Assessing the Effects of Trade on Employment:

an Assessment Toolkit

International Labour Organization

1919·2019

Produced with the financial support of the European Union

Assessing the Effects of Trade on Employment:

an Assessment Toolkit

First published 2019

Assessing the Effects of Trade on Employment: an Assessment Toolkit

ISBN: 978-92-2-132682-3 (print)
ISBN: 978-92-2-132683-0 (web pdf)
ISBN: 978-92-2-132684-7 (epub)

ILO publications can be obtained through major booksellers or ILO local offices in many countries, or direct from ILO Publications, International Labour Office, CH-1211 Geneva 22, Switzerland. Catalogues or lists of new publications are available free of charge from the above address, or by email: pubvente@ilo.org

Visit our website: www.ilo.org/publns

Printed by the International Labour Office, Geneva, Switzerland

This publication was produced by the Document and Publications Production, Printing and Distribution Branch (PRODOC) of the ILO.

Graphic and typographic design, layout and composition, printing, electronic publishing and distribution.

PRODOC endeavours to use paper sourced from forests managed in an environmentally sustainable and socially responsible manner.

Code: CPG-JMB-REPRO

Preface

Employment is a key driver for development as it constitutes a bridge between economic growth and poverty reduction. People and households get out of poverty most often by moving into more productive and decent jobs or improving existing jobs. Placing the aim of achieving full and productive employment at the heart of development policy is therefore critical for reducing and eventually eliminating poverty, reducing inequality and addressing informality. This is also now globally recognized with the adoption of Sustainable Development Goal (SDG) 8: "Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all"

The European Commission (EC) and the International Labour Organization (ILO) both recognize that, in order to achieve SDG 8, it is critical that full and productive employment be at the heart of development policy. In the "New European Consensus on Development", the EC emphasizes the importance of targeted policies in developing countries to promote the engagement of citizens - especially the youth, women and potential migrants - in social, civic and economic life and to ensure their full contribution to inclusive growth and sustainable development.

International trade has been advocated as a means of achieving sustainable development. Paragraph 79 of the Addis Ababa Action Agenda states that "with appropriate supporting policies, infrastructure and an educated work force, trade can also help to promote productive employment and decent work, women's empowerment and food security, as well as a reduction in inequality, and contribute to achieving the sustainable development goals".

However, creating more and better-quality jobs through international trade requires a coherent policy framework aimed at generating and upgrading employment. This policy framework should be based on a clear and shared understanding of how trade policy and other policies complementary to trade (e.g., sectoral, skills, infrastructure, investment, exchange rate, etc.) are expected to affect employment.

In this regard, the EC and ILO have jointly initiated a project entitled "Strengthening the Impact on Employment of Sectoral and Trade Policies". This innovative project includes developing methods and capacities to determine the effects of trade and complementary policies on employment. This project, being implemented in nine partner countries and working with national governments and social partners, aims to strengthen the capabilities of country partners to analyse, design and implement sectoral and trade policies and programmes for more and better jobs.

This toolkit is one in a series of project publications that aim to capture the tools, methods and processes developed under this project as well as the findings from implementing these in the nine partner countries. By doing so, the experience and learning of the project can be disseminated to other countries and partners for their benefit, thus encouraging the integration of global and national employment objectives into sectoral and trade policies and consequently supporting the global employment agenda and the achievement of SDG 8.

Acknowledgements

This assessment toolkit was produced as part of the project called “Strengthening the Impact on Employment of Sectoral and Trade Policies” (STRENGTHEN), which is being implemented by the International Labour Office with financial support from the European Union.

The material in this toolkit was first presented at project workshops in several countries in Asia, Africa and Central America. The interaction with and feedback from the workshop participants were essential to developing the contents of this toolkit. The toolkit has also been informed by research commissioned within the STRENGTHEN project.

The main author and editor of this toolkit was David Cheong (Trade and Employment Specialist, ILO). Others who contributed to the toolkit were: Haile Abebe (ILO), Luisito Abueg (De La Salle University), Alvin Ang (Ateneo de Manila University), Samuel Asfaha (ILO, former ITCILO), Michael Baltensperger (Graduate Institute, University of Geneva), Anda David (Université de Paris Dauphine), Laura Gauer (University of Geneva), Albert Lamberte (De La Salle University), Ward Rinehart and Philip Arnold Tuano (Ateneo de Manila University). The STRENGTHEN project would like to acknowledge the valuable contributions of all the above for their close collaboration and support in producing this toolkit.

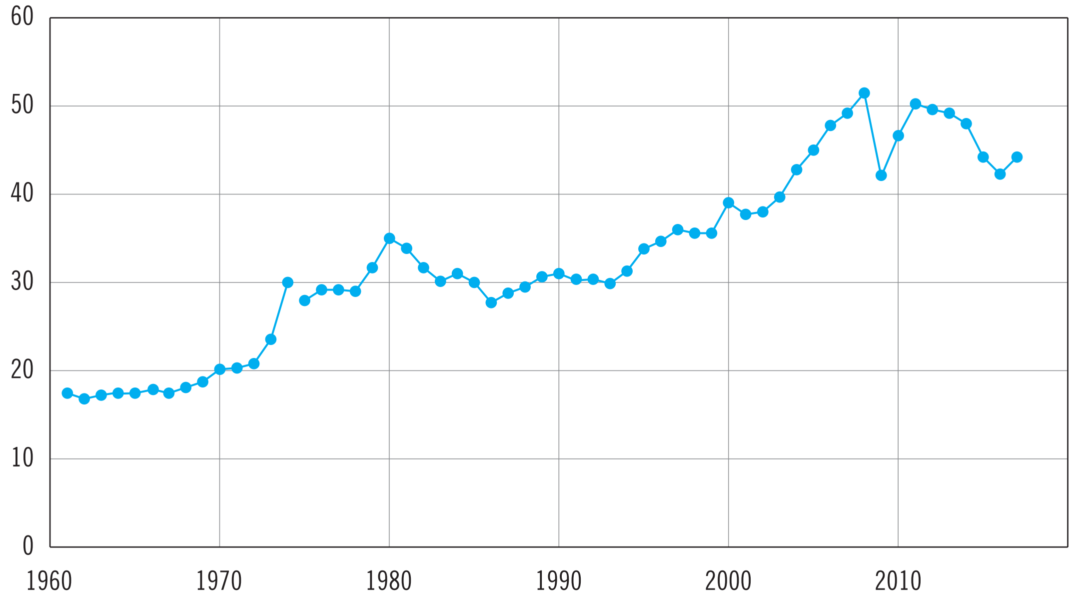
Disclaimer

Table of contents

Introduction

The current spate of bilateral trade wars and fears of the "death of trade"[1] do not negate the fact that the world has become highly interdependent through international trade, at least compared to the previous five decades. Figure 1 below shows that the value of world merchandise trade was less than a fifth of world GDP in the 1960s but rose to equal more than half of world GDP by 2008. If the chart included world services trade, which has also grown rapidly in recent decades, the trade to GDP ratio would be several percentage points higher. Trade is therefore still an important feature of the contemporary global economy, and governments still need to consider how trade can help or hurt their efforts to cater for the needs of their citizens.

Figure 1 World Merchandise Trade as % of GDP



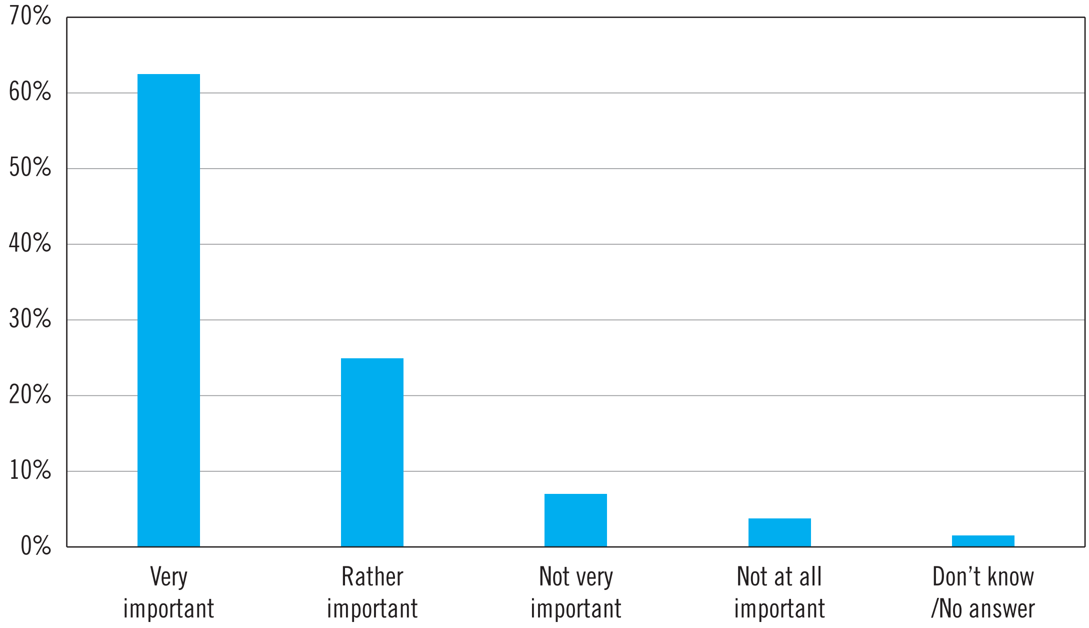
Data source: World Development Indicators 2018; Merchandise trade as a percentage of GDP is the sum of merchandise exports and imports divided by the value of GDP, all in current U.S. dollars.

Most of the world's citizens need to work in order to earn a living to support themselves and their families. According to the World Values Survey of close to 90 thousand people across 60 countries in the period 2010 to 2014, when asked to indicate how important work was to their lives, an overwhelming majority (87.5%) of those surveyed considered work to be very or rather important. There were no significant differences in the importance placed

1 The World Economic Forum's Global Risks Report 2018 (13th. edition) characterizes the current upsurge in protectionism and undermining of the multilateral trading system as the "death of trade".

on work between respondents from developed and developing countries or from various regional groupings. In other words, most people placed a high value on having work, regardless of their country's level of economic development or geographic location.

Figure 2 How important is work in your life?



Data source: World Values Survey (2010-2014 wave)

Given the prevalence of trade and the clear importance of work to the lives of people all over the world, it may seem surprising that governments have paid relatively little attention to how trade affects labour markets. There are several reasons for this. Firstly, as policy domains, both trade and labour are extremely diverse and complex in terms of the principles, regulations, instruments and outcomes involved. Trade policy covers various forms of tariffs and non-tariff measures (for example, quotas, technical barriers to trade, sanitary or phytosanitary standards, contingent protection, etc.), which are often combined in different ways within bilateral, plurilateral or multilateral trade agreements. Labour policy encompasses labour regulation and inspection, occupational safety and health, employment policies and job-search services, industrial relations and social protection. A high level of technical expertise is required for each policy domain, and very few policymakers can objectively speak to both trade and labour. Secondly, governments typically assign the mandates for trade and labour policies to separate ministries or departments. This institutional separation means that policymakers responsible for either domain pursue different sets of goals, which may or may not be coherent. Given the different areas of focus, officials who work in the Department of Trade may have little need to coordinate with those in the Ministry of Labour and vise-versa. As a result, few policymakers pay attention to the intersection between trade and labour. Thirdly, while there has been a substantial amount of research on the effects of trade on employment (as discussed in the next section), no practical tools have as yet emerged from this research to guide policymakers and their advisers interested in answering the question: “How many jobs are expected to be created or destroyed as a result of a given trade policy?”.

This toolkit attempts to fill the need for a practical approach to assess the effects of trade on employment. The methods in this toolkit were developed to be as intuitive, simple and low-cost as possible so that any interested person with a computer, an ability to use spreadsheets and internet access to freely-available data could perform an analysis of the anticipated effects of a given trade policy on employment. It is hoped that this assessment toolkit will be useful for policymakers, technical advisors, researchers and all others who work on the nexus between trade and labour markets.

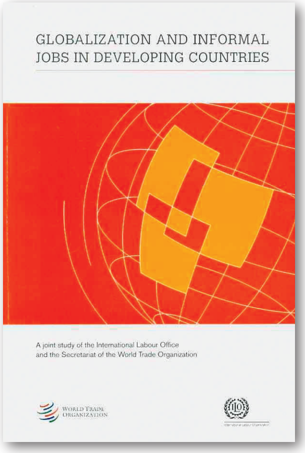
How does trade affect employment?

Before attempting an assessment of the effects of a given trade policy on employment, it may be helpful to get acquainted with the main themes and issues in the research literature on the links between trade and jobs. For this, we can refer to the work that the International Labour Organization (ILO), often in collaboration with other international organizations such as the World Trade Organization (WTO) and the United Nations Conference on Trade and Development (UNCTAD), has conducted over the past decade to review pertinent aspects of this line of research. These efforts have resulted in the publication of seven edited volumes on trade and employment. Below are the summaries of these volumes to provide a quick overview of all the conceptual and empirical issues that these volumes cover. Readers who wish to explore any issue in more detail can access any of these volumes online.

(1) Trade and Employment: Challenges for Policy Research (2007), ILO-WTO, Geneva

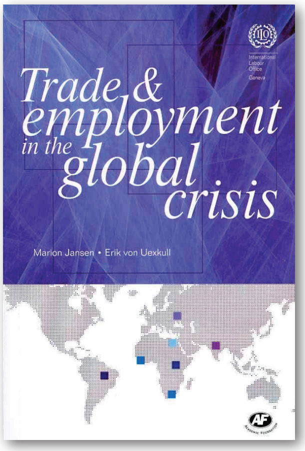
This volume reviews the academic literature, both theoretical and empirical, focusing on the connections between trade policies and labour and social policies. It lays out the main predictions in theory of the effects of trade on employment. In developed countries, it is expected that labour-intensive sectors shrink while skill- or capital-intensive sectors expand. The opposite phenomenon is expected to happen in developing countries. In terms of distributional consequences, trade liberalization implies increased inequality in developed countries but lower inequality in developing countries. Some of the empirical evidence confirms these predictions. In particular, decreases in inequality were observed in a number of East Asian economies that liberalized trade. At the same time, increases in the wage differential between high-skilled and low-skilled labour – the so-called skill premium – were observed in a number of developed countries. On the other hand, some important phenomena emerged that were not in line with theory. Increases in the skill premium were also observed in developing economies during periods of trade liberalization, notably in a number of Latin-American countries. Further, a lot of employment reshuffling was observed to take place within sectors rather than across sectors as theory would predict. This volume concludes that trade policies and labour and social policies do interact and that greater policy coherence in the two domains can help to ensure that trade reforms have significantly positive effects on both growth and employment. Policy coherence would be necessary to: facilitate worker transitions following trade reform, provide workers with social security and insurance against adverse events, redistribute some of the gains from trade to those who lose, and ensure an adequate supply response of the economy to trade liberalization.

(2) Globalization and Informal Jobs in Developing Countries (2009), ILO-WTO, Geneva



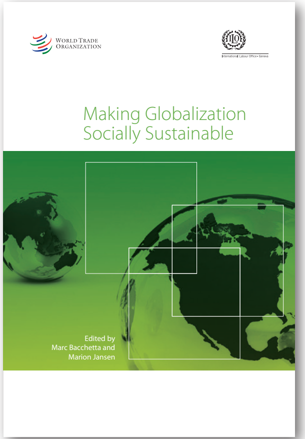
This volume discusses the mechanisms, in theory, by which trade liberalization impacts informal employment and presents the relevant empirical evidence. The important elements within the theoretical models are: the production linkages between the informal and the formal sectors, the mobility of capital between the formal and informal sectors, wage-setting in the formal and informal sectors and the tradability of informal output. These models identify a number of mechanisms through which trade liberalization could raise informal employment, as well as the conditions under which it raises informal wages. The literature concludes that the opening of the import-competing formal sector typically pushes workers towards the informal sector and, depending on capital mobility and production linkages, prompts an increase or decrease in informal wages. Relevant empirical evidence is only available for a small group of mainly Latin American countries. This evidence suggests that both the direction and extent of the effect of trade liberalization on informality are highly dependent on country-specific circumstances. Trade liberalization increased informality in Colombia, reduced it in Mexico and had no measurable effect on it in Brazil.

(3) Trade and Employment in the Global Crisis (2009), ILO-Academic Foundation, Geneva



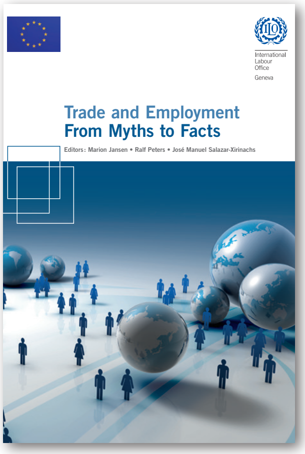
Based on the findings of ILO-sponsored studies of employment impacts in Brazil, Egypt, India, Liberia, South Africa, Uganda and Ukraine during the global crisis of 2008-2009, this volume analyses how cross-border trade acted as a transmission channel, spreading the crisis to developing and emerging economies. Key topics covered include the role of export concentration in increasing labour markets' vulnerability to trade shocks, the effects of global price volatility on household and company investment decisions, the impact of the global slowdown on workers' and governments' bargaining power and the impact of negative trade shocks on gender inequality. The volume reviews the suitability of the different policy instruments that countries applied during the crisis. The main finding is that social or labour market policies, such as social protection systems or labour market legislation, act as automatic buffers and can be rapidly scaled up or targeted towards groups particularly affected by the crisis. With a minimal potential to distort trade flows, such measures perform extremely well with regard to both employment and trade objectives.

(4) Making Globalization Socially Sustainable (2011), ILO-WTO, Geneva.



