^{-1}$. Given the production technology observed in the IO table, $\boldsymbol{L}$ captures how the whole supply chain reacts to a change in final demand. It captures the total production across all sectors needed to produce a given level of final demand.

Figure 1 | Steps to build an IO model from a SAM



Source: authors

The Leontief multipliers described in equation (3) only capture direct and indirect effects and are also called the 'type I' multipliers. They measure the total change in an economy's output (i.e., value of production) resulting from an initial change in demand or spending. In a sense the model is not closed as the income earned by factors and households as a result of additional production is not spent.

When adding the household as an additional agent that receives income from factors of production and consumes output, we can derive the 'type-II' multipliers. In a SAM framework where the transaction matrix is supplemented with the factor distribution of income and household consumption patterns, we can endogenize factors and households as an additional sector in the model. This will close the flow of income by ensuring the induced effect from households' increased earnings are fed through additional consumption.

Box 2

Type I and II multipliers

It is important to note that type I multipliers tend to underestimate total effects while type II multipliers tend to overestimate them. According to Miller and Blair (2009, p.253), this happens because household activities are not considered (for type-I) and due to the inflexible assumptions regarding labor incomes and the resulting consumer spending (for type-II). Both of those multipliers can be viewed as "upper and lower bounds" on the actual indirect effect resulting from an increase in final demand. A reasonable estimate typically falls midway between them (Oosterhaven, Pick and Stelder 1986).

We can combine the output multipliers with data compiled in the SAM or other sources to get the multipliers on other variables. Both type I and II multipliers refer to output as they capture the change in the value of production resulting from an intervention. While value of output is a useful metric, we'd usually want more specific effects like number of jobs or value added:

Gross Value Added

Netting out all domestic and imported inputs required to produce the total output effect we can derive the GVA effect. This is equivalent to adding factor payments together, that is labor and capital, and adjusting for indirect taxes. A SAM will usually provide the GVA content of each sector's output.

Fiscal revenue

Similar to GVA we rely on the tax content of output and consumption to get the fiscal revenue

Import

We can rely on the import content of output and consumption to derive the balance of trade effects

Employment

The SAM provides the total labor content of each sector. We can combine this information with average salaries per sector from employment statistics to estimate the employment effect. Other approaches to estimate employment effects would require sectoral level data of the job-intensity of output.

2.1.3 Incorporating the regional dimension

Including the regional dimension allows us to assess the regional economic benefits of a public investment. Most applications of input–output models are done at the national level as full tables are rarely compiled at lower geographical levels. As discussed in chapter 1, including the regional dimensions to ex-ante evaluations allows to tailor investments to each region's needs while fitting them within a wider national strategy.[45] Even at the national level, analysts and stakeholders are keen to understand how economic shocks affect different regions. It's not just about the overall sectoral output changes; understanding the geographic distribution of these changes is equally important.

The literature suggests using regional multipliers derived from a bi-regional IO model for regional analyses.[46] Early regional studies (Isard and Kuenne, 1953; Miller, 1957) used a national table of technical coefficients in conjunction with an adjustment procedure that was designed to capture some of the characteristics of the regional economies since specific coefficient tables for the regions did not exist. However, this approach failed to capture the existence of interregional trade, a central element of regional analysis. The interregional input–output model (IRIO) structure was first described by Isard (1951) and refined in Isard et al. (1960). The multiregional input–output model (MRIO) was also described in Chenery (1953) in a two-region model for Italy.

The two-region model requires a large amount of detailed data. For this reason, there have been few real-world applications. The most ambitious attempts at implementation are contained in a series of Japanese survey based interregional tables, with 9 regions and 25 sectors, beginning with 1960 and updated every five years. This very rich data source has generated a number of Japanese comparative regional studies (Akita, 1994, 1999; Akita and Kataoka, 2002).

[45] OECD 2019

[46] Witter, Dixon, Madden 2017

2.2

BUILDING A REGIONAL TOOL

2.2.1 The bi-regional SAM

Producing a regional table from firm level surveys in the economy is an expensive and time-consuming task.[47] The most common issue with survey-based tables is that it takes a great deal of time to obtain the data, organize the information, and reconcile inconsistencies – for example, reported purchases of sector i goods by sector j firms may differ from reported sales by sector i to sector j firms. Several approaches exist in the literature that attempt to adapt national tables to reflect specificities of the regional economy.

We propose using a variant of the Double-Entry Bi-Regional Input-Output Tables (DEBRIOT) to build a two regions model that accounts for both inter-regional trade within a national economy and cross-hauling.[48] The DEBRIOT regionalization methodology was developed in the Netherlands and is used to construct a bi-regional input-output table from a national table. It focuses on a two-region structure with one region of interest (referred to as "r") and the rest of the country (referred to as "s"). By leveraging sectoral sales data, it recognizes the challenges associated with cross-hauling to provide more realistic insights into regional economic interdependencies.

Re-using the 2-sector example, the national table was defined as:

$$x = \begin{bmatrix} z_{11} + z_{12} + d_1 \\ z_{21} + z_{22} + d_2 \end{bmatrix} + \begin{bmatrix} e_1 \\ e_2 \end{bmatrix} = \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

From there we want to derive a two-regions table as follows:

$$x^{reg} = \begin{bmatrix} z_{11}^{rr} + z_{12}^{rr} + z_{11}^{rs} + z_{12}^{rs} \\ z_{21}^{rr} + z_{22}^{rr} + z_{21}^{rs} + z_{22}^{rs} \\ z_{11}^{rs} + z_{12}^{rs} + z_{11}^{ss} + z_{12}^{ss} \\ z_{21}^{sr} + z_{22}^{sr} + z_{21}^{ss} + z_{22}^{ss} \end{bmatrix} + \begin{bmatrix} d_1^r \\ d_2^r \\ d_1^s \\ d_2^s \end{bmatrix} + \begin{bmatrix} e_1^r \\ e_2^r \\ e_1^s \\ e_2^s \end{bmatrix} = \begin{bmatrix} x_1^r \\ x_2^r \\ x_1^s \\ x_2^s \end{bmatrix}$$

Where:

- z_{ij}^{xy}: intermediate outputs from sector i in region x used by sector j in region y
- d_i^x: domestic final demand of outputs i from region x
- e_i^x: exports of outputs i from region x
- x_i^x: total value of output of sector i in region x
- By construction we have $x_i = x_i^r + x_i^r$ and $d_i = e_i^r + d_i^r + e_i^s + d_i^s$

The DEBRIOT methodology provides a unique regionalization approach that relies on frequently available economic statistics. The major data requirements are a national IO table and the regional sectors' value added, usually compiled by national statistical offices. Unlike other regionalization techniques, DEBRIOT places a strong emphasis on gathering data related to the sectoral composition and spatial destinations of firms' sales rather than focusing primarily on purchase data. This strategic choice is rooted in the observation that firms tend to have better knowledge of where their products are sold than where they acquire their inputs. The approach reflects a practical acknowledgment of information flows within the business environment to facilitate its compilation through targeted surveys where official statistics are not available.

[47] West 1990

[48] Boomsma, Piet, Oosterhaven 1992

Starting from a national input-output table the objective is to consistently split it into four regional and inter-regional submatrices. The national table referred to as Z^{nn} captures the national intermediate inputs used by the national industries. For the region of interest r, we want to derive the intraregional transactions matrix Z^{rr} which represents economic interactions within the region r. To account for inter-regional trade and cross hauling we'll also derive Z^{sr} (representing purchases by region r from region s) and Z^{rs} (purchases by region s from region r). Finally, we'll derive the intraregional transactions within the rest of the country (region s) Z^{ss}. The resulting bi-regional table is summarized in Figure 2. It is important to note that the following identity must hold, so that the sum of the inter-regional submatrices reflects the data in the national table:

$$Z^{nn} = Z^{rr} + Z^{sr} + Z^{rs} + Z^{ss} \quad (4)$$

Figure 2 | Representation of the two-region table

	Use by sectors in region r	Use by sectors in region s	Capitalization	Final domestic demand
Sales by sector in region r	Z^{rr}	Z^{rs}	e^r	d^r
Sales by sector in region s	Z^{sr}	Z^{ss}	e^s	d^s
Foreign imports	m^r	m^s		
Value added	v^r	v^s		

Source: Boomsma, Piet and Jan Oosterhaven 1992

The fundamental problem to regionalize a national table is the estimation of the transactions between regions and cross-hauling. In our framework, interregional trade flows are captured by the submatrices Z^{sr} and Z^{rs}. Cross-hauling refers to the situation where goods or services produced in one region are transported to another region for intermediate use in the production process, only to be later sent back to the original region as part of the final product. This type of complex interregional trade occurs by definition within a single market where no borders are crossed and trade is rarely recorded.[49] In the absence of direct trade data, interregional trade flows need to be estimated. On top of the legislation not requiring declaring goods moving between regions of the same country, many such trades occur between small firms that may not be required to register for VAT.[50] This complicates further the understanding of interregional flows in countries where the informal sector is an important part of the economy. [51]

The DEBRIOT approach requires four steps to build a bi-regional table from the national one. Figure 3 summarizes the intermediary tables that need to be built before arriving at the balanced table represented in Figure 2. Starting from a national table, we regionalize it by combining information from regional economic data.[52] Among the regional data needed, the most important input can be referred to as the 'regional domestic export coefficient'. Theoretically, a single coefficient per sector for all sales of the regional industries to the rest of the country would be sufficient. We define t_i^{rs} as the proportion of the total domestic sales of sector i produced in region r that go to region s:

$$t_i^{rs} = \frac{\text{total intermediate and final sales of sector i to region s}}{\text{total value of production of sector i in region r}}$$

[49] EC 2019

[50] HMRC 2024

[51] In Latin America, it is estimated that 46% of non-agricultural employment is informal, EC 2013

[52] National SAMs are usually compiled by the national statistics office or global databases.

Figure 3 | The four steps to regionalize the national IO table

STEP 1	STEP 2	STEP 3	STEP 4
Regional use of domestic inputs	**Regional domestic sales**	**Inter-regional transactions bounds**	**Balancing**
Build the regional intermediate tables of use of domestic inputs Z^{nr} and Z^{ns}: $Z^{nr} = Z^{rr} + Z^{sr}$ $Z^{ns} = Z^{rs} + Z^{ss}$	Build the regional domestic sales Z^{rn} for the region of interest (Capitlization) $Z^{rn} = Z^{rr} + Z^{rs}$	Using Z^{nr}, Z^{rr} and Z^{sr} estimate upper and lower bounds for inter-regional tables: Z^{rr}, Z^{rs}, Z^{sr} and Z^{ss}	The last step balances the resulting bi-regional table to ensure rows, columns and aggregate transactions are consistent with the available data

Source: authors, Boomsma, Piet, Oosterhaven 1992

2.2.1.1 *Notation*

In order to discuss the derivations required for the regionalization, we introduce specific notation for each matrix sub-table composed of a variable, a superscript, and a subscript. Taking as an example the sub-table X_{ij}^{sr} :

Variable: in this case X. It reflects the magnitude of interest, and can adopt any of the following values:

- x: value of output
- z: intermediate inputs
- d: domestic final demand
- v: value added
- m: imports
- e: exports

Subscript: refers to the economic sector. We define two generalizable sectors i and j. The presence of two subscripts indicates a flow. The first is the origin sector, the second the destination. In this case ij refers to 'from sector i to j'.

Superscripts: encodes the region where the variable is produced or demanded. Two superscripts indicate a flow. The first is the origin region, the second the destination. In this case sr refers to 'from region s to r'. It can adopt one of the following three values:

- n: national
- r: region of interest
- s: rest of the country

2.2.1.2 *Step 1: the regional use of domestic inputs*

The first step combines the sectoral value of regional output to build intermediary matrices that capture the domestic inputs used by firms in each region. At this stage we make the assumption that national and regional technology are identical on aggregate, where they only differ in the origin of inputs. For example, if the national manufacturing sector requires one third of its inputs to be energy, both regional manufacturing sectors in regions s and r will also require it. However, that third of inputs might be differently sourced from any combination of imported, regional and rest of the country goods.

Define $z_{ij}^{\cdot r}$ as the total use of products from sector i from all origins (imports, r and s), in the production of sector j in region r:

$$z_{ij}^{\cdot r} = z_{ij}^{rr} + z_{ij}^{sr} + m_{ij}^{r} \quad (5)$$

We apply the national coefficients to the regional output to estimate $z_{ij}^{\cdot r}$ as

$$z_{ij}^{\cdot r} = \left[\frac{z_{ij}^{\cdot n}}{x_j^{n}}\right] x_j^{r} \quad (6)$$

To estimate $z_{ij}^{\cdot r}$ we need to have:

- the requirement by sector j of inputs from sector i with imports $z_{ij}^{n} = z_{ij}^{rn} + m_{ij}^{n}$
- the value of regional sectoral output x_j^{r}

We can now use $z_{ij}^{\cdot r}$ to estimate the regional use of domestic inputs:

$$z_{ij}^{nr} = \left[\frac{1 - m_{ij}^{\cdot n}}{z_{ij}^{n}}\right] z_{ij}^{r} = \quad (7)$$

Note that in the situation where detailed regional import data per sector is available, we can also use the regional import ratio $\frac{m_{ij}^{r}}{z_{ij}^{r}}$

For regional final demand, an analogous formula applies:

$$d_j^{nr} = \left[\frac{1 - m_{ij}^{\cdot n}}{d_{ij}^{n}}\right] d_j^{\cdot r} \quad (8)$$

To estimate equations (7) and (8) we need:

- The value of regional final demand of each sector d_j^{r}
- The import content of production and consumption at the national level $\frac{m_{ij}^{n}}{z_{ij}^{n}}$ and $\frac{m_{ij}^{n}}{d_j^{n}}$

The same steps apply to region s.

2.2.1.3 *Step 2: the regional domestic sales*

The second step uses a weighted average of the demand structure of the region of interest and the rest of the country to estimate non-survey 'regional domestic sales' coefficients s_{ij}^{rn}. The coefficient corresponds to the proportion of domestically supplied output from sector i produced in region r that is used by sector j in region s.

$$s_{ij}^{rn} = t_i^{rs} = \left[\frac{z_{ij}^{ns}}{(z_{i\cdot}^{ns} + d_{i\cdot}^{ns})}\right] + (1 - t_i^{rs}) \left[\frac{z_{ij}^{nr}}{(z_{i\cdot}^{nr} + d_{i\cdot}^{nr})}\right] \quad (9)$$

$$s\_d_i^{rn} = t_i^{rs} \left[\frac{d_i^{ns}}{(z_{i\cdot}^{ns} + d_{i\cdot}^{ns})}\right] + (1 - t_i^{rs}) \left[\frac{d_i^{nr}}{(z_{i\cdot}^{nr} + d_{i\cdot}^{nr})}\right] \quad (10)$$

Let us break down s_{ij}^{rn} to understand what it captures:

- t_i^{rn} is the proportion of the total domestic sales of sector i produced in region r that go to region s, also referred to as the 'regional domestic export coefficient'
- $\left[\frac{z_{ij}^{rn}}{(z_{i\cdot}^{rn} + d_{i\cdot}^{rn})}\right]$ is the proportion of the total amount of output produced by sector i from all domestic sources (s and r) used as intermediary inputs by sector j in region s
- $(1 - t_i^{rs})$ is the proportion of the total domestic sales of sector i produced in region s that go to region r
- $\left[\frac{z_{ij}^{nr}}{(z_{i\cdot}^{nr} + d_{i\cdot}^{nr})}\right]$ is the proportion of the total amount of output produced by sector i from all domestic sources (s and r) used as intermediary inputs by sector j in region r

To estimate equations (9) and (10) we need:

- the outputs from the previous steps, the regional use of domestic inputs z_{ij}^{rn}, d_j^{rn}, z_{ij}^{ns} and d_j^{ns}
- the proportion of the total domestic sales of sector i produced in region r that go to region s, t_i^{rs}

From s_{ij}^{rn} and $s\_d_{ij}^{rn}$ we respectively derive the regional sales to the domestic market for intermediate use and final demand:

$$z_{ij} = s_{ij}^{rn} \left(x_i^{r} - e_i^{r}\right) \quad (11)$$

$$d_i^{rn} = s\_d_i^{rn} \left(x_i^{r} - e_i^{r}\right) \quad (12)$$

2.2.1.4 *Step 3: inter-regional transactions bounds*

In the third step we use the regional sales tables and regional domestic use tables to estimate the upper and lower bound values for inter-regional flows. The purchases of sector j in region r from sector i in region r are at most equal to either purchases of sector j in r from nationally produced output of sector i, or sales of sector i produced in r to the nation's sector j. We get the following upper bound for the region of interest:

$$z_{ij}^{rr} = (max) = min\,(z_{ij}^{nr}, z_{ij}^{rn}) \quad (13)$$

From where the lower bounds can be computed:

$$z_{ij}^{rs} = (min) = z_{ij}^{rn} - z_{ij}^{rr}\,(max) \quad (14)$$

$$z_{ij}^{sr} = (min) = z_{ij}^{nr} - z_{ij}^{rr}\,(max) \quad (15)$$

As before, we do the same exercise for final demand and derive the region r upper bounds and the inter-regional lower bounds, $d_i^{rr}\,(max)$, $d_i^{rs}\,(max)$ and $d_i^{sr}\,(max)$.