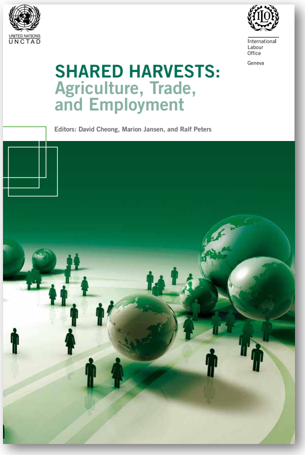
This volume revolves around three themes: globalization and employment, globalization and inequality, and globalization and uncertainty. Concerning trade and employment, the key finding is that globalization's promise of expanding high-productivity employment opportunities and inducing structural change and growth has been fulfilled in some countries (most notably China, India and some other Asian countries) but not kept in other countries (in Latin America and sub-Saharan Africa). As for globalization and inequality, there is evidence that the growing skill premia in developed and developing countries could in part be driven by increases in offshore outsourcing. On globalization and uncertainty, the main finding is that perceptions of globalization being a threat to employment are more prominent in countries characterized by a negative estimated employment effect of offshoring. These volume points to the importance of social protection in labour markets exposed to external shocks and redistribution and education policies in making globalization more inclusive.

(5) Trade and Employment: From Myths to Facts (2011), ILO, Geneva.



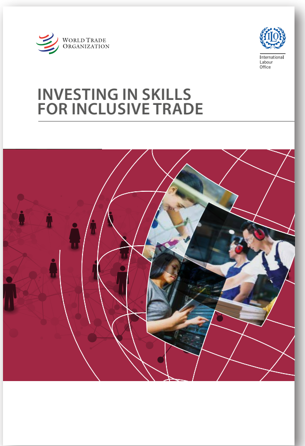
This volume deals with important aspects related to trade and employment in developing countries, namely the informal economy, gender, export diversification, and adjustment following trade liberalization. The publication highlights a number of measures that governments can take to strengthen the supply response of their economies and the resulting employment creation. The volume emphasizes the crucial role of governments in: helping firms – particularly informal ones – to survive or to grow in the face of global markets; providing the right infrastructure and workforce education as the basis for economic diversification and the development of new export products; addressing the gender aspects of trade through equity policies; and implementing strong social protection instruments rather than targeted adjustment assistance.

(6) Shared Harvests: Agriculture, Trade, and Employment (2013), ILO-UNCTAD, Geneva.



This volume analyzes the relationship between agricultural trade and employment, particularly with respect to developing countries. Agriculture is among the most distorted sectors in international trade with high tariffs and subsidies. This volume argues that access to agricultural markets in developed and emerging economies is key to catalyzing agriculture-based development in the rest of the world. To capitalize on agricultural exports for employment, developing countries should ensure coherence between agricultural trade policy, agricultural support programmes to farmers (especially smallholders), and government measures targeted at agricultural workers. Agricultural trade policy should seek export-market access for agricultural activities that are more productive or expected to have higher productivity and value-addition through support programmes. Agricultural support programmes could include extension services as well as efforts to disseminate market information (e.g. price developments, changes in foreign demand, and trade standards) and improve access to export markets (e.g. infrastructure, integration into global supply chains, and distribution networks). Measures targeted at agricultural workers should help them become more employable in the agricultural activities concerned and encourage transitions to formal employment so that more of these workers are covered by social insurance schemes and protected by national labour legislation. This volume also covers other pertinent issues such as food and job security, rural–urban migration, skills mismatch and domestic regulation.

(7) Investing in Skills for Inclusive Trade (2017), ILO-WTO, Geneva.



This volume argues that the availability of workers with appropriate skills and capabilities are an important prerequisite for reaping the benefits of globalization. Firstly, skills are an important factor in establishing and developing comparative advantage. Skills development can be used as part of strategies to strengthen a country's trade performance, either through a broad emphasis on ensuring that skills development systems strengthen participation in trade or through more targeted skills development aimed at developing comparative advantage in specific activities. Secondly, if there is a trade-connected employment shock, this can have a persistent negative impact on the labour market prospects of workers who lose their jobs. These workers may be helped by skills strategies such as reskilling, upskilling, or strengthening transferable skills. Thirdly, trade may tend to increase wage inequality by increasing the skill premium. Increasing the supply of in-demand skills inhibits this tendency by allowing more workers to access better-paid jobs.

Using this toolkit

This toolkit comprises a manual with five units and an accompanying Excel file with example data and analytical templates. The units present the tools and the mechanics of a methodology to assess the impact of trade policy on employment. While the tools are applied to the main topic of interest, they are more generally applicable. Hence, the units in this manual can be read individually to learn about each tool and possibly for employment impact analysis in other policy areas.

Unit 1 introduces a framework known as a Social Accounting Matrix (SAM) to represent an economy. This framework is the basis for the methodology contained in this toolbox for assessing the impact of trade on employment. Unit 1 explains what a SAM is and, most importantly, how it serves as a data source for policy assessment.

Unit 2 sets out the main assessment tool of the methodology presented in this manual: multiplier analysis. A multiplier can capture the economic effects of a given policy not only in the economic sector that is directly affected by the policy but also in the rest of the economy. As such, it is an economy-wide measure of a policy's "bang for the buck".

Unit 3 focuses on a policy's consequences on employment. By extending multiplier analysis, this unit shows how to obtain estimates of a policy's effects in terms of employment.

Unit 4 assembles the tools presented in the previous units and combines them with a trade policy model that quantifies trade flows to ultimately compute the effects of a given trade policy on employment. This unit contains the core of the methodology developed in this manual to assess the impact of trade policy on employment.

Finally, using the tools from the previous units, Unit 5 presents how to identify economic sectors with strong linkages to the rest of the economy. Policy interventions in such sectors would be expected to have the largest impact on an economy and hold the largest potential for economic growth, value-added contribution and employment creation. Having a way to identify these "key sectors" could be useful to economic planners.

UNIT 1

Introduction to the Social Accounting Matrix

Key questions of this unit:

1 What is a Social Accounting Matrix (SAM) and what are its main accounts?

2 How are economic agents and actors of a given economy linked to each other through a circular flow of income and expenditure?

Important observations:

- A SAM is a square matrix that represents the transactions taking place in an economy during an accounting period, usually one year (Round, 2003). The corresponding row and column totals of a given account in the SAM must be equal.
- The main purposes of a SAM include: providing information on the social and economic structure of a country, providing a snapshot view of transactions and transfers in an economic system and serving as a data source for various models to assess the effects of a given shock or intervention.

1.1 What is a SAM?

A social accounting matrix (SAM) is a consistent framework representing the entire economy of a country or a region for a defined period (usually one year). It provides a static image of the economy and can serve as a data source for various models to assess the effects of a given shock or intervention.

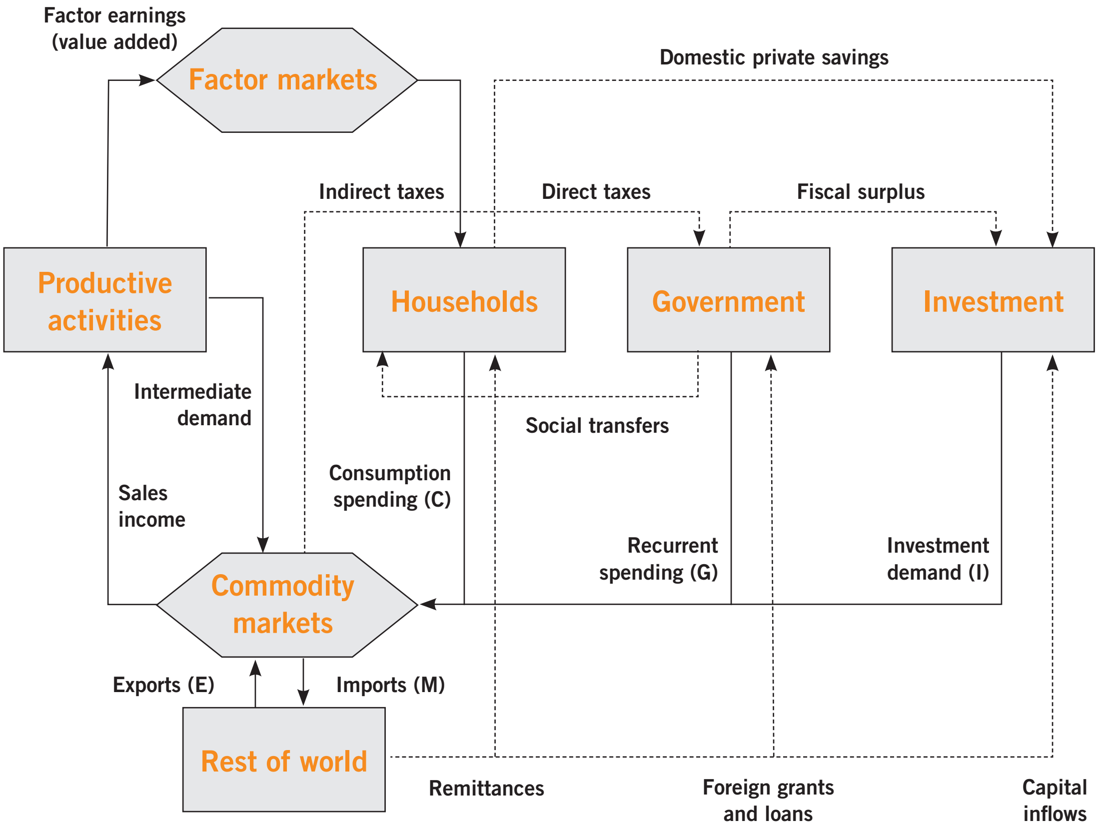
A social accounting matrix (SAM) records transactions among economic actors or agents in an economy.

A SAM records transactions among economic actors or agents in an economy. The term "economic actors" refers to agents such as consumers, producers, and governments. A SAM consists of monetary exchanges; hence, all flows are in monetary values and not in volumes of goods and services exchanged. These monetary flows represent payments by one economic agent to another agent. By recording payments and receipts among economic agents, the SAM captures linkages between production sectors, factors of productions (labour and capital), and institutions (households and government), providing a comprehensive view of interactions in the economy. In addition to linkages among domestic economic agents, the SAM records transactions between the domestic economy and the rest of the world, such as imports, exports and remittances.

1.2 The circular flow of income

A SAM displays information on how the various actors in an economy are linked with one another. One way to depict the linkages among economic actors is by tracking the monetary transactions that take place among them – a method known as the circular flow of income. The circular flow of income describes an economy in terms of the flow of resources among enterprises, households, governments and the rest of the world. Figure 1.1 illustrates the circular flow of income.

Figure 1.1 Circular flow diagram of the economy



Source: Breisinger, Thomas, and Thurlow (2009).

Let us look first at productive activities. To produce, enterprises need intermediate inputs, which are bought from the commodities market. Some intermediate inputs might be domestically produced, and some might be imported. In addition, factors of production, mostly labour and capital, are needed. These are purchased from factor markets; enterprises pay wages to labour and rent to capital. Together, the amount of wages paid to labour and rent paid to capital are assumed to equal the "value" that labour and capital add to output; hence, this amount is called "value added". A productive activity is labour-intensive if the value added of labour is greater than the value added of capital.

The output of productive activities goes into the market for commodities (goods and services). Commodities are either exported abroad or used domestically by households and government for final consumption or are used by domestic activities as intermediate inputs.

Who supplies the services of labour and capital to factors markets? Households do. Hence, payments for factors of production are an important source of income for households. Other sources of income for households include remittances from abroad, social transfers such as unemployment benefits from government and inter-household transfers.

How do households use their income? They spend part of their income on consumption of goods and services. This part of household spending represents income to productive activities (i.e. sales income). But households do not consume only domestically-produced goods. They also consume imported goods. Households also spend part of their income to pay income taxes (direct tax). What remains after consumption and tax expenditures is the households' savings.

The government is an important part of the circular flow. Like households, the government consumes goods and services and makes transfers to activities in the form of subsidies and to households in the form of social transfers. It generates its income through direct taxes (income tax) and indirect taxes (sales tax and tariffs).

A SAM can be described as a tabular representation of the circular flow of income

In short, the circular flow captures the generation of income for activities by producing commodities, the mapping of these income payments to factors of production, the distribution of factor and non-factor income to households and the subsequent spending of income by households on commodities (Round, 2003). A SAM can be described as a tabular representation of the circular flow of income.

1.3 The structure and components of a SAM

The core structure of every SAM includes – the activities accounts, the commodities accounts, the factor accounts, the institutions accounts, the "Savings and Investment" account and the "Rest of World" account (table 1.1). In the discussion that follows, we present the details for each class of accounts.

Activities

The activities accounts capture the sectors that carry out production. These sectors buy intermediate inputs from the commodities accounts, pay the value added to the factors accounts and pay production taxes and/or value added tax, if any, to the government. Activities receive the value of sales from commodities, which are recorded at producers' prices.

Commodities

The commodities accounts refer to the goods and services that activities produce. These accounts receive payments from activities that use the commodities as intermediate inputs, from households (private consumption), from government (public spending), from the "Savings and Investment" account (investment demand) and from the "Rest of World" or foreign account (export value). As mentioned, commodities pay the value of sales to activities, and they also pay the value of imports to the "Rest of World" account and import taxes to the government when applicable. Commodities are recorded at market prices.

Factors

The factors accounts represent labour and capital. These accounts receive payments from the activities in the form of value added, either as wages for labour or as rents for capital and land. Factors use these receipts for payments to households as factor income. Factors also pay compensation for foreign labour and payment for foreign capital services to the "Rest of World" account.

Households and Firms

The household account represents the private institutions in the economy. They receive the value of the payroll in the form of wages, rents from capital and land, and transfers from other domestic and foreign institutions. Households use their income for consumption of goods and services, income taxes, transfers to institutions (e.g. transfer from one household group such as urban households to another household group such as rural households) and savings, which will be paid to the "Savings and Investment" account. Firms are often integrated into the household account because households are assumed to own the firms. Thus, firms are assumed to have an earning and consumption pattern similar to that of households. If it is assumed otherwise, then firms will receive the non-distributed capital earnings and other transfers (i.e. that part of activities' income not distributed to households) and will pay taxes to government, pay dividends to institutions holding shares, pay foreign remittances to the rest of the world and transfer the rest to the "Savings and Investment" account as private savings.

Table 1.1 Representation of a SAM

		Expenditures (Columns)								
Incomes (Rows)		**Activities**	**Commodities**	**Labour**	**Capital**	**Households**	**Government**	**Savings and Investment**	**Rest of World**	**Total**
	Activities		Domestic supply							**Activities income**
	Commodities	Intermediate demand	Transaction cost			Private consumption (C)	Government consumption (G)	Investment demand (I)	Exports (E)	**Total demand**
	Labour	Value added							Foreign factor earnings	**Factor income**
	Capital	Value added							Foreign factor earnings	**Factor income**
	Households			Factor income to households (wages)	Factor income to households (rents)	Inter household transfers	Social transfers		Foreign remittances	**Household income**
	Government	Production taxes/subsidy	Sales taxes and import tariffs			Direct household taxes	Within public sector transfers		Foreign grants and loans	**Total government revenue**
	Savings and Investment					Private savings	Fiscal surplus		Current account balance	**Total savings**
	Rest of World		Import payments (M)	Factor income to RoW	Factor income to RoW	Foreign remittances paid	Government transfers to RoW			**Foreign exchange outflow**
	Total	**Gross output**	**Total supply**	**Total factor spending**	**Total factor spending**	**Total household spending**	**Total government expenditure**	**Total investment spending**	**Foreign exchange inflow**	

Source: Modified from Breisinger, Thomas and Thurlow (2009).

Government

The government account records public expenditure in the form of recurrent spending and transfer payments to households (e.g. social security and pensions). It also captures government revenue such as direct taxes paid by households, indirect taxes such as sales taxes and import tariffs. In addition, this account captures production taxes from activities when applicable and in the case of negative values or entries these production taxes indicate production subsidies. Transfer payments such as foreign grants and development assistance from the rest of the world are also recorded under the government account of the SAM. In countries where there are transfers from one public entity to another, these transactions are recorded as within public sector transfers. The difference between total government revenues and expenditures is the fiscal surplus (or deficit, if expenditures exceed revenues) which is recorded as a government payment to the "Savings and Investment" account.

Savings and Investment

The "Savings and Investment" account collects savings from the households, the government and the rest of the world (foreign savings) and then uses it for investment in commodities (i.e. investment demand for producing output).

Rest of World

The "Rest of World" account captures the monetary flows between the country and all its foreign partners. This account records outflows of foreign exchange such as payment for imports and foreign production factors as well as remittances to foreign households and transfers to foreign governments. The "Rest of World" account also shows inflows of foreign exchange such as export income, earnings of factors employed abroad, foreign remittances to domestic households and grants and loans from foreign governments.

1.4 Reading the structure of an economy from a SAM

As previously mentioned, a SAM provides a snapshot of the economy for a given year. From it we can deduce the main economic aggregates and describe the structure of the economy. In the following discussion we will use the example of the 2008 SAM of Indonesia[2] as shown in table 1.2.

Reading a SAM is an easy exercise. All you need to know is that columns pay and rows receive.

Reading a SAM is an easy exercise. All you need to know is that columns pay and rows receive. For example, the cell at the intersection of the column "Activities"

[2] The Indonesian SAM 2008 used in this assessment toolkit is an aggregated version of the detailed SAM provided by the Central Statistics Bureau of Indonesia in the publication "Sistem Neraca Sosial Ekonomi 1975-2008", pp. 268-291.

(column 1) and the row "Commodities" (row 2) in table 1.2 represents intermediate consumption. Recall that each cell in a SAM represents a monetary transfer from a column account to a row account. The amounts in each cell in table 1.2 are in billions of rupiahs, which is the Indonesian currency.