2.2.1.5 *Step 4: balancing the two-regions table*

The final step iteratively adjusts Z^{rr} and Z^{rs} to ensure the final tables are consistent with the data on interregional trade t_i^{rs}. We start by increasing $z_{ij}^{rs}\,(min)$ and decreasing the $z_{ij}^{rr}\,(max)$ values by small quantities until the compiled values t_i^{rs} can be obtained. In effect we are ensuring that the regional export coefficients can be computed from the resulting regional table while each value of the table also falls within the upper and lower bound values estimated in the previous step.

We define a parameter h to update the entries of Z^{rr} and Z^{rs}:

$$z_{ij}^{rr} = (1 - h)\, z_{ij}^{rr}(max) \quad (16)$$

$$z_{ij}^{rs}(min) = h\, z_{ij}^{rr}(max) + z_{ij}^{rs}(min) \quad (17)$$

In this step, where sector specific regional domestic exports coefficients are available, t_{ij}^{rs}, we can directly apply them to the regional domestic sales before the balancing starts. These coefficients can be compiled as part of a targeted firm level survey that has identified the most important destination sectors for each production sector. In this case:

$$z_{ij}^{rs} = t_{ij}^{rs}\, z_{ij}^{rn} \qquad z_{ij}^{rr} = t_{ij}^{rn} - z_{ij}^{rs}$$

Given the cost of compiling individual sector t_{ij}^{rs} coefficients, we'll typically only have a handful of 'important sectors', and still need applying the balancing for the majority of sectors.

Once we have derived Z^{rr} and Z^{rs} such that the implied interregional trade is consistent with our data, we derive Z^{sr} and Z^{ss}. We need to ensure there are no inconsistencies between the implied values of z_{ij}^{sr} and their theoretical minimum $z_{ij}^{sr}(min)$. Some recalibration based on the available regional data might be needed. We first derive Z^{sr} as:

$$z_{ij}^{sr} = z_{ij}^{nr} - z_{ij}^{rr} \quad (18)$$

So that the last of the four regional table, Z^{ss}, can be derived:

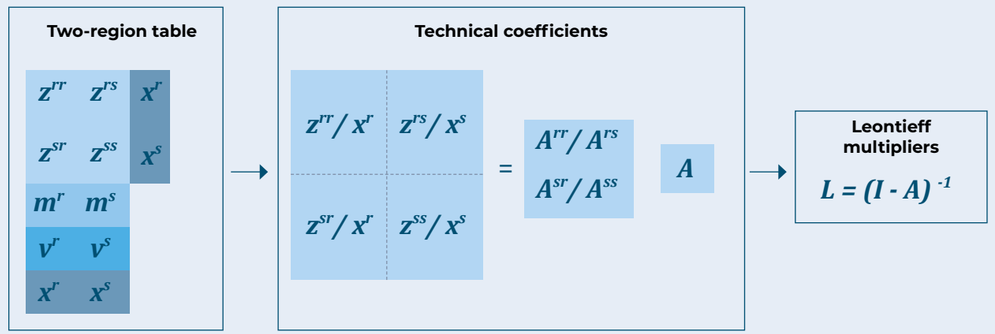
$$z_{ij}^{ss} = z_{ij}^{nn} - z_{ij}^{rr} - z_{ij}^{rs} - z_{ij}^{sr} \quad (18)$$

All the steps applied to the intermediate inputs Z are also applied to final demand d, so that regional final demand vectors are also derived.

2.2.2 Deriving the regional multipliers

The regionalized table can be used straight away to derive the type I multipliers as shown in Figure 4.[53] The four matrices Z^{rr},Z^{sr},Z^{rs} and Z^{ss} fully describe the input mix of industries within the region of interest and in the rest of the country. However, they do not include the households and consumption. Compiling type II multipliers requires extending the bi-regional input output table to a SAM-like framework. This extension incorporates income distribution among households, income flows between them, savings, taxes, and transfers. The national SAM can be used as a benchmark to identify factor incomes per sector. Regional statistics of GVA intensity across sectors allow to split the factor incomes across regions and extend the bi-regional table to a bi-regional SAM. We can get the household consumption basket from consumption surveys. Raw data about household location is needed, so that the correct aggregation for the region of interest and the rest of the country can be done. The consumption baskets are then separated into imported and domestic inputs using the SAM composition of national consumption of each good.

Figure 4 | The regional model is derived from the regionalized IO table



Source: authors

[53] The interregional input–output model (IRIO) structure was first described by Isard (1951) and refined in Isard et al. (1960). Leontief et al. (1953) sketched the framework of an intranational input–output model that was later applied to assess the sectoral and regional effect of a cut in US arms spending in Leontief et al. (1965). The multiregional input–output model (MRIO) was also described in Chenery (1953) in a two-region model for Italy.

2.3

DATA NEEDS

2.3.1 Aggregate data

We need specific information about the regional distribution of national output to downscale the national table:

- **A national SAM or IO table:** comprehensive description of all transactions between economic agents within a specific economy during a defined time frame.[54]
- **Regional output per sector, including GVA and factor payments breakdown:** the total amount of regional production of each sector and their GVA content. The GVA being the payments received by labor and capital.

2.3.2 Microdata

To capture the regional supply chain and the interactions between the firms from the region of interest and the rest of the country we need specific information on the destination of sales, consumption patterns of the regional households and the job intensity of each sector or average salaries:

- **Geographical destination of regional output to identify inter-regional interactions** refers to the regional destination of the goods and services produced. It is important to know the geographical destination so we can establish the links and connections between the different regions to better understand the structure of the regional economy.
- **Household consumption composition and regional split:** the detailed breakdown of the household spending basket which includes categories like food, transport, healthcare and leisure. These expenses are geographically distributed, so understanding where households spend their money is also important for tracking regional effects.
- **Job intensity and sectoral salaries:** the wage distribution per sector is relevant to calibrate the regional model's employment multipliers. Alternatively, the job intensity of each sector can also be used.

[54] EC 2018
[55] Eurostat 2008

2.4

INTERPRETING RESULTS

2.4.1 Assumptions

IO models rely on four main assumptions:[55]

- **Constant returns to scale.** The empirical technology observed in the IO table is assumed to be the same at any level of production. Doubling production would require doubling all inputs as described in the table.

- **Slack production capacity in the economy.** There is enough underused capacity to scale up production without requiring additional investment.
- **Fixed prices.** The models do not allow for price adjustments.
- **Symmetry.** Negative and positive shocks are treated identically. For the purpose of the model, they will have the same effect on the supply chain, yet of opposite signs.

2.4.2 Limitations

The assumptions behind IO multipliers introduce limitations to the interpretation of modeling results.[56] Though they provide valuable economic analysis, they are not suitable to answer all questions. Researchers and policymakers need to be aware of these limitations to use IO models effectively.

To begin with, all interventions must be modeled as shocks to final demand. By construction IO models are static, and do not account for economic growth or changes in consumer behavior. The only source of change they can model is an exogenous shock to final demand. More importantly, they assume that the supply side of the economy is able to produce that additional demand with the available capacity, without the need to invest in production facilities. During periods of high growth or large-scale stimulus programs this might be violated. For example, the IO model will not be able to identify that the economy may overheat, fueling inflation due to supply constraints.[57]

IO models are likely to overestimate actual effects and should be taken cautiously as an upper bound estimate.[58] IO models assume fixed technical coefficients and prices. This implies that production relationships between industries are constant over time, frozen in the state they were observed when the IO table was compiled. In reality, these relationships will change due to technological change, productivity changes and input substitution. While in the short run the fixed price assumption is reasonable, in the longer run prices will adapt to the relative scarcity of goods. For example, they will reflect increases in demand through upward movements, which will translate into input substitution away from the more expensive inputs.

The assumption that all firms within a given industry are homogeneous does not allow us to measure marginal effects. All firms are assumed to produce identical goods or services using the same production technology. Elements like economies of scale, unused capacity or more advanced technology used by different firms cannot be taken into account by an IO model. In practice, when appraising an intervention this means that the firms that will provide the additional output will do so using the average technology observed in the economy. If the technology of the initially impacted company deviates from the average relationships found in the industry, then the model estimated effect will also deviate from the actual effect.

In light of these limitations, it is important to treat IO model results carefully and apply them for short to medium term analyses. Produced estimates may constitute an upper bound of the total average effect of an investment program.

[56] Bess, Ambargis 2011
[57] Christ 1955
[58] Stelder, Oosterhaven, Pick 1986

CHAPTER

3

BUILDING A REGIONAL IO MODEL IN THE DOMINICAN REPUBLIC

3.1

DATA SCOPING IN THE REGION OF OZAMA

We applied the regionalization methodology to build the regional model of Ozama.[59] It is the most important economic region of the Dominican Republic accounting for over 40% of GDP.[60] Ozama also contributes the most to economic growth, driving 30% of the GDP increase over the period 2016-19.[61] Thanks to its trading ports, Ozama concentrates Dominican trade with exports valued at USD 8,298 million and imports at USD 22,658 million.[62] When looking at public spending, about 65% of the budget is spent in the region every year, concentrating the major part of social spending and public services.[63] Given the economic importance of Ozama in the Dominican economy, we selected it as the focus of the pilot application of the methodology.

Box 3

The Dominican Republic and the region of Ozama

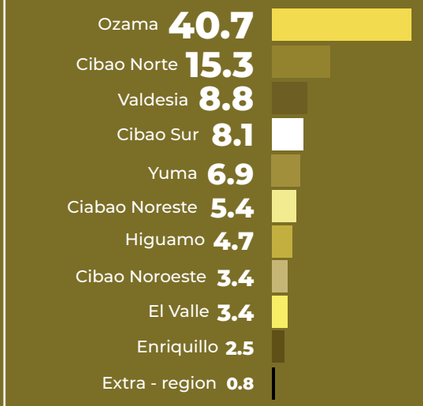
The Dominican Republic is the seventh-largest economy in Latin America and the largest one in both Central America and the Caribbean. In the past twenty years, the country has emerged as one of the most rapidly expanding economies in the region, growing 159% since 2004.[64] This remarkable growth can be attributed to a blend of market-oriented structural reforms implemented in the early 1990s and favorable external conditions that propelled economic development.[65] Classified as an upper-middle-income developing country, it features significant sectors such as mining, tourism, manufacturing and agriculture.

[59] Ozama is composed of Santo Domingo and Distrito Nacional.
[60] The regional GDP reached an average value of RD$419,522 during the period 2015-2019, the highest of the regions, MEPyD 2023
[61] MEPyD 2023
[62] MEPyD 2022
[63] MEPyD 2022
[64] WB data
[65] WB 2023

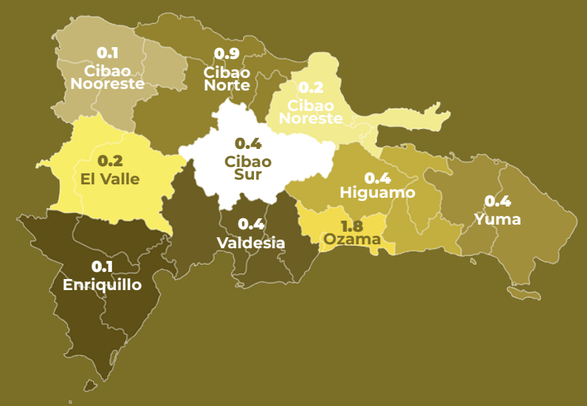
However, the forces driving this impressive growth are encountering limitations.[66] Productivity growth has been slow in recent years, hindered by a shortage of human capital to meet the demands of the business sector. Despite a decrease in the poverty rate, which remains above pre-pandemic levels, several sectors struggle to create quality jobs, and high inflation impacts the most vulnerable populations. Moreover, the occurrence of climate change-related disasters and several market distortions further contribute to these challenges.

In this context, the region of Ozama is the economic engine of the country. Its two provinces, Santo Domingo and Distrito Nacional contribute to 40.7% of GDP and drove more than 36% of growth over the period 2016-2022.[67] In 2023, 38.4% of the Dominican population lived in Santo Domingo, the country's most populated city with 3 million inhabitants.[68] The region of Ozama represents ony 3% of the country's surface, resulting in the highest population density of the Dominican Republic.[69] This is sustained by a strong labor market concentrating 49.9% of Dominican employers and 65% of the country's formal employment. The average Ozama salary is 62% higher than the national average. The economic importance of the region is further enhanced by its prominent role in trade thanks to the ports of Haina Oriental and Multimodal Caucedo. Over 82% of Dominican exports and 93% of imports occur through Ozama.

Distribution of GDP across regions
(percentage of the 2015-2022 average)



Average contribution to growth
(percentage points over 2016-2022 average)



Source: MEPyD, WB

[66] WB 2023
[67] MEPyD 2023
[68] ONE 2023
[69] ONE 2017

We use the SAM of the Dominican Republic provided by the GTAP 11 database as our primary IO data.[70] Thanks to its methodical compilation and high-quality standard, GTAP data has become a key input for economic analysis and modeling worldwide.[71] GTAP is a global database that reconciles multiple data sources within and across 141 countries. It provides data of the value of production flows, volumes, taxes, trade and supply chain compositions at a disaggregation of 65 sectors, covering both imported and domestic commodities.

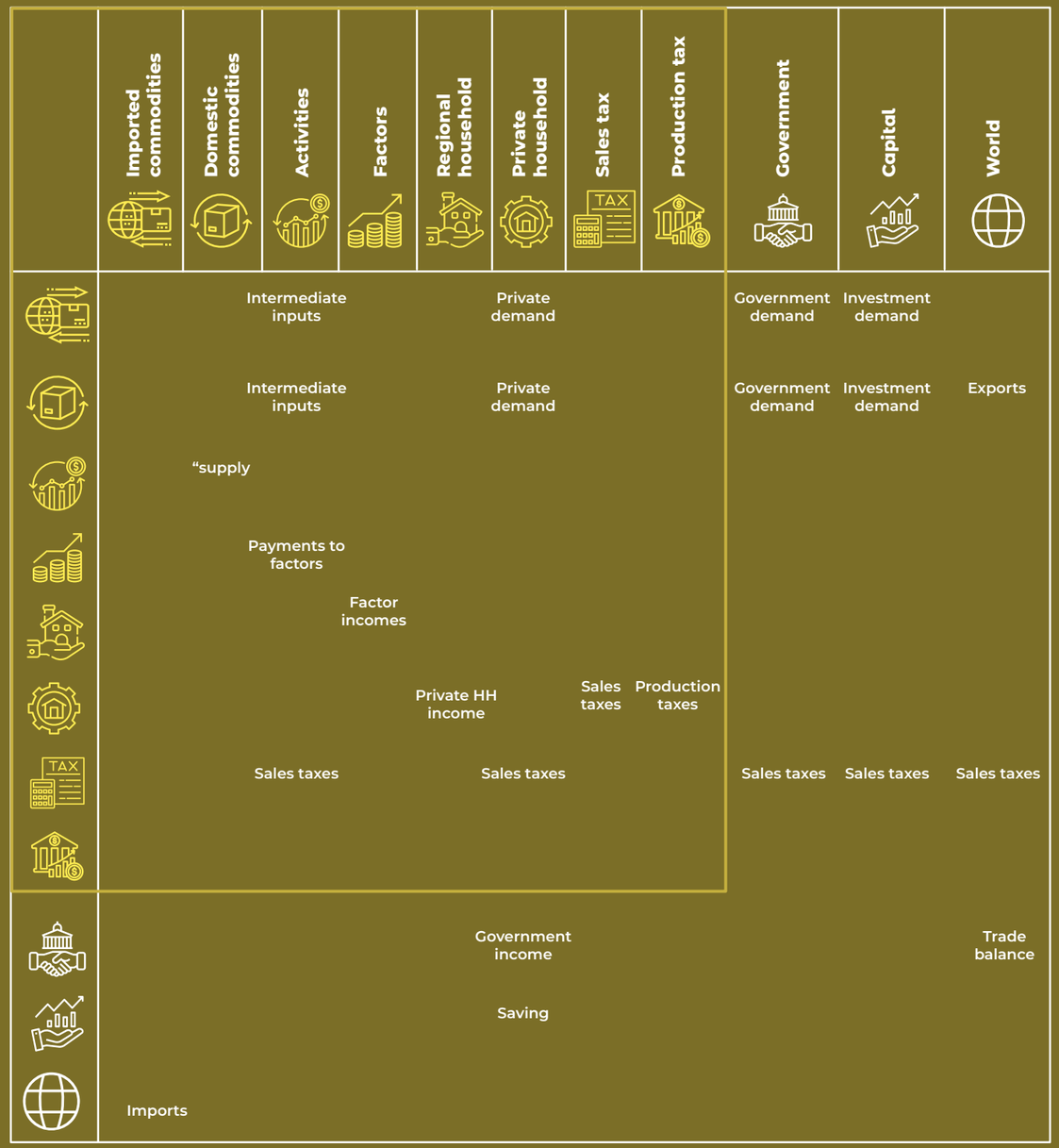
Box 4

The GTAP Social Accounting Matrix

GTAP maintains the SAM of 141 countries in the format illustrated below. The activities label covers the production units that produce domestic output across the 65 sectors considered. The regional household is a construct that simplifies tracking consumption and savings. In effect, the regional household is the agent making the saving decisions at the aggregate level. It distributes income to the private household (who exclusively consumes it), determines government consumption and aggregate savings. The factors of production are combined with inputs by activities to produce domestic output. Factor incomes are paid into the regional household as can be seen in the figure. The SAM also considers flows of income collected by sales taxes (VAT) and production taxes (i.e. taxes on extractive industries). Finally, consumption by the government, demand for investment (capital column) and demand for exports by the rest of the world (world column) are also disaggregated.

[70] GTAP 11 was released in 2023.

[71] WB 2006



Source: GTAP documentation

Note: the red square contains the relevant matrix to build the model including indirect and induced effects

We rely on the estimation of regional GVA produced by the MEPyD, ONE and the WB in October 2022.[72] Regional GVA allows to allocate national output to each region and start downscaling the national table to a regional one. The joint effort led by the MEPyD estimated the regional value added for 15 sectors in the Dominican Republic across 10 regions. It also provides annual changes and estimates of the value of output for selected sectors.

The ENGIH compiled in 2018 provides a detailed breakdown of household incomes and spending patterns to estimate the regional type II multipliers. The typical consumption basket is an important input to calibrate the induced effects from changes in household spending. The anonymized survey data is publicly available through the BCRD. It collects information on the breakdown of spending and sources of income of Dominican households, recording the province where the household resides. The sample consists of 8,881 households covering 28,394 people.

We use data for regional employment and salaries to calibrate the employment multipliers of the model. We rely on three complementary sources to gather this information:

I **Fiscal statements from the Dominican Tax Agency (DGII):** every company submits annual statements to the fiscal authority, from where the sectoral breakdown can be derived as well as the value of output and the number of employees.

II **National Survey of Economic Activities (ENAE):** the goal of the survey is to collect financial data across a sample of circa 2,000 Dominican firms selected from the DEE.[73]The level of disaggregation of the survey identifies relevant operating costs, including salaries, cost of sales and raw materials across 9 economic sectors: hospitality, transport, information and communications, retail, manufacturing, mining, construction, water and electricity supply.

III **Continuous National Labor Force Survey (ENCFT):** published quarterly[74], it compiles data on employment status and income of the working age population as well as the type of occupation and the economic sector. The sample consists of 6,500 households.

Box 5

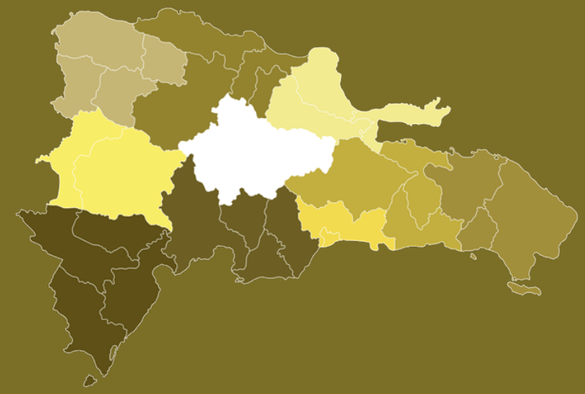
The regional GVA from ONE, MEPyD and WB - 2022

The study provides a regional breakdown of GVA across the regions of the Dominican Republic. Since the Dominican Republic currently lacks regional accounts, despite some analytical attempts to approximate regional economic activity, the study offers an accounting approach to approximate them for the following regions:

[72] MEPyD, ONE, WB 2022

[73] ONE 2020

[74] Data collection actually occurs on a weekly basis then aggregated quarterly



In each region fifteen sectors are covered:

- Manufacturing
- Transport and warehousing
- Communications
- Real estate and renting activities
- Hotels, bars and restaurants
- Energy and water
- Retail
- Financial intermediaries
- Mining
- Construction
- Public administration and defense
- Agriculture and cattle
- Market services
- Education
- Healthcare

Source: MEPyD 2022, MEPyD 2023

Finally, we identified data gaps that are either not currently compiled or not readily available. In the Dominican context most of them can be addressed by using existing raw data for estimation. To apply the regionalization methodology, on top of the data readily available from the identified sources, we also need the regional value of production by economic sector and the amount of inter-regional trade. We derived it by combining the sectoral GVA at the regional level with the value-added content of output as found in DGII financial statements for each region's firms. However, inter-regional trade data is neither compiled directly nor indirectly.

3.2

COMPILING THE REGIONAL SUPPLY CHAIN FROM FIRM LEVEL SURVEYS

3.2.1 Survey design

Data on regional technology and inter-regional trade is not available and we compiled it through a specially designed survey. Inter-regional trade is rarely captured in economic statistics and the Dominican Republic is no exception. The geographical destination of sales is of vital importance to represent the inter-regional relationships between sectors. We conducted a tailored firm level survey to gather insights on the regional dimension of the supply chain, asking about input sourcing and sales destination.

The survey aims to capture data of the geographical destination of output produced by firms within the region of Ozama.[75] Based on the observation that firms are typically better informed about the geographic destination of their sales (Oosterhaven et al. 1992), the targeted survey compiles the regional 'national' export coefficient per sector. It captures the value of output sold by a firm in the same region where it operates, in the rest of the country and exported, as a proportion of the total value of sales. We also gather 'important cells' of the production technology that we identify in the national SAM as suggested in the literature.[76] These are sectors whose inputs are particularly important in the input mix of production. The focus on important inputs for every economic sector would reduce the reliance on the implicit secondary estimation that happens when balancing the bi-regional table.

A structured questionnaire facilitated the information collection process.[77] The survey was conducted through an online platform distributed via email. We also complemented email responses with telephone interviews for more in-depth data gathering. The interviews targeted key personnel in the sampled companies including roles such as the Director, General Manager, and Head of Operations.

Through our sampling, we aimed to cover 80% of each sector by value of production, amounting to 523 companies. We sampled from the universe of registered companies that can be found in DGII data and the DEE. We identified all firms producing in Ozama across the fifteen sectors considered and ranked them according to the value of their output. Given weak anti-monopoly laws in the Dominican economy,[78] such a large level of coverage could be achieved through a relatively small sample size across each sector with an oligopolistic structure. In the end about 25 firms per sector were targeted.[79]

[75] See Annex 'Survey form' for the full survey form.
[76] Boomsma, Piet, Oosterhaven 1992
[77] Detailed in the Annex 'Survey form'.
[78] UNDP 2021, p. 147
[79] Since there was less concentration in the retail sector, 100 firms were targeted to cover the same percentage of value production.

Box 6

Survey of Ozama firms

The data collection took place between August and October 2023. The survey mapped out the intricate complexity of geographical sales distribution within Ozama.

We focused on the top 25 companies for each sector. The target was to ensure we represented 80% of each sector by volume of sales in the Dominican Republic in 2022. For the retail sector, the top 100 companies were chosen due to less concentration in that sector. We selected the companies based on their sales volume reported for the closing of calendar year 2022 through the IR2 form compiled by the DGII. After noticing low response rates in the first run of the survey, we increased the sample to the top 50 companies in each sector but could not achieve any noticeable increase in responses.

A total of 523 companies, leading in sales for the year 2022 as per the DGII records, constituted the survey's sample. We categorized companies under the following fifteen economic activities:

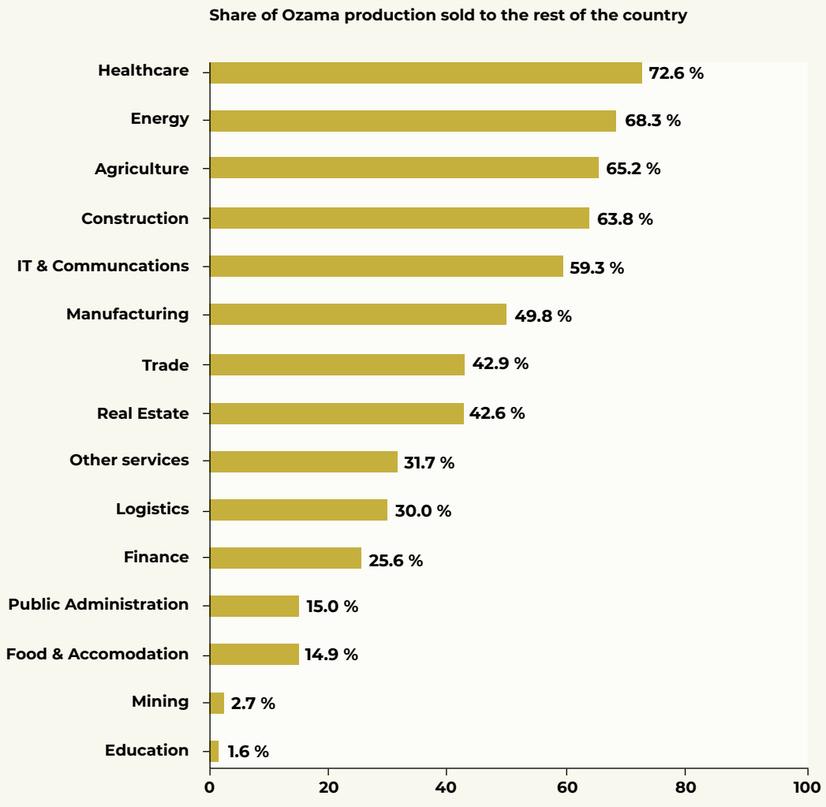
Manufacturing	Transport and warehousing	Communications
Real estate and renting activities	Hotels, bars and restaurants	Energy and water
Retail	Financial intermediaries	Mining
Construction	Public administration and defense	Agriculture and cattle
Market services	Education	Healthcare

Source: MEPyD 2022, MEPyD 2023

3.2.2 Learnings

The data collected through the trade survey showed the patterns of the geographical destination of outputs produced in Ozama. For healthcare and energy provision services, the regional supply chain is tightly integrated with the rest of the country. Dominican healthcare is concentrated in Ozama, where 40% of its outputs are produced. We see a high level of cross-hauling from the rest of the country to Ozama in those integrated sectors. On the other hand, the sectors that are less tradeable like education and tourism are sold locally. Agriculture in Ozama is an anomaly as it represents only 2% of Dominican output.

Figure 5 | Inter-regional sales between Ozama and the Rest of the Dominican Republic



Source: authors, IDB

Notes: 'Other' refers to 'Other services' and 'Administration' stands short for 'Public administration'.

Of the 523 sampled companies, only 128 responded to the survey in full. Six economic sectors were responsible for over 80% of survey responses. The data underscored the predominance of commerce, electricity, gas, water, manufacturing and other services, indicating their pivotal role in the economy. The surveyed companies reported a cumulative sales figure of around 30% of total recorded sales for the country in 2022. The responses were analyzed according to the revenues, leading to a distribution that represents the economic significance of the participating companies.

The obstacles encountered in this survey underscore the complexities inherent in gathering firm level data. The survey showed a response rate of 24.5%, highlighting the need for improved engagement strategies in future studies. The refusal to participate, primarily due to data confidentiality concerns, suggests the necessity of enhancing trust and privacy assurances. Additionally, many respondents lacked the information for specific survey sections, indicating a potential need for survey accessibility and comprehensibility improvements. More than half of surveyed companies that started the survey could not finish it because they did not have the information regarding the regional destination of their revenue and location of their inputs. This high level of segmentation found within firms' sales data did not allow them to disentangle their geographical destination in a cheap way. Future surveys must address these challenges to enhance data quality and coverage.

Table 1 | Summary of the survey outcomes

Survey title: Encuesta Regional de Tejido Productivo en la Región Ozama de República Dominicana	
Scope	Largest companies in the DR to understand sectoral and regional linkages
Methodology	Descriptive and exploratory study using quantitative and qualitative methods
Design	**Mixed 30 questions** survey open-ended and multiple-choice
Distribution	Online platform and email distribution, supplemented by telephone interviews
Sampling frame	**Top 25 companies by 2022** revenue (for Commerce sector, top 100 companies)
Sample size	**523 companies**
Response rate	**128 out of 523 (24.5%)**
Sales volume	**30% of recorded sales by DGII**
Data collection period	August to October 2023
Key respondents	Directors, General Managers, Heads of Operations, etc.
Data Analysis	Weighting responses by company revenues to represent economic contributions
Challenges	Data confidentiality, lack of information for revenues and breakdown of inputscontributions

Source: authors

3.3

CALIBRATION OF THE OZAMA PILOT MODEL

After compiling the data, we applied the regionalization methodology to build the bi-regional IO table of Ozama. First, we engaged in sector harmonization. The sectoral breakdown of the regional table is provided by the 15 sectors for which the regional GDP was compiled in 2023 by the WB and MEPyD. The exercise requires mapping the 65 GTAP sectors to the 15 for which regional data is available. We then followed the four steps described in Chapter 2 to produce a bi-regional IO table from the national SAM.

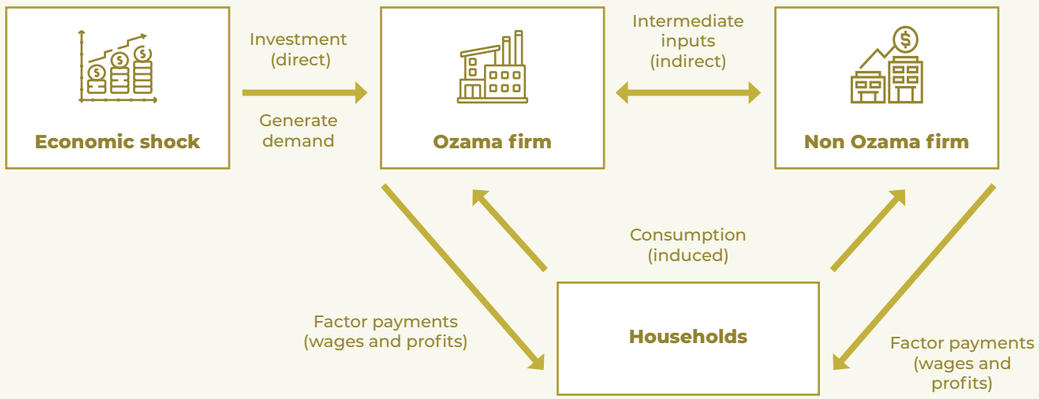
Table 2 | Summary of steps to build the Ozama bi-regional model

Regional data scoping and collection	i. Approximating the Regional GDP in the Dominican Republic – MEPyD, ONE, WB, 2022 ii. National Survey of Economic Activities (ENAE) – ONE, 2021 iii. National Census of Population and Housing – ONE, 2022 iv. Continuous National Survey of Labor Force (ENCFT) - BCRD v. Directory of Companies and Establishments (DEE) – ONE, 2020 vi. National Survey of Household Expenditures and Incomes (ENGIH) – BCRD, 2018 vii. Statistical Bulletins – DGII, 2022
National SAM and economic data	SAM of the Dominican Republic from GTAP 11
Data gaps identification	Geographical destination of regional production by sector Geographical origin of inputs for production by sector in the regional economy
Sector harmonization	The sectoral breakdown is provided by the 15 sectors for which the regional GDP was compiled in 2023 by the World Bank and MEPyD
Data gathering	Targeted firm level surveys in the region of Ozama to compile statistics on the geographical destination of sales Target 80% of each sector by volume of output
Building the bi-regional table	Apply the methodology using the complid data to derive the bi-region table
Build the bi-regional model	Use the bi-regional table to derive the leontief multipliers Get GVA, import and tax composition of output Combine the employment data with the multipliers to get the employment multipliers

Source: authors
References: i, ii, iii, iv, v, vi, vii

From the bi-regional table we computed all the multipliers of the regional tool. The resulting bi-regional model captures the supply chain links between Ozama and the rest of the Dominican Republic. It can model shocks to any of the fifteen sectors considered in either region. For each shock the model will produce direct, indirect and induced effects on Ozama and the rest of the country. The effects are further broken down in terms of GVA, employment, tax receipts and imports. Figure 6 illustrates how the calibrated tool tracks down the effects of an economic shock in Ozama through the regional and national supply chains. An investment in the region of Ozama directly generates demand there. To fulfill that demand, the Ozama based firms increase their output and purchase inputs from their providers. These are firms both inside and outside Ozama. In turn, the indirectly affected companies also need to get their supplies across both regions. This also increases the wages and profits translating into increased household consumption in both regions - the induced effects.

Figure 6 | Diagram of an intervention



Source: authors

CHAPTER

4

CASE STUDY: ASSESSING THE BENEFITS OF THE REHABILITATION OF THE COLONIAL CITY OF SANTO DOMINGO

4.1

THE REVITALIZATION PROGRAM OF CCSD

We assessed the benefits of a recent IDB program in the CCSD using the Ozama bi-regional model to demonstrate the tool's use case. The program of USD 90 million was approved in 2016 to support the rehabilitation of the historical center of Santo Domingo and boost its touristic potential. We modeled the different effects of the investment program throughout the components of the regional and national supply chains.