Table 1.2 Indonesian SAM (in billion rupiahs), 2008

	Activities	Commodities	Labour	Capital	Households	Government	Savings and Investment	Rest of World	Total
Activities		10,175,383							**10,175,383**
Commodities	5,218,150	2,341,959			3,318,105	335,756	1,508,831	1,487,238	**14,210,038**
Labour	2,692,618							1,707	**2,694,325**
Capital	2,464,317							6,658	**2,470,975**
Households			2,688,905	2,379,748	298,084	288,726		87,683	**5,743,146**
Government	-199,702	344,940			735,126	767,508		2,291	**1,650,163**
Savings and Investment					1,316,041	229,473		-36,684	**1,508,831**
Rest of World		1,347,756	5,420	91,227	75,790	28,700			**1,548,892**
Total	**10,175,383**	**14,210,038**	**2,694,325**	**2,470,975**	**5,743,146**	**1,650,163**	**1,508,831**	**1,548,892**	

Source: Central Statistics Bureau of Indonesia

What does the SAM in table 1.2 tell us about the structure of Indonesia's economy? In other words, can we infer the GDP of Indonesia, the value of intermediate consumption, the size of taxes, imports and exports, factor incomes etc.?

Intermediate consumption

This is what activities pay for commodities, i.e. both for domestically produced intermediate inputs and payment for imported intermediate inputs (5,218,150 billion).

The payments from activities to commodities (domestic or imported) represent the value of intermediate inputs used in the production process. In this example SAM, we find only one value, but, in a more disaggregated SAM, we could find the intermediate inputs for each productive sector.

Value added – gross domestic product (GDP) at factor cost

This is what activities pay for labour (2,692,618 billion) and capital (2,464,317 billion). Total value added is the sum of payments from activities to factors. The Indonesian GDP at factor cost in 2008 was therefore 5,156,935 billion rupiah.

Government, Taxes and Subsidies

In the Indonesian SAM, public transactions are captured in the "Government" account. The "Government" account records public expenditure on commodities as government consumption, i.e. recurrent spending (335,756 billion), transfers from government to households, i.e. social transfers (288,726 billion), intra-governmental transfers[3] or within public sector transfer (767,508 billion). The "Government" account also records government savings as a fiscal surplus (229,473 billion), and payments made to the rest of the world, e.g. interest payments on foreign debt (28,700 billion).

Taxes and subsidies are important components of the "Government" account in a SAM. Taxes consist of: (i) Indirect taxes, i.e. sales tax and import tariffs (where the "Commodity" column and the "Government" row meet: *344,940 billion*). (ii) Income tax (where the "Households" column intersects with the "Government" row: *735,126 billion*). (iii) Activity or production taxes (where the "Activities" column and the "Government" row meet: *–199,702 billion*). The negative entry represents production subsidies. So, production activities received 199,702 billion rupiah in the form of subsidies from the Indonesian government.[4]

Foreign trade

This refers to imports (payments by the commodities account to the "Rest of World" account for imported commodities) and exports (payments by the "Rest of World" account to commodities).

Indonesian imports from the rest of the world in 2008 amounted to *1,347,756 billion* rupiahs, whereas the value of its exports was *1,487,238 billion* rupiahs, indicating a trade surplus of about *139,482 billion* rupiahs.

Transaction cost

Transaction costs are payments associated with the exchange of goods and services. These costs include: transportation cost, payment to financial intermediary entities such

3 International Labour Organization (ILO), Social Accounting Matrix Advisory Support and Monitoring Assistance (SAMASAMA) Project Brief, Geneva, 2009, pp. 3.

4 For a similar recording of subsidies, see Breisinger, C., Thurlow, J., Duncan, M., A 2005 Social Accounting Matrix (SAM) for Ghana, International Food Policy Research Institute (IFPRI), 2007, pp. 7. See also IFPRI working paper, A disaggregated social accounting matrix 2010/11 for policy analysis in Egypt, Egypt SSP 02, 2016, pp. 5.

as banks and brokers, communication charges, legal fees and product information costs, among other costs.

In the Indonesian SAM, transaction costs are recorded as transfers between the "Commodities" accounts (*2,341,959 billion*).

Factor income

Factor income refers to transfers from labour to households (2,688,905 billion) and from capital to households (2,379,748 billion).

The factor income that accrues to households comes from labour and from capital. For Indonesia in 2008, payments for labour were also made to foreign workers *(5,420 billion)* and to foreign owners of capital *(91,227 billion)*. In the SAM in table 1.2, there is only a single, homogeneous household sector. A more disaggregated SAM could include different household categories with different sources of income. This would be useful for analysing the distributional impact of a given policy.

Private and Public spending

Payments from households for commodities, i.e. household consumption (3,318,105 billion) constitute private spending, and payments from government for commodities, i.e. government consumption or recurrent spending (335,756 billion), constitute public spending.

The value of private consumption in the economy can be inferred from household payments for commodities. If households and commodities were disaggregated, we could also analyse the differing consumption patterns of different household types. Public spending corresponds to government payments for commodities. Usually, commodities consumed by government are very specific: education, health, defence and public administration. The weight of each of these commodities in total government spending could offer insight into the government's priorities.

Household transfers

Household transfers consist of transfers between households (298,084 billion), transfers from households to the rest of the world (75,790 billion), transfers from government to households, i.e. social transfers (288,726 billion), and transfers from the rest of the world to households, i.e. remittances (87,683 billion).

The SAM covers different types of household transfers. First, households could transfer to other households; a more detailed disaggregation would allow us to understand the direction of these transfers (for instance, a transfer from urban households to rural households could indicate rural-to-urban migration). Transfers from government to households include social security benefits, pensions and other allowances. Here, a distinction between poor and non-poor households would give us insight to help address those in vulnerable categories. The transfers from the rest of the world to households can be directly linked to migration, since they include remittances from family members living abroad.In the Indonesian economy, remittances are quite low, constituting around 1.53 per cent of households' total income.

Savings

Savings include transfers from households to the "Savings and Investment" account, i.e. private saving (1,316,041 billion), transfers from the government account to the "Savings and Investment" account, i.e. fiscal surplus (229,473 billion) and transfers from the "Rest of the World" account to the "Savings and Investment" account, i.e. foreign savings (–36,684 billion).

We can infer the value of private, public, and foreign savings (i.e. the current account balance) from the SAM. We notice that private savings are significantly higher than public savings (or a fiscal surplus). The negative foreign savings indicate that in 2008 Indonesia had a current account deficit. The *"*Savings and Investment*"* account collects all the savings and then transfers it to commodities according to investment demand.

All in all, a SAM is an accounting summary of transactions that took place within an economy during a given period, usually one year. This information is useful for analysing the impacts of external shocks and macroeconomic policies. The purpose of the SAM and the availability of data determine the level of aggregation of its accounts. Thus, the choice of the accounts is not fixed; one can add accounts to increase the specificity of the SAM, or accounts could be merged if this will cause no loss of information.

The information in a SAM is useful for analysing the impacts of external shocks and macroeconomic policies.

UNIT 2

SAM-multiplier analysis

Key questions of this unit:

1. How does an exogenous shock to one sector of the economy have an impact on the rest of the economy?
2. What are the main types of SAM multipliers and what are the steps to compute SAM multipliers?

Important observations:

- Sectors in an economy are interdependent through economic linkages. Hence, a change in one sector could have a significant impact on the others. This effect is captured through multiplier analysis.
- The first step in SAM multiplier analysis is to distinguish the endogenous accounts of the SAM from exogenous accounts.

A SAM is a database that contains information that represents the economy. As a database, the SAM can be used for different types of studies using different analytical methods. One such method is multiplier analysis, which was developed by the economist and Nobel laureate, Wassily Leontief.

2.1 Concepts of multipliers

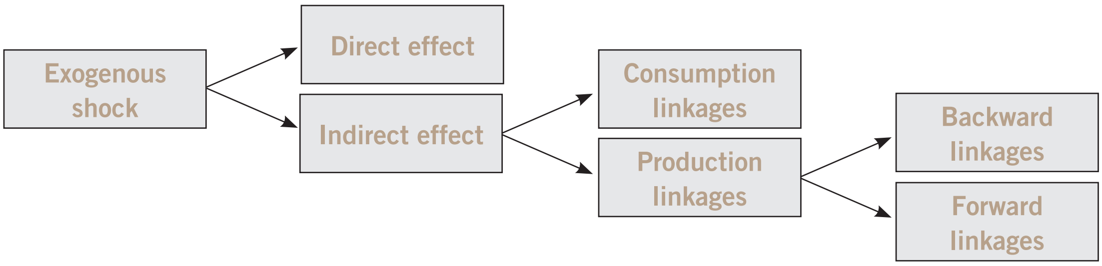
A multiplier captures the effects that an exogenous monetary transfer to a sector (i.e. injection) or outflow from a sector (i.e. leakage) has on the rest of the economy due to the interdependencies among economic sectors and actors. This injection (or leakage), usually called an "exogenous shock" because it is out of the scope of direct decision or control of consumers and firms, often refers to changes in export demand, government spending or investment. As indicated in figure 2.1, the effects of these shocks can be both direct (that is, they concern the sector initially affected by the shock) and

A multiplier captures the effects that an exogenous monetary transfer to or from a sector could have on the rest of the economy.

indirect (that is, consequences of the interdependence between the affected sector and the rest of the economy). The sum of direct and indirect effects constitutes the "total multiplier effect" of the exogenous shock, meaning how much a direct effect is multiplied due to the economic linkages (indirect effects).

The indirect effects of an exogenous shock are channelled either by production or consumption linkages. Production linkages are partly determined by the range and intensity of other sectors' inputs used to produce the output of the sector initially affected by the shock (i.e. backward linkages). The extent to which the output of the affected sector is used as inputs in the production of upstream industries is also a determinant of production linkages (forward linkages). Unit 5 of this toolkit discusses production linkages in more detail.

Figure 2.1 Economic linkages



Source: Breisinger, Thomas and Thurlow (2009).

The interrelationship between value-added and final expenditure by households in a SAM allows us to consider consumption linkages. Consumption linkages arise when the production changes stimulated by an exogenous shock entail changes in factor income and thus in household revenue and private consumption. Consumption linkages are also known as induced effects. For example, if, following a positive production shock in the corn sector, there is an increase in rural households' income, these households will use part of their additional revenue to increase their consumption, creating additional demand for commodities. The magnitude of these linkages depends on the households' consumption patterns and the distribution of income. Haggblade, Hammer and Hazell (1991) show that consumption linkages account for 75 to 90 per cent of the total multiplier effect in Sub-Saharan Africa and thus are significantly larger than the effect of production linkages.

We will use the standard Leontief inverse formula to compute the SAM multipliers:

$$y = A * y + x = (I - A)^{-1} * x = M_a x$$

with y being the vector of endogenous accounts (the accounts' totals), A the matrix of average propensities of expenditures (also called the technology matrix) for endogenous accounts, x the vector of exogenous shock and I the identity matrix.[5] The derivation of the equations above can be found in Thorbecke (2000, pp. 16 to 19).

In the above formula, M_a or $(I - A)^{-1}$ represent the SAM multiplier matrix, which is also known as the Leontief inverse matrix. It shows the extent to which the exogenous shock (x)

[5] An identity matrix is a square matrix (with the same number of rows and columns) with 1 in all of its diagonal cells and zero elsewhere.

is multiplied through the endogenous interactions in the economic system. To compute the SAM multiplier, we first need to derive matrix $\boldsymbol{A}$ (the average expenditure propensity matrix) and then generate an identity matrix $\boldsymbol{I}$. Then, we subtract $\boldsymbol{A}$ from $\boldsymbol{I}$ and invert the matrix to get $(\boldsymbol{I}-\boldsymbol{A})^{-1}$ which gives us the SAM multiplier matrix.[6] Let us have a look at these steps one by one.

2.2 Steps for the SAM multiplier calculation

Step 1. Identifying exogenous and endogenous accounts

The first step in SAM multiplier analysis is to distinguish endogenous accounts from exogenous accounts. The endogenous accounts are those defined by interactions within an economic system. They often include goods and services purchased for intermediate and final consumption (commodities), production sectors (activities), factors of production (capital, labour and land) and the household account. Exogenous accounts are defined outside the economic system or through economic policies. Often, the exogenous accounts considered are government, savings–investment and foreign accounts. Once the endogenous accounts have been identified, the SAM must be arranged to present all the endogenous accounts first, followed by all the exogenous accounts. Hence, SAM multiplier analysis is a study of how a given injection into (or leakage from) the exogenous accounts of the SAM is transmitted to the endogenous accounts through the interdependent SAM system (Round, 2003).

In our Indonesian example, the exogenous accounts will be government, savings–investment (SI) and the rest of the world (RoW). All the other accounts are endogenous. The SAM is already arranged with endogenous accounts first, followed by exogenous accounts, so no rearrangement is necessary. The size of the matrix is 8 by 8, with 5 endogenous accounts (activities, commodities, labour, capital and households) and 3 exogenous accounts (government, SI, and RoW).

Step 2. Computing the A matrix

$\boldsymbol{A}$ is the average expenditure propensity matrix, and it represents the pattern of outlays. $\boldsymbol{A}$ is also known as the technology matrix because it shows how production sectors combine factors and intermediate inputs to produce output.

$\boldsymbol{A}$ is calculated by dividing each element of the endogenous accounts by the corresponding column total. This must be done for all the accounts in each row but only for the endogenous column accounts, resulting in a matrix with five endogenous columns and eight rows in our example of the Indonesian SAM. The three remaining, exogenous columns must be filled with zeros in order to ensure the "squareness" of the matrix so that it is solvable. $\boldsymbol{A}$ is assumed to be constant. This implies that each account will continue to allocate fixed proportions of their totals across activities regardless of the amount of the exogenous shock.

6 Note that not all matrices have inverses. Only matrices that are square and have rows and columns that are linearly independent have inverses. Linear independence means that none of the rows or columns can be expressed as a linear combination or function of any other row or column.

Table 2.1 shows the ***A*** matrix for the Indonesian SAM. Each entry in the ***A*** matrix is calculated by dividing the corresponding cell of the SAM by its column total. This is done for each endogenous account, i.e. the five first columns of the SAM. In our example, the ***A*** matrix shows how the endogenous accounts spend one rupiah, thus the column sum of values in each endogenous account should be one as indicated below. As we have identified earlier, the "Government" account, the "Savings and Investment" account, and the "Rest of World" account are exogenous accounts.

Table 2.1 Matrix A and exogenous accounts

	Activities	Commodities	Labour	Capital	Households	Government	Savings and Investment	Rest of World
Activities	0.00	0.72	0.00	0.00	0.00	0.00	0.00	0.00
Commodities	0.51	0.16	0.00	0.00	0.58	0.00	0.00	0.00
Labour	0.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Capital	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Households	0.00	0.00	1.00	0.96	0.05	0.00	0.00	0.00
Government	-0.02	0.02	0.00	0.00	0.13	0.00	0.00	0.00
Savings and Investment	0.00	0.00	0.00	0.00	0.23	0.00	0.00	0.00
Rest of World	0.00	0.09	0.00	0.04	0.01	0.00	0.00	0.00
Total	1	1	1	1	1	0	0	0

How do we read the ***A*** matrix? To demonstrate this, let us take column 1 (Activities) as an example and discuss the results in table 2.2. As indicated, activities spend one rupiah in four SAM accounts: commodities, labour, capital, and government.

Table 2.2 Interpretation of matrix A

	Activities	What does it show us
Commodities	0.51	Out of every rupiah spent by activities, 51 rupiah cents will be spent on both domestically produced and imported intermediate goods.
Labour	0.26	Out of every rupiah spent by activities, 26 rupiah cents will be factor payments to labour.
Capital	0.24	Out of every rupiah spent by activities, 24 rupiah cents will be factor payments to capital.
Government	-0.02	Out of every rupiah spent by activities, 0.2 rupiah cents will be given by the Indonesian government as a production subsidy.

Step 3. Creating an identity matrix (the I matrix)

The identity matrix has ones on its main diagonal and zeros elsewhere. Matrix conformity requires that the identity matrix have the same dimensions (numbers of rows and columns) as the SAM. Since the SAM that we are using is 8 rows by 8 columns, the dimensions of the identity matrix should also be 8 by 8.

In Excel, you can generate the identity matrix by inserting the formula: "=if(ROW(A1)= COLUMN(A1),1,0)" and pressing "Enter". This generates "1" at the top left corner of the matrix. Copy the formula; shade or block the entire 8-by-8 matrix, click the right button of your mouse, and choose "Paste Special" to paste the formula. See the steps illustrated below from figures 2.2(a) to 2.2(d).