Box 7

The Dominican touristic sector

The Dominican Republic is one of the main destinations in the Caribbean. In 2023, it welcomed 10.2 million visitors, with a 13% increase in passengers coming by air relative to 2022, reaching an all-time high of 8 million.[80] According to the BCRD[81], tourism revenues accounted for 6.8% of GDP in 2023.[82] Tourism is also a key sector for job creation, with nearly three additional job opportunities generated for every 2.5 direct jobs in the sector.[83]

[80] MITUR 2024
[81] BCRD 2024
[82] Broader estimates from MITUR and UNWTO place the direct and indirect contribution to 15% of GDP.
[83] MITUR 2021

4.1.1 Context

The CCSD stands as the major historical and cultural site of the Dominican Republic.[84] It is the first European settlement of the Americas and is a declared UNESCO World Heritage site. The CCSD spans 1.06 square kilometers enclosed by walls at the heart of Santo Domingo. This historic area holds the country's most significant tangible and intangible cultural heritage. It is also the home of major landmarks and museums like the Alcázar de Colon, the Ozama Fortress and the Museo de las Casas Reales.

While the CCSD historical heritage is an important attraction for tourism, the absence of systematic planning and low investment levels have favored the recent deterioration of the area. Expansive public investments in the Greater Santo Domingo without a comprehensive urban development plan has resulted in a 30% population decrease from 2002 to 2015 in the CCSD.[85] This is in stark contrast to the population growth of the metropolitan area of Greater Santo Domingo that witnessed an increase from 2.8 million inhabitants to 3.7m over the same period.[86] The Colonial City now has a substantially lower density than comparable historic centers like La Paz and Quito. According to the IDB, 67.8% of residents consider it necessary to revert the degradation through active investments.[87]

The deterioration of public spaces and monuments of the CCSD is coupled with insufficient recreational services for visitors. According to the Touristic Demand Survey (2015)[88] more than 80% of tourists suggested that a wider offer of cultural activities would make the CCSD more attractive. In addition, 20.1% of visitors to CCSD stated that they would not revisit it. They mentioned concerns about the perceived lack of safety in the CCSD (8.2%), pointing to urban neglect and deterioration (8.1%), and indicating that the visit did not meet their expectations or align with their anticipated experience.

4.1.2 Objectives of the program

While the CCSD's touristic capabilities are underutilized, its residents also have an unequal access to the economic benefits of tourism in the area. It is estimated that 60% of the CCSD population does not surpass secondary education, hindering their access to economic opportunities.[89] This situation is particularly acute in the northern area of CCSD, in the communities of San Lázaro, San Miguel, San Antón, and Santa Barbara. Surveys conducted by MITUR estimated that the informal economy is more prevalent in the touristic sector of CCSD than it is in the rest of the city, with 50.2% of touristic employment in CCSD being informal against 46% in the wider Santo Domingo.[90] The revitalization program aims to enhance the CCSD touristic potential while strengthening the local economy. The rehabilitation project will not only make the CCSD a more attractive touristic destination, but also positively affect surrounding communities through job creation and business opportunities.[91]

The Colonial City has the potential to foster the diversification of tourism in the Dominican Republic and contribute to increase economic growth and social well-being.[92] Currently, tourism is predominantly focused on coastal

[84] MITUR 2023
[85] IDB 2016
[86] ONE 2016, Estimaciones de la población total por año calendario según región y provincia
[87] MITUR, CESDEM 2015
[88] MITUR 2015
[89] MITUR 2015
[90] IDB, MITUR 2015
[91] IDB 2016
[92] IDB 2016

activities like beaches and resorts, where 71.1% of spending goes to accommodation, food and drinks.[93] CCDS's rich historical and cultural heritage offers a unique opportunity to diversify tourism, fostering economic growth and social well-being. By strategically promoting cultural activities, preserving historical sites and creating immersive experiences, the Colonial City can attract a different demographic of travelers and contribute to a more resilient and inclusive touristic industry.

4.1.3 Planned investments

The IDB approved the "Comprehensive Touristic and Urban Development Program of the Colonial City" in 2016 (3879/OC-DR).[94] The program builds on the success of a first intervention of USD 30 million conducted by the ADN in 2011 under the responsibility of MITUR.[95] The current intervention has a broader objective than the previous one and aims to revitalize the CCSD in its urban, economic, and cultural tourism aspects through: (i) the recovery of public spaces and historical monuments; (ii) improving living conditions for residents; (iii) developing the local economy; and (iv) strengthening the management of the CCSD. Table 3 shows a summary of the more important targeted interventions.[96]

The proposed intervention addresses the main challenge of stopping and reverting the deterioration of the CCSD. It will also improve mobility and housing, with significant effects on cultural tourism, the local economy and social development. Major investments will go towards the rehabilitation of landmark buildings and housing units. Smaller disbursements will also provide incentives to the private sector and support the implementation of an electromobility pilot project to enhance the movement of residents and tourists within the CCSD. Improving mobility will facilitate transportation between strategic points in Santo Domingo and CCSD for residents and visitors alike.

Table 3 | Breakdown of the CCSD investment components

Components
Recovery of public spaces and historic monuments
Public spaces in prioritized streets
Convent of San Francisco
Ozama Riverbank - Linear Park Project
Museums
Urban mobility plan
Waste management and collection
Video surveillance and lighting
Improving the living conditions of residents
Housing improvement
Facade recovery program and affordable house supply
Recovery of community public spaces
Strengthening the local economy
Mercado Modelo Municipal Market
Private sector incentives
Human capital training
Urban cultural offer
Improving the governance of the CCSD
Improving CCSD Governance
Enhancing the Promotion of CCSD
Strengthening Institutions Responsible for CCSD
Improve communication with social actors

Source: IDB 2016

[93] MITUR 2021
[94] IDB 2016
[95] IDB 2011
[96] Comprehensive breakdown in Annex 'Detailed annual results of the case study '.

The total value of the program is worth USD 90 million, of which USD 75 million will be invested in the CCSD between 2021 and 2026 to boost tourism and the economy.[97] The major focus of the IDB financed program is on renovation and transportation, but also land planning and management, housing, security, and institutional capacity. The operation became eligible in July 2020 and is financed in its entirety by the IDB via ordinary capital. The IDB estimated that the program's investments will yield a Net Present Value of USD 44.1 million after 30 years.[98] The analysis used a discount rate of 12%, with an Internal Rate of Return (IRR) of 15%. These results remain robust under the conducted sensitivity analysis.

4.2 RESULTS OF THE REGIONAL ANALYSIS

We used the regional tool calibrated to the region of Ozama to model the benefits of the revitalization program. As discussed in Chapter 3, the tool can model shocks to any of the fifteen sectors considered in either Ozama or the rest of the country. For each shock the model produces the direct, indirect and induced effects providing a regional dimension to the total benefits.

[97] The difference of USD 15 million covers administrative and unexpected expenses.
[98] IDB 2022

Box 8

Simulating an investment in the Ozama calibrated tool

The modeling requires translating the various spending components of the investment program to model inputs. It is important to ensure we pass the interventions as inputs compatible with the tool's framework. By breaking down each intervention and aligning them with our framework we can effectively simulate the benefits of the program.

For example, modeling the shock 'Housing improvement' of USD 2.58 million from the second component of the CCSD investments 'Improving the living conditions of residents' requires identifying which sector included in the tool relates to this shock. The sectors covered are:

Administration	Education	Housing
Agriculture	Energy	Logistic
Business	Extraction	Manufacture
Communication	Finance	Healthcare
Construction	Hospitality	Others

In this case, it will relate to 'Construction'. We can simulate the investment benefit by shocking the Ozama construction sector with an amount of USD 2.58 million. After the simulation run, we are able to see the effect of that shock in the output, GVA, employment, import and taxes. The software package readily produces the estimates in a readable format as shown below.

```
Impact summary:

Change in domestic activity: 5.49 million USD
Change in GVA: 3.29 million USD
Total change in employment: 209 jobs
Additional imports: 0.58 million USD
Additional tax revenues: 0.14 million USD
```

Source: sample raw output from the tool calibrated for Ozama of a USD 2.58 million shock to construction

4.2.1 Investment phase

In a first step we modeled the direct investments made by the program. They correspond to each disbursement specified across the four components detailed in section 4.1.3. Given the composition of the intervention, they mostly correspond to one-off spending in renovation, construction, equipment and professional services. Table 4 provides a breakdown of the investments carried out each year of the program from 2021 to 2023, as well as those planned until 2026.

Table 4 | Planned investments by year and product within the CCSD revitalization program

Program disbursement (USD million)	Year						Total
	2021	2022	2023	2024	2025	2026	
Street rehabilitation	0.1	7.7	6.2	11.7	16.0	1.5	43.3
Communication plan		0.1	0.2	0.2	0.2		0.7
Public spaces			0.1	0.2	3.2		3.6
Strategy DEL			0.2				0.2
Fund				0.5	0.1		0.7
Governance ADN				0.1	0.2		0.3
Governance MINC				0.4	0.0		0.4
Governance MITUR				0.1	0.0		0.1
Governance CCSD			0.1	0.0			0.1
Service management				0.1	0.1		0.2
Street lighting			0.0	1.0			1.0
Mercado Modelo			0.2	0.4	0.2		0.8
SMEs			0.2	0.3	0.4		0.9
Museum planning	0.1	0.1	2.3	1.8	2.1		6.4
Observation registry		0.0	0.1	0.1	0.1		0.2
Other				0.8	0.1		0.9
Social Action Plan		0.0	0.1	0.1	0.0		0.3
Mobility plan			0.2	0.7	0.7		1.5
Trading plan		0.0			0.1		0.1
Cultural programs			0.9	0.3	0.1		1.3
Capacity building				0.2			0.2
Waste collection			0.1	2.3	0.1		2.6
Façade rehabilitation			0.1	2.1			2.1
Rehabilitation of ruins		0.1	0.7	0.8	1.9		3.6
Touristic routes				0.2	0.1		0.3
Business systems		0.0	0.1				0.2
CCTV							-
Dwellings			0.1				0.1
Renovations		0.0	0.1	0.6	1.9		2.7
Total national	0.1	7.9	9.3	23.6	27.4	1.4	**69.7**
Total international	0.1	0.2	2.7	1.5	0.5	0.1	**5.1**
Total investment	0.2	8.1	12.0	25.1	27.9	1.5	**74.8**
Administrative costs							**8.0**
Incidental expenses							**7.2**
Total disbursement							**90.00**

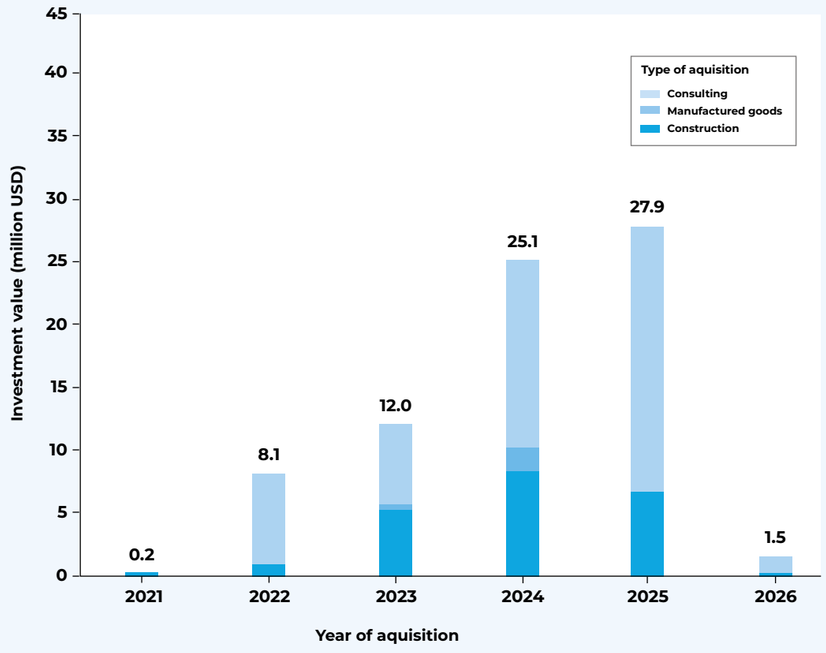
Source: IDB

Notes: values for 2024-2026 correspond to planned expenditures.

The total value of the national investment after accounting for imported goods and services and administrative costs is USD 69.7 million. This is the central figure used to assess the effect of the program on the local and national economy. A small amount worth USD 5.1 million is used to purchase international consulting services. The administrative costs born to ensure the successful completion of the program amount to USD 8 million, while USD 7.2 million are reserved for incidental expenses. Neither of these costs are considered for the benefit assessment as they are spent overseas, within the administration or unassigned at the time of analysis.

As shown in Figure 7, the major investments started in 2022 and are expected to conclude in 2026. The first year of the program (2021) was mostly devoted to project scoping. In 2022 the bulk of the renovation started, with large interventions like the rehabilitation of public spaces in the prioritized streets. In the next three years, investments will be maintained at a sustained level. In 2024 a total of USD 25.1 million is planned to be disbursed across construction, equipment and professional services. In 2025 the program is expected to purchase construction and consulting services for a value of USD 27.9 million, before finishing operations in 2026 with a USD 1.5 million intervention.

Figure 7 | Investment schedule of the CCSD revitalization program as model inputs



Source: IDB, MITUR

Note: The reported figures exclude international purchases, administrative costs and incidental expenses. Given the tool's sectoral coverage, the investments of the different interventions are categorized as either renovation and construction, consulting services or the purchase of durable equipment

Regional effects

Table 5 shows the effects across the Ozama supply chain tracked by the regional tool. The direct effect of the intervention is expected to remain within the CCSD. To carry out the rehabilitation of the CCSD, contracted firms are purchasing important shares of their inputs from the region. For each dollar worth of direct GVA in CCSD, an additional 19 cents are indirectly created within Ozama.

Table 5 | Regional annual effects in Ozama from the revitalization program's investments

Year	Direct CCSD GVA (USD m)	Direct jobs in CCSD	Indirect Ozama GVA (USD m)	Indirect jobs in Ozama
2021	-	-	-	-
2022	4.7	250	1.0	40
2023	6.0	310	1.1	50
2024	15.1	780	2.7	120
2025	17.3	890	3.2	140
2026	0.8	40	0.2	10
Total	**43.9**	**2,270**	**8.2**	**360**

Source: authors

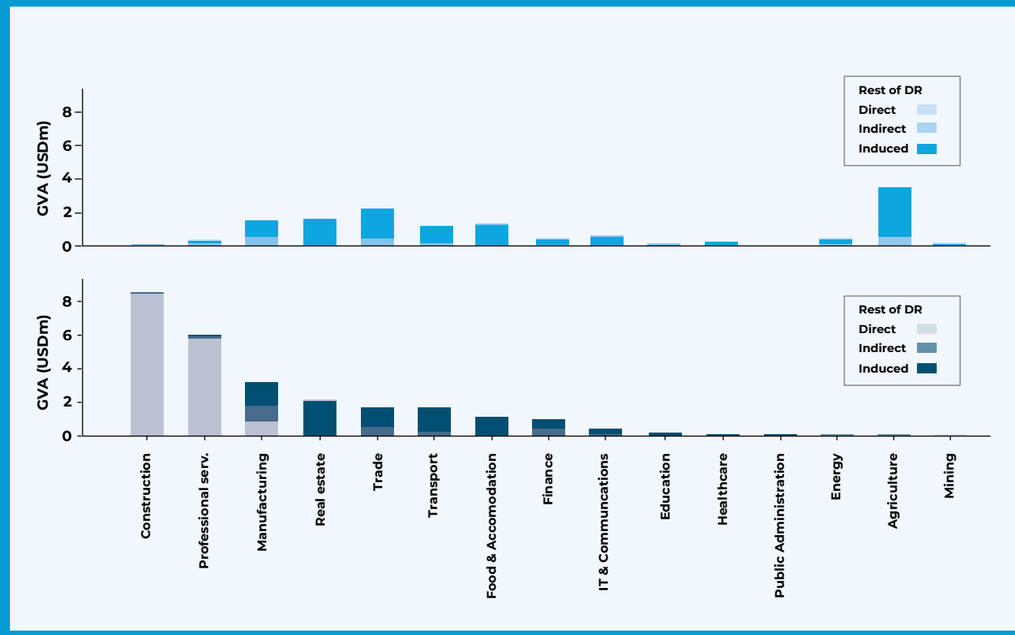
In Ozama, the sectors that benefit the most from the indirect effects are manufacturing, financial services and trade. These are the major suppliers to the construction and professional services sectors, where the majority of the investment program is going. In the year 2024 alone the indirect effect in those key sectors is expected to amount to USD 2 million of GVA as illustrated in Box 8. When looking at the induced effects, or the effect of higher spending by households resulting from higher disposable incomes, the most affected sector is real estate.

In the rest of the country the most indirectly affected sectors are manufacturing, trade and agriculture. This reflects the regional specialization of the country where agriculture is not an important sector in Ozama. Induced effects are also skewed towards agriculture, as most of the country's higher demand for food staples needs to be satisfied from the agrarian sector which is almost in its entirety outside of Ozama. In the year 2024 the induced and indirect increase in agriculture could amount to USD 3.5m.