Figure 2.2(a) Generating an identity matrix: Insert the formula in the matrix's top-left cell

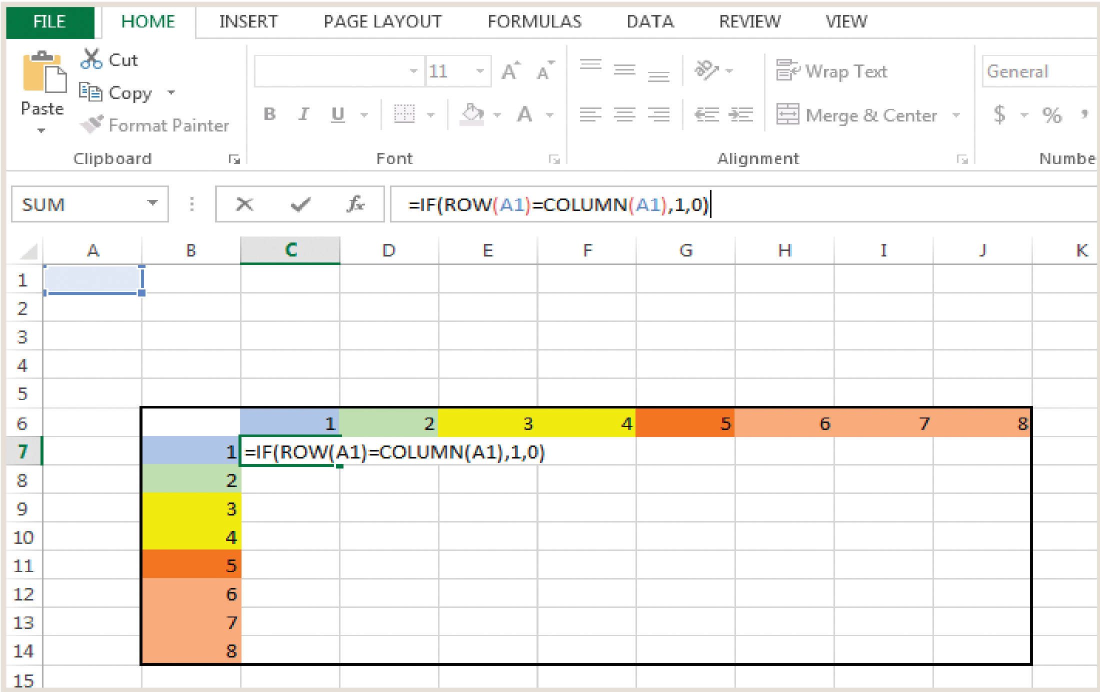


Figure 2.2(b) Generating an identity matrix: Copy the formula

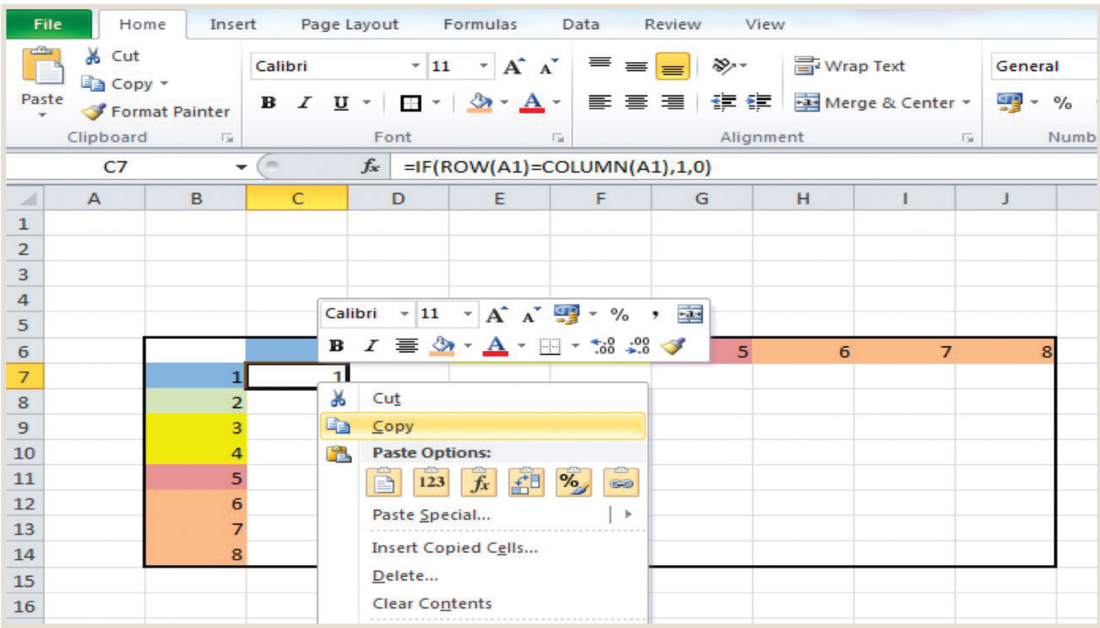


Figure 2.2(c) Generating an identity matrix: Paste the formula using the *fx* button under "Paste Special"

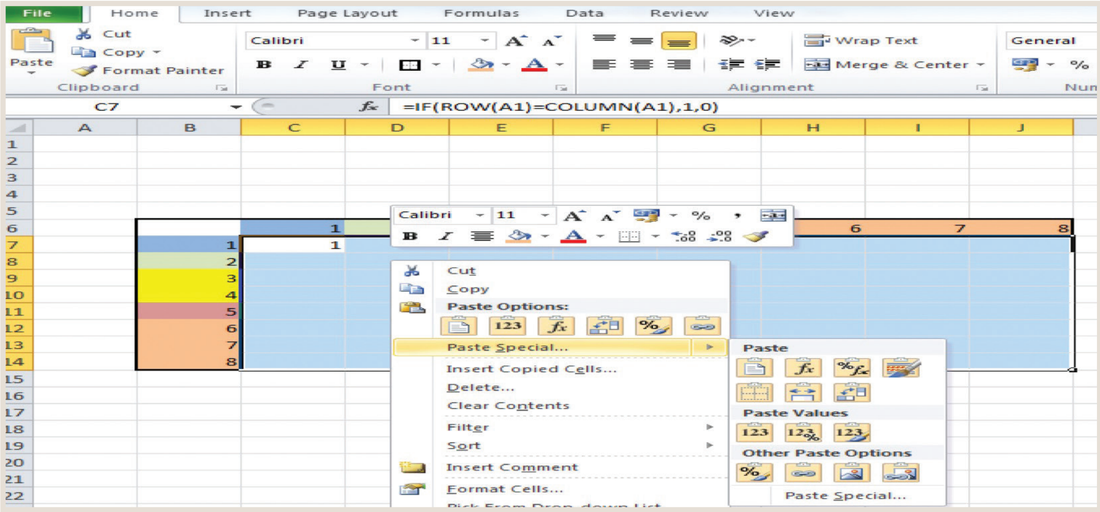
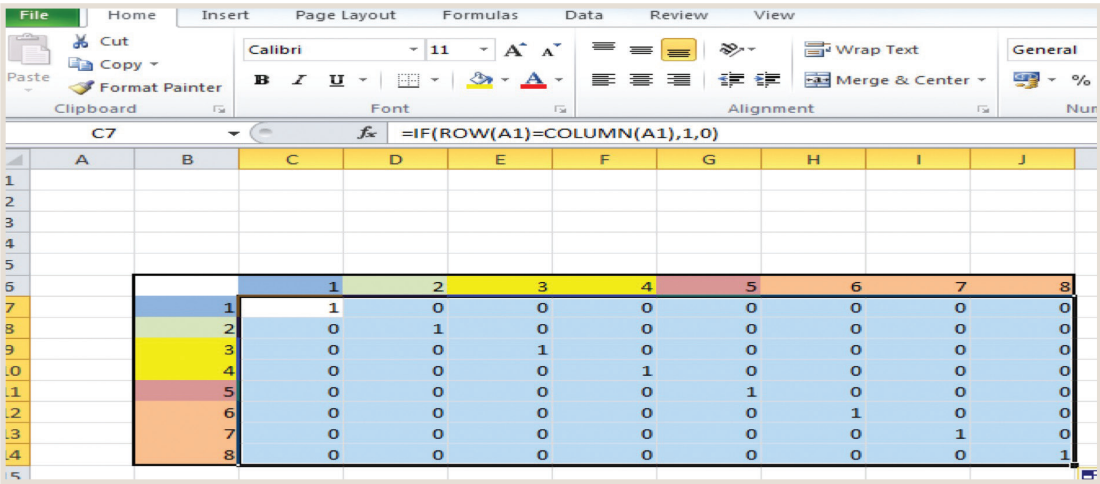


Figure 2.2(d) The identity matrix (I)



Step 4. Creating the (I – A) matrix

The last step before reaching the SAM multiplier is subtracting the matrix of technology (***A*** matrix) from the identity matrix (table 2.3). In Excel, you need first to select the area where the result will appear – an 8-by-8 square. Next, you need to type "=" (which tells Excel that a formula is being written), followed by the row and column coordinates of the identity matrix. Then, subtract matrix ***A*** by identifying its row and column coordinates and press the "Shift", "Ctrl" and "Enter" keys at the same time. By pressing these keys simultaneously, you are telling Excel to use a matrix operation.

Table 2.3 **Generating the (I – A) matrix**

	Activities	Commodities	Labour	Capital	Households	Government	Savings and Investment	Rest of World
Activities	1.00	-0.71	0.00	0.00	0.00	0.00	0.00	0.00
Commodities	-0.50	0.84	0.00	0.00	-0.58	0.00	0.00	0.00
Labour	-0.27	0.00	1.00	0.00	0.00	0.00	0.00	0.00
Capital	-0.24	0.00	0.00	1.00	0.00	0.00	0.00	0.00
Households	0.00	0.00	-1.00	-0.93	0.93	0.00	0.00	0.00
Government	0.01	-0.02	0.00	0.00	-0.12	1.00	0.00	0.00
Savings and Investment	0.00	0.00	0.00	0.00	-0.21	0.00	1.00	0.00
Rest of World	0.00	-0.11	0.00	-0.07	-0.02	0.00	0.00	1.00

Step 5. Creating the matrix $M_a = (I - A)^{-1}$

The SAM multiplier matrix is the inverse of the $(I - A)$ matrix. In our example, we need to select an 8-by-8 block in Excel and insert the formula for the matrix inverse: =MINVERSE (coordinates of the matrix to be inverted) and then simultaneously press the “Shift”, “Ctrl” and “Enter” keys. The SAM multiplier matrix or Leontief inverse matrix as computed for our example is shown in table 2.4.

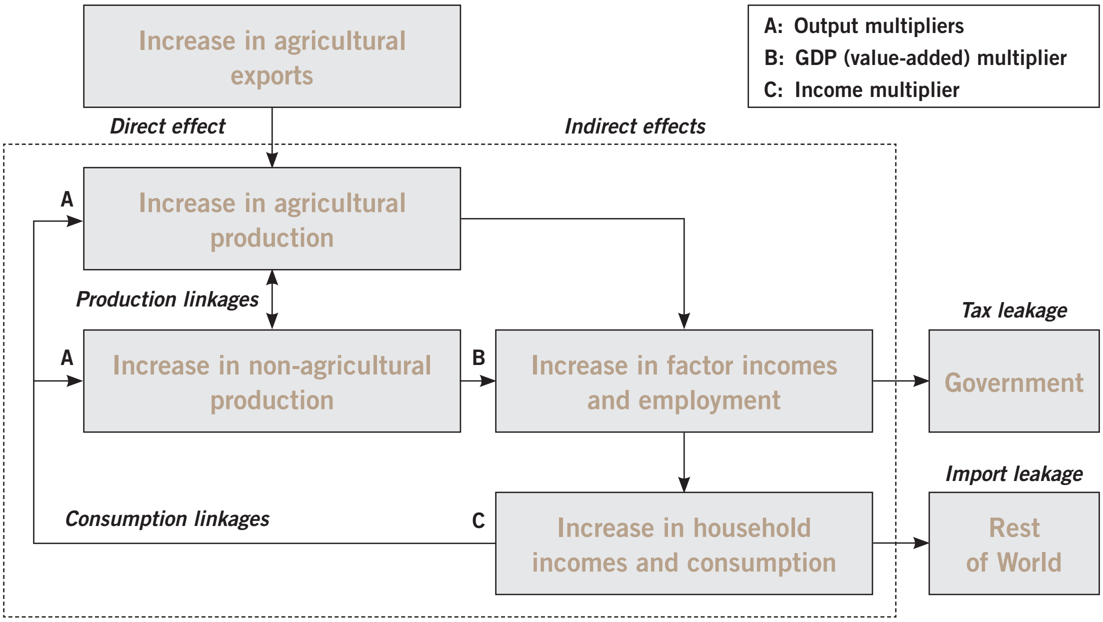
Table 2.4 **The matrix of multipliers, $M_a = (I - A)^{-1}$**

	Activities	Commodities	Labour	Capital	Households	Government	Savings and Investment	Rest of World
Activities	3.33	2.85	1.74	1.67	1.74	0.00	0.00	0.00
Commodities	3.25	3.98	2.42	2.34	2.43	0.00	0.00	0.00
Labour	0.88	0.76	1.46	0.44	0.46	0.00	0.00	0.00
Capital	0.81	0.69	0.42	1.41	0.42	0.00	0.00	0.00
Households	1.75	1.50	1.96	1.89	1.97	0.00	0.00	0.00
Government	0.24	0.23	0.28	0.27	0.28	1.00	0.00	0.00
Savings and Investment	0.40	0.34	0.45	0.43	0.45	0.00	1.00	0.00
Rest of World	0.36	0.42	0.27	0.30	0.27	0.00	0.00	1.00

2.3 Explaining SAM multipliers by types

As discussed, SAM multipliers show how an exogenous demand shock induces a change in total production and income. We can distinguish between the different impacts to identify the changes in various important outcomes, such as value added, gross output and income, involved in the circular income flow. Figure 2.3 illustrates the multiplier process using the example of an exogenous increase in the demand for agricultural exports.

Figure 2.3 Circular flow of income in the multiplier process



Source: Breisinger, Thomas and Thurlow (2009).

We distinguish three types of multipliers:

1. Output multiplier

The output multiplier of a given activity can be defined as the final increase in the activity's gross output as the result of an exogenous one unit increase in the final demand for a given commodity. The output multiplier captures the change in the sector's total value due to the exogenous shock by combining the direct and indirect effects. For instance, as shown in table 2.5, an additional demand of one rupiah in commodities will increase the value of total production by 2.85 rupiahs. Thus, the output multiplier is 2.85. If the commodities accounts in the SAM were disaggregated, we could compute output multipliers that capture the effects on production activity of an exogenous change in the final demand for each commodity. This will be illustrated in Unit 3.

Three types of multipliers:

– output
– value added
– income

Table 2.5 Illustration of the output multiplier

	Activities	Commodities	Labour	Capital	Households	Government	Savings and Investment	Rest of World
Activities	3.33	2.85	1.74	1.67	1.74	0.00	0.00	0.00
Commodities	3.25	3.98	2.42	2.34	2.43	0.00	0.00	0.00
Labour	0.88	0.76	1.46	0.44	0.46	0.00	0.00	0.00
Capital	0.81	0.69	0.42	1.41	0.42	0.00	0.00	0.00
Households	1.75	1.50	1.96	1.89	1.97	0.00	0.00	0.00
Government	0.24	0.23	0.28	0.27	0.28	1.00	0.00	0.00
Savings and Investment	0.40	0.34	0.45	0.43	0.45	0.00	1.00	0.00
Rest of World	0.36	0.42	0.27	0.30	0.27	0.00	0.00	1.00

2. GDP multiplier or value added multiplier

The GDP multiplier measures the total increase in value added, that is the increase in factor incomes due to direct and indirect effects.

For the Indonesian SAM, the GDP multiplier is 1.35 (0.76 + 0.69), meaning that an exogenous increase of one rupiah in the demand for commodities will increase GDP by 1.35 rupiahs, as table 2.6 shows. In a disaggregated SAM, we could compute which commodity has the largest GDP multiplier.

Table 2.6 Illustration of the GDP multiplier

	Activities	Commodities	Labour	Capital	Households	Government	Savings and Investment	Rest of World
Activities	3.33	2.85	1.74	1.67	1.74	0.00	0.00	0.00
Commodities	3.25	3.98	2.42	2.34	2.43	0.00	0.00	0.00
Labour	0.88	0.76	1.46	0.44	0.46	0.00	0.00	0.00
Capital	0.81	0.69	0.42	1.41	0.42	0.00	0.00	0.00
Households	1.75	1.50	1.96	1.89	1.97	0.00	0.00	0.00
Government	0.24	0.23	0.28	0.27	0.28	1.00	0.00	0.00
Savings and Investment	0.40	0.34	0.45	0.43	0.45	0.00	1.00	0.00
Rest of World	0.36	0.42	0.27	0.30	0.27	0.00	0.00	1.00

3. Income multiplier

The income multiplier reflects the additional income created for households in response to an exogenous shock. In table 2.7 we can see that a positive exogenous shock of one rupiah in commodities entails an increase of 1.50 rupiahs in households' income. Thus, the income multiplier is 1.50. If the households account were disaggregated by different household categories (e.g. urban/rural, high/middle/low-income households, etc.), then we could obtain an income multiplier for each household category.

Table 2.7 Ilustration of income multiplier

	Activities	Commodities	Labour	Capital	Households	Government	Savings and Investment	Rest of World
Activities	3.33	2.85	1.74	1.67	1.74	0.00	0.00	0.00
Commodities	3.25	3.98	2.42	2.34	2.43	0.00	0.00	0.00
Labour	0.88	0.76	1.46	0.44	0.46	0.00	0.00	0.00
Capital	0.81	0.69	0.42	1.41	0.42	0.00	0.00	0.00
Households	1.75	1.50	1.96	1.89	1.97	0.00	0.00	0.00
Government	0.24	0.23	0.28	0.27	0.28	1.00	0.00	0.00
Savings and Investment	0.40	0.34	0.45	0.43	0.45	0.00	1.00	0.00
Rest of World	0.36	0.42	0.27	0.30	0.27	0.00	0.00	1.00

It is important to note that the magnitudes of the SAM multipliers are determined by the structure of the economy and the linkages among sectors and institutions. For example, if households' consumption patterns were more oriented towards imported goods,[7] then an increase in households' income would benefit domestic producers less, leading to weak indirect linkages and therefore to smaller multiplier effects. Due to various leakages in the circular flow of income, income multipliers are lower than output multipliers.

[7] Import demand is a leakage from the circular flow of income.

UNIT 3

Multiplier analysis of employment effects

Key questions of this unit:

1. What effect does an exogenously-injected shock to one sector have on the economy in terms of employment?
2. What is an employment satellite account?
3. How are employment-output ratios computed?

Important observations:

- Employment multiplier analysis is conducted in order to quantify the effects of an exogenous shock to an economy on employment – that is, the number of jobs created or destroyed because of the shock.
- A matrix of employment multipliers ($EmpM$) is the product of employment-output ratios (ε) and their corresponding output multipliers (M_a).
- The employment effects of a given exogenous shock to final demand can be computed by simply multiplying the matrix of employment multipliers ($EmpM$) with a vector representing the shock to final demand (x) in the different sectors of the economy

The multipliers we have seen to this point are in "monetary" terms, but for policy-oriented models of labour markets, we need to compute employment multipliers. Employment multipliers indicate the impact of an exogenous shock to an economy in terms of employment – that is, the number of jobs created or destroyed.

3.1 Employment Satellite Accounts and Employment-Output Ratios

The concept of an employment satellite account refers to a matrix containing employment data, namely the number of employees per sector. Data in the employment satellite account usually come from labour force surveys, population censuses, and secondary sources such as public or administrative reports on the number of employees per sector.

If the workforce detail is not directly available, data on the wage bills and the average wage by sector can be used to infer the number of workers. Furthermore, provided that there is information, the number of employees by sector can be further disaggregated by skill, age or sex, thus permitting a more detailed analysis of employment impact.

Output data from the SAM and employment statistics from the employment satellite account are used to compute an **employment-output ratio** for each sector. This ratio indicates the number of workers needed to produce one unit worth of sectoral output for a specified year – hence, how much labour is used per unit of output. It is obtained by dividing the number of workers in each sector by the output value of each sector (activity).

In order to compute the employment-output ratio, the structure of the employment satellite account should be the same as the SAM in terms of sectoral classification. However, it is often the case that sectoral employment data are available at a more aggregated level than that of output data in the SAM. For example, in the SAM, there may be output data for agriculture, forestry, and fishing individually, but only one employment statistic containing the sum of all workers in these three activities. To resolve the mismatch in the aggregation levels, the output data in the SAM can be aggregated up to the level of the employment statistics in order to compute employment-output ratios. As a result, there will be as many employment/output ratios as sectoral employment statistics. In the example of agriculture, forestry and fishing, the result will be one employment-output ratio that captures the average number of workers across these three activities. As the SAM is structured at a more disaggregated level, the resulting employment/output ratios are then attributed to each activity based on how the activities were aggregated. To continue with the example, agriculture, forestry and fishing as individual activities will have the same employment-output ratio. The implicit assumption is that, within a group of activities whose output has been aggregated up, the labour intensities of all activities in that group are the same.

Based on data from the 2008 Indonesian labour force survey and the 2008 SAM, we have computed employment-output ratios as presented in table 3.1. In the table, we can see that agriculture is the most labour-intensive sector, needing 27 workers to produce 1 billion rupiah worth of output. As expected, industries are less labour–intensive, needing only 3 workers to produce an output of 1 billion rupiah. For services, 7 workers are needed to produce 1 billion rupiah worth of output.

Table 3.1 Employment/output ratios by sector

	Total employment	Output (billion rupiah)	Employment-Output ratio
Agriculture	42,011,000	1,529,716	27
Industry	18,852,000	6,606,482	3
Services	41,363,000	6,073,839	7

Source: 2008 SAM and Labour force survey 2008

3.2 Employment multipliers

To estimate the employment effects of an exogenous shock to final demand, we will use the output multipliers to obtain the resulting changes in output and then we transform these output changes into employment effects by applying employment-output ratios. An employment multiplier is shorthand for this method of estimating employment impact. A matrix of employment multipliers ($EmpM$) is the product of employment-output ratios (ε) and their corresponding output multipliers (M_a).

$$EmpM = \varepsilon * M_a$$

In the above equation, the matrix of employment-output ratios (ε) is a square matrix with n rows (where n is the number of sectors in the SAM) that places the employment-output ratios of the sectors along the diagonal with zeros elsewhere. The matrix of output multipliers (M_a) is also a square matrix of order n. Examples of both the matrix of employment-output ratios (ε) and the matrix of output multipliers (M_a) are shown in figure 3.1 for a 3-sector economy (Agriculture, Industry and Services). Note that the computation of the matrix of output multipliers (M_a) will be discussed in the next section.

Figure 3.1 Matrix of employment-output ratios (ε) and matrix of output multipliers (M_a)

Matrix of Employment-Output Ratios (ε)

	Agric	Ind	Serv
Agric	ε_A	0	0
Ind	0	ε_I	0
Serv	0	0	ε_S

Matrix of Output Multipliers (M_a)

	Agric	Ind	Serv
Agric	M_{AA}	M_{IA}	M_{SA}
Ind	M_{AI}	M_{II}	M_{SI}
Serv	M_{AS}	M_{IS}	M_{SS}

Matrix of Employment Multipliers ($EmpM$)

	Agric	Ind	Serv
Agric	$\varepsilon_A * M_{AA}$	$\varepsilon_A * M_{IA}$	$\varepsilon_A * M_{SA}$
Ind	$\varepsilon_I * M_{AI}$	$\varepsilon_I * M_{II}$	$\varepsilon_I * M_{SI}$
Serv	$\varepsilon_S * M_{AS}$	$\varepsilon_S * M_{IS}$	$\varepsilon_S * M_{SS}$

Exogenous Shock (x)

Agric	x_A
Ind	x_I
Serv	x_S

Note: Agric = Agriculture, Ind = Industry, Serv = Services

As the product of ε and M_a, the matrix of employment multipliers ($EmpM$) is therefore also a square matrix of order n. Each row element in the matrix of employment multipliers ($EmpM$) captures the employment effect of a one unit increase in the final demand for output of the sector represented by the element's column.

The employment effects of a given exogenous shock to final demand can be computed by simply multiplying the matrix of employment multipliers ($EmpM$) with a vector representing the shock to final demand (x) in the different sectors of the economy. The exogenous shock to final demand (x) has n rows and one column.

$$\textit{Employment effects} = \textit{EmpM} * x$$

The above equation shows the number of jobs created or destroyed as a result of the exogenous shock x. The next section will demonstrate how to construct the matrix of employment-output ratios, the matrix of output multipliers and the matrix of employment multipliers in order to compute the employment effects due to an exogenous shock.

3.3 Practical demonstration and interpretation of results

As mentioned previously, depending on the availability of data and the purpose of the analysis, we can aggregate or disaggregate the accounts in the SAM without losing any basic information. Thus, in this section, in order to compute sectoral employment multipliers and the employment effects of an exogenous shock, we have disaggregated the 'activities' and 'commodities' accounts of the SAM into three major sectors: agriculture, industry, and services as presented in table 3.2. The source of data for this disaggregation is the detailed Indonesian 2008 SAM (see Central Statistics Bureau, 2011).

Using a similar procedure of computing SAM multipliers as discussed in Unit 2, we have computed multipliers for the above SAM and the results are presented in table 3.3. The intermediate steps for our computations can be found in the Excel file that accompanies this assessment toolkit. As discussed previously, the SAM multipliers contain three types of specific multipliers: output multipliers, income multipliers, and value-added multipliers. Of these three types of multipliers, we will only use output multipliers to compute employment effects. The output multipliers are the highlighted cells in table 3.3 where the commodities columns meet activities rows. In addition to the output multipliers, employment-output ratios that we have computed in table 3.1 will be used to compute employment effects.

Table 3.2 Indonesian SAM 2008 with commodities and activities disaggregated

	CM-Agr	CM-Ind	CM-Serv	PA-Agri	PA-Ind	PA-Serv	Labour	Capital	Households	Government	S/I	RoW	Total
CM-Agr				155 791	533 831	183 433			644 481	49	-16 740	28 871	1 529 716
CM-Ind				173 406	1 759 370	1 315 297			1 603 142	75 185	361 276	1 318 807	6 606 482
CM-Serv	287 174	883 586	1 171 200	30 902	237 662	828 457			1 070 481	260 522	1 164 295	139 560	6 073 839
PA-Agri	1 169 324												1 169 324
PA-Ind		4 406 804											4 406 804
PA-Serv			4 599 255										4 599 255
Labour				619 026	654 535	1 419 057						1 707	2 694 325
Capital				191 185	1 334 486	938 647						6 658	2 470 975
Households							2 688 905	2 379 748	298 084	288 726		87 683	5 743 146
Government	18 832	211 205	114 903	-985	-113 081	-85 636			735 126	767 508		2 291	1 650 163
S/I									1 316 041	229 473		-36 684	1 508 831
RoW	54 386	1 104 888	188 482				5 420	91 227	75 790	28 700			1 548 892
Total	**1 529 716**	**6 606 482**	**6 073 839**	**1 169 324**	**4 406 804**	**4 599 255**	**2 694 325**	**2 470 975**	**5 743 146**	**1 650 163**	**1 508 831**	**1 548 892**	

Note: CM = Commodity; PA = Production Activity; Agric = Agriculture; Ind = Industry; Serv = Services RoW = Rest of World

Table 3.3 **Multipliers computed from the disaggregated Indonesian SAM 2008**

	CM-Agr	CM-Ind	CM-Serv	PA-Agri	PA-Ind	PA-Serv	Labour	Capital	Households	Government	S/I	RoW
CM-Agr	1.47	0.39	0.39	0.51	0.51	0.42	0.36	0.35	0.37	0.00	0.00	0.00
CM-Ind	1.21	2.20	1.35	1.25	1.54	1.43	1.05	1.02	1.06	0.00	0.00	0.00
CM-Serv	1.21	1.03	2.38	1.00	1.06	1.21	0.91	0.88	0.91	0.00	0.00	0.00
PA-Agri	1.12	0.30	0.30	1.39	0.39	0.32	0.28	0.27	0.28	0.00	0.00	0.00
PA-Ind	0.80	1.47	0.90	0.83	2.02	0.96	0.70	0.68	0.70	0.00	0.00	0.00
PA-Serv	0.92	0.78	1.80	0.76	0.81	1.92	0.69	0.67	0.69	0.00	0.00	0.00
Labour	1.00	0.62	0.85	1.10	0.75	0.90	1.47	0.45	0.47	0.00	0.00	0.00
Capital	0.61	0.65	0.69	0.63	0.84	0.73	0.40	1.39	0.40	0.00	0.00	0.00
Households	1.63	1.26	1.53	1.76	1.58	1.63	1.92	1.85	1.92	0.00	0.00	0.00
Government	0.25	0.20	0.23	0.25	0.21	0.22	0.27	0.26	0.27	1.00	0.00	0.00
S/I	0.37	0.29	0.35	0.40	0.36	0.37	0.44	0.42	0.44	0.00	1.00	0.00
RoW	0.34	0.46	0.36	0.31	0.36	0.34	0.26	0.29	0.26	0.00	0.00	1.00

Note: PA = Production Activity; CM = Commodity; Agric = Agriculture; Ind = Industry; Serv = Services, RoW = Rest of World.

Figure 3.2 Estimating employment effects

Matrix of Employment-Output Ratios (ε)

	Agric	Ind	Serv
Agric	27	0	0
Ind	0	3	0
Serv	0	0	7

Matrix of Output Multipliers (M_a)

	Agric	Ind	Serv
Agric	1.12	0.3	0.3
Ind	0.8	1.47	0.9
Serv	0.92	0.78	1.8

Matrix of Employment Multipliers ($EmpM$)					Exogenous Shock (x)		Employment Effects
	Agric	Ind	Serv				
Agric	31	8	8	Agric	10	Agric	**303**
Ind	2	4	3	Ind	0	Ind	**23**
Serv	6	5	12	Serv	0	Serv	**63**
							393

Figure 3.2 contains the matrix of employment-output ratios (ε) and the matrix of output multipliers (M_a). The matrix of employment multipliers ($EmpM$) is the matrix product obtained by multiplication of the previous two matrices. We can interpret each column of the matrix of employment multipliers as the employment effects of a one-unit increase in final demand for the output of the sector that corresponds to the column in question. For example, in column Agric, we see that a one-billion rupiah increase in the final demand of agricultural commodities leads to employment expansion by 31, 2, and 6 jobs in agriculture, industry and services respectively. The other two columns (Ind and Serv) have a similar interpretation.

To fix ideas, let's assume that there is an exogenous increase in final demand for agricultural commodities of 10 billion rupiah. We want to estimate how much job creation would be triggered by this positive shock and how the new jobs will be distributed across sectors. As shown in figure 3.2, we have constructed an exogenous shock vector where the increase of 10 billion rupiah in the final demand for agricultural commodities is represented by the top cell. There are zeros in the other two cells because we have assumed no shocks to the final demands of industrial products and services.

As stated in the previous section, the employment effects of a given exogenous shock to final demand can be computed by simply multiplying the matrix of employment multipliers ($EmpM$) with the exogenous shock vector. Matrix multiplication can done in Excel with the MMULT function (see the Excel file accompanying this assessment toolkit). In our example, the effect of an exogenous increase of 10 billion rupiah in the final demand for agricultural commodities in the economy would entail job creation of 308 in agriculture, 23 in industry and 63 in services for a total employment effect of 393 jobs. As expected, the most significant increase in labour demand is in the agricultural sector, due to its high labour-intensity. This is followed by the employment effect in services, and, given its low labour intensity; the additional jobs created in industry would be the smallest.

If the exogenous shock was instead an increase of 10 billion rupiah in the final demand for industrial products, we would construct an exogenous shock vector with 10 in the middle cell and zeros in the other two cells. By the method described above, the estimates obtained would be the creation of 82 additional jobs in agriculture, 42 in industry and 53 in services. The total employment effect of the 10 billion rupiah rise in final demand for industrial commodities would be 177 additional jobs in the economy.

It is worth noting that the elements of the exogenous shock vector can contain both positive (i.e., net expansion of final demand) or negative values (i.e., net contraction of final demand), and shocks in different sectors can be combined for an integrated analysis. The values used within the exogenous shock vector would be the expected effects of a proposed policy or other exogenous event on final demand across different economic sectors.

UNIT 4

Estimating the effects of trade on employment

Key questions of this unit:

1. How can we model and quantify a trade shock?
2. How does trade policy affect employment, and how are these employment effects measured?

Important observations:

- Trade has always been associated with both employment creation and destruction, depending crucially on the trade policies of a country and its trading partners. Hence, modelling trade policy is the first step in computing the effects of trade on employment.
- The SMART (Software for Market Analysis and Restrictions on Trade) model is one of the models used to estimate the trade, tariff revenue, and other consequences of a trade policy.

In the previous unit, we saw that for a given exogenous demand shock we could estimate the employment effects using multiplier analysis within a SAM framework. In order to compute the effects of trade on employment, this unit looks at a simple way to simulate trade policy and quantify the resulting trade as an exogenous demand shock. As stated in Unit 2, exogenous accounts are defined outside the economic system or through economic policies. Therefore, this unit will take trade policy as the starting point for obtaining numeric estimates of changes in export and import demand. These numeric estimates can then be fed into a SAM multiplier analysis to compute the effects of a given trade policy on employment.

4.1 Modelling trade policy

To model trade policy, this section describes the framework of a partial equilibrium model known as SMART (Software for Market Analysis and Restrictions on Trade) that can be used to estimate the trade, tariff revenue, and other consequences of a trade policy.

The SMART model and simulation tools are part of the World Integrated Trade Solutions (WITS) database and software suite provided jointly by the World Bank and the United Nations Conference on Trade and Development. The SMART model and simulation tools in WITS are accessible upon registration, which is free, at: https://wits.worldbank.org/WITS/WITS/Restricted/Login.aspx.

4.1.1 The SMART model

The SMART model is a partial-equilibrium model in that it focuses only on *one market* that is directly affected by a trade policy. This is different from a general-equilibrium model, where *all markets* are analysed simultaneously. The SMART model focuses on the changes in imports into a particular market when there is a change in trade policy. The demand side of the market in SMART is based on the **Armington assumption,** i.e., commodities are differentiated by their country of origin. This assumption implies that, for a particular commodity, there can be many country varieties and a variety from one country is an imperfect substitute for the variety from another country. So, for example, if the tariff on an imported product from one country is reduced while tariffs on the same product from other countries are kept constant, import demand does not completely shift to the source country with the lower tariff.

In the SMART model, it is assumed that consumers' demand is decided in a two-stage optimization process that involves allocating their spending by commodity and by country variety. At the first stage, consumers decide how much to spend on the commodity given changes in the commodity's price index, which captures the prices of all varieties of this commodity. The relationship between changes in the price index and the impact on import demand for this commodity is determined by a given import demand elasticity. At the second stage, the chosen level of spending for this commodity is allocated among the varieties of the imported commodity as distinguished by their source countries, depending on the relative price of each variety. The extent of the between-variety response to a change in the relative price is determined by the substitution elasticity.

Different countries compete to supply (export to) the market and the model simulates changes in the composition and volume of imports into that market after a tariff reduction or another change in trade policy. The degree of responsiveness of each foreign exporter's supply to changes in the price is known as the export supply elasticity. The SMART model, by default, assumes that the export supply elasticity of each foreign country is infinite, which implies that each foreign country has the capacity to produce and export as much of a given commodity as possible at a certain price. This assumption may be appropriate when the foreign trade partners have excess production capacity and the importing country's demand for each country variety is small relative to the production capacity of the corresponding source country.

4.1.2 Quantifying trade shocks with SMART

To quantify a trade shock induced by a given trade policy, the SMART model requires the following data:

(i) the import value from each foreign partner,

(ii) the tariff faced by each foreign partner,

(iii) the import demand elasticity for the commodity,

(iv) the export supply elasticity for the commodity, and

(v) the substitution elasticity between varieties of the commodity.

With respect to the elasticity parameters, it is important to note that SMART accepts only one value per elasticity and that value is the same for all foreign trade partners. All the five data elements above are provided within WITS and are automatically retrieved when conducting a simulation within the SMART module. If a user has alternative data for these elements, the SMART module allows the user to incorporate the external data into a SMART simulation.

Box 4.1 What is a SMART query and what is the required information?

A SMART query is a process within WITS to set up simulation data and specify a trade-policy scenario. The following information is required:

1) A **Country** is the country that is going to change its tariff. SMART is a single country simulation tool. A simulation involving several countries cutting their tariffs at the same time (regional trade agreement for example) may require several separate SMART simulations (one for each market/importer) depending on what is to be analyzed.