Box 9

Estimated GVA across the regional and national supply chains from the 2024 investments

The regionalization effort and the regional data collection detailed in section 3.1.2 allow to track down the effects through all the sectors and regions of an economic shock in Ozama. The tool captures the linkages, cross hauling and inter regional trade within the regional framework. For a detailed breakdown of the effects for each year of the program, see the Annex.



Source: authors

National effects

The contribution to GDP could reach USD 100 million over the duration of the investment program across the Dominican Republic. NThis is the total cumulative contribution to GVA over the 6 years that reflects the potential economic value generated by the program across the country. It is important to note that imports are expected to increase by USD 18.1 million to satisfy part of the intermediate demand for inputs.

The average annual contribution to total GDP could amount to 0.014%. There is substantial variation across each year of the program. In 2021 and 2026 the effects are marginal as the investments are of a small magnitude. In 2024 however, the disbursement of USD 25.1 million mostly into construction and rehabilitation is expected to have a large spillover effect across the national supply chain amounting to 0.027% of GDP.

Across the country an average of 1,250 jobs are supported for every year of the program. This amounts to a total of 7,500 FTE jobs, each lasting one year. Similar to the GVA effects, job benefits are spread across the years unevenly, moving on par with the magnitude of the disbursements.

Table 6 | Summary of the revitalization program effects across the Dominican Republic

Year	Amount disbursed (USD m)	GVA (USD m)	Imports (USD m)	Tax revenue (USD m)	Number of jobs	Annual GDP contribution
2021	0.1	0.1	-	0	6	-
2022	7.9	11.0	2.2	0.5	840	0.01%[i]
2023	9.3	13.5	2.4	0.6	1000	0.011%[ii]
2024	23.6	34.4	6.0	1.4	2550	0.027%[ii]
2025	27.3	39.4	7.1	1.8	2950	0.029%[ii]
2026	1.4	1.9	0.4	0.1	150	0.001%[ii]
Total	**69.7**	**100.4**	**18.1**	**4.4**	**7,500**	**0.014%[iii]**

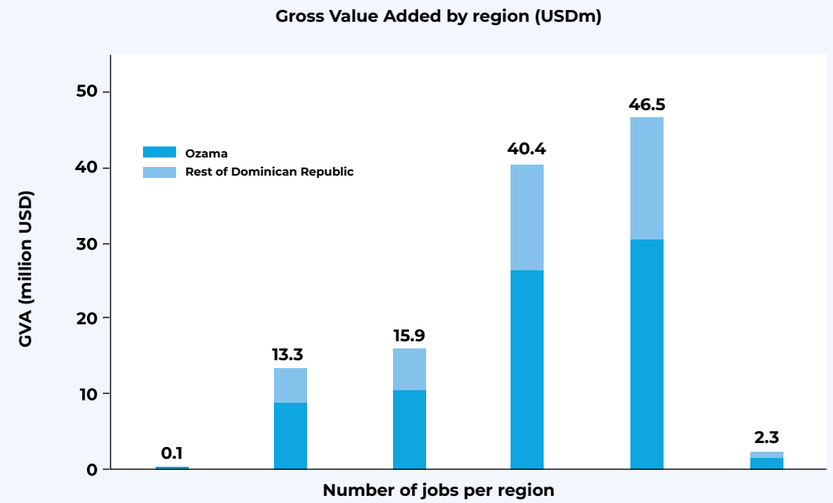
Source: authors
Note: [i]WB, [ii]IMF - WEO, [iii]Estimated using a weighted average of observed and estimated GDP.

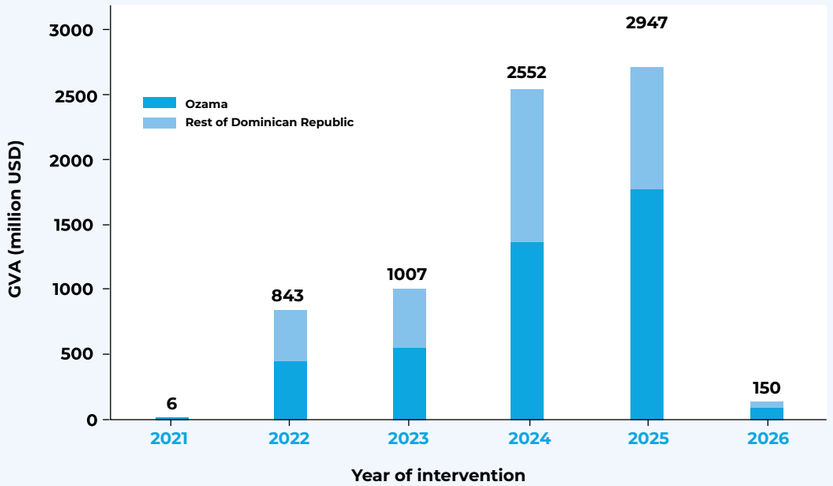
The strongest GVA effect is found in the region of Ozama every year. In 2023 for example, the total GVA effect across the Dominican Republic is estimated to be USD 15.9 million, of which 65% occurs in Ozama. This breakdown remains roughly unchanged in each year of the program.

The relatively higher effect to employment in the rest of the country than in Ozama reflects regional productivity differences. When focusing on the jobs supported by the intervention, we find that only 52% are found in Ozama, a significantly lower share relative to the GVA effects. This is explained by the existing regional differences in productivity and sectoral specialization.[99] While productivity tends to be higher in Ozama across all sectors, labor intensive sectors tend to be located in other parts of the country.

[99] MEPyD 2022

Figure 8 | Summary breakdown of the GVA and employment effects by region





Source: authors

4.2.2 Expected lasting effects

According to IDB's projections, the program's interventions are expected to increase touristic revenues in the CCSD. The investments may generate lasting effects in the regional and national economy in the form of permanent increases to touristic revenues. They are expected to increase the ratio of tourists visiting CCSD compared to the total tourists in Santo Domingo. A rise in the number of tourists staying overnight in CCSD is also expected.[100]

The increase will come from a combination of higher spending per tourist and an increase in the number of visitors. Table 7 shows that the CCSD is expected to welcome up to 47,000 more visitors after the revitalization investments, each spending 5 USD more than before for each day of stay. The highest level of spending is supported by the expected increase of pernoctation in the CCSD following the investments in accommodation and enhancement of cultural activities.

Table 7 | Expected effects after the program's finalization

Metric	Benchmark year (2021)	After program completion	Expected change
Number of tourists visiting CCSD	569,687	616,648	46,961
Average spending per tourist per day (USD / day)	84	89	5
Total annual tourism spending in CCSD (USD million)	96	109	**13**

Source: IDB 2016, authors. Each tourist is assumed to spend an average of 2 days in CCSD.

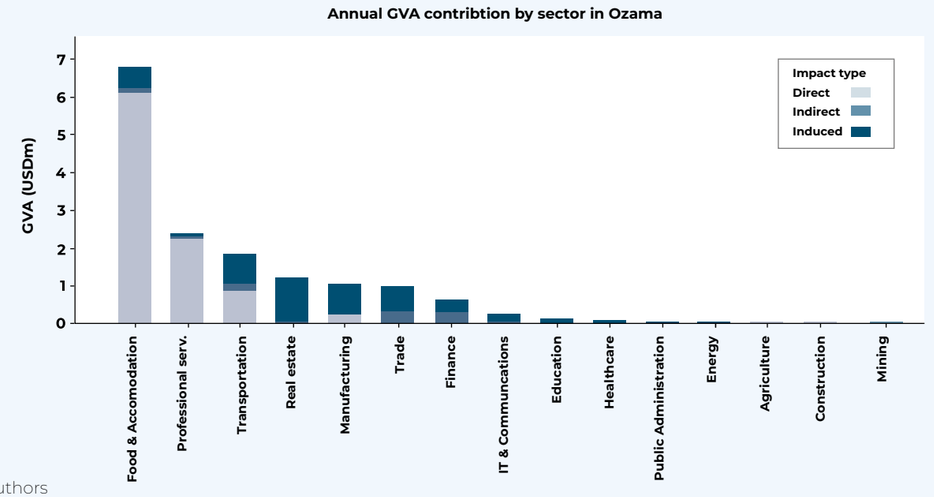
Regional effects

After the program's completion in 2026, the IDB estimates tourism spending in the CCSD would increase by USD 13 million a year.[101] Following spending patterns of tourists in the region, the spending will happen mostly in hospitality services, accommodation, transport and recreational services. We model the effects of this boost to tourism in the local economy, the regional and the national supply chains.

On top of the direct effects to the hospitality, services and transport sectors, the boost in CCDS tourism is likely to stimulate the Ozama supply chain as shown in Figure 9. The indirect effects will mostly be felt in the manufacturing, retail and finance sectors, each contributing to about USD 0.5 million in annual GVA. Induced effects will mostly be felt in transport, real estate and manufacturing to respond to the increase in household demands resulting from the income boost.

[100] IDB 2016
[101] IDB 2016

Figure 9 | Annual expected GVA effects in Ozama from sustained increase in tourism



Source: authors

National effects

The GVA contribution of the CCSD to the national GDP could increase by USD 8.6 million, supporting 970 jobs. This corresponds to the direct effect of the localized provision of touristic services inside the CCDS. Thanks to the intervention, the demand can be met through a more comprehensive offer of cultural activities and accommodation services. The total national effect is expected to be USD 21.2 million, estimated to be worth 0.015% of GDP in 2026. Such an effect could support up to 1,990 jobs throughout the country, including the 970 of CCSD.

Table 8 | Potential annual effects after finalization of the investments

Impact type	GVA (USD m)	Imports (USD m)	Tax revenue (USD m)	Number of jobs
Direct (in CCSD)	8.6	0.6	0.4	970
Indirect (Ozama supply chain)	1.2	0.2	-	60
Indirect (rest of DR supply chain)	1.2	0.2	-	110
Induced (national)	10.2	1.5	0.3	850
Total	**21.2**	**2.5**	**0.7**	**1990**

Source: authors

4.3

CASE STUDY CONCLUSIONS

Through the case study of the CCSD revitalization program we showed how the tool could be used to support investment planning. We first modelled the effects of the program's planned disbursements on the regional and national economy before analyzing how its expected boost to tourism could translate into sustained economic activity in CCSD.

We found the program has the potential to contribute 0.014% of GDP between 2021 and 2026. This amounts to a cumulative USD 100 millions of GVA across the Dominican Republic. There is however substantial variability across the years depending on the disbursements realized. Notably, the 2023 investments could have contributed USD 15.9 million to GDP, while planned investments for 2024 and 2025 are expected to yield USD 40.4 million and USD 46.5 million respectively. The stimulus generated by the investments could sustain an average of 1,250 jobs every year of the program. Like GVA, the employment effects vary with the investments realized. They could amount to 1,000 jobs in 2023 while the upcoming 2024 and 2025 acquisitions could support 2,500 and 2,900 jobs respectively.

Thanks to a diversified supply chain, the local economy would be able to meet most of the changes in demand. Ozama is expected to experience 65% of the national GVA effects. In terms of employment, 52% of the national impact will be localized in Ozama. This reflects the region's specialization in higher-productivity sectors as not only productivity tends to be higher in Ozama across all sectors, but also labor-intensive sectors are concentrated in other parts of the country.

Conditional on the revitalization program achieving its objectives of rendering the CCSD a more attractive touristic destination, the boost to tourism could contribute to about 0.015% of GDP in 2026. The expected increase in the numbers of tourists after the program's completion could support up to 970 jobs in CCSD and contribute USD 8.6m to GDP every year. This increased economic activity could support up to 1990 jobs throughout the country, including in CCSD.

Imagen: Adobe Stock

CHAPTER

5

USING THE METHODOLOGY IN OTHER GEOGRAPHIES

5.1

A REPLICABLE FRAMEWORK

The overall framework derived from the DEBRIOT regionalization methodology can be applied to any region of interest. The 9 points in Figure 10 outline all the phases required to build a bi-regional model, from inception to data collection, sectoral harmonization and data processing. This checklist is designed to make the application of the regionalization methodology to new regions a straightforward process.

The first phase is to define region where the regional tool needs to be calibrated. The area of interest will define the data scoping and data collection phases. It is advised to focus on regions with clearly delimited subnational administrations to maximize data availability. In the phases 2 to 6, we will consider three main sources of data: regional macroeconomic statistics, firm level production data and households consumptions baskets. The country where the region is located will also guide which existing databases compiling national SAMs to use. The most important piece of information at this stage concerns the region's local economy and its interaction with the country's supply chain, which is probably not available in official statistics. To understand the supply chain interactions, we are likely to require collecting the destination of outputs and origin of inputs of the region's production mix via specially designed firm level surveys. Before proceeding to building the model, we'll need to harmonize all data sources. Typically, this will require identifying the common sectoral breakdown throughout all the collected data and aggregating it to match it.

After the data for the region of interest has been collected and harmonized, we can move to phase 7 to calibrate the tool. At this point we can build the bi-regional table by following the steps described in chapter 2. Ideally, we'd extend the bi-regional table to a SAM structure by using the regional household's consumption basket to allocate national consumption. This step will allow the computation of type II multipliers capturing the induced effects. We'd also rely on the national SAM where tax, imports and factor payments are compiled to estimate their regional allocation. Having a SAM structure for the regional table allows to derive the GVA, fiscal and import multipliers in the final phase. In this phase we also combine the data compiled on regional salaries to calibrate the employment multipliers.

Finally, in phase 9 we use the bi-regional SAM to build the IO bi-regional model. We can apply the steps described in section 2.2.2 to derive the economic multipliers.

Figure 10 | The 9-steps framework checklist

Phase 1

Define the geographical scope

The region *r* (region of interest)

Identify the region of interest for which to build the model

The region *s* (residual region)

All other regions are defined as a single Rest of the Country (ROC) region

Phase 2

Regional data scoping and collection (surveys compiled by National Statistics bodies)

Households (HH) surveys

- Spending
- Income
- Regional info / geographical location
- Most recent census (universe of HH)

Regional Marco data

- Regional GVA and value of output by sector
- Regional employment and salaries by sector
- Sources and value of national and regional taxes

Firms´data (surveys and tax office)

- Firm registry (universe of firms)
- Value of imports/exports
- Salaries / dividends
- Geographical location
- Taxes
- Value of production
- Economic sector

Phase 3

National SAM and economic data

Get national Input-Output or SAM tables

To be obtained from the most appropriate sources:

- GTAP
- EORA
- OECD
- IMPLAN
- National statics offices

National economic data

Some can be found in a SAM, but additional sources allow

- Sectoral value of production
- Sectoral GVA
- Sectoral employment and average salaries

Phase 4

Identification of data gaps

Geographical destination of regional production

Destination of production of the regional output (region of interest / ROC / exports)

Geographical origin of production inputs

Origin of inputs for production of the regional firms (firms of interest / ROC / imports)

Phase 5

Sector harmonisation

Identify common denominator sector between all data sources available

Define sectoral mapping tables for consistent aggregation

Aggregate the available data to the defined sectoral selection. This may require aggregating the SAM at a less granular level by combining sector together

Phase 6

Data gathering

Identify target population to collect the missing data

- Firms (regional / national)
- Households (regional / national)

Identify the most effective way to collect or derive the missing data

- Targeted surveys
- Accounting data from specialised accounting firms or tax authorities
- Estimation from secondary data sources

Desing survey questionnaires

- As simple as possible
- Cover all missing data identified in *phase 4*

Sampling strategy

- Firms registry (universe of firms)
- Census (universe of households

Other sources

- Conduct surveys, purchase accounting data or estimate data

Phase 7

Estimate the bi-regional table

Follow the four steps described in **Chapter 2**

This is the crucial step that builds the table from which the model is deriverd

Cross check resulting table with national SAM national statistics

Phase 8

Extend the bi-regional table to a SAM like table from the national SAM

The region *r* (region of interest)

Use national output of tax, imports, factor payments

The region *s* (residual region)

Incorporate regional household consumption basket

The region *s* (residual region)

These will be used to derive the tax, imports and employment coefficients

Phase 9

Build the two-region IO model

Technical coefficients

Estimate them from the balanced bi-regional SAM table

Modules

Calibrate them from the bi-regional SAM like table: GVA, employment, taxes and import

Leontief multpliers

Compute them, with and without households, to have both type I and II multipliers available

Source: authors

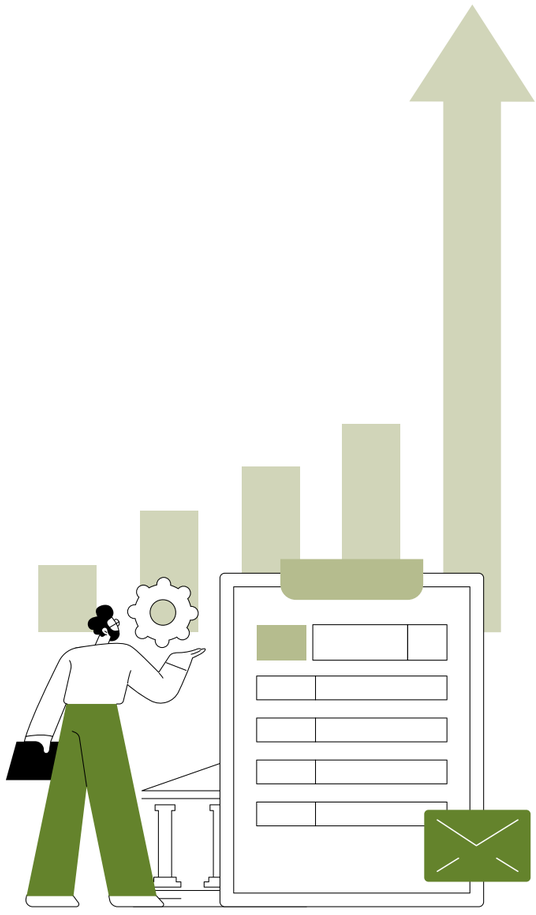
5.2

DATA COLLECTION AND CALIBRATION

The most important step to apply the framework is the data collection that allows the calibration of the regional model. We can summarize all data inputs needed to build a regional model into three categories:

1. **National SAM.** This is the building block from which the bi-regional table and the model multipliers are derived.
2. **Regional macroeconomic data.** To capture the regional supply chain and the interactions between the firms from the region of interest and the rest of the country we need specific information about the regional composition of output and the destination of sales.
3. **Regional microdata.** To regionalize the type II and employment multipliers, the consumption patterns of the regional households are required as well as the job intensity of each sector.

Once the data has been identified and collected, the calibration can be done easily with the software package built for the Ozama implementation.[102] The package empowers users literate in the python programming language with a set of tools to seamlessly calibrate the regional model to any region of interest. It provides the necessary functionalities to apply the regional input-output methodology to any geographic context provided the required data has been previously compiled. It embeds the necessary configurations in a python framework to create a balanced regional model following the methodology described in chapter 2.



[102] Access to the software package implementing the tool can be granted upon request.

5.3

EXTENSIONS AND REFINEMENTS

The regional tool is useful to measure partial economic benefits in the regional and national economy but has room for improvements. The case study showed it can provide an insightful picture of the transmission of an economic shock like an investment through the supply chain. However, the many limitations of IO models need to be acknowledged when utilizing the regional tool. As discussed in section 2.4.2 the standard approach does not account for the dynamic nature of markets and the adaptability of businesses to price changes and technological change through input substitution. This leads among other things to an overestimation of the benefits as general equilibrium effects are omitted from the framework.[103]

In future extensions, a particular emphasis to better account for displacement effects and substitution is needed to refine the current tool.[104] Displacement occurs when an intervention leads to the acquisition of market share by the targeted firms from established firms. For instance, an investment supporting a firm's expansion may cause this business to compete with local firms producing similar goods and services, resulting in competitors losing trade and potentially experiencing staff reductions. An accurate assessment of the net effect on the economy needs to correct the displacement of economic activity. In the future we propose focusing on refining the treatment of displacement effects within the tool's framework. Similarly, we cannot currently account for input substitutions derived from price adjustments and technological change given the static nature of the tool. Dynamic frameworks generalizing the standard IO model can address these phenomena by accounting for more sophisticated temporal behaviors.[105] With these refinements IO models can become more robust in capturing the complexities of economic systems, making them better suited to analyze additionality and longer-term effects.

The IO framework can also be extended to account for environmental effects, including pollution and emissions of GHG.[106] The focus of environmental IO analyses are the environmental consequences of an intervention. The goal is to quantify the environmental effects associated with economic activities, including resource use, emissions, and waste generation. These analyses provide insights into the environmental footprint of different sectors and help understand the connections between economic development and environmental sustainability. The current tool is only able to track down effects on GVA, imports, fiscal revenues and employment derived from the shock. We propose expanding it to also account for a wide range of environmental effects alongside the economic ones.

Finally, we will consider embedding the tool in a web-based user interface to facilitate regional economic analyses in the calibrated regions. We envision a simple dashboard that streamlines the process of running simulated shocks to assess their effects through the regional economy. With an intuitive design and user-friendly interface, analysts would effortlessly navigate the model estimates and derive insights from the simulated scenarios of investment. The dashboard would be available on the web for anyone that needs it. Users would need to select the region to apply the shock to and the type of intervention and the dashboard will prepare the results of the simulation for analysis.

[103] Bess,Ambargis 2011 - Oosterhaven, Pick, Stelder 1986
[104] UK GOV 2008
[105] Miller, Blair 2009
[106] Lenzen, Pade & Munksgaard 2004

CONCLUSIONS

“During the investment phase, the program could contribute up to USD 100 millions of GVA between 2021 and 2026 across the Dominican Republic, equivalent to an annual 0.014% of GDP”

- **In this study we adapted a blueprint methodology from the literature to build and calibrate a regional input-output model.** The methodology combines regional economic data with a national Input-Output table to capture the supply chain interdependencies within a regional economy. The resulting model allows policymakers at national, regional and local levels to estimate the potential benefits of policy interventions ranging from investment programs to stimulus packages. By capturing the complexity of relationships between industries, households, and institutions, our framework allows for a comprehensive understanding of the regional economic dynamics. The approach is scalable to new regions in different countries once all the necessary data has been compiled for the geography of interest. Calibrating a new regional model with this approach requires a minimal set of inputs from the user.

- **We applied the methodology to the region of Ozama.** The geographical destination of sales data from firms in the region of interest are not readily compiled in the Dominican Republic. We conducted a tailored firm level survey to gather insights on the regional dimension of the supply chain, asking about input sourcing and sales destination. From there we regionalized a Dominican IO table to build the regional model.

  We demonstrated the tool’s use case by using it to assess a recent IDB program in the CCSD as a case study. The program of USD 90 million was approved in 2016 to support the rehabilitation of the historical center of Santo Domingo. We modeled the different effects of the investment program throughout the components of the regional and national supply chains. We first looked at the program’s disbursement schedule to model its wider economic benefits, and then turned to its expected results after completion.

- **During the investment phase, the program could contribute up to USD 100 millions of GVA between 2021 and 2026 across the Dominican Republic, equivalent to an annual 0.014% of GDP.** There is however substantial variability across the years depending on the disbursements realized. The GDP contribution of the 2023 investments amounted to USD 15.9m while those planned for 2024 and 2025 can expect a contribution of USD 40.4m and USD 46.5m respectively. These effects could support 7,500 over 6 years – equivalent to an average of 1,250 job/year. Employment effects amounted to 1,000 jobs in 2023 while the upcoming 2024 and 2025 acquisitions could support 2,500 and 2,900 jobs.

- **Up to 65% of the national effects are expected to materialize in Ozama.** The GVA effects are concentrated in the region where the investments take place due to a diversified supply chain that is able to respond to changes in demand. When looking at employment, only 52% of the national effects will occur in Ozama, or about 3,900 jobs over the 6-year period. This reflects the specialization of the region into higher productivity sectors relative to the rest of the country.

- **Once the investment is finalized, the boost to the tourism industry could support up to 970 jobs in CCSD that contribute USD 8.6m to GDP every year.** In the whole Dominican Republic, the GVA contribution could add up to USD 21.2m, or about 0.015% of GDP in 2026. The total level of employment this could support across the country, including in CCSD, is 1990 jobs. These benefits are conditional on the expected results of the program to attract more visitors to materialize.

- **The case study demonstrated the tool offers valuable insights of how an economic shock, such as an investment, spreads through the national and regional supply chain.** Nevertheless, it remains essential to recognize the numerous limitations inherent in IO models when employing this tool. We plan to address some of these in future iterations of this work, including better treatment of displacement effects and environmental analysis extensions.

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ANNEXES

Survey form

The survey below was designed to be carried out in Ozama, Dominican Republic. We decided to leave it as is to serve as a template for other regions of Latin America where the Bank operates.

Ideally, we would conduct a full detailed survey of all the costs faced by firms across all the relevant sectors. Say we consider 3 economic sectors: agriculture, manufacturing and services. We will then require surveyed firms to provide:

Value of sales

- Total value of production
- Total value of sales destination to the rest of the country and the foreign sector
- Value of sales to specific sectors in the rest of the country identified as important (i.e. sales of manufacturing goods to regional firms for a manufacturing firm)
- Sales through the wholesale sector in the region
- Sales through wholesale in the rest of the country

Cost of intermediate inputs

- Value of foreign imported inputs (combined agriculture, manufacturing and services)
- Value of foreign imported inputs from specific sectors (selected based on national technology relevance)
- Value of inputs from the rest of the country from specific sectors (selected based on national technology relevance)

There is a trade-off to be balanced between survey completion and data granularity. Additional breakdowns are welcome, but negatively impact on the response rate. In case the surveyed firms have access to the data and are willing to complete the surveys, we ask for a further breakdown of the cost of intermediate inputs. These questions were marked as optional to reduce the attrition rate.

- Value of each sector's inputs purchased from the region
- Value of each sector's inputs purchased from the rest of the rest of the country

Datos de Control				
Datos genéricos de la empresa y el resultado de la encuesta tras su realización				
A. Datos de contacto de la empresa				
Detalle	**a) Contacto principal**	**b) Contacto secundario**		
1. Nombre 2. Cargo 3. Departamento 4. Correo electrónico 5. Teléfono y extensión				
B. Datos de contacto de la empresa				
Detalle	**a) Visita / contacto 1**	**b) Visita / contacto 2**		
1. Fecha 2. Hora de inicio 3. Hora de término				
4. Resultado de la entrevista				
Estatus	Completa	Imcompleta	No aplica / no encontrada	inactiva	Rechazada
Sección I. Datos de la empresa				
La ubicación más relevante es la del establecimiento de producción principal. A gtravés del muestreo hemos identificado las empresas a entrevistar por sector y geografía de la sede social (región de Ozama). La ubicación principal de producción puede ser distinta a la de la sede. Esta sección permite confirmar que la ubicación principal de la producción está en la región de Ozama (y no en el resto del país) para reajustar la muestra si fuera necesario. En el caso de que ambas ubicaciones difieran, continuar la encuesta con normalidad				
A. Datos generales				
1. Nombre comercial 2. NRC 3. Cantidad de establecimientos 4. Número de empleados				
B. Ubicación geográfica de la sede de la empresa				
1. Provincia 2. Municipio 3. Dirección				
C. Ubicación del establecimiento de producción principal				
1. Tipo de establecimientos	a. Fábrica	b. Almacén	c. Oficina	d. Otro
2. Provincia 3. Municipio 4. Dirección				

Source: authors

Sección II. Actividad Económica

Actividad económica principal y secundaria de la empresa. Confirmar el sector identificado durante el muestreo con un nivel mayor de desagregación.

La actividad principal de una entidad económica es aquella que más contribuye a los ingresos y beneficios.

Las actividades secundarias son todas las actividades independientes que generan productos destinados a terceros, y que no son la actividad principal de la entidad productiva. La mayoría de las entidades económicas producen, al menos, un tipo de producto secundario. Estos últimos se generan al obtenerse los productos principales (por ejemplo: el cuero de los animales durante el proceso de obtención de su carne.

[Entrevistador**]**: Véase Anexo I para identificar el código de producto en el apartado "Divisiones" de la CNAE. El objetivo de esta sección es confirmar que la empresa consultada pertecene al sector económico identificado durante el muestreo.

Sección CNAE	Descripción
A	Agricultura, ganadería, silvicultura y pesca
B	Explotación de minas y canteras
C	Suministro de electricidad, gas, vapor y aire acondicionado
D	Suministro de agua; evacuación de aguas residuales, gestión de desechos y descontaminación
E	Construcción
F	Comercio al por mayor y al por menor; reparación de vehículos automotores y motocicletas
G	Transporte y almacenamiento
H	Actividades de alojamiento y de servicio de comidas
I	Información y comunicaciones
J	Actividades financieras y de seguros
K	Actividades inmobiliarias
L	Actividades profesionales, científicas y técnicas
M	Actividades de srevicios administrativos y de apoyo
N	Administración pública y defensa; planes de seguridad social de afiliación obligatoria
O	Enseñanza
P	Actividades de atención de la salud humana y de asistencia social
Q	Actividades artísticas, de entrenamiento y recreativas
R	Otras actividades de servicios
S	Actividades de organizaciones y órganos extraterritoriales

1. Actividades económicas proncipal: la que genera a la empresa mayor beneficio, ventas o en su defecto la que emplee mayor personal	
a. Sección CNAE	b. Division CNAE

1. Actividades económicas secundaria: aquella que se desarrolla dentro de la misma unidad de producción, en edición a la actividad principal	
a. Sección CNAE	b. Division CNAE

Optativo - sección III. Ingresos

El objeto de esta sección es compilar sobre el valor total de producción de la empresa. Es una sección optativa.

El valor de producción es equivalente al valor de ingresos totales por la venta de bienes y servicios de la empresa.

3. Otros ingresos: corresponde a otros por transporte de personas o fletes prestados a terceros (no incluidos en el punto 4), y todos los demás ingresos NO registrados en puntos anteriores.

4. Total: Corresponde a la sumatoria del 1 al 3, y a los ingresos TOTALES de la empresa en el ejercicio fiscal 2022.

Nota: Esta sección comprende los ingresos por las ventas de bienes producidos o comercializados por la empresa, la prestación de srevicios y otros ingresos de la empresa, aunque hayan sido cobrados en el año fiscal 2022. Se evalúan a precio de venta de contado, SIN ITBIS, además las ventas deben ser netas de devoluciones y descuentos.

Tipo de ingresos (periodo fiscal 2021 - 2022)	Total, anual en RD$ (Año 2022)
1. Venta de bienes y servicios producidos por la empresa	
2. Ingresos por ventas de mercaderías de bienes y servicios revendidos sin transformación	
3. Otros ingresos	
4. Total	

Destino geográfico de las ventas

Esta sección compila información sobre la composición de las ventas y su destino geográfico.
Distinguimos dos tipos de ventas:
- Ventas directas: venta de productos directamente a empresas o consumidores (excluyendo distribuidores).
- Ventas al por mayor: venta de productos a empresas distribuidoras de venta al por mayor.

De la misma forma distinguimos tres posibles destinos geográficos:
- Extranjero: exportaciones al exterior
- Región de Ozama: ventas destinadas a la región de Ozama
-Resto del país: ventas a destinadas al resto del país (todo el territorio nacional excluyendo la región de Ozama)

B.3. Total: Corresponde a la sumatoria del B.1 y B.2, la proporción del total de ventas que se destinan al mercado nacional.

En el apartado IV.C. las preguntas son específicas a cada sector, dependiendo de la respuesta a la pregunta II.1 y empresa/sector seleccionado durante el meustreo.

El total de las entradas a IV.A.1, IV.B.1, IV.B.2, V.A.1 y V.A.2 ha de ser igual a 100% (1)

Sección IV. Ventas directas

A. Exportaciones al extranjero

Tipo de ingresos (periodo fiscal 2021 - 2022)	Proporción de las ventas (%)
1. Proporción de ventas en el exterior (exportaciones) del total de ventas	

B. Ventas nacionales agregadas

Tipo de venta (periodo fiscal 2021-2022)	Proporción de las ventas totales (%)
1. Proporción de ventas directas (de las ventas totales) en la región Ozama.	
2. Proporción de ventas directas (de las ventas totales) en el resto del país	
3. TOTAL: Proporción de ventas nacionales del total de ventas	

C. Ventas directas nacionales a sectores específicos

Actividad económica principal (sección II.1.a)	Proporción de ventas DIRECTAS en el RESTO DEL PAÍS a sectores específicos respecto al total de ventas (periodo fiscal 2021 - 2022)	Proporción de las ventas a cada sector (%)
Agropecuario Sección CNAE: A	Ventas al sector: **Manufactura** Ventas al sector: **Agropecuario**	
Minas y canteras Sección CNAE: B	Ventas al sector: **Manufactura** Ventas al sector: **Construcción**	
Manufactura Sección CNAE: C	Ventas al sector: **Manufactura** Ventas al sector: **Construcción**	
Energía y agua Sección CNAE: D,E	Ventas al sector: **Manufactura** Ventas al sector: **Energía y agua** Ventas al sector: **Comercio** Ventas al sector: **Agropecuario** Ventas al sector: **Hoteles, bares y restaurantes**	
Construcción Sección CNAE: F	NA	
Comercio Sección CNAE: G	Ventas al sector: **Manufactura** Ventas al sector: **Transporte y almacenamiento** Ventas al sector: **Construcción** Ventas al sector: **Agropecuario**	
Transporte y almacenamiento Sección CNAE: H	Ventas al sector: **Comercio**	
Hoteles, bares y restaurantes Sección CNAE: i	NA	
Comunicaciones Sección CNAE: j	Ventas al sector: **Comercio**	
Intermediación financiera Sección CNAE: k	Ventas al sector: **Manufactura** Ventas al sector: **Comercio** Ventas al sector: **Transporte y almacenamiento** Ventas al sector: **Intermediación financiera** Ventas al sector: **Agropecuario** Ventas al sector: **Activudades inmobiliarias y de alquiler** Ventas al sector: **Hoteles, bares y restaurantes** Ventas al sector: **Comunicaciones** Ventas al sector: **Construcción**	
Actividaedes inmobiliarias y de alquiler Sección CNAE: L	Ventas al sector: **Intermediación financiera**	
Otras actividades de servicicios de mercado Sección CNAE: M, N, R, S, R	**NA**	
Administración pública y defensa; seguridad social obligatoria Sección CNAE: O,U	**NA**	
Enseñanza Sección CNAE: P	**NA**	
Salud Sección CNAE: Q	**NA**	

Sección V. Ventas al por mayor

A. Ventas nacionales al por mayor

Tipo de venta (periodo fiscal 2022-2022)	Proporción de las ventas totales (%)
1. Proporción de ventas realizadas a través del sector de venta al por mayor en la región de Ozama	
2. Proporción de ventas realizadas a través del sector de venta al por mayor en el resto del país	

Sección IV. Ventas directas

El objeto de esta sección es compilar información sobre la composición de los insumos más importantes para cada sector por origen geográfico.