2) A **Year** for the tariff and import data is to be used since the simulation needs a starting point in order to interpolate the consequences of the tariff reform. When available, SMART uses the same year for both tariffs and trade data. Otherwise, SMART goes for the best alternative (closest year or inverted trade).

3) **Products** are the products involved in the simulation, i.e. in the tariff reform.

4) A **Scenario** is made of three sets of parameters:

   i) **Partners** which export to the considered market and will be affected by the tariff reform.

   ii) **Products** are those items for which the tariff is changed by the scenario.

   iii) **Formula** which defines how tariffs are to be changed for the partners and products involved.

   - **New Rate** can be chosen freely
   - **Maximum Rate** will define the maximum rate to be applied.
   - **Linear Cut** defines a certain percentage cut over all products.
   - **Swiss Formula** is a formula used in order to reduce tariffs. It is defined as **r1=(a*r0)/(a+r0)** with **r1** and **r0** as the new and initial tariffs respectively and **a** as a coefficient to be entered in the parameter box (**a**=16 by default).

5) **Elasticities** which define behaviors and affect the magnitude of the scenario impact:

   (i) **Import Demand Elasticity:** Values used by default in SMART have been empirically estimated for each country and every HS 6-digit product. For more details see Kee, Nicita and Olarreaga (2008).

   (ii) **Substitution Elasticity:** Is the substitution elasticity value between partners. SMART uses 1.5 as the default value. However, you can change this default value. It is recommended to keep it at 1.5 for industrial products but to increase it for primary goods. The reason being that the higher the substitution elasticity, the higher the substitutability of the same product from different suppliers. However, the more sophisticated a product is, the higher its rigidity of being substitutable.

(iii) **Export Supply Elasticity:** Is the export supply elasticity value. By default, SMART uses 99 for an infinite elasticity for all products and partners. The reason being that we are dealing with a single-country simulation tool, so one country is too small compared to the rest of the world in order to have an impact on the price level. However, if you consider imports of a certain product from a bigger entity (like the European Union) to be relatively high and have a real impact on the world price level, you can lower the supply elasticity.

6) In **Apply Tariff Change on**, you can either choose between an **Applied MFN** rate or a **Bound Rate**. The **Applied MFN rate** is the current rate that is applied, while the **bound rate** is a rate agreed upon within WTO negotiations. Note that if the bound rate is cut below the percentage of the **applied MFN rate**, a change in the actual applied tariff rate will occur.

4.2 The employment effects of an import shock

4.2.1 Estimating a shock to imports

To illustrate, suppose Indonesia completely liberalized rice imports from all foreign partners in 2009. This change in import policy could be formulated in SMART as the following:

1) **Country:** Indonesia.

2) **Year:** 2009

3) **Products:** Harmonized System (HS)-1006 Rice (SMART offers a search function to look for relevant products and their corresponding customs codes).

4) **Scenario:**

   (i) **Partners:** All Countries (SMART offers the option of “All Countries” to include all foreign trade partners that export the product being analysed to the country in question).

   (ii) **Products:** HS-1006 Rice

   (iii) **Formula:** New Rate = 0

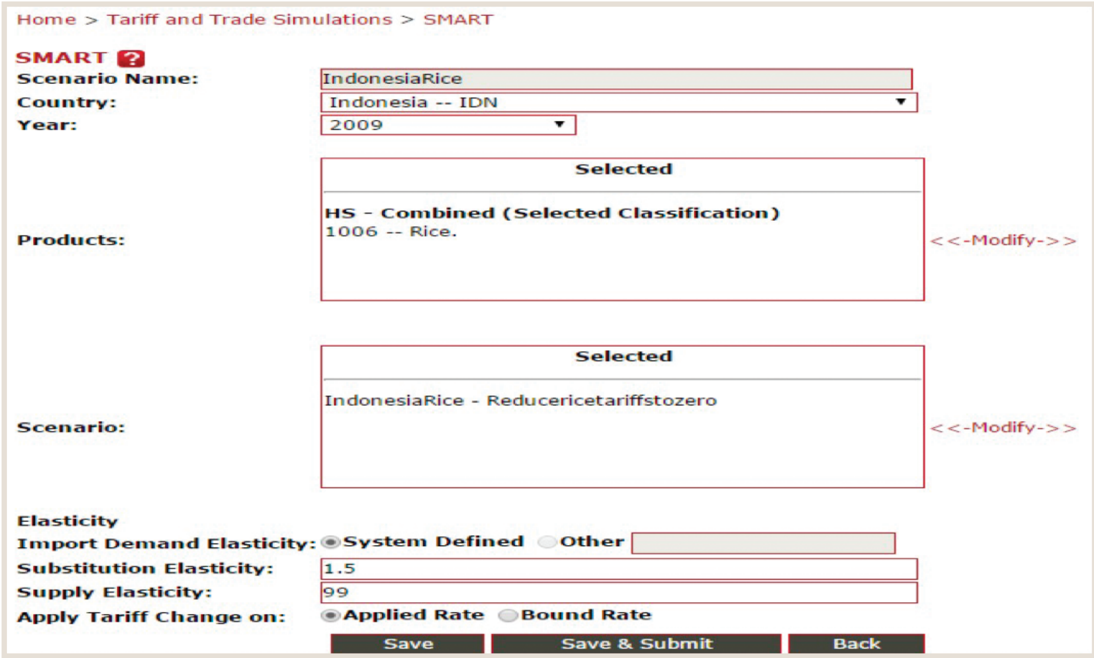
5) **Elasticities:**

   (i) **Import Demand Elasticity:** Value used by default in SMART.

   (ii) **Substitution Elasticity:** SMART uses 1.5 as the default value.

   (iii) **Export Supply Elasticity:** SMART uses 99 as the default value.

6) **Apply Tariff Change:** Applied MFN rate



To recapitulate, we have reduced Indonesia's tariffs to zero for rice imports from all its foreign trade partners in the year 2009. The SMART query above returns the following results in a file (.csv) with "Detailed Data" in the title:

Table 4.1 the results of the SMART query

(1) partner_iso_n	(2) Trade Value in 1000 USD	(3) Applied Duty Rate	(4) New Duty Rate	(5) Supply Elasticity	(6) Substitution Elasticity	(7) Import Demand Elasticity	(8) Trade Total Effect in 1000 USD	(9) Bound Duty Rate	(10) Product Code
0	5,768	8.16	0	99	1.5	0.25	110		100610
0	137,413	5.52	0	99	1.5	0.05	393		100630
0	107,292	9.40	0	99	1.5	1.21	11,154		100640
156	5,168	8.16	0	99	1.5	0.25	99	160	100610
356	243	8.16	0	99	1.5	0.25	5	160	100610
356	230	5.52	0	99	1.5	0.05	1	160	100630
392	39	5.52	0	99	1.5	0.05	0	160	100630
410	17	5.52	0	99	1.5	0.05	0	160	100630
586	2	5.52	0	99	1.5	0.05	0	160	100630
586	499	9.40	0	99	1.5	1.21	52	160	100640
608	358	8.16	0	99	1.5	0.25	7	160	100610
626	1,323	5.52	0	99	1.5	0.05	4	160	100630
702	250	5.52	0	99	1.5	0.05	1	160	100630
704	18,471	5.52	0	99	1.5	0.05	53	160	100630
704	2,500	9.40	0	99	1.5	1.21	260	160	100640
764	117,080	5.52	0	99	1.5	0.05	335	160	100630
764	104,293	9.40	0	99	1.5	1.21	10,842	160	100640

The most relevant results are in columns (1), (8), and (10). Column (1) contains the country codes of Indonesia's trade partners from which it imports rice. For example, 156 is China and 764 is Thailand. 0 is a code that aggregates all foreign trade partners. These numerical country codes are those used for statistical processing purposes by the Statistics Division of the United Nations. The full list of country codes can be found under the "Reference Data" section of the WITS website.

Column (10) shows the Harmonized System (HS) 6-digit product codes for rice imports. In this case, there are three relevant product codes: 100610 (Rice in the husk (paddy or rough)), 100630 (Semi-milled or wholly milled rice, whether or not polished or glazed), and 100640 (Broken rice). The full lists of HS-product codes with their descriptions are also available in the "Reference Data" section of the WITS website.

Column (8) with the heading "Trade Total Effect in 1000 USD" is where SMART reports the anticipated changes in imports due to a simulated trade policy. In the SMART query above, the simulated trade policy was applied to rice imports from all partners. So, for the purposes of obtaining a numeric estimate of the trade shock, we only need to look at the rows that aggregate all foreign trade partners, i.e. country code 0, and these are the first three rows. We can see that Indonesia's full reduction of rice tariffs is expected to increase rice imports of HS 100610 (Rice in the husk (paddy or rough) by $0.110 million, of HS 100630 (Semi-milled or wholly milled rice, whether or not polished or glazed) by $0.393 million, and of HS 100640 (Broken rice) by $11.154 million. In sum, the magnitude of the import shock is expected to be US$11.657 million.

4.2.2 Computing the employment effects of an import shock

Step 1: As trade and production statistics are usually produced according to different classification systems, the first step is to establish a correspondence between the two systems. As seen above, the trade results are classified according to the HS system at the 6-digit level. A SAM and its employment satellite account contain production and employment statistics respectively that are often classified according to a national version of the International Standard Industrial Classification (ISIC) system. A HS-ISIC concordance is provided by WITS under the "Reference Data" section. In the example of Indonesia's rice tariff reduction, the following table shows the concordance of the different codes:

Table 4.2 Rice products and their HS-6, ISIC-Rev.3, and national classifications

HS-6	ISIC-Rev.3	Indonesian 24- Sector Classification	Indonesian 3-Sector Classification
100610 (Rice in the husk (paddy or rough))	0111 (Growing of cereals and other crops n.e.c.)	Food Crop Agriculture	Agriculture
100630 (Semi-milled or wholly milled rice, whether or not polished or glazed)	1531 (Manufacture of grain mill products)	Food, beverage and tobacco industry	Industry
100640 (Broken rice)	1531 (Manufacture of grain mill products)	Food, beverage and tobacco industry	Industry

Step 2: While the SMART estimate of the import shock is in US$, output statistics are usually denominated in the national currency, which in the case of Indonesia is the Rupiah. The trade estimates therefore need to be converted to the national currency with an appropriate exchange rate. Exchange rate statistics are available within the World Development Indicators database: https://data.worldbank.org/indicator/PA.NUS.FCRF (Annual averages of official exchange rates, US$ per local currency unit). In our example, the appropriate exchange rate would be the US$-Rupiah average exchange rate in 2009, which was 1US$ = 10,390 Rupiah.

Step 3: It is likely that the SMART simulation is of a year that is different from the year for which the SAM was constructed. In the example, the simulated rice import shock is in 2009 whereas the Indonesian SAM is from 2008. It is therefore necessary to deflate the SMART estimates by an appropriate measure of price changes. Ideally, we would use product- or sector-level price deflators. However, these are often not available. As an approximate solution, we could use the changes in the GDP deflator from the year of the SAM to the year of the SMART simulation. This data is available also within the World Development Indicators database: https://data.worldbank.org/indicator/NY.GDP.DEFL.ZS (GDP deflator). For Indonesia, the base year was 2010 and the GDP deflators for 2008 and 2009 were 85.317 and 92.373 respectively. The increase in the price level of the Indonesian economy as a whole from 2008 to 2009 was therefore 8.2%.

Step 4: To assess how an import shock changes final demand for domestic output, we have to judge the degree to which the imports compete with domestic production in satisfying final demand. If the imports are a perfect substitute for domestic output, then there would be full (100%) displacement of demand for the domestic equivalent. On the contrary, if the imported product was not at all a substitute for the domestic variety or there was no domestic equivalent, then there would be no (0%) domestic demand displacement. If the imported good was an imperfect substitute for the domestic variety or there was limited output of the domestic variety, then the degree of domestic demand displacement would be between 0% and 100%. In the example of Indonesia's rice imports, because rice is a homogenous commodity, it may be assumed that the imports fully displace domestic production. If the analysis was for imported wheat instead, then it would be reasonable to assume that the displacement of domestic demand would be 0% as Indonesia does not produce any wheat.

Table 4.3 shows analytical results from the Indonesian rice example after steps 1 to 4. Note that, in this example, we are considering the impact of reducing the import tariffs of three different rice products; HS 100610 Rice in the husk (both paddy and rough), HS 100630 Semi-milled or wholly-milled rice (whether or not polished or glazed), and HS 100640 Broken rice. While the first rice product is an output of the agriculture sector, the second and the third rice products come from the industrial sector. It is assumed that imports of these rice products will fully displace demand for domestic output. This translates into equivalent but negative values for the exogenous change in final demand.

Table 4.3 Exogenous change in final demand due to an import shock (example of Indonesian rice imports)

HS-6 Product	Indonesian 3-Sector Classification	Import Shock (millions of US$)	Converted to billions of Rupiah in 2009 (1US$ = 10,391)	Deflated to billions of Rupiah in 2008 (Deflator = 1.082)	Assumed Degree of Domestic Demand Displacement (%)	Exogenous Change in Final Demand (billions of Rupiah)
100610 (Rice in the husk (paddy or rough))	Agriculture	0.11	1.14	1.06	100	-1.06
100630 (Semi-milled or wholly milled rice, whether or not polished or glazed)	Industry	0.39	4.09	3.78	100	-3.78
100640 (Broken rice)	Industry	11.15	115.90	107.11	100	-107.11

Figure 4.1 Employment effects of an import shock (example of Indonesian rice imports)

Matrix of Employment-Output Ratios *(E)*

	Agric	Ind	Serv
Agric	27	0	0
Ind	0	3	0
Serv	0	0	7

Matrix of Output Multipliers (M_a)

	Agric	Ind	Serv
Agric	1.12	0.30	0.30
Ind	0.80	1.47	0.90
Serv	0.92	0.78	1.80

Matrix of Employment Multipliers ($EmpM$)

	Agric	Ind	Serv
Agric	31	8	8
Ind	2	4	3
Serv	6	5	12

Exogenous Shock (x)

Agric	-1.06
Ind	-110.89
Serv	0

Employment Effects

Agric	-940
Ind	-468
Serv	-594
	-2002

Step 5: With values for the exogenous change in final demand caused by an import shock, we can use the method of multiplier analysis as described in Unit 3 to compute the employment effects. Figure 4.1 replicates the matrix of employment multipliers as computed in Unit 3. The values contained in the exogenous shock vector are a reduction of 1.06 billion rupiah of final demand for domestic agricultural goods and a drop of 110.89 (= 3.77 + 107.12) of final demand for domestic industrial products. The employment effects are computed as the matrix product of the matrix of employment multipliers and the exogenous shock vector. As indicated in figure 4.1, the elimination of import tariffs on

the three rice products are estimated to reduce employment by 940 in agriculture, 468 in industry, and 594 in services for a total of 2002 jobs. In sum, to estimate how an import shock affects employment, the estimates from SMART of the import shock first need to be reclassified. Then, they need to be converted into the domestic currency and deflated to reflect price levels of the year for which the SAM was constructed. Next, a judgement needs to be made about the degree to which the imports are expected to displace demand for their domestic equivalents. After making the prerequisite adjustments, we obtain a value for the exogenous change in final demand caused by the import shock, which can be used with employment multipliers to compute numeric estimates of employment effects in different sectors of the economy.

4.3 The employment effects of a shock to exports

4.3.1 Estimating a shock to exports

There are many factors that determine what and how much of a product a country exports. One of these factors is access to the markets of a country's trading partners. This access depends on the trade-policy regime of the country's trading partners, which include any trade agreements they have signed with the country in question. To illustrate, suppose that Indonesia signs a trade agreement with China that provides for the total reduction of Chinese tariffs on Indonesian exports of cotton (HS 52) to China in 2009. This change in Indonesia's export market access could be formulated in SMART as the following:

1) **Country:** China.
2) **Year:** 2009
3) **Products**: Harmonized System (HS)-52 Cotton
4) **Scenario:**
    (i) **Partners:** Indonesia
    (ii) **Products:** HS-52 Cotton
    (iii) **Formula:** New Rate = 0
5) **Elasticities:**
    (i) **Import Demand Elasticity**: Value used by default in SMART.
    (ii) **Substitution Elasticity:** SMART uses 1.5 as the default value.
    (iii) **Export Supply Elasticity:** SMART uses 99 as the default value.
6) **Apply Tariff Change:** Applied MFN rate

Note that Country in the SMART query is the importing country, which in this case is China. The scenario being simulated is a reduction of China's tariffs to zero for cotton exports from Indonesia to China in the year 2009. The SMART query above returns the simulation results in a file (.csv) with "Detailed Data" in the title. These results contain the effects on trade for all of China's trading partners. However, the results of interest are those on the effects of increased market access for Indonesian cotton exporters. These results are shown in table 4.4 for all HS 6-digit cotton products of which Indonesia is predicted to export more to China.