Todas las preguntas de los apartados B y C de esta sección son diferentes para cada sector, dependiendo de la respuesta a la pregunta II.1 y empresa / sector seleccionado durante el muestreo.

Distinguimos dos orígenes geográficos de interés:
- Extranjero: importaciones del exterior
- Resto del país: insumos comprados en el resto del país y transportados hasta Ozama para su procesamiento. El "resto del país" incluye todo el territorio nacional excluyendo la región de Ozama.

La suma de las entradas A.4 y A.5 ha de ser igual a 100%
La suma de las entradas B y C ha de ser inferior o igual a 100%

A. Valor total de insumos

Tipo de venta (periodo fiscal 2021-2022)	Total anual en RD$ (Año 2022)
1. Valor TOTAL de insumos IMPORTADOS **(OPCIONAL)**	
2. Valor TOTAL de insumos NACIONALES **(OPCIONAL)**	
3. Valor total de insumos (OPCIONAL)	
4. Proporción de insumos IMPORTADOS de los insumos totales **(OBLIGATORIA)**	
5. Proporción de insumos NACIONALES de los insumos totales **(OBLIGATORIA)**	

B. Insumos específicos provenientes del resto del país

Actividad económica principal (sección II.1.a)	Proporción de INSUMOS NATURALES provenientes de sectores específicos del RESTO DEL PAÍS (periodo fiscal 2021 - 2022)	Proporción de los insumos totales (%)
Agropecuario Sección CNAE: A	Insumos nacionales del sector: **Manufactura**	
	Insumos nacionales del sector: **Comercio**	
	Insumos nacionales del sector: **Agropecuario**	
Minas y canteras Sección CNAE: B	Insumos nacionales del sector: **Energía y agua**	
	Insumos nacionales del sector: **Manufactura**	
	Insumos nacionales del sector: **Comercio**	
	Insumos nacionales del sector: **Transporte y almacenamiento**	
	Insumos nacionales del sector: **Otras actividades de servicios de mercado**	
	Insumos nacionales del sector: **Intermediación financiera**	
Manufactura Sección CNAE: C	Insumos nacionales del sector: **Manufactura**	
	Insumos nacionales del sector: **Agropecuario**	
	Insumos nacionales del sector: **Energía y agua**	
	Insumos nacionales del sector: **Comercio**	
Energía y agua Sección CNAE: D,E	Insumos nacionales del sector: **Manufactura**	
	Insumos nacionales del sector: **Energía y agua**	
	Insumos nacionales del sector: **Comercio**	

B. Insumos específicos provenientes del resto del país

Actividad económica principal (sección II.1.a)	Proporción de INSUMOS NATURALES provenientes de sectores específicos del RESTO DEL PAÍS (periodo fiscal 2021 - 2022)	Proporción de los insumos totales (%)
Construcción Sección CNAE: F	Insumos nacionales del sector: **Manufactura**	
	Insumos nacionales del sector: **Comercio**	
Comercio Sección CNAE: G	Insumos nacionales del sector: **Transporte y almacenamiento**	
	Insumos nacionales del sector: **Intermediación financiera**	
	Insumos nacionales del sector: **Energía y agua**	
	Insumos nacionales del sector: **Comunicaciones**	
Transporte y almacenamiento Sección CNAE: H	Insumos nacionales del sector: **Comercio**	
	Insumos nacionales del sector: **Intermediación financiera**	
	Insumos nacionales del sector: **Transporte y almacenamiento**	
	Insumos nacionales del sector: **Manufactura**	
Hoteles, bares y restaurantes Sección CNAE: i	Insumos nacionales del sector: **Energía y agua**	
	Insumos nacionales del sector: **Comercio**	
	Insumos nacionales del sector: **Manufactura**	
	Insumos nacionales del sector: **Agropecuario**	
Comunicaciones Sección CNAE: j	Insumos nacionales del sector: **Transporte y almacenamiento**	
	Insumos nacionales del sector: **Energía y agua**	
	Insumos nacionales del sector: **Comercio**	

B. Insumos específicos provenientes del resto del país

Actividad económica principal (sección II.1.a)	Proporción de INSUMOS NATURALES provenientes de sectores específicos del RESTO DEL PAÍS (periodo fiscal 2021 - 2022)	Proporción de los insumos totales (%)
Intermediación financiera Sección CNAE: K	Insumos nacionales del sector: **Intermediación financiera**	
	Insumos nacionales del sector: **Otras actividades de servicios de mercado**	
	Insumos nacionales del sector: **Comunicaciones**	
Actividades inmobiliarias y de alquiler Sección CNAE: L	Insumos nacionales del sector: **Intermediación financiera**	
Otras actividades de servicios de mercado Sección CNAE: M, N, R, S, R	**NA**	
Administración pública y defensa; seguridad social obligartoria Sección CNAE: O, U	Insumos nacionales del sector: **Otras actividades de servicios de mercado**	
Enseñanza Sección CNAE: P	**NA**	
Salud Sección CNAE: Q	Insumos nacionales del sector: **Manufactura**	
	Insumos nacionales del sector: **Comercio**	
	Insumos nacionales del sector: **Agropecuario**	

C. Insumos específicos importados

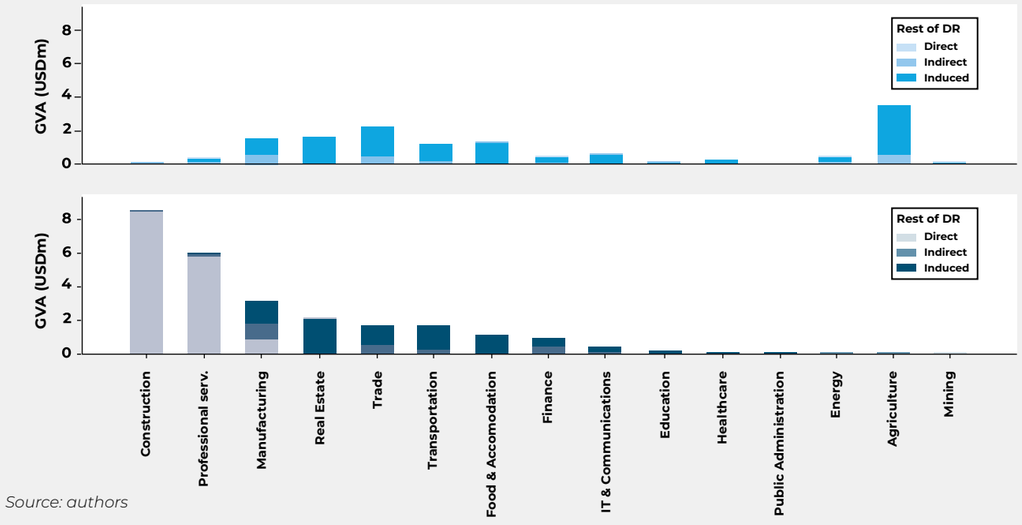
Actividad económica principal (sección II.1.a)	Proporción de INSUMOS IMPORTADOS provenientes de sectores específicos (periodo fiscal 2021 - 2022)	Proporción de los insumos totales (%)
Agropecuario Sección CNAE: A	Insumos importados del sector: **Manufactura**	
Minas y canteras Sección CNAE: B	Insumos importados del sector: **Manufactura**	
Manufactura Sección CNAE: C	Insumos importados del sector: **Manufactura** Insumos importados del sector: **Minas y**	
Energía y agua Sección CNAE: D,E	Insumos importados del sector: **Manufactura**	
	Insumos importados del sector: **Minas y**	
Comercio Sección CNAE: G	**NA**	
Transporte y almacenamiento Sección CNAE: H	Insumos importados del sector: **Manufactura**	
Hoteles, bares y restaurantes Sección CNAE: i	**NA**	
Comunicaciones Sección CNAE: j	Insumos importados del sector: **Manufactura**	
Intermediación financiera Sección CNAE: K	**NA**	
Actividades inmobiliarias y de alquiler Sección CNAE: L	**NA**	
Otras actividades de servicios de mercado Sección CNAE: M, N, R, S, R	**NA**	
Administración pública y defensa; seguridad social obligartoria Sección CNAE: O, U	Insumos importados del sector: **Manufactura**	
Enseñanza Sección CNAE: P	**NA**	
Salud Sección CNAE: Q	Insumos importados del sector: **Manufactura**	

Source: authors

Detailed annual results of the case study

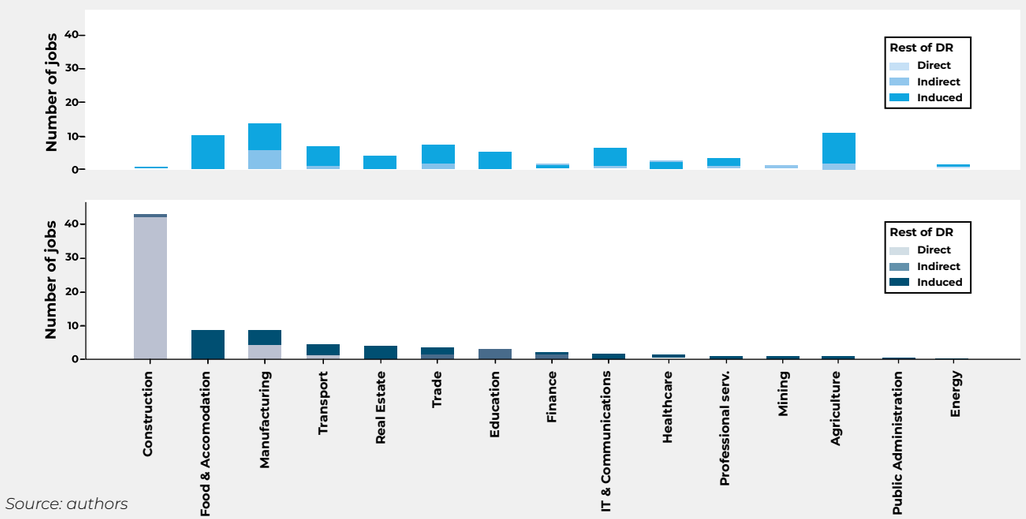
Effects from the 2026 intervention

Figure 11 | GVA effects from the 2026 intervention



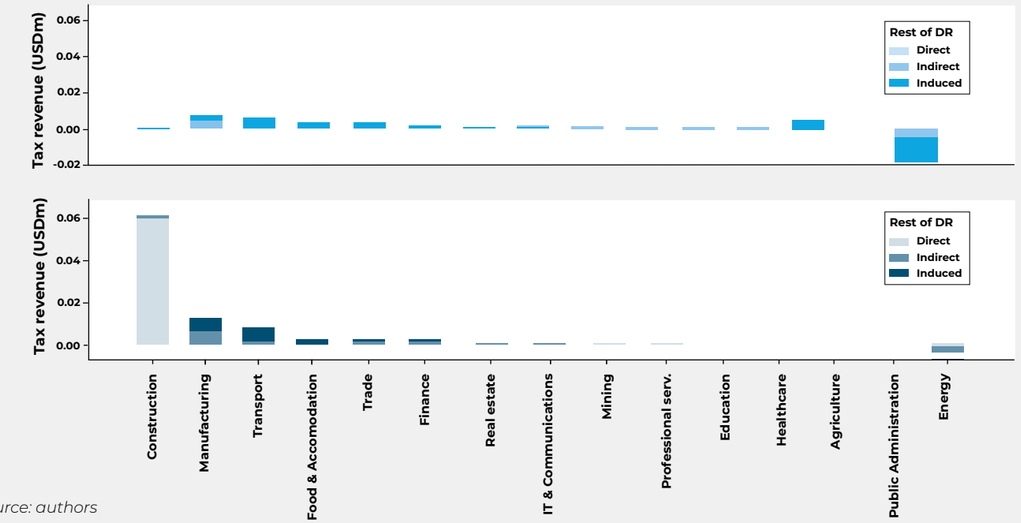
Source: authors

Figure 12 | Employment effects from the 2026 intervention



Source: authors

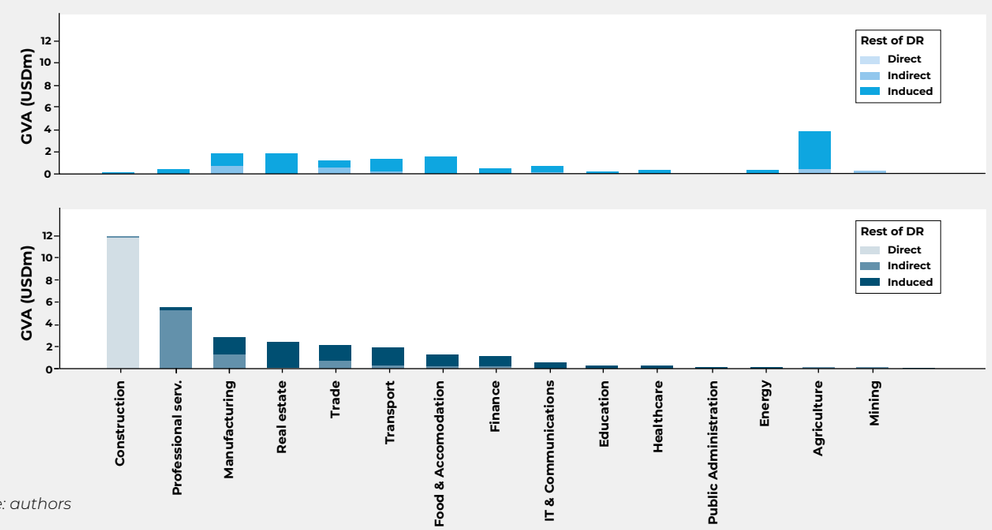
Figure 13 | Employment effects from the 2026 intervention