Table 4.4 The results of the SMART query on Indonesia's cotton exports to China

(1) partner_iso_n	(2) Trade Value in 1000 USD	(3) Applied Duty Rate	(4) New Duty Rate	(5) Supply Elasticity	(6) Substitution Elasticity	(7) Import Demand Elasticity	(8) Trade Total Effect in 1000 USD	(9) Bound Duty Rate	(10) Product Code
360	426	5	0	99	1.5	1	54	40	520100
360	336	40	0	99	1.5	0.6	157	40	520300
360	1 247	5	0	99	1.5	0.9	143	5	520542
360	5 795	5	0	99	1.5	0.5	486	10	520812
360	396	5	0	99	1.5	0.4	35	10	520819
360	226	5	0	99	1.5	1.1	28	10	520832
360	51	5	0	99	1.5	0.5	5	10	520839
360	214	5	0	99	1.5	1.2	27	10	520842
360	5	5	0	99	1.5	2.8	1	10	520849
360	16	10	0	99	1.5	0.9	3	10	520911
360	43	5	0	99	1.5	1	5	10	520912
360	86	5	0	99	1.5	0.5	8	10	520919
360	1	5	0	99	1.5	0.6	0	12	520921
360	8	5	0	99	1.5	1.7	1	12	520929
360	19	5	0	99	1.5	0.9	2	10	520931
360	208	5	0	99	1.5	1.2	27	10	520932
360	209	5	0	99	1.5	1.4	28	10	520939
360	727	5	0	99	1.5	1.6	108	10	520942
360	12	5	0	99	1.5	1.2	2	10	520951
360	1 199	5	0	99	1.5	1.9	152	12	521011
360	268	5	0	99	1.5	1.4	32	14	521021
360	1 225	5	0	99	1.5	0.5	54	14	521029
360	869	5	0	99	1.5	1.8	135	10	521031
360	1 194	5	0	99	1.5	1.1	142	10	521041
360	8	5	0	99	1.5	0.9	1	10	521131

Column (1) contains the country codes of China's trade partners from which it imports cotton. 360 is the country code for Indonesia. Column (10) shows the Harmonized System (HS) 6-digit product codes for cotton imports. In this case of increased market access for Indonesian cotton exporters, there are 26 relevant product codes. Column (8) with the heading "Trade Total Effect in 1000 USD" is where SMART reports the anticipated changes in Indonesia's cotton exports to China. By summing the numbers in column (8), we can see that China's full reduction of cotton tariffs on imports from Indonesia is expected to increase Indonesia's total exports of HS 52 Cotton to China by $1.64 million.

4.3.2 Computing the employment effects of an export shock

Step 1: The first step is to establish a correspondence between the HS system at the 6-digit level and the sectoral classification of the national SAM. Based on the example of increased market access to China for Indonesia's cotton exports, table 4.5 shows the concordance of the different codes. As can be seen in table 4.5, all the relevant Indonesian cotton exports are produced by Indonesia's industrial sector except for HS 520100 (Cotton, not carded or combed), which is an output of the agricultural sector.

Table 4.5 Cotton products and their HS-6, ISIC-Rev.3, and National classifications

HS-6	ISIC-Rev.3	Indonesian 24- Sector Classification	Indonesian 3-Sector Classification
520100 (Cotton, not carded or combed.)	111 (Growing of cereals and other crops n.e.c.)	Crop Agriculture	Agriculture
520300 (Cotton, carded or combed.)	1711 (Preparation and spinning of textile fibres; weaving of textiles)	Weaving, Textile, Garment & Leather	Industry
520542 (Measuring per single yarn less than 714.29 decitex but not less than 232.56 decitex (exceeding 14 metric number but not exceeding 43 metric number per single yarn))	1711 (Preparation and spinning of textile fibres; weaving of textiles)	Weaving, Textile, Garment & Leather	Industry
520812 (Plain weave, weighing more than 100 g/m^2)	1711 (Preparation and spinning of textile fibres; weaving of textiles)	Weaving, Textile, Garment & Leather	Industry
520819 (Other fabrics)	1711 (Preparation and spinning of textile fibres; weaving of textiles)	Weaving, Textile, Garment & Leather	Industry
520832 (Plain weave, weighing more than 100 g/m^2)	1711 (Preparation and spinning of textile fibres; weaving of textiles)	Weaving, Textile, Garment & Leather	Industry
520839 (Other fabrics)	1711 (Preparation and spinning of textile fibres; weaving of textiles)	Weaving, Textile, Garment & Leather	Industry
520842 (Plain weave, weighing more than 100 g/m^2)	1711 (Preparation and spinning of textile fibres; weaving of textiles)	Weaving, Textile, Garment & Leather	Industry
520849 (Other fabrics)	1711 (Preparation and spinning of textile fibres; weaving of textiles)	Weaving, Textile, Garment & Leather	Industry
520911 (Plain weave)	1711 (Preparation and spinning of textile fibres; weaving of textiles)	Weaving, Textile, Garment & Leather	Industry
520912 (3thread or 4thread twill, including cross twill)	1711 (Preparation and spinning of textile fibres; weaving of textiles)	Weaving, Textile, Garment & Leather	Industry
520919 (Other fabrics)	1711 (Preparation and spinning of textile fibres; weaving of textiles)	Weaving, Textile, Garment & Leather	Industry

HS-6	ISIC-Rev.3	Indonesian 24- Sector Classification	Indonesian 3-Sector Classification
520921 (Plain weave)	1711 (Preparation and spinning of textile fibres; weaving of textiles)	Weaving, Textile, Garment & Leather	Industry
520929 (Other fabrics)	1711 (Preparation and spinning of textile fibres; weaving of textiles)	Weaving, Textile, Garment & Leather	Industry
520931 (Plain weave)	1711 (Preparation and spinning of textile fibres; weaving of textiles)	Weaving, Textile, Garment & Leather	Industry
520932 (3thread or 4thread twill, including cross twill)	1711 (Preparation and spinning of textile fibres; weaving of textiles)	Weaving, Textile, Garment & Leather	Industry
520939 (Other fabrics)	1711 (Preparation and spinning of textile fibres; weaving of textiles)	Weaving, Textile, Garment & Leather	Industry
520942 (Denim)	1711 (Preparation and spinning of textile fibres; weaving of textiles)	Weaving, Textile, Garment & Leather	Industry
520951 (Plain weave)	1711 (Preparation and spinning of textile fibres; weaving of textiles)	Weaving, Textile, Garment & Leather	Industry
521011 (Plain weave)	1711 (Preparation and spinning of textile fibres; weaving of textiles)	Weaving, Textile, Garment & Leather	Industry
521021 (Plain weave)	1711 (Preparation and spinning of textile fibres; weaving of textiles)	Weaving, Textile, Garment & Leather	Industry
521029 (Other fabrics)	1711 (Preparation and spinning of textile fibres; weaving of textiles)	Weaving, Textile, Garment & Leather	Industry
521031 (Plain weave)	1711 (Preparation and spinning of textile fibres; weaving of textiles)	Weaving, Textile, Garment & Leather	Industry
521041 (Plain weave)	1711 (Preparation and spinning of textile fibres; weaving of textiles)	Weaving, Textile, Garment & Leather	Industry
521131 (Plain weave)	1711 (Preparation and spinning of textile fibres; weaving of textiles)	Weaving, Textile, Garment & Leather	Industry
521139 (Other fabrics)	1711 (Preparation and spinning of textile fibres; weaving of textiles)	Weaving, Textile, Garment & Leather	Industry

Step 2: The second step is to convert the trade estimates obtained from the SMART simulation to the national currency with an appropriate exchange rate as the SMART results of the export shock are in US$. In the example of Indonesian cotton exports, the appropriate exchange rate would be the US$-Rupiah average exchange rate in 2009, which was 1US$ = 10,390 Rupiah.

Step 3: As in the case of an import shock, it is necessary to deflate the SMART estimates by an appropriate measure of price changes to align values from the SMART simulation of a particular year to the price levels of the year for which the SAM was constructed. In the example, the simulated cotton export shock is in 2009 whereas the Indonesian SAM is from 2008. As an approximate deflator, we could use the changes in the GDP deflator from the year of the SAM to the year of the SMART simulation. For Indonesia, the base year was 2010 and the GDP deflators for 2008 and 2009 were 85.31 and 92.37 respectively. The increase in the price level of the Indonesian economy as a whole from 2008 to 2009 was therefore 8.2%.

In the case of an export shock, the values obtained from the SMART simulation can be used after conversion and deflation as the values for an exogenous change in final demand. A predicted change in exports is a change in foreign demand for national output. This is different from the case of an import shock, where one needs to consider the degree to which the imports compete with domestic production in satisfying final demand.

Table 4.6 shows analytical results from the Indonesian cotton exports example after steps 1 to 3. Recall that this example is of a trade agreement between Indonesia and China, where China eliminates its cotton tariffs on imports from Indonesia. This is predicted to raise export demand for Indonesian cotton and therefore the country's output.

Table 4.6 Exogenous change in final demand due to an export shock (example of Indonesian cotton exports to China)

HS-6 Product	Indonesian 3-Sector Classification	Export Shock (millions of US$)	Converted to billions of Rupiah in 2009 (1US$ = 10,391)	Deflated to billions of Rupiah in 2008 (Deflator = 1.082)	Exogenous Change in Final Demand (billions of Rupiah)
520100 (Cotton, not carded or combed.)	Agriculture	0.05	0.57	0.52	0.52
520300 to 521139	Industry	1.59	16.47	15.22	15.22

Step 4: Given the values for the exogenous change in final demand caused by an export shock, we can compute the employment effects using the method of multiplier analysis as described in Unit 3. Figure 4.2 replicates the matrix of employment multipliers as computed in Unit 3. The values contained in the exogenous shock vector are an increase of 0.52 billion rupiah of final demand for domestic agricultural goods accompanied by an increase of 15.22 billion rupiah of final demand for domestic industrial products. The employment effects are computed as the matrix product of the matrix of employment multipliers and the exogenous shock vector. As shown in Figure 4.2, the elimination of Chinese import tariffs on Indonesian cotton exports is estimated to raise employment in Indonesia by 141 in agriculture, 65 in industry, and 84 in services for a total of 290 jobs.

Figure 4.2 Employment effects of an export shock (example of Indonesian cotton exports to China)

Matrix of Employment-Output Ratios *(E)*

	Agric	Ind	Serv
Agric	27	0	0
Ind	0	3	0
Serv	0	0	7

Matrix of Output Multipliers (M_a)

	Agric	Ind	Serv
Agric	1.12	0.30	0.30
Ind	0.80	1.47	0.90
Serv	0.92	0.78	1.80

Matrix of Employment Multipliers ($EmpM$)					Exogenous Shock (x)		Employment Effects
	Agric	Ind	Serv				
Agric	31	8	8	Agric	0.52	Agric	141
Ind	2	4	3	Ind	15.22	Ind	65
Serv	6	5	12	Serv	0	Serv	84
							290

To recapitulate, we can estimate the employment effects of an export shock by:

- Obtaining estimates from a SMART simulation of the export shock
- Converting the SMART simulation results from US$ into the domestic currency, and deflating them to obtain values for the exogenous change in final demand caused by the export shock and
- Combining the values for the exogenous change in final demand with employment multipliers to compute numeric estimates of employment effects in different sectors of the economy.

UNIT 5

Backward and Forward Linkages and Key Sectors

Key questions of this unit:

1. What are backward and forward linkages, and how are these measures of sectoral interdependence computed?
2. How can key sectors of an economy be identified?
3. What are the implications of identifying key sectors for sectoral, trade and labour-market policies?

Important observations:

- A sector is said to be a key sector of the economy if it is strongly connected to other sectors through both backward and forward linkages.
- To compute the backward linkages of a given sector, we use the corresponding column sum of the Leontief inverse multiplier matrix, and to compute the forward linkages of a sector, we use the corresponding row sum of the Ghosh inverse multiplier matrix.

Identifying key sectors is an essential part of economic planning. As noted by McGilvray (1977), if resources are channelled into key sectors, output and employment are likely to grow more rapidly than if the resources were allocated in some alternative way. From a development strategy point of view, it is necessary for countries with a limited amount of financial resources to prioritize and invest in a few key sectors. The key sectors could be those that show the largest potential for catalysing growth, value-added contribution, export potential, employment creation, or any other similar economic indicator. One of the main uses of backward and forward linkage analysis is to identify key sectors of the economy. A sector is said to be a key sector if it is strongly connected to other sectors through both backward and forward linkages. Thus, this unit describes these two types of economic linkages, and, using the **intermediate demand** submatrix of a SAM, shows how these linkage measures are computed.

5.1 Calculating backward and forward linkages

A shock within a given sector can spread to the rest of the economy through backward and forward linkages **Backward linkages** represent additional intermediate demand generated upstream by the expansion of a sector's production. For example, an increase in corn production leads to an increase in demand for labour and for intermediate goods such as fertilizers, thus increasing production in the fertilizers sector.

Backward linkages represent additional intermediate demand generated by the expansion of a sector's production

Forward linkages are the effects of the expansion of a sector's production on downstream activities. In the example of corn production, higher corn output will provide additional input for the food industry, whose production thus will increase as well. The size of backward and forward linkages depends on a sector's level of integration into the economy. A sector that uses domestic inputs intensively while producing important inputs for downstream industries will have, at the same time, strong backward and forward production linkages and, thus, a large multiplier.

Forward linkages are the effects of the expansion of a sector's production on downstream activities

In sectoral linkage studies, various computation methods for quantifying backward and forward linkages have been proposed. However, in this assessment toolkit, we will present only the most commonly-used method for each linkage measure. To compute the backward linkages of a given sector, we will use the column sum of the sector's multipliers in the Leontief inverse matrix. To compute the forward linkages of a sector, we will use the row sum of the sector's multipliers in a matrix known as the Ghosh inverse. The computation of the Ghosh inverse matrix is presented in the section which discusses forward linkages. Both linkage measures will be normalized based on Rasmussen's (1956) proposal to normalize inverse multipliers.

5.1.1 Backward linkages

To compute a measure of backward linkages, we will use the intermediate demand submatrix of a SAM, which is where the commodities rows meet production activities columns. We will illustrate this with the Indonesian 2008 SAM whose intermediate demand submatrix contains accounts for 23 commodities and 23 production activities as shown in Annex 1. Without loss of generality and to simplify, we will aggregate these 23 accounts into 3 sectors (agriculture, industry and services) as presented in table 5.1. The table captures production linkages and only shows the inter-sectoral transactions of intermediate inputs.

Backward linkages capture the effects that an increase in the final demand of a given sector j has on the sectors which provide inputs to the production of sector j's output. An increase in the final demand of sector j's output will lead to higher output of sector j and this, in turn, will increase sector j's input demand from other sectors. Since back-

Table 5.1 Aggregated intermediate demand submatrix of Indonesian SAM 2008

	PA Agric	PA Ind	PA Serv
CM Agric	154,228	490,206	183,118
CM Ind	139,790	1,186,797	1,052,601
CM Serv	30,543	205,542	747,316
Gross Output	**1,170,310**	**4,519,885**	**4,684,890**

Note: PA = Production Activity; CM = Commodity; Agric = Agriculture; Ind = Industry; Serv = Services

ward linkages are computed by the Leontief inverse matrix, the first step is to derive the technology matrix A. To do so, each column element in table 5.1 should be divided by the corresponding gross output associated with that column.

It is important to note that the gross outputs indicated in table 5.1 are the total column sum of the Indonesian SAM in each respective sector. For instance, the gross output of PA-Agric (1,170,310 rupiahs) includes not only the sum of total intermediate demand indicated in the table but also the value-added payment to factors as presented in the SAM. The technology matrix A is shown in table 5.2.

Table 5.2 The technology matrix A

	PA Agric	PA Ind	PA Serv
CM-Agric	0.13	0.11	0.04
CM-Ind	0.12	0.26	0.22
CM-Serv	0.03	0.05	0.16

Furthermore, following the steps described in Unit 2, we have computed the Leontief inverse multiplier matrix $(I\text{-}A)^{-1}$ and the results are presented in table 5.3.

Table 5.3 The Leontief inverse multiplier matrix

	PA Agric	PA Ind	PA Serv
CM-Agric	1.18	0.18	0.10
CM-Ind	0.21	1.41	0.39
CM-Serv	0.05	0.08	1.21
Sum of Leontief inverse	**1.43**	**1.67**	**1.7**

The column sum of the Leontief inverse is considered to be the total backward linkage of a given sector. Thus, table 5.3 shows that the total backward linkage of agriculture is 1.43, and for industry and services the total backward linkages are 1.67 and 1.70 respectively. For agriculture, the interpretation is that a one rupiah increase in the total output of agriculture production will increase the output of the three sectors by 1.43 rupiahs. A similar interpretation should be applied to the backward linkage estimates for industry and services.

However, there is a disagreement in the literature on sectoral linkages on whether to include or net-out the on-diagonal elements of the Leontief inverse. This is mainly because the on-diagonal elements contain the exogenously injected one unit stimulus (in our case one rupiah) in final demand of each sector. To avoid this controversy, Rasmussen (1956) proposed to normalize the Leontief inverse multipliers which we are using to compute the backward linkage effects. To do so, he suggested dividing the column sum of each sector by the total column sum of all sectors divided by the total number of sectors (n). For example, the normalized backward linkage of production activities in agriculture can be computed in the following way:

$$\textbf{Backward effect Agriculture} = \frac{\textbf{Column sum of Leontief inverse in PA Agric}}{\frac{1}{n}\,\textbf{(Sum of total cells in Leontief inverse)}}$$

$$= \frac{1.43}{\frac{1}{3}(1.43 + 1.67 + 1.70)}$$

$$= 0.89$$

Using a similar normalization procedure, we have calculated the normalized backward effects for industry and services as well. The results are presented in table 5.4.

Table 5.4 Normalized backward linkages

	PA Agric	PA Ind	PA Serv
Normalized backward linkages	0.89	1.04	1.06

Reading the estimates of normalized backward effects, we can see that an exogenous increase of one rupiah demand for agricultural products has a 0.89 rupiah backward effect throughout the economy. Similarly, an exogenous increase of one rupiah in the demand for industrial products would result in a total backward effect of 1.04 rupiah. For services, a one rupiah increase in services demand would generate a backward effect of 1.06 rupiah in the rest of the economy.

5.1.2 Forward linkages

Several studies on sectoral linkages have proposed to measure the forward linkages of a given sector by the row sum of the Leontief inverse matrix. However, this approach of measuring forward effects has been subjected to criticism since these effects are the results of what Miller and Biller (2009) call ‘a peculiar stimulus’ – a simultaneous increase of one unit in the gross output or in the final demand of every sector. This “stimulus” (a simultaneous increase by one unit of final demand in all sectors) does not reflect the economic realities of a country. It is never the case that all economic sectors increase their output by the same amount at the same time. As a result, the row sum of Ghosh inverse multipliers has been suggested as a suitable measure of total forward effects[8]. To compute forward linkages, we will use the intermediate demand submatrix of the SAM (i.e., table 5.1, replicated below) to compute the Ghosh inverse multipliers.

	PA-Agric	PA-Ind	PA-Serv
CM-Agric	154,228	490,206	183,118
CM-Ind	139,790	1,186,797	1,052,601
CM-Serv	30,543	205,542	747,316
Gross Output	**1,170,310**	**4,519,885**	**4,684,890**

Note: PA = Production Activity; CM = Commodity; Agric = Agriculture; Ind = Industry; Serv = Services

The Ghosh inverse multipliers capture the forward linkage effects from the output-selling or output-allocation perspective. It shows how the output of a given sector i is distributed among all sectors that use sector i’s output as an input in their production processes. This is simply the value of total intermediate sales by the sector i as a proportion of the value of i’s gross output. From a mathematical viewpoint, the Ghosh approach is made operational by essentially rotating the vertical (column) view of the model to a horizontal (row) one (Miller and Biller, 2009). That is, instead of dividing the cells of each column by the gross output of the sector associated with that column, the cells of each row are divided by the gross output of the sector associated with that row. The results of this computation are presented in table 5.5 and the matrix is denoted as the allocation matrix B as opposed to the technology matrix A in the case of Leontief inverse.

[8] Ghosh inverse multipliers have been widely applied to measure forward economic linkages (see, for instance, Beyers, 1976; Jones, 1976; and Cai and Leung, 2004).

Table 5.5 The allocation matrix B

	PA-Agric	PA-Ind	PA-Serv
CM-Agric	0.13	0.42	0.16
CM-Ind	0.03	0.26	0.23
CM-Serv	0.01	0.04	0.16

These coefficients show how one rupiah worth of output from agriculture, industries and services is distributed across the three production activities that purchase the output as intermediate input. Once the allocation matrix B is calculated, the next step is to compute the Ghosh inverse multipliers denoted as $(I\text{-}B)^{-1}$ with *I* representing the identity matrix. To compute the Ghosh inverse multipliers, we can follow the matrix procedures shown in Unit 2 where the computation of multipliers was presented. The Ghosh inverse multipliers of our example are presented in table 5.6.

Table 5.6 Ghosh inverse multipliers

	PA-Agric	PA-Ind	PA-Serv	Row sum of Ghosh inverse
CM-Agric	1.18	0.69	0.16	2.29
CM-Ind	0.05	1.41	0.23	1.86
CM-Serv	0.01	0.08	0.16	1.30

Each row sum of the Ghosh inverse multipliers captures the total additional output possible in all the sectors due to the availability of an additional one rupiah worth of primary inputs from the sector corresponding to the given row. For instance, one rupiah worth of additional input from agriculture would increase total output by 2.29 rupiahs. Similarly, one rupiah worth of input from industry and services would increase the output of all production activities by 1.86 and 1.3 rupiahs respectively.

Like the backward effect computation, there is a disagreement over the inclusion or exclusion of the on-diagonal elements of Ghosh multipliers in forward linkage analysis as well. As a result, we have normalized the results of Ghosh inverse multipliers using the method which was proposed by Rasmussen (1956). The normalized forward linkage measures are presented in table 5.8. In the formula below, n denotes the number of sectors being considered in the analysis, in our case n=3: agriculture, industry, and services.

$$\text{Forward effect Sector } i = \frac{\text{Row sum of Ghosh inverse in Sector } i}{\frac{1}{n}\ \text{(Sum of total cells in Ghosh inverse)}}$$

For example, the forward linkages of Agriculture (CM Agric) will be:

$$= \frac{2.29}{\frac{1}{3}(2.29 + 1.86 + 1.30)}$$

$$= 1.26$$

In our example, the normalized forward linkages of the three sectors have been computed and are presented in table 5.7. We can see that agriculture has the highest forward linkage effect (1.26 rupiah), followed by industry (1.03 rupiah), with services having the lowest forward linkage effect (0.72 rupiah).

Table 5.7 Normalized forward linkages

	Normalized forward linkages
CM Agric	1.26
CM Ind	1.03
CM Serv	0.72

5.1.3 Key-sector identification and intersectoral comparison

Based on Rasmussen's (1956) normalized computation of backward and forward linkages, which we have discussed in the previous sections, Miller and Biller (2009) developed a simple method to identify a key sector in a given economy. They indicated that sectoral linkages can be classified under four major categories:

(1) *Generally independent*, a sector which is not strongly connected to other sectors, meaning the sector has weak backward and weak forward linkages, i.e., when both the backward and forward linkage measures are less than one.

(2) *Generally dependent*, a sector which is strongly connected to other sectors through backward and forward linkages, this is a situation when both linkage measures are greater than one.

(3) *Dependent on inter-industry demand*, a sector with strong forward linkages but weak backward linkages, i.e., when only the forward linkage measure is greater than one.

(4) *Dependent on inter-industry supply*, this is when a sector has strong backward linkages but weak forward linkages, i.e., when only the backward linkage measure is greater than one.

Based on this classification, a sector is considered to be a key sector if it is classified under the category of generally dependent. A simple summary of classifying backward and forward linkages to identify a key sector is presented in table 5.8.

Table 5.8 Classification of backward and forward linkages

		Total Forward Linkage	
		Low(<1)	**High(>1)**
Total Backward Linkage	Low(<1)	(I) Generally independent	II) Dependent on Inter-industry demand
	High(>1)	(IV) Dependent on Inter-industry supply	(III) Generally dependent

Source: Miller and Blair (2009)

Recalling our running example, the backward linkages of agriculture are 0.89 and forward linkages are 1.26. This indicates that agriculture is *dependent on inter-industry demand*, that is agriculture has strong forward linkages but weak backward linkages. On the other hand, the backward linkages for industry are 1.04, and forward linkages are 1.03, showing that the industrial sector is categorized as *generally dependent*, creating both strong backward and forward linkages since the measures of both linkages are greater than one. For services, the backward linkage measure is 1.06, indicating strong backward effects, but the forward linkage measure of services is 0.72, implying weak forward effects. Services are therefore *dependent on inter-industry supply*. Since both the backward and forward linkage measures of industry are greater than one, industry is identified as the key sector of the Indonesian economy based on the classification above.

To recapitulate, this unit dealt with the analysis of intersectoral linkages and the identification of key sectors. Based on the intermediate demand data from the Indonesian 2008 SAM, this unit showed how to compute measures of backward and forward linkages. Furthermore, we showed how to classify sectors according to the strength of their backward and forward linkages. Lastly, we showed how to identify a key sector, i.e., a sector that is strongly connected to the economy through ***both*** backward and forward linkages. Since the main objective of this unit was to provide a methodological approach to identify the key sectors of a given economy, for simplicity, we presented the analysis using only three broad sectors: agriculture, industry, and services. However, the same procedures can be used for any number of sectors provided an intermediate demand submatrix is available at the desired level of sectoral disaggregation. The more disaggregated the analysis, the more the picture of backward and forward linkages will be nuanced and the more the identification of key sectors will be precise.

References

Beyers, William B. 1976. "Empirical Identification of Key Sectors: Some Further Evidence", Environment and Planning A, Vol. 8 pp. 231–236.

Breisinger, C.; Thomas, M.; Thurlow, J. 2009. Social Accounting Matrices and Multiplier Analysis. An Introduction with Exercises. Food Security in Practice technical guide 5 (Washington, D.C, IFPRI).

Breisinger, C.; Thomas, M.; Thurlow, J., eds. 2007. A 2005 Social Accounting Matrix (SAM) For Ghana. Ghana Statistical Services (GSS) and International Food Policy Research Institute (Washington, DC, IFPRI).

Cai, J.; Leung, P. 2004. "Linkage Measures: a Revisit and a Suggested Alternative," Economic Systems Research, Vol.16, No.1, pp. 65-85.

Central Bureau of Statistics. 2011. Sistem Neraca Sosial Ekonomi, pp. 268-291 https://www.bps.go.id/publication/2011/11/07/6f64b0c03431a059c8569105/sistem-neraca-sosial-ekonomi-indonesia-1976-2008.html

Haggblade, S. Hammer, J. Hazell, P. 1991." Modelling Agricultural Growth Multipliers". American Journal of Agricultural Economics, Vol. 73, Issue 2, pp. 361–374.

Ghosh, A. 1958. "Input–output approach in an allocation system", Economica. Vol. 25, No. 97, pp. 58–64.

International Labour Organization (ILO). 2009. Social Accounting Matrix Advisory Support and Monitoring Assistance (SAMASAMA) Project Brief, pp. 3, (Geneva).

Jones, L.P. 1976. "The Measurement of Hirschmanian Linkages", Quarterly Journal of Economics, Vol. 90, pp. 323–333.

Kee, H. L.; Nicita, A.; Olarreaga,M. 2008. "Import Demand Elasticities and Trade Distortions", The Review of Economics and Statistics, Vol. 90, No. 4, pp. 666-682.

Leontief, Wassily W., 1936. "Quantitative input and output relations in the economic systems of the United States". The Review of Economics and Statistics, Vol. 18, No. 3, pp. 105-125.

McGilvary, J. 1977. "Linkages, Key sectors and Development Strategy," in Structure, System and Economic Policy, ed. W, Leontief (Cambridge, UK Cambridge University Press).

Miller, R.E.; Blair, P.D. 2009. *Input–Output Analysis: foundations and extensions*. 2nd edition (Cambridge, UK Cambridge University Press).

Rasmussen, P. N. 1956. Studies in Inter-Sectoral Relations. Economic review, Vol. 8, No. 6, pp. 11031104.

Round, J. 2003. "Social accounting matrices and SAM-based multiplier analysis", in F. Bourguignon and L.A. Pereira da Silva (eds.), The impact of economic policies on poverty and income distribution: Evaluation techniques and tools. (Washington, DC, World Bank).

Thorbecke, E. 2000 "The Use of Social Accounting Matrices in Modeling", paper prepared for the 26th. General Conference of the International Association for Research in Income and Wealth, Krakow, Poland.

Annex

Intermediate Demand Submatrix of Indonesian 2008 SAM (in billion rupiahs)

	PA Crops	PA Other agriculture related	PA Animal husbandry (Livestock) & its products	PA Forestry and Hunting	PA Fishery	PA Coal Mining, Metal Ore and Petroleum	PA Mining & Quarrying	PA Food, Drink and Tobacco Industries	PA Weaving, Textile, Garment & Leather	PA Wood Industry & Wood's Products	PA Paper, Printing, Transportation & Metal goods & Industry
CM Crops	19195.54	343.88	7389.24	0.00	675.64	0.00	0.00	233960.34	0.00	0.00	423.21
CM Other agriculture related	11847.84	12913.41	2137.43	2075.68	664.15	0.00	0.00	102693.46	3005.11	113.50	351.74
CM Animal husbandry (Livestock) & its products	16311.81	4204.50	51712.37	0.00	137.87	0.00	0.00	10938.53	10527.67	0.01	351.31
CM Forestry and Hunting	10.75	71.84	52.57	1128.55	138.18	21.90	129.62	501.28	102.92	23638.21	2548.91
CM Fishery	0.00	10.30	0.00	0.00	23206.74	0.00	0.00	53336.57	0.13	0.00	803.15
CM Coal Mining, Metal Ore and Petroleum	0.00	0.00	0.00	0.00	0.00	64105.17	0.00	662.37	585.57	112.09	56617.60
CM Mining & Quarrying	0.00	0.03	2.11	0.00	0.00	0.00	611.10	493.00	0.06	0.00	291.76
CM Food, Drink and Tobacco Industries	0.00	489.24	61608.32	0.00	8260.69	0.00	0.00	168967.82	1690.24	917.80	1032.14
CM Weaving, Textile, Garment & Leather	251.08	225.76	7.69	120.54	14.38	183.86	33.65	229.02	79237.86	727.89	2953.95
CM Wood Industry & Wood's Products	72.99	76.54	16.33	0.00	166.10	0.00	99.88	259.72	188.57	38212.92	6929.70
CM Paper, Printing, Transportation & Metal goods & Industry	527.43	2267.19	84.78	3268.34	1835.39	13142.29	1555.45	6865.58	6143.11	4181.43	250090.71
CM Chemical, Fertilizer, Clay Products & Cement	23104.38	26293.89	2808.30	811.79	7476.40	7415.87	6552.40	14082.90	25814.63	10494.22	99102.13
CM Electricity, Gas and Drinking Water	0.59	45.53	451.28	46.32	220.26	309.67	57.00	1668.25	5578.40	1479.30	14492.55
CM Construction	1046.86	5430.97	122.63	1083.72	550.77	3719.74	4188.96	232.82	706.53	68.87	1856.67
CM Trade	38.24	56.70	27.99	83.91	41.76	92.14	60.05	655.52	540.97	760.69	2282.26
CM Restaurant	117.22	117.85	12.64	36.83	304.30	10.71	649.12	1174.41	1266.77	766.97	3667.84
CM Hotel Affairs	10.01	16.05	3.29	2.13	2.98	90.90	25.49	223.29	302.10	7.72	672.66
CM Land Transportation	935.24	1031.86	320.99	348.34	60.70	1564.68	793.34	2753.29	2295.30	2729.48	11454.38
CM Air Transportation, Water and Communication	111.37	195.66	173.91	554.05	337.31	1755.52	225.46	1865.46	1713.88	934.57	7376.43
CM Bank and Insurance	1083.83	6672.16	718.35	496.06	885.37	1975.05	531.51	8372.83	4855.19	2695.33	13328.76
CMReal Estate and Business Services	676.92	529.11	278.77	348.69	62.69	1774.12	985.32	2734.47	1686.96	1232.85	16011.70
CM Government & Defence, Education, Health, Film & Other Social Services	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3888.10	702.83	622.12	2843.84
CM Individual service, Household and Other services	762.51	2718.46	520.35	763.71	86.09	3742.47	1852.71	2577.76	1237.30	1434.02	8636.21
Gross output	468256.54	202251.11	265105.49	52221.85	182474.58	610107.14	82053.44	952513.77	292371.06	173145.44	1246992.57

PA Chemical, Fertilizer, Clay Products & Cement	PA Electricity, Gas and Drinking Water	PA Construction	PA Trade	PA Restaurant	PA Hotel Affairs	PA Land Transportation	PA Air Transportation, Water and Communication	PA Bank and Insurance	PA Real Estate and Business Services	PA Government & Defence, Education, Health, Film & Other Social Services	PA Individual service, Household and Other services
771.64	0.00	0.00	456.69	23409.05	1794.77	0.00	69.38	0.00	0.00	30296.20	0.00
44908.37	0.00	0.00	41.75	1281.76	14.94	1.54	6.38	0.07	0.00	486.38	778.64
377.16	0.00	0.00	0.00	65763.04	5868.28	75.35	164.14	0.00	1.94	11954.34	0.00
651.37	0.02	24478.51	28.31	67.98	10.78	6.71	0.00	0.00	19.24	21.15	307.08
49.82	0.00	0.00	0.00	11307.54	767.70	0.00	58.03	0.00	310.33	3269.80	0.00
179264.09	21748.80	9.54	0.00	0.00	8.24	65.92	0.00	0.00	0.00	0.00	0.00
6950.55	0.00	88378.10	43.36	0.10	0.00	0.00	0.00	0.00	0.00	1162.46	0.00
4172.35	0.00	0.00	1379.93	58732.12	5748.37	115.27	3395.46	298.73	920.92	23957.00	538.31
1380.03	18.07	515.53	9084.35	2111.22	131.95	497.27	403.61	62.18	739.18	1304.04	2757.77
389.24	0.00	67375.77	4768.99	17.47	2.09	23.92	11.98	4.56	15.47	279.32	194.52
11126.87	2603.38	217801.09	30255.78	161.65	160.81	6984.25	11176.81	6378.71	6561.34	22545.81	42697.43
112929.82	29374.76	174676.25	55628.11	1493.00	179.39	59616.90	28457.59	2255.23	4078.78	22848.47	29843.30
6754.75	12811.11	405.91	25507.17	502.15	120.90	1152.22	2905.04	1461.03	1650.04	1747.35	3228.50
1068.93	1003.73	1203.12	33143.28	49.81	32.87	1428.55	4139.35	1641.88	15685.19	3474.03	855.24
878.56	6.20	0.00	4360.57	9.13	21.75	2463.21	11133.10	150.02	285.37	148.07	30.15
2443.05	48.47	7030.75	13749.90	79.23	114.19	830.49	2618.04	809.92	1678.38	1169.99	1069.51
430.98	25.45	1178.07	1834.72	60.48	13.77	67.46	895.70	441.73	435.74	177.57	350.09
3619.76	169.13	3645.86	44553.04	41.61	25.86	2255.94	469.96	1457.88	1492.03	1191.25	508.71
4787.89	163.99	6482.10	41219.04	147.20	200.29	3818.03	17320.17	4604.46	6377.44	3093.43	1883.94
8516.67	1020.39	12036.86	62193.25	779.30	101.07	5893.56	8219.77	52440.61	9727.80	2647.63	1764.89
3290.79	1499.20	27213.04	83951.62	723.77	241.74	3826.71	6067.08	6607.43	5051.38	6812.95	6115.34
3422.74	28.27	0.00	1024.17	200.97	241.59	2.68	1924.40	1863.25	3189.42	9828.04	1741.79
3535.88	159.30	6330.45	27802.69	130.86	16.70	50202.14	4172.31	5611.37	14555.55	3050.11	1747.31
1162701.21	206047.02	1219988.91	1013876.82	285031.99	39602.62	266367.4	326708.7	268189.98	286491.48	493328.1	279257.25