Source: authors

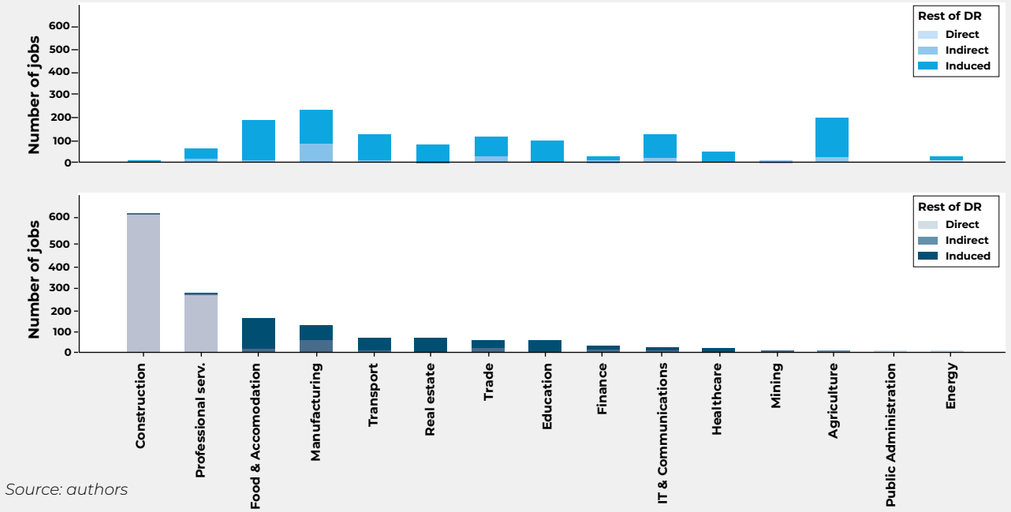
Effects from the 2025 intervention

Figure 14 | GVA effects from the 2025 intervention



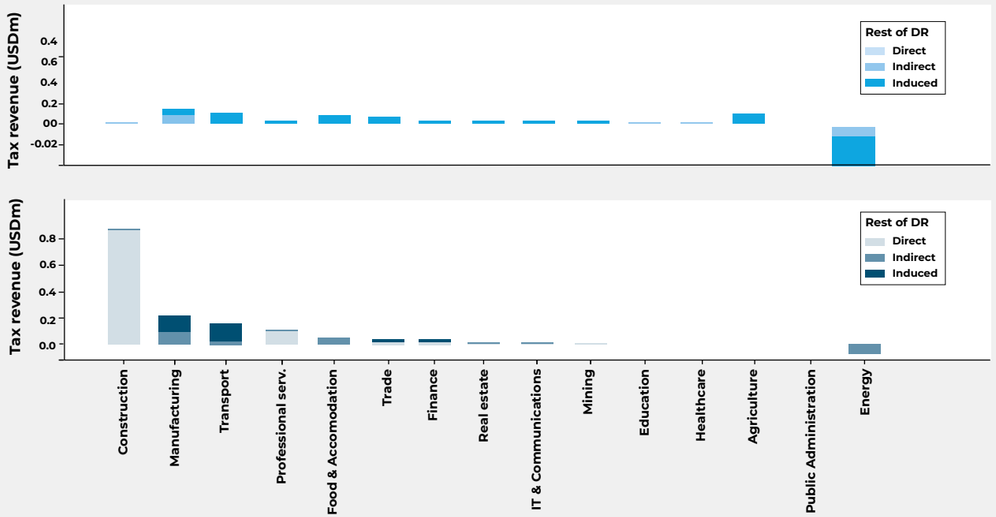
Source: authors

Figure 15 | Employment effects from the 2025 intervention



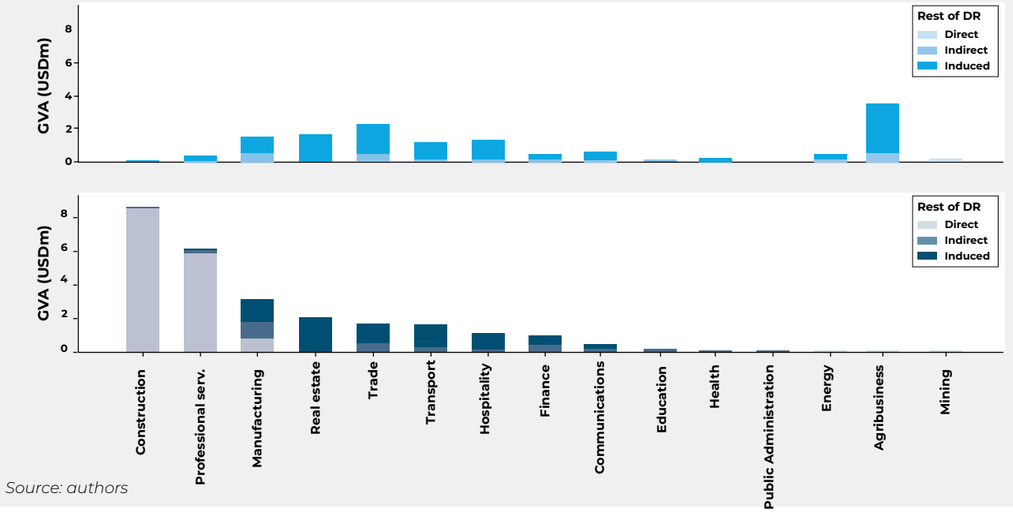
Source: authors

Figure 16 | Tax revenues effects from the 2025 intervention



Source: authors

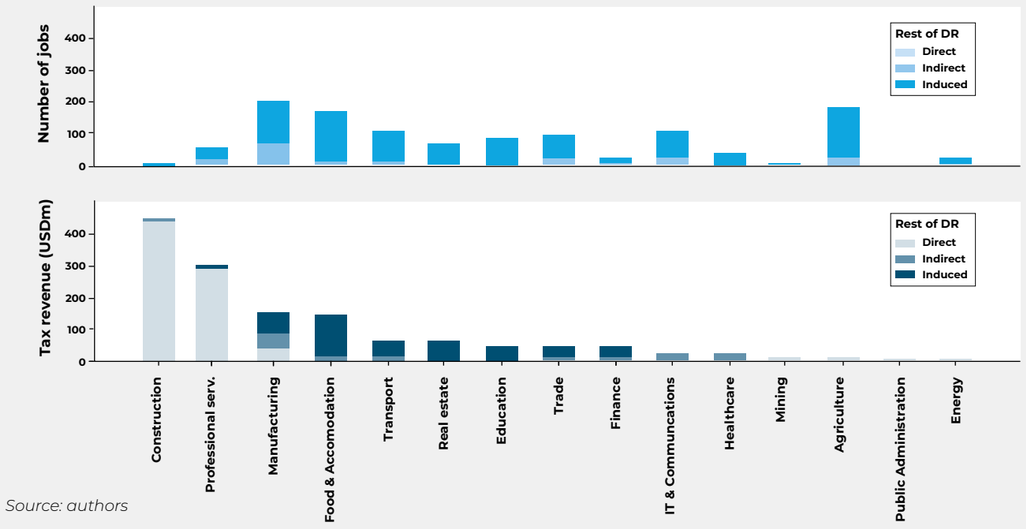
Figure 17 | GVA effects from the 2024 intervention



Source: authors

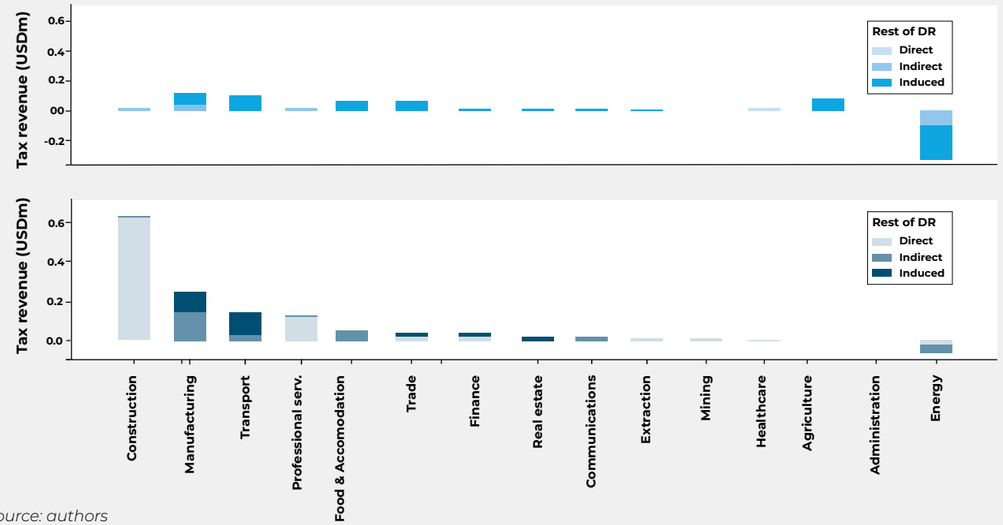
Effects from the 2024 intervention

Figure 18 | Employment effects from the 2024 intervention



Source: authors

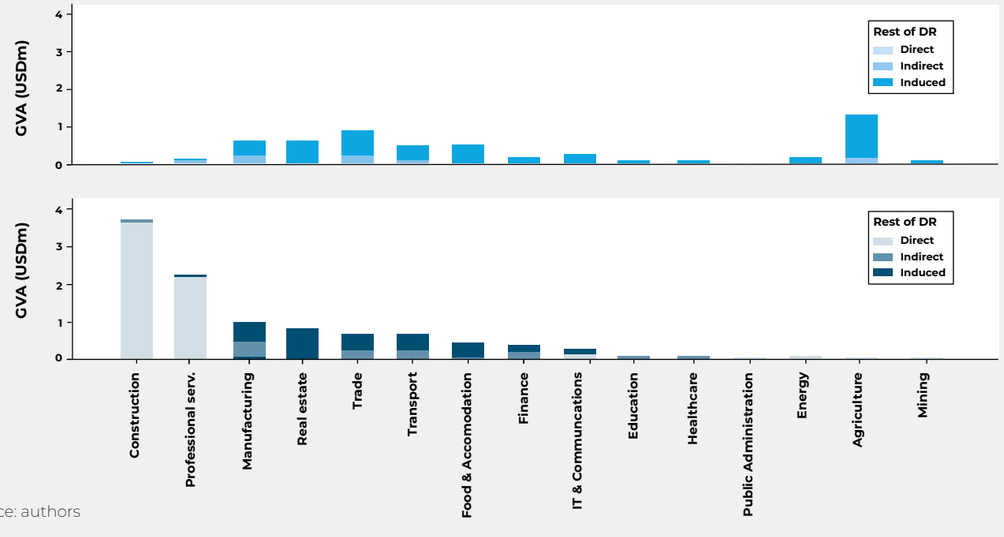
Figure 19 | Tax revenues effects from the 2024 intervention



Source: authors

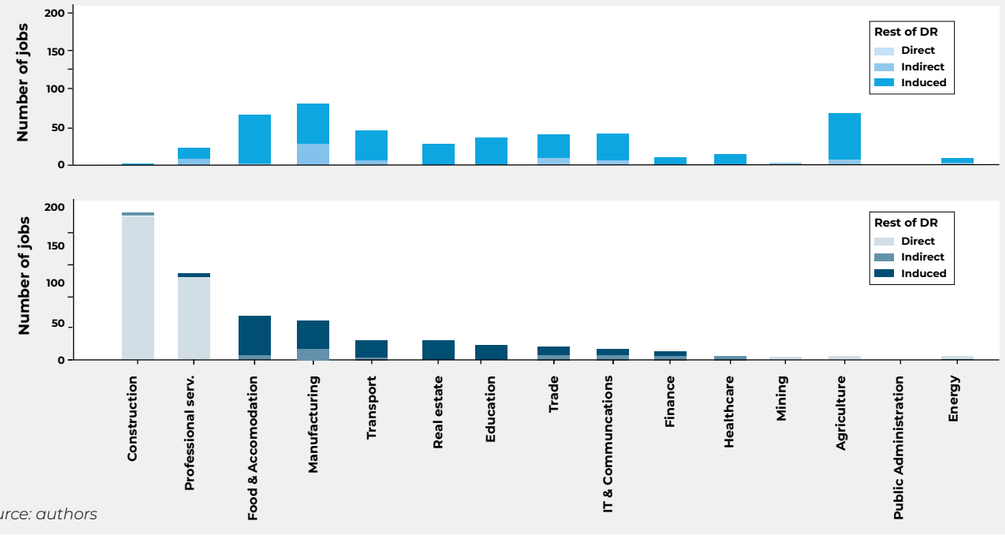
Effects from the 2025 intervention

Figure 20 | Figure 20 GVA effects from the 2023



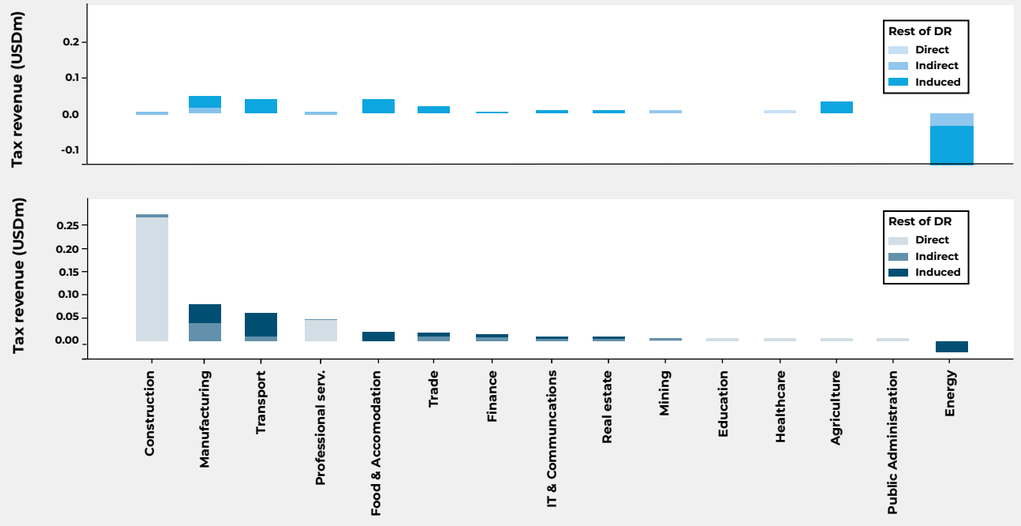
Source: authors

Figure 21 | Employment effects from the 2023 intervention



Source: authors

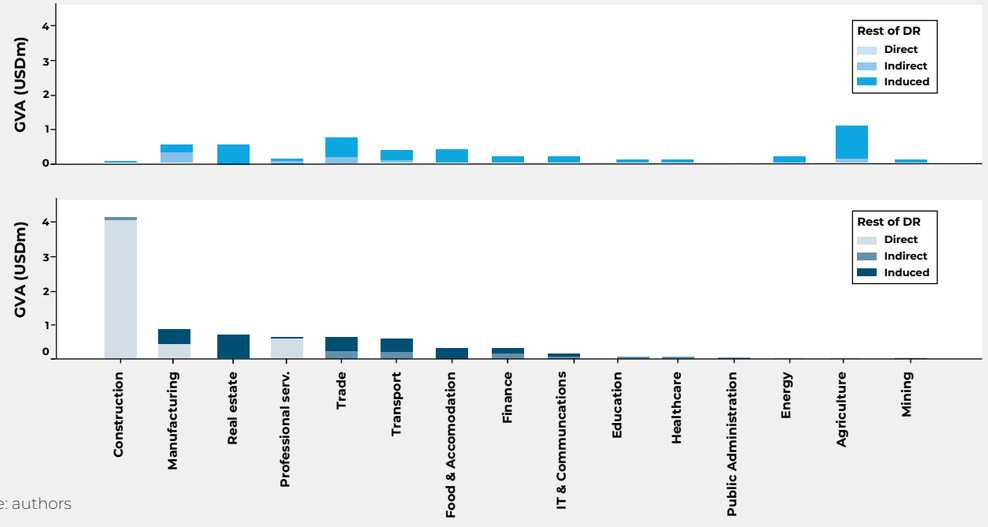
Figure 22 | Tax revenues effects from the 2023 intervention



Source: authors

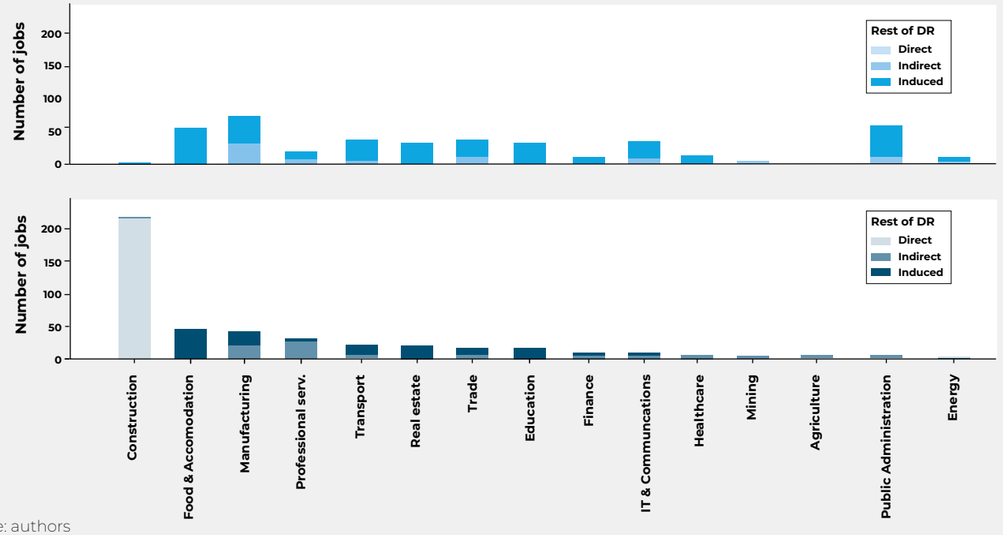
Source: authors

Figure 23 | GVA effects from the 2022 intervention



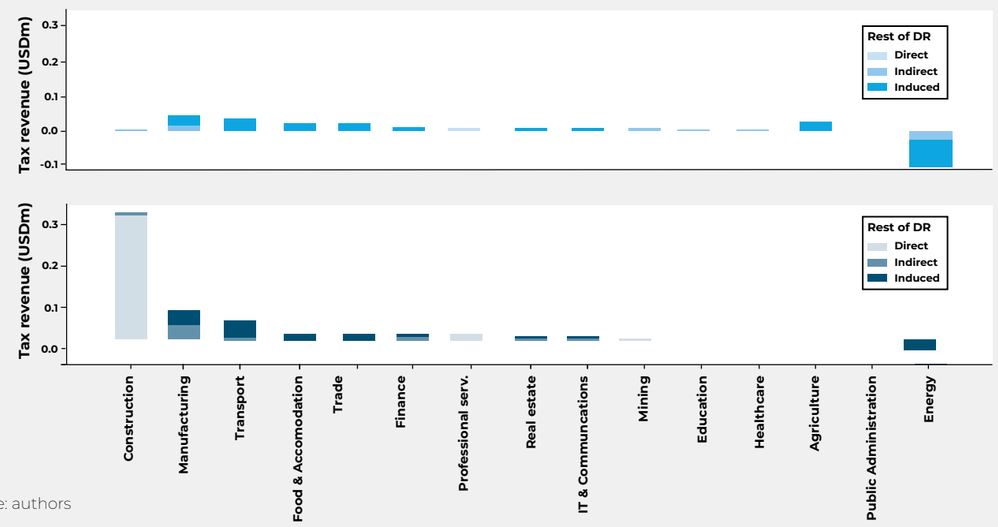
Source: authors

Figure 24 | Employment effects from the 2022 intervention



Source: authors

Figure 25 | Tax revenues effects from the 2022 intervention



Source: authors

